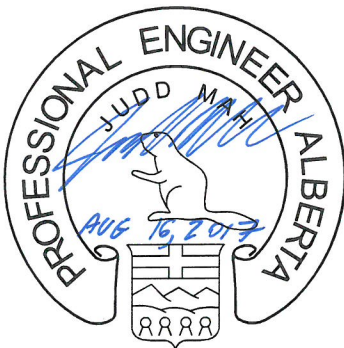
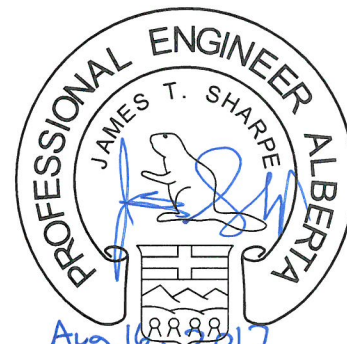


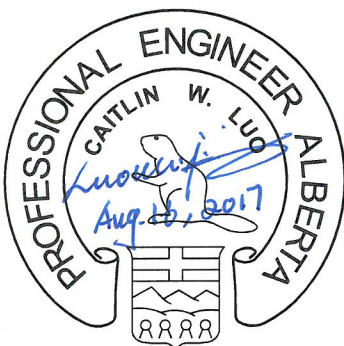
**TECHNICAL SPECIFICATIONS**  
**FOR THE**  
**EDMONTON MAXIMUM SECURITY INSTITUTION**  
**AIR HANDLER, HEATING, AND PIPING REPLACEMENT**  
**AUGUST 2017**



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<b>QUALITY MANAGEMENT SIGN-OFF</b>	
Signature:	<u>Hans Wolf</u>
Date:	<u>16 Aug 2017</u>
<b>APEGA Permit to Practice P 3979</b>	

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G3	SITE ACCESS MAIN FLOOR PLAN
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**Structural**

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**Mechanical**

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<b><u>Drawing No.</u></b>	<b><u>Title</u></b>
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<b><u>Electrical</u></b>	
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E25	EQUIPMENT LOAD SCHEDULE - SHEET 2 of 2

**END OF DOCUMENT**

**Part 1 General**

**1.1 WORK COVERED BY CONTRACT DOCUMENTS**

- .1 Work of this Contract comprises Edmonton Maximum Security Institution, Main Building, Air Handlers Heating and Piping Replacement.
- .2 For all intents and purposes of the contract between Public Works Government Services Canada (otherwise known as Public Services and Procurement Canada) and the Contractor, all contractual obligations for the coordination and performance of the Work remain with the Contractor, regardless if a specialty trade or major subcontractor is listed in the specifications. Major subcontractor and trade references are made to provide an organizationally practical means for coordination and scope division, to aid the Contractor with managing the project with major subcontractors and various trades, but is not intended to otherwise alleviate the Contractor from contractual obligations for the performance and coordination of the Work. All references to Sub-contractors, Mechanical Contractor, Electrical Contractor, TAB contractor, etc. shall ultimately be interpreted as being the contractual responsibility of the Contractor.
- .3 Demolition: Removal of existing mechanical equipment, ductwork, pipes, controls, wiring, conduit, breakers, motor control centres, drywall for access to items.
- .4 Hazardous material: Work will require abatement of hazardous material which include: Asbestos, lead, silica, and mercury.
- .5 Hours of work shall be 8 a.m. – 4 p.m. Monday to Friday.
  - .1 No work shall take place on site during federal statutory holidays, unless approved in writing by the Departmental Representative
- .6 Architectural:
  - .1 Work is to related to areas impacted by HVAC upgrades.
  - .2 Selective demolition of walls, floors, roof to facilitate work by other trades.
  - .3 Replacement of an existing suspended ceiling, removal and replacement of ceiling (gypsum and suspended) to facilitate other work
  - .4 Fire stopping of penetrations.
  - .5 Addition of new exterior doors.
  - .6 New exterior wall penetrations and modifications of existing roof curbs.
  - .7 Patching of fire proofing material on ceilings of mechanical room.
  - .8 Patch and repair penetrations required for controls work.
- .7 Structural:
  - .1 Work is to related to areas impacted by HVAC upgrades.
  - .2 Reinforcing of existing roof,
  - .3 New stands for mechanical equipment,
  - .4 New house keeping pads and changes to existing pads.
  - .5 Miscellaneous metal work.
- .8 Mechanical:
  - .1 Replacement of existing air handlers throughout the facility.

- .1 Modifications to the existing heating system in relation to the air handler replacement.
  - .2 Replacement of boiler system and domestics hot water heaters serving Segregation Unit
  - .3 Replacement of pneumatic control components with electronic.
  - .4 Replacement of existing domestic water distribution system.
  - .5 Replacement of a computer cooling unit.
  - .6 Upgrade of ventilation system serving the executive area (new VAV system)
  - .7 Addition of exhaust and make up air to work shop
  - .8 Replacement and addition of exhaust fans serving cell blocks
  - .9 Replacement of domestic hot water boilers serving the Kitchen.
  - .10 Hydronic and air balancing in coordination with Commissioning Plan.
- .9 Controls:
- .1 Coordinate work done by base building controls contractor, Johnson Controls.
  - .2 Arrange and pay for access and security system modifications by Delco Security.
    - .1 Coordinate Delco Security work to modify existing security controls systems. Contact to obtain quote:  
**Delco Automation Inc.**  
**Adam Grabka, P. Eng.**  
**P: (306) 244-6449 x 361**  
**Email: [agrabka@delcoautomation.com](mailto:agrabka@delcoautomation.com)**
- .10 Electrical:
- .1 Electrical scope is to provide support for HVAC upgrades. Existing MCCs and panelboards will remain in place with new breakers/buckets installed as required. Refer to electrical SLD and equipment schedule.
  - .2 All existing air handling units have a minimum of 2 smoke detectors associated with it, one for supply and one for return. During HVAC work, electrical contractor shall temporarily remove, support and re-install fire alarm equipment as required.
  - .3 Provide power to new smoke dampers as required.
  - .4 Provide wiring between new and existing unit heaters, as indicated, to new thermostats and control valves.
  - .5 Provide power to new BMS control panels.
  - .6 Coordinate with mechanical contractor for locations of dampers, thermostats, control valves, and new BMS control panels.
  - .7 In areas where ceiling tiles or HVAC ceiling diffuser are being modified/replaced, electrical contractor is responsible to provide temporary support for fire alarm devices, security system devices, and lighting fixtures. After other contractors complete their work, the electrical contractor shall re-install all electrical equipment in previous locations.
  - .8 To mitigate the need for a generator during busduct key interlock breaker replacement, a recommended shutdown procedure has been provided (see Section 26 05 00). It is expected that individual MCCs will be shutdown for a short period, less than 1 hour, during busduct breaker replacement.



- .9 Existing MCC buckets that are removed shall be sent back to the manufacture for testing. buckets that pass testing are to be given to the Departmental Representative for spare buckets. Provide test results to Department Representative.
- .10 Coordination with Department Representative is required during shutdown of any powered equipment.
- .11 Refer to electrical drawings for complete scope of work.
- .12 Any cables being demolished are to be demolished back to the source or last accessible location and marked as unused.
- .13 During commissioning, contractor to confirm loading of MCCs or panels by completing a thermal scan as well as measuring current in main incoming feeders to MCCs or panels. Provide data to Department Representative.
- .11 The work also requires
  - .1 Provisions for temporary heating and ventilation.
  - .2 Full time supervision during any work at the project site.
  - .3 Weekly Construction Progress Reports.
  - .4 Provisions for Commissioning process.

## **1.2 CONTRACT METHOD**

- .1 Construct Work under stipulated price contract.

## **1.3 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.
- .3 Work of Project executed during Work of this Contract, and which is specifically excluded from this Contract:
  - .1 R.077214.001 EMSI Program Building A/C
  - .2 R.077217.001 EMSI Unit Offices A/C
  - .3 R.077218.001 EMSI Heating Controls Upgrade (Gate House and DNS)
- .4 Work of this Project must include provisions for co-ordinating work, identified in Contract Documents, for following principal items.
  - .1 Building Automation System - Johnson Controls

## **1.4 WORK SEQUENCE**

- .1 Definitions
  - .1 Shoulder season: Mar 15 – May 15 & Sept. 15 – Nov. 15
  - .2 Warm weather conditions: May 16 – Sept. 14
  - .3 Winter season: Nov. 16 – Mar. 14
  - .4 Long lead term: More than 2 weeks' delivery

- .2 Shut downs shall not occur unless new equipment for work is on site.
- .3 Construct Work in stages to accommodate Departmental Representative continued use of premises during construction.
- .4 Co-ordinate Progress Schedule and co-ordinate with Departmental Representative Occupancy during construction.
- .5 Below is a non-exhaustive list of distinct work areas for this project. The following areas have unique phasing constraints.
  - .1 Segregation Wing (SEG)
  - .2 Segregation Boiler Room
  - .3 West Mechanical Room
  - .4 Executive Area
  - .5 Tunnel System
  - .6 Cell Blocks (A/ B, C/ D, E/ F, G/ H)
  - .7 Roof Top Area
  - .8 East Mechanical Room
  - .9 Main Boiler Room (SIS)
  - .10 Engineering & Maintenance
  - .11 Education
  - .12 Corcan
  - .13 Gym
  - .14 Laundry Area
  - .15 Plumbing General
  - .16 Valves and Controls General
- .6 Work in these areas will be guided by the following high level restrictions
  - .1 Segregation Wing
    - .1 AS-1 serves the Segregation Wing inmates, and shall not be decommissioned and replaced while any of the other cell blocks are shut down. Work on only one of the following five units (SEG, A/B, C/D, E/F, G/H) may proceed at any given time:
      - .1 AS-1 – Segregation wing,
      - .2 AH-13 – Cell Block A/B,
      - .3 AH-10 – Cell Block C/D,
      - .4 AH-4 – Cell Block E/F,
      - .5 AH-7 – Cell Block G/H.
    - .2 Work on AS-1 must be successfully commissioned and interim acceptance attained prior to shutdown of any other cell block system.
    - .3 This work must be scheduled well in advance.
    - .4 AS-1 must be replaced in warm weather conditions
    - .5 AS-2 serving program rooms, must be replaced in the shoulder season or in warm weather conditions
  - .2 Segregation Boiler Room

- .1 Phasing of the hot water tank replacement shall not interrupt the supply of hot water to the area.
- .3 West Mechanical Room
  - .1 A new double door accessible from the roof is included in the scope of work for this area to provide options for the removal and installation of the Air Handling Units.
  - .2 There are multiple air handlers serving multiple areas in this wing. Only one AH can be decommissioned at any given time unless stated otherwise below.
  - .3 Each unit is to be fully commissioned and each area is to be cleaned; and accepted prior to shutdown of the next air handler.
    - .1 AH-18 & AH-19 will be replaced by one single AH. Both units serve the Admin & Discharge area and shall be decommissioned together.
    - .2 AH-101 will be replaced. This unit serves the Chapel and Staff Lounge. This unit will have an A/C rooftop condenser added. AH-101 must be replaced in the shoulder season or in warm weather conditions
    - .3 AH-26 will be replaced. This unit serves the Psychology offices. This unit will have an A/C rooftop condenser added. AH-26 must be replaced in the shoulder season or in warm weather conditions
    - .4 AH-27 will be replaced. This unit serves corridor between L & K block. The ductwork capping and associated demolition/new-installation scope in this area must be scheduled well in advance. AH-27 must be replaced in warm weather conditions.
    - .5 AH-20, 21, 22 will undergo a 3-way valve replacement and controls upgrade. Work on these three units must take place at the same time. These units serve the healthcare area. This work must be performed in warm weather conditions.
    - .6 AH-28 will be replaced. This unit serves the west catwalk. The A/C rooftop condenser is also being replaced. AH-28 must be replaced in warm weather conditions.
    - .7 AH-25 is an abandoned unit that will undergo a 3-way valve replacement and controls upgrade. This work may take place while other AH driven work is being performed on other units. This unit does not have any constraints on when the work can take place.
    - .8 AH-102 is not included in the scope of work.
    - .9 AH-103 will be replaced. This unit serves the aboriginal offices. This unit shall be replaced in warm weather conditions.
    - .10 AH-23 will be replaced. This unit serves the gym. There is some associated demolition of abandoned piping in the Gym that must be scheduled well in advance. This unit should be replaced in warm weather conditions.
    - .11 AH-33 will undergo 3-way valve replacement and controls upgrade. It is not located in a separate room adjacent the weight pit. This work can take place while other AH driven work is

being performed on other units. This unit does not have any constraints on when the work can take place.

.4 Executive Area

- .1 This is a sub area of the West Mechanical Room but is treated as standalone work area. During work on the HVAC system in the Executive Services area, no other AH work may proceed in the West Mechanical Room.
- .2 AH-16 and AH-17 both serve the Executive Services area and will both be replaced at the same time
- .3 When work is scheduled to take place in the Executive Services area, the detailed work plan must be approved at least 6 weeks in advance.
- .4 If adequate temporary heat is provided, this work can take place in winter conditions. Refer to section 01 51 00 for temporary heating requirements.
- .5 Under separate contract, not included in the contractor's scope of work, is the complete move of all of the existing furniture (including desks, filing cabinets, etc.) and office supplies out of the Executive Services area and setup into the temporary office area.
  - .1 All furniture and equipment in the Conference Room and the Server room will not be removed, and must be diligently protected from dust/damage by the contractor; these two rooms will remain locked when work is not scheduled to take place in these two rooms specifically.
- .6 AH-16 & AH-17 must be fully commissioned, and the associated demolition, drywall, final painting, etc. must be complete in the Executive Services area to obtain interim acceptance of this area.
- .7 As a condition of interim acceptance for this area, it should be completely cleaned, to the same or better condition in which it was before work began. The cleanliness must be to the satisfaction of the Departmental Representative.
- .8 Upon acceptance, under separate contract, not included in the contractor's scope of work, is the complete return of all of the existing furniture (including desks, filing cabinets, etc.) and office supplies out of the Executive Services area and setup into the temporary office area.

.5 Tunnel System & Cell Unit A/B, C/D, E/F, G/H & SEG Unit

- .1 The AH serving the units are in the tunnel system, though there is work that must take place in the cell areas themselves.
- .2 There are restricted/confined spaces in the tunnel system that must be accessed to perform some of the AH driven work in the cell units.
- .3 The cell blocks shall remain occupied during construction. Work is to be staged to interrupt only 1 cell block at a time. A cell block AH shall not be decommissioned and replaced while any of the other cell blocks are shut down. Work on only one of the following five units (SEG, A/B, C/D, E/F, G/H) may proceed at any given time. Each cell block is to be fully commissioned and accepted work prior to commencement of next air handler replacement.
- .4 The tunnel system air handling units will all be replaced. Constraints for this area for staging are as follows:

- .1 First phase: AH-6, AH-9, AH-12, AH-15 are to be replaced first. These units provide outside air to the tunnel system.
- .2 Second phase: AH-5, AH-8, AH-11, AH-14 are to be replaced in the second phase. These units serve the unit offices. These AH may be replaced in the shoulder season or in warm weather conditions.
- .3 Interim phase: AH-13A, AH-10C, AH-7G, AH-4E form part of the new HVAC system serving the cells (in conjunction with AH-13B, AH-10D, AH-7H, AH-4F) though can be roughed-in as long as the rough-in does not disrupt the HVAC systems serving the cell blocks.
- .4 Third phase: AH-13B, AH-10D, AH-7H, AH-4F must be replaced one at a time as they serve the cell blocks (note AS-1 forms part of the constraint of replacing/commissioned one cell unit at a time). These four units must be commissioned alongside their counterpart (AH-13A and AH-13B for example must be commissioned together) in order to have a fully commissioned unit. This work must take place in warm weather conditions. This work must be scheduled well in advance.
- .5 Since this work will disrupt HVAC to inmate occupied area, authorization to be proceed with this work must be received from the Departmental Representative. In order to take AS-1, AH-13, AH-10, AH-7 or AH-4 offline, the following criteria must be met:
  - .1 Three-week lookahead schedule for each cell unit must be approved by the Departmental Representative
  - .2 All long lead time material and equipment must be already received on site and verified by the Departmental Representative
  - .3 All required rough-in for the cell unit must be complete and verified by the Departmental Representative, including but not limited to:
    - .1 Re-heat coils, associated ductwork and sensors/control wiring installed
    - .2 Ductwork modifications and wall grills installed
    - .3 New exhaust fans installed & old ones replaced
    - .4 Interim phase / companion AH in place and roughed in
- .6 Roof Top Area
  - .1 RTU-1 serves the west lobby entrance and must be replaced in shoulder season or warm weather conditions.
  - .2 If contractors intend to use the roof top exhaust fans for the cells to provide temporary ventilation for the inmates, then the replacement of the exhaust fans must be performed ahead of the planned replacement of the cell unit AH.
    - .1 Roof top exhaust fans serving cell units must be included in the final commissioning of the cell unit AH as they form part of the system

- .2 If contractor uses newly installed exhaust fans for temporary ventilation, this shall not trigger warranty period. Warranty period for the exhaust fans and entire AH system will start after commissioning and interim acceptance.
- .7 East Mechanical Room
  - .1 There are two domestic water heaters that are being replaced in the East Mechanical Room. This replacement must be done without disrupting service. There is a water bypass available to facilitate the installation without disrupting service. The transition from old to new shall be done after final dishwasher use at the end of the work day for DHW-4 only.
  - .2 There are three AH that will be replaced in the East Mechanical Room (AH-29, AH-30, AH-32). These units must be replaced in the shoulder season or in warm weather conditions.
  - .3 AH-29 and AH-30 must be decommissioned and their replacement units roughed in, as well as replacement unit AH-32 roughed into its new location, prior to decommissioning the existing AH-32 unit.
- .8 Main Boiler Room (SIS)
  - .1 There are three AH that will be replaced in this area (AH-1, AH-2, AH-3B). These units must be replaced in the shoulder season or in warm weather conditions. Any associated demolition/finishing work must be scheduled well in advance.
  - .2 Staging of work in this area must allow continuous partial occupancy. Attain Partial Interim Acceptance of each stage of the work prior to commencement of next space in this area
- .9 Engineering & Maintenance
  - .1 As long as there is not total interruption to heat supply to this area, work can take place any time.
- .10 Education
  - .1 There are no additional restrictions for when the work in this area must take place
- .11 Corcan
  - .1 There are no additional restrictions for when the work in this area must take place
- .12 Laundry Area
  - .1 If scaffolding is used in the laundry area, it may only remain erected for 2 days at a time, after such a time, the scaffolding must be dismantled to allow for inmates to perform their laundry duties w/o having outside tools or equipment residing in the area. The allowable work schedule in the laundry area are 2 days in, 2 days out.
  - .2 This work must be scheduled well in advance.
- .13 Plumbing General
  - .1 Much of the piping replacement takes place within a suspended drywall ceiling. Work within the ceiling space will require measures to protect the ceilings and to support personnel in the ceiling. (i.e. plywood).
  - .2 The drywall ceilings are accessed from secure access hatches that will remain unlocked while there are employees working in the ceiling space
  - .3 The ceiling space is a return air plenum.

- .4 Any disruption of water service shall be done during night shift and water shall be operational for the beginning of the next regular work day.
- .14 Heating Terminal Valves and Controls General
  - .1 This work is sporadic throughout the institution and will involve the disruption of numerous spaces. The overall restriction for this work is that only one area may be disrupted at any given time, and that this work must be scheduled well in advance. Interim acceptance must be received prior to moving to the next area of work.
- .7 There are six principal areas that have AH driven work. Further to the phasing constraints described above, there are further restrictions on AH driven mechanical work. Only two areas may be active at any given time. Any AH that are being replaced in a given area must be commissioned, interim acceptance received and associated area occupied prior to moving on to a new principal area of work. The work areas shown on the drawing are:
  - .1 Segregation Wing
  - .2 West Mechanical Room
  - .3 Executive Area
  - .4 Tunnels / Cell Blocks
  - .5 East Mechanical Room – Food Service
  - .6 Main Boiler Room – SIS
- .8 Work outside of each phase Work area is to be coordinated with the Department Representative.
- .9 Maintain fire access/control.

## **1.5 CONTRACTOR USE OF PREMISES**

- .1 Limit use of premises for storage, for Work, for access to allow:
  - .1 Maintain 24-hour operational access through all areas of work to meet operational requirements
- .2 Refer to Section 01 35 13 - Security Requirements.
- .3 Co-ordinate use of premises under direction of Departmental Representative.
- .4 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.
- .5 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.
- .6 At completion of operations, restore condition of existing work to equal to or better than that which existed before new work started.

## **1.6 PARTIAL OWNER OCCUPANCY**

- .1 Premises will be occupied during entire construction period for execution of normal operations.
- .2 Cooperate with Department Representative in scheduling operations to minimize conflict and to facilitate usage.

- .3 Execute Partial Interim Certificate of Completion for each designated portion of Work prior to Owner occupancy.
- .4 The facility will be fully occupied during construction.

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

- .1 Execute work with least possible interference or disturbance to occupants, building operations 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 a minimum of 48 hr in advance.
- .2 Provide alternative routes for personnel only with written permission from the Departmental Representative.
- .3 Establish location and extent of service lines in area of work before starting Work. Notify Departmental Representative of findings.
- .4 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.
- .5 Provide temporary services when directed by Departmental Representative to maintain critical building systems.
- .6 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.
- .7 Protect, relocate or maintain existing active services. Record locations of maintained, re-routed and abandoned service lines.
- .8 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

#### **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 Three (3) week look ahead.
  - .11 Health and Safety Plan and Other Safety Related Documents.
  - .12 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            ACCESS AND EGRESS**

- .1      Design, construct and maintain temporary "access to" and "egress from" work areas, including stairs, runways, ramps or ladders and scaffolding, independent of finished surfaces and in accordance with relevant municipal, provincial and other regulations.

**1.2            USE OF SITE AND FACILITIES**

- .1      Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with Departmental Representative to facilitate work as stated.
- .2      Maintain existing services to building and provide for personnel and vehicle access.
- .3      Where security is reduced by work arrange with Departmental Representative to provide temporary means to maintain security. Refer to Section 01 35 13 - Security Requirements.
- .4      Contractor must provide sanitary facilities that will remain outdoors, located inside the security fence, in near proximity to the work area.
  - .1          Coordinate bathroom access and schedule with Commissionaires.
  - .2          If Departmental Representative confirms in writing that CSC operational requirements make it unfeasible for contractor to supply a sanitary facility in near proximity to work area, the contractor will be authorized to use one or more sanitary facilities currently existing within the institution
  - .3          Contractor must be respectful and keep clean any sanitary facilities existing within the institution that are provided temporarily for use. Miss use of facilities will result in removal withdrawal permission.
- .5      Contractor laydown and parking shall be located outside of the security fence, north of the GO building. Security provisions for all tools, assets, equipment & material located in the contractor laydown shall be the responsibility of the contractor.
- .6      Closures: protect work temporarily until permanent enclosures are completed.

**1.3            ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING**

- .1      Execute work with least possible interference or disturbance to occupants, building operations and normal use of premises. Arrange with Departmental Representative to facilitate execution of work.

**1.4            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, Departmental Representative 48 hours of notice for necessary interruption of mechanical or electrical service throughout course of work. Keep duration of interruptions minimum.
- .3      Provide for pedestrian personnel and vehicular traffic.

- .4 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

## **1.5 SPECIAL REQUIREMENTS**

- .1 Ensure Contractor's personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations. Refer to 01 35 13 - Security Requirements.
- .2 Noise generating activities shall be coordinated with department representative and require authorized from the institution.
- .3 Submit schedule in accordance with Section 01 32 16.07 - Construction Progress Schedule - Bar (GANTT) Chart.
- .4 Site access requests:
  - .1 Canadian Police Information Center (CPIC) submission procedure, save file name & pdf format "CPIC\_FirstName\_LastName\_Company.pdf", submissions must be sent once weekly (before Monday 12 pm noon on any given week, or before 12pm noon Tuesday if the Monday falls on a federal statutory holiday) Contractor shall designate a dedicated CPIC responsible manager. Each CPIC must be sent from the same responsible manager from the general contractor to Departmental Representative. Each submission must be accompanied by an updated log that contains a list of First Name, Last Name, Company Name, Date of CPIC submission. Each submission must list the names of the personnel requesting CPIC clearance in the body of the email; following each emailed submission, the email (without including detailed CPIC request, though including detailed CPIC submission log) is to then be sent to additional Departmental Representatives for monitoring. The definition of which Departmental Representative will receive the detailed request and which Departmental Representatives will receive the monitoring email, shall be defined in the kick-off meeting and may be subject to change periodically over the course of the project.
- .5 All deliveries must be received and offloaded outside the security fence by the contractor, in the contractor's laydown. No deliveries will be allowed to be received inside the security fence.
- .6 Half-an-hour (0.5) allowance to be made for screening each instance of personnel at the beginning of the work shift, and for any re-entries throughout the work shift.
  - .1 Any personnel to arrive at site at an unscheduled time or otherwise arrive on site for an unscheduled reason (i.e. late for shift, drop-in or unexpected site visit, etc.) shall allow for one (1) hour for security screening and escort to area of work
- .7 One (1) hour allowance to be made for screening each vehicle.

## **1.6 SECURITY**

- .1 CPIC:
  - .1 Personnel employed on this project will be subject to security check. Obtain CPIC clearance, as instructed, for each individual who will require to enter premises.

- .2 Obtain requisite CPIC clearance, as instructed, for each individual required to enter premises.
- .3 Personnel will be checked daily at start of work shift and provided with pass which must be worn at all times. Pass must be returned at end of work shift and personnel checked out.
- .4 CPIC Request Form attached.
- .2 Security escort:
  - .1 Escort required at all times.
  - .2 Personnel employed on this project must be escorted when executing work in non-public areas during normal working hours. Personnel must be escorted in all areas after normal working hours.
  - .3 Submit an escort request to Departmental Representative at least 14 days before service is needed. For requests submitted within time noted above, costs of security escort will be paid for by Departmental Representative. Cost incurred by late request will be Contractor's responsibility.
  - .4 Any escort request may be cancelled free of charge if notification of cancellation is given at least 4 hours before scheduled time of escort. Cost incurred by late request will be Contractor's responsibility.
  - .5 Calculation of costs will be based on average hourly rate of security officer for minimum of 8 hours per day for late service request and of 4 hours for late cancellations.

## **1.7 BUILDING SMOKING ENVIRONMENT**

- .1 Comply with smoking restrictions. Smoking is not permitted.

## **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      Project Supplementary Conditions

**1.2              CASH ALLOWANCES**

- .1      Include in Contract Price specified cash allowances.
- .2      Cash allowances, unless otherwise specified, cover net cost to Contractor of services, products, construction machinery and equipment, freight, handling, unloading, storage installation and other authorized expenses incurred in performing Work.
- .3      Contract Price, and not cash allowance, includes Contractor's overhead and profit in connection with such cash allowance.
- .4      Contract Price will be adjusted by written order to provide for excess or deficit to each cash allowance.
- .5      Where costs under a cash allowance exceed amount of allowance, Contractor will be compensated for excess incurred and substantiated plus allowance for overhead and profit as set out in Contract Documents.
- .6      Include progress payments on accounts of work authorized under cash allowances in Departmental Representative's monthly certificate for payment.
- .7      Prepare schedule jointly with Departmental Representative and Contractor to show when items called for under cash allowances must be authorized by Departmental Representative for ordering purposes so that progress of Work will not be delayed.
- .8      Amount of each allowance, for Work specified in respective specification Sections is as follows:
  - .1          Section 25 01 11 to 25 90 01 Work assigned to Johnson Controls

**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 APPLICATIONS FOR PROGRESS PAYMENT**

- .1 Submit to Department Representative, at least 30 days before first application for payment. Schedule of values for parts of Work, aggregating total amount of Contract Price, to facilitate evaluation of applications for payment.
- .2 Support claims for products delivered to Place of Work but not yet incorporated into Work by such evidence as Department Representative may reasonably require to establish value and delivery of products.

**1.2 SCHEDULE OF VALUES**

- .1 Provide schedule of values supported by evidence as Department Representative may reasonably direct and when accepted by Department Representative, be used as basis for applications for payment.
- .2 Include statement based on schedule of values with each application for payment.
- .3 Support claims for products delivered to Place of Work but not yet incorporated into Work by such evidence as Department Representative may reasonably require to establish value and delivery of products.
- .4 Work Area/ Phases requiring separate breakdowns are shown on drawing G3. Schedule of values shall include a breakdown by Specification Divisions for each Work Area/ Phase.
  - .1 Division 01 - GENERAL REQUIREMENTS
    - .1 Mobilization
    - .2 General Conditions
    - .3 Close out and Documentation
  - .2 Division 02 - EXISTING CONDITIONS
    - .1 Demolition
    - .2 Hazardous material/Asbestos Abatement
  - .3 Division 03 - CONCRETE
  - .4 Division 04 - MASONRY
  - .5 Division 05 - METALS
  - .6 Division 06 – WOOD, PLASTICS AND COMPOSITES
  - .7 Division 07 - THERMAL AND MOISTURE PROTECTION
  - .8 Division 08 - OPENINGS
  - .9 Division 09- painting and FINISHES
  - .10 Division 10 - SPECIALTIES
  - .11 Division 22- PLUMBING
  - .12 Division 23- HEATING, VENTILATING AND AIR CONDITIONING (HVAC)
  - .13 Division 25 - INTEGRATED AUTOMATION
  - .14 Division 26 - ELECTRICAL
  - .15 Division 28- ELECTRONIC SAFETY AND SECURITY

- .5 Further detailed breakdown of for Divisions 22, 23, 25, and 26 is required for each sub trade with a minimum of the following sub-categories:

- .1 Mobilization
- .2 Demolition
- .3 Equipment
- .4 Material
- .5 Labour
- .6 Testing Adjusting and Balancing. (Div 23)
- .7 Commissioning
- .8 Training and Close Out Submittals (BMM &, as-builts)
- .9 Documentation

### **1.3 SUBSTANTIAL PERFORMANCE OF WORK**

Prepare and submit to Department Representative, comprehensive list of items to be completed or corrected and apply for a review by Department Representative to establish Substantial Performance of Work or substantial performance of designated portion of Work when Cx Functional Performance Testing is completed and approved by the Department Representative. Failure to include items on list does not alter responsibility to complete Contract.

- .1 Upon receipt of list and application, Department Representative will review Work to verify validity of application, and no later than 7 days after completing review, will notify Contractor if Work or designated portion of Work is substantially performed.
- .2 Department Representative will establish a date of Substantial Performance of Work or designated portion of Work.
- .3 Immediately following issuance of certificate of Substantial Performance of Work, in consultation with Department Representative, establish reasonable date for finishing Work.

### **1.4 PAYMENT OF HOLDBACK UPON SUBSTANTIAL PERFORMANCE OF WORK**

- .1 After issuance of certificate of Substantial Performance of Work:
  - .1 Submit application for payment of holdback amount.
  - .2 Submit sworn statement that accounts for labour, subcontracts, products, construction machinery and equipment, and other indebtedness which may have been incurred in Substantial Performance of Work and for which Owner might in be held responsible have been paid in full, except for amounts properly retained as holdback or as identified amount in dispute.
- .2 After receipt of application for payment and sworn statement, Department Representative will issue certificate for payment of holdback amount.

### **1.5 PROGRESSIVE RELEASE OF HOLDBACK**

- .1 Where legislation permits, if Department Representative has certified that Work of subcontractor or supplier has been performed prior to Substantial Performance of Work, Owner shall pay holdback amount retained for such subcontract Work, or products

supplied by such supplier, on day following expiration of holdback period for such Work stipulated in lien legislation applicable to Place of Work.

- .2 In addition to provisions of preceding paragraph, and certificate wording, ensure that such subcontract Work or products is protected pending issuance of final certificate for payment and be responsible for correction of defects or Work not performed regardless of whether or not such was apparent when such certificates were issued.

## **1.6 FINAL PAYMENT**

- .1 Submit application for final payment when Work is completed.
- .2 Upon receipt of application for final payment, Department Representative will review Work to verify validity of application. Department Representative will give notification that application is valid or give reasons why it is not valid, no later than 7 days after reviewing Work.
- .3 Department Representative will issue final certificate for payment when application for final payment is found valid.

## **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                ADMINISTRATIVE**

- .1     Schedule and administer project meetings throughout the progress of the work at the call of Departmental Representative.
- .2     Prepare agenda for meetings.
- .3     Provide physical space and make arrangements for meetings.
- .4     Preside at meetings.
- .5     Record the meeting minutes. Include significant proceedings and decisions. Identify actions by parties.
- .6     Reproduce and distribute copies of minutes within three days after meetings and transmit to meeting participants affected parties not in attendance, and Departmental Representative.
- .7     Representative of Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

**1.2                PRECONSTRUCTION MEETING**

- .1     Within 15 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
- .2     Departmental Representative, Contractor, major Subcontractors, field inspectors must be in attendance.
- .3     Establish time and location of meeting and notify parties concerned minimum 7 days before meeting.
- .4     Agenda to include:
  - .1     Appointment of official representative of participants in the Work.
  - .2     Schedule of Work: in accordance with Section 01 32 16.07 - Construction Progress Schedule – Bar (GANTT) Chart.
  - .3     Schedule of submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
  - .4     Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences in accordance with Section 01 52 00 - Construction Facilities.
  - .5     Site security in accordance with Section 01 35 13 Security Requirements.
  - .6     Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
  - .7     Products provided by Department Representative.
  - .8     Record drawings in accordance with Section 01 33 00 - Submittal Procedures.
  - .9     Maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals.
  - .10    Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 - Closeout Submittals.

- .11 Monthly progress claims, administrative procedures, photographs, holdbacks.
- .12 Appointment of inspection and testing agencies or firms.
- .13 Insurances, transcript of policies.

### **1.3 PHASING AND PLANNING MEETINGS**

- .1 Schedule and administer bi-weekly (every two weeks alternating with progress meetings) phasing and planning meetings for 12 weeks (six instances) following the pre-construction meeting
- .2 Schedule and administer bi-weekly (every two weeks alternating with progress meetings) phasing and planning meetings at the beginning each subsequent new year that the project is underway
- .3 Pre-schedule and distribute written notice of each phasing and planning meeting five (5) days in advance of the first phasing and planning meeting, submit this to Department Representative.
- .4 Contractor to provide meeting space and make arrangements for meetings.
- .5 Contractor, major Subcontractors involved in Work and Departmental Representative must be in attendance.
- .6 Record minutes of meetings and circulate to attending parties and affected parties not in attendance within 2 days. Agenda to include the following:
  - .1 Review, approval of minutes of previous meeting
  - .2 Critical review of 3-week look-ahead
  - .3 Critical review of Master Schedule
  - .4 Review phasing constraints and opportunities
  - .5 Review prioritizing activities driven by operational requirements and contractor presented items
  - .6 Review logistical challenges and opportunities
  - .7 Review of changes and/or discrepancies that may affect quality or schedule
  - .8 Summarize and organize all items recorded at the phasing and planning meetings into categories that are designated as actions and information for the appropriate parties

### **1.4 PROGRESS MEETINGS**

- .1 Schedule and administer bi-weekly (every two weeks) project meetings throughout progress of Work.
- .2 Contractor to provide meeting space and make arrangements for meetings.
- .3 Contractor, major Subcontractors involved in Work and Departmental Representative must be in attendance.
- .4 Notify parties minimum 5 days in advance of meeting

- .5 Record minutes of meetings and circulate to attending parties and affected parties not in attendance within 4 days. Agenda to include the following:
  - .1 Review, approval of minutes of previous meeting.
  - .2 Review of Work progress since previous meeting.
  - .3 Field observations, problems, conflicts.
  - .4 Problems which impede construction schedule.
  - .5 Review of off-site fabrication delivery schedules.
  - .6 Corrective measures and procedures to regain projected schedule.
  - .7 Revision to construction schedule.
  - .8 Progress schedule, during succeeding work period.
  - .9 Review submittal schedules: expedite as required.
  - .10 Maintenance of quality standards.
  - .11 Review proposed changes for affect on construction schedule and on completion date.
  - .12 Shop drawing, RFI and CCN logs.
  - .13 Other business.

**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            DEFINITIONS**

- .1      Activity: element of Work performed during course of Project. Activity normally has expected duration, and expected cost and expected resource requirements. Activities can be subdivided into tasks.
- .2      Bar Chart (GANTT Chart): graphic display of schedule-related information. In typical bar chart, activities or other Project elements are listed down left side of chart, dates are shown across top, and activity durations are shown as date-placed horizontal bars. Generally, Bar Chart should be derived from commercially available computerized project management system.
- .3      Baseline: original approved plan (for project, work package, or activity), plus or minus approved scope changes.
- .4      Construction Work Week: Monday to Friday, inclusive, will provide five-day work week and define schedule calendar working days as part of Bar (GANTT) Chart submission.
- .5      Duration: number of work periods (not including holidays or other nonworking periods) required to complete activity or other project element. Usually expressed as workdays or workweeks.
- .6      Master Plan: summary-level schedule that identifies major activities and key milestones.
- .7      Milestone: significant event in project, usually completion of major deliverable.
- .8      Project Schedule: planned dates for performing activities and the planned dates for meeting milestones. Dynamic, detailed record of tasks or activities that must be accomplished to satisfy Project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.
- .9      Project Planning, Monitoring and Control System: overall system operated by Departmental Representative to enable monitoring of project work in relation to established milestones.

### **1.2            REQUIREMENTS**

- .1      Ensure Master Plan and Detail Schedules are practical and remain within specified Contract duration.
- .2      Plan to complete Work in accordance with prescribed milestones and time frame.
- .3      Limit activity durations to maximum of approximately 10 working days, to allow for progress reporting.
- .4      Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Interim Certificate and Final Certificate as defined times of completion are of essence of this contract.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit to Department Representative within seven (15) working days of Award of Contract Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of project progress.
- .3 Submit Project Schedule to Departmental Representative within 5 working days of receipt of acceptance of Master Plan.

### **1.4 PROJECT MILESTONES**

- .1 Project milestones form interim targets for Project Schedule. Indicate the following:
  - .1 Indicate the number of working days to complete each work area/phase and the start and end date. The work areas shown on the drawing are:
    - .1 Segregation Wing
    - .2 West Mechanical Room
    - .3 Executive Area
    - .4 Tunnels / Cell Blocks
    - .5 East Mechanical Room – Food Service
    - .6 Main Bolier Room – SIS
  - .2 Within each work area/phase indicate the number of working days to complete each Air Handler System and the start and end date.

### **1.5 MASTER PLAN**

- .1 Structure schedule to allow orderly planning, organizing and execution of Work as Bar Chart (GANTT).
- .2 Departmental Representative will review and return revised schedules within 7 working days.
- .3 Revise impractical schedule and resubmit within 5 working days.
- .4 Accepted revised schedule will become Master Plan and be used as baseline for updates.

### **1.6 PROJECT SCHEDULE**

- .1 Develop detailed Project Schedule derived from Master Plan.
- .2 Ensure detailed Project Schedule includes as minimum milestone and activity types as follows:
  - .1 Award.
  - .2 Permits.
  - .3 Mobilization.
  - .4 Pre-shut down confirmation review.
  - .5 Specific Work Area Phase
    - .1 Shop Drawings, Samples.

- .2 Supplied equipment long delivery items.
- .3 Area Preparation and Demolition
- .4 Interior Architecture (Walls, Floors and Ceiling).
- .5 Plumbing.
- .6 Lighting.
- .7 Electrical.
- .8 Piping.
- .9 Controls.
- .10 Heating, Ventilating, and Air Conditioning.
- .11 Fire Systems.
- .12 Testing and Commissioning.
  - .1 Pre-function Checks
  - .2 Start-up
  - .3 Controls Functional Start up
  - .4 Functional Performance Verifications.
- .13 Documentation
- .14 Training
- .15 Other supplied equipment required dates.

## **1.7 PROJECT SCHEDULE REPORTING**

- .1 Update Project Schedule on weekly basis reflecting activity changes and completions, as well as activities in progress.
- .2 Include as part of Project Schedule, narrative report identifying Work status to date, comparing current progress to baseline, presenting current forecasts, defining problem areas, anticipated delays and impact with possible mitigation.
- .3 Weekly Reports should include
  - .1 Summary of weekly man hours spent the previous week, forecast of weekly man hours for the next week.
  - .2 Schedule forecast on areas of work for the week coming up and any major activities. Identify escort requirements to department representative for scheduling.
  - .3 Material section: report on deliveries, forecasted deliveries in the weeks coming up.
  - .4 Progress of work that has been completed that last week.
  - .5 Commissioning milestones
  - .6 Deficient items.
  - .7 Forecasted inspections.
  - .8 Weather issues.
  - .9 RFI, SI, CCN, CO (forecasted or outstanding).
  - .10 Any as-builts or pictures as required.

- .11 Any upcoming CPICs that will be submitted and when they are requested to be processed by.
  - .4 Communicate daily any deviations from the weekly report.
- 1.8 PROJECT MEETINGS**
  - .1 Discuss Project Schedule at regular site meetings, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current accepted dates shown on baseline schedule.
- 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            ADMINISTRATIVE**

- .1      Submit to Departmental Representative 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      Present shop drawings, product data, samples and mock-ups in SI Metric units.
- .4      Where items or information is not produced in SI Metric units converted values are acceptable.
- .5      Review submittals prior to submission to Departmental Representative. 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.
- .6      Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7      Verify field measurements and affected adjacent Work are co-ordinated.
- .8      Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submittals.
- .9      Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.
- .10     Keep one reviewed copy of each submission on site.
- .11     Submittals shall be posted to Project Buzzsaw Directory and shall be organized and named by specification section.
  - .1      Naming convention shall be "Specification Number\_Shop Drawing Description\_Date of Submission".
  - .2      Once uploaded, a separate email notification indicating that the submission has been posted shall be sent from the contractor to the Departmental Representative.

**1.2            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      Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.



- .3 Allow 5 days for review of each submission by Departmental Representatives.
- .4 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .5 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions other than those requested.
- .6 Accompany submissions with transmittal letter, containing:
  - .1 Date.
  - .2 Project title and number.
  - .3 Contractor's name and address.
  - .4 Identification and quantity of each shop drawing, product data and sample.
  - .5 Other pertinent data.
- .7 Submissions include:
  - .1 Date and revision dates.
  - .2 Project title and number.
  - .3 Name and address of:
    - .1 Subcontractor.
    - .2 Supplier.
    - .3 Manufacturer.
  - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
  - .5 Details of appropriate portions of Work as applicable:
    - .1 Fabrication.
    - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
    - .3 Setting or erection details.
    - .4 Capacities.
    - .5 Performance characteristics.
    - .6 Standards.
    - .7 Operating weight.
    - .8 Wiring diagrams.
    - .9 Single line and schematic diagrams.
    - .10 Relationship to adjacent work.
- .8 After Departmental Representative's review, distribute copies.
- .9 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.

- .10 Submit electronic copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.
- .11 Submit electronic copies of test reports for requirements requested in specification Sections and as requested by Departmental Representative.
  - .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.
- .12 Submit electronic copies of certificates for requirements requested in specification Sections and as requested by Departmental Representative.
  - .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.
- .13 Submit electronic copies of manufacturers instructions for requirements requested in specification Sections and as requested by Departmental Representative.
  - .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.
- .14 Submit electronic copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.
- .15 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .16 Submit electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.
- .17 Delete information not applicable to project.
- .18 Supplement standard information to provide details applicable to project.
- .19 If upon review by Departmental Representative, 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.

### **1.3 SAMPLES**

- .1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to Departmental Representative's.
- .3 Notify Departmental Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.

- .4 Where colour, pattern or texture is criterion, submit full range of samples.
- .5 Adjustments made on samples by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .6 Make changes in samples which Departmental Representative may require, consistent with Contract Documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

#### **1.4 MOCK-UPS**

- .1 Erect mock-ups in accordance with Section 01 45 00 - Quality Control.
- .2 Provide a mock-up of the wall penetration detail for cell block exhaust grille and fan installation. Refer to architectural drawings.

#### **1.5 PHOTOGRAPHIC DOCUMENTATION**

- .1 Submit electronic colour digital photography in jpg format, fine resolution monthly with progress statement as directed by Departmental Representative.
- .2 Project identification: name and number of project and date of exposure indicated.
- .3 Number of viewpoints: 4 locations.
  - .1 Viewpoints and their location as determined by Departmental Representative.
- .4 Frequency of photographic documentation: weekly.

#### **1.6 CERTIFICATES AND TRANSCRIPTS**

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

### **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            PURPOSE**

- .1        To ensure that both the construction project and the institutional operations may proceed without undue disruption or hindrance and that the security of the institution is maintained at all times.

**1.2            DEFINITIONS**

- .1        "Contraband" means:
  - .1            an intoxicant, including alcoholic beverages, drugs and narcotics;
  - .2            a weapon or a component thereof, ammunition for a weapon, and anything that is designed to kill, injure or disable a person or that is altered so as to be capable of killing, injuring or disabling a person, when possessed without prior authorization;
  - .3            an explosive or a bomb or a component thereof;
  - .4            currency over \$25, when possessed by an inmate without prior authorization; and
  - .5            any item not described in paragraphs (1) to (4) that could jeopardize the security of a Penitentiary or the safety of persons, when that item is possessed without prior authorization.
- .2        "Unauthorized Smoking Items" means all smoking items including, but not limited to, cigarettes, cigars, tobacco, chewing or snuffing tobacco, cigarette making machines, matches and lighters.
- .3        "Commercial Vehicle" means any motor vehicle used for the shipment of material, equipment and tools required for the construction project.
- .4        "CSC" means Correctional Service Canada.
- .5        "Construction employees" means persons working for the general Contractor, the sub-contractors, equipment operators, material suppliers, testing and inspection companies and regulatory agencies.
- .6        "Departmental Representative" means the Public Works and Government Services Canada (PWGSC) or the Correctional Service Canada (CSC) project manager depending on project.
- .7        "Perimeter" means the fenced or walled area of the institution that restrains the movement of the inmates.
- .8        "Construction zone" means the area as shown on the contract drawings where the contractor will be allowed to work. This area may or may not be isolated from the security area of the institution.

**1.3            PRELIMINARY PROCEEDINGS**

- .1        Prior to the commencement of work, the Contractor will meet with the Departmental Representative to:
  - .1            Discuss the nature and extent of all activities involved in the Project.

- .2 Establish mutually acceptable security procedures in accordance with this instruction and the institution's particular requirements.
- .2 The Contractor will:
  - .1 Ensure that all construction employees are aware of the rules of the institution.
  - .2 Ensure that a copy of the institutional rules is always prominently on display at the job site.
  - .3 Co-operate with institutional personnel in ensuring that the rules of the institution are observed by all construction employees.

#### **1.4 CONSTRUCTION EMPLOYEES**

- .1 Submit to the Departmental Representative a list of the names with date of birth of all construction employees to be employed on the construction site and a CPIC clearance form for each employee. (Institutional Access CPIC Clearance Request form CSC/SCC 1279).
- .2 Allow two (2) weeks for processing of security clearances. Construction employees will not be admitted to the institution without a valid CPIC clearance in place and a recent picture identification such as a provincial driver's license. CPIC clearances obtained from other CSC institutions are not valid at the institution where the project is taking place.
- .3 The Departmental Representative may require that facial photographs be taken of construction employees and that these photographs be displayed at appropriate locations in the institution or in an electronic database for identification purposes. The Departmental Representative requires that Photo ID cards be provided for all construction workers. ID cards will then be left at the designated entrance to be picked upon arrival at the institution and shall be displayed prominently on the construction employees clothing at all time while employees are at the institution.
- .4 Entry to Institutional Property will be refused to any person there may be reason to believe may be a security risk.
- .5 Any person employed on the construction site will be subject to immediate removal from Institutional Property if they:
  - .1 appear to be under the influence of alcohol, drugs or narcotics.
  - .2 behave in an unusual or disorderly manner.
  - .3 are in possession of contraband.

#### **1.5 VEHICLES**

- .1 All unattended vehicles on CSC property shall have windows closed; doors and trunks shall be locked and keys removed. The keys shall be securely in the possession of the vehicle owner or an employee of the company that owns the vehicle.
- .2 The Departmental Representative may limit at any time the number and type of vehicles allowed within the institution.
- .3 Drivers of delivery vehicles for material required by the project shall require security clearances and must remain with their vehicle the entire time that the vehicle is in the institution. The director may require that these vehicles be escorted by institutional staff or Commissionaires while in the institution.

- .4 If the Departmental Representative permits trailers to be left inside the secure perimeter of the institution, these trailer doors will be locked at all times. All windows will be securely locked when left unoccupied. All trailer windows shall be covered with expanded metal mesh. All storage trailers inside and outside the perimeter must be locked when not in use.

## **1.6 PARKING**

- .1 The parking area(s) to be used by construction employees will be designated by the Departmental Representative. Parking in other locations will be prohibited and vehicles may be subject to removal.
- .2 Contractor parking shall be north of the GO building

## **1.7 SHIPMENTS**

- .1 All shipments of project material, equipment and tools shall be addressed in the Contractor's name to avoid confusion with the institution's own shipments. The Contractor must have his own construction employees on site to receive any deliveries or shipments. CSC staff will NOT accept receipt of deliveries or shipments of any material equipment or tools.
- .2 Contractor shall receive and offload all deliveries outside of the security gate to the contractor laydown north of the GO building. Only after a delivery has been offloaded and received outside of the security gate, may it be brought inside the security fence, for use on the job site.
- .3 Security provisions for all tools, assets, equipment & material located in the contractor laydown shall be the responsibility of the contractor.

## **1.8 TELEPHONES**

- .1 There will be no installation of telephones, Facsimile machines and computers with Internet connections permitted within the perimeter of the institution unless prior approval of the Departmental Representative is received.
- .2 The Departmental Representative will ensure that approved telephones, Facsimile machine and computers with Internet connections are located where they are not accessible to inmates. All computers will have an approved password protection that will stop an Internet connection to unauthorized personnel.
- .3 Wireless cellular and digital telephones, including but not limited to devices for telephone messaging, pagers, BlackBerries, telephone used as two-way radios, are not permitted within the perimeter of the institution unless approved by the Departmental Representative. If wireless cellular telephones are permitted, the user will not permit their use by any inmate. Cellular telephones approved by the Departmental Representative must be signed in and out of the institution.
- .4 The Departmental Representative may approve and limit the use of two-way radios.

## **1.9 WORK HOURS**

- .1 Work hours within the institution are: 8:00 a.m. to 4:00 p.m., Monday to Friday.

#### **1.10 OVERTIME WORK**

- .1 Workers can work during the weekend outside of the building for longer hours subject to approval from the Departmental Representative.
- .2 Give a minimum twenty-four (24) hours advance notice when overtime work on the construction project is necessary and approved.
- .3 When overtime work, weekend statutory holiday work is required and approved by the Departmental Representative, extra staff members may be posted by the Departmental Representative or his designate, to maintain the security surveillance. The actual cost of this extra staff may be attributed to the contractor.

#### **1.11 TOOLS AND EQUIPMENT**

- .1 Tools brought in need to be counted every day and workers need to have a security briefing upon their initial arrival.
- .2 Maintain on site a complete list of all tools and equipment to be used during the construction project. Make this inventory available for inspection when required.
- .3 Throughout the construction project maintain up-to-date the list of tools and equipment specified above.
- .4 Keep all tools and equipment under constant supervision, particularly power-driven and cartridge-driven tools, cartridges, files, saw blades, rod saws, wire, rope, ladders and any sort of jacking device.
- .5 Store all tools and equipment in approved secure locations.
- .6 Lock all toolboxes when not in use. Keys to remain in the possession of the construction employees of the Contractor.
- .7 Scaffolding shall be secured and locked when not erected and when erected, shall be secured in a manner agreed upon with the Departmental Representative.
- .8 All missing or lost tools or equipment shall be reported immediately to the Departmental Representative.
- .9 The Departmental Representative will ensure that the security staff members carry out checks of the Contractor's tools and equipment against the list provided by the Contractor. These checks may be carried out at the following intervals:
  - .1 At the beginning and conclusion of every construction project.
  - .2 Weekly, when the construction project extends longer than a one-week period.
- .10 Certain tools/equipment such as cartridges and hacksaw blades are highly controlled items. The contractor will be given at the beginning of the day, a quantity that will permit one day's work. Used blades/cartridges will be returned to the Departmental Representative at the end of each day. The use of explosive-actuated tools is prohibited on site unless otherwise approved by the Departmental Representative. All broken blades and tools must be accounted for and broken tools are not to be thrown away. Particular attention must be given to power driven tools, files, saw blades, rod saws, wire, rope and ladders. Tool kits must be locked when the area is unattended.

- .11 If propane or natural gas is used for heating the construction, the institution will require that an employee of the contractor supervise the construction site during non-working hours.
- .12 Prior to the mobilization of the job box to the project, the following procedure is to be followed:
  - .1 Name of responsible foreman/field supervisor for the job box
  - .2 Provide a list of tools that will be inside the job box
    - .1 This list must be signed off by the warden
  - .3 No tools can be added to the job box without a formal revision to the tools list
  - .4 For job box, each tool is to have a number affixed to it (unless unsafe to do so and risks damaging the tool thus rendering it unsafe to use), to facilitate the tool inventory.
- .13 A laminated tool list or paper copy should be kept with the job box at all times

#### **1.12 PRESCRIPTION DRUGS**

- .1 Employees of the Contractor who are required to take prescription drugs during the workday shall obtain approval of the Departmental Representative to bring a one-day supply only into the institution.

#### **1.13 SMOKING RESTRICTIONS**

- .1 Contractors and construction employees are not permitted to smoke inside correctional facilities or outdoors within the perimeter of a correctional facility and must not possess unauthorized smoking items within the perimeter of a correctional facility.
- .2 Contractors and construction employees who are in violation of this policy will be requested to immediately cease smoking or dispose of any unauthorized smoking items and, if they persist, will be directed to leave the institution.
- .3 Smoking is only permitted outside the perimeter of a correctional facility in an area to be designated by the Departmental Representative.

#### **1.14 CONTRABAND**

- .1 Weapons, ammunition, explosives, alcoholic beverages, drugs and narcotics are prohibited on institutional property.
- .2 The discovery of contraband on the construction site and the identification of the person(s) responsible for the contraband shall be reported immediately to the Departmental Representative.
- .3 Contractors should be vigilant with both their staff and the staff of their sub-contractors and suppliers that the discovery of contraband may result in cancellation of the CPIC clearance of the affected employee. Serious infractions may result in the removal of the company from the institution for the duration of the construction.
- .4 Presence of arms and ammunition in vehicles of contractors, sub-contractors and suppliers or employees of these will result in the immediate cancellation of CPIC clearances for the driver of the vehicle.



**1.15 SEARCHES**

- .1 All vehicles and persons entering institutional property may be subject to search.
- .2 When the Departmental Representative suspects, on reasonable grounds, that an employee of the Contractor is in possession of contraband or unauthorized items, he may order that person to be searched.
- .3 All employees entering the institution may be subject to screening of personal effects for traces of contraband drug residue.

**1.16 ACCESS TO AND REMOVAL FROM INSTITUTIONAL PROPERTY**

- .1 Construction personnel and commercial vehicles will not be admitted to the institution after normal working hours, unless approved by the Departmental Representative.

**1.17 MOVEMENT OF VEHICLES**

- .1 Escorted commercial vehicles will be allowed to enter or leave the institution through the vehicle access gate during the following hours:
  - .1 8:00 a.m. to 4:00 p.m., Monday to Friday with the following exception:
    - .1 Vehicles cannot access the north sally port from 12:00 p.m. to 1:00 p.m. and 4:30 p.m. to 5:30 p.m.
- .2 The contractor shall advise the Departmental Representative twenty-four (24) hours in advance to the arrival on the site of heavy equipment such as concrete trucks, cranes, etc.
- .3 Vehicles being loaded with soil or other debris, or any vehicle considered impossible to search, must be under continuous supervision by CSC staff or Commissionaires working under the authority of the Departmental Representative.
- .4 Commercial vehicles will only be allowed access to institutional property when their contents are certified by the Contractor or his representative as being strictly necessary to the execution of the construction project.
- .5 Vehicles shall be refused access to institutional property if, in the opinion of the Departmental Representative, they contain any article which may jeopardize the security of the institution.
- .6 Private vehicles of construction employees will not be allowed within the security perimeter of medium or maximum security institutions without the authorization of the Departmental Representative. Contractor's employees will park their vehicles in a designated area outside the perimeter of the institution.
- .7 With the approval of the Departmental Representative, certain equipment may be permitted to remain on the construction site overnight or over the weekend. This equipment must be securely locked, with the battery removed. The Departmental Representative may require that the equipment be secured with a chain and padlock to another fixed object.

**1.18 MOVEMENT OF CONSTRUCTION EMPLOYEES ON INSTITUTIONAL PROPERTY**

- .1 Subject to the requirements of good security, the Departmental Representative will permit the Contractor and his employees as much freedom of action and movement as is possible.
- .2 However, notwithstanding paragraph above, the Departmental Representative may prohibit or restrict access to any part of the institution.
- .3 The Departmental Representative will also require the following:
  - .1 Workers need to be escorted by Correctional Officers while working inside of the building.
  - .2 Workers need to be escorted by commissionaires while working outside of the building.
- .4 During the lunch and coffee/health breaks, all construction employees will remain within the construction site. Construction employees are not permitted to eat in the officer's lounge or the dining room of the institution.

**1.19 SURVEILLANCE AND INSPECTION**

- .1 Construction activities and all related movement of personnel and vehicles will be subject to surveillance and inspection by CSC security staff members to ensure that established security requirements are met.
- .2 CSC staff members will ensure that an understanding of the need to carry out surveillance and inspections, as specified above, is established among construction employees and maintained throughout the construction project.

**1.20 STOPPAGE OF WORK**

- .1 The Departmental Representative may order at any time that the contractor, his employees, sub-contractors and their employees to not enter or to leave the work site immediately due to a security situation occurring within the institution. The contractor's site supervisor shall note the name of the CSC staff member giving this instruction, the time of the request and obey the order as quickly as possible.
- .2 The contractor shall advise the Departmental Representative of this interruption of the work within 24 hours.

**1.21 CONTACT WITH INMATES**

- .1 Unless specifically authorized, the contractor is not encouraged to come into contact with inmates, to talk with them, to receive objects from them or to give them objects. Any construction employee doing any of the above without permission will be removed from the site and his security clearance revoked.
- .2 It is to be noted that cameras are not allowed on CSC property except if required for photographic history of the project. In this case, the contractor will be asked to use a designated memory card for the project.

- .3 Notwithstanding the above paragraph, if the Departmental Representative approves of the usage of cameras, it is strictly forbidden to take pictures of inmates, of CSC staff members or of any part of the institution other than those required as part of this contract.

#### **1.22 TEMPORARY FENCES**

- .1 Temporary fencing should be assumed as necessary around work area unless otherwise told by the Departmental Representative.
- .2 Refer to Section 01 56 00 - Temporary Barriers and Enclosures for other temporary fence requirements.

#### **1.23 COMPLETION OF CONSTRUCTION PROJECT**

- .1 Upon completion of the construction project or, when applicable, the takeover of a facility, the Contractor shall remove all remaining construction material, tools and equipment that are not specified to remain in the institution as part of the construction contract.

### **Part 2 Products**

#### **2.1 NOT USED**

- .1 Not used.

### **Part 3 Execution**

#### **3.1 NOT USED**

- .1 Not used.

**END OF SECTION**



INSTITUTIONAL ACCESS  
CPIC CLEARANCE REQUEST

ACCÈS À UN ÉTABLISSEMENT  
DEMANDE DE VÉRIFICATION  
DU DOSSIER AU CIPC

PUT AWAY ON FILE – CLASSER AU DOSSIER  
ADMINISTRATIVE OR OPERATIONAL FILE  
DOSSIER ADMINISTRATIF OU OPÉRATIONNEL

Original = 3170-12

U PLEASE PRINT INFORMATION CLEARLY - VEUILLEZ ÉCRIRE EN LETTRES MOULÉES

Institution – Établissement	Request received Demande reçue le	Date (YYAA-MM-DJ)	PUT AWAY ON FILE CLASSER AU DOSSIER	3170-12
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A. PERSONAL INFORMATION – RENSEIGNEMENTS PERSONNELS

Surname Nom de famille	Full name (no nicknames or initials) Nom au complet (pas de surnoms ou d'initiales)	Maiden name (if applicable) Nom de jeune fille (s'il y a lieu)
Date of birth Date de naissance (YYAA-MM-DJ)	Place of birth – Lieu de naissance City/Town – Ville ou municipalité	Province/State – Province ou état
		Country – Pays

B. PHYSICAL DESCRIPTION – DESCRIPTION PHYSIQUE

<input type="checkbox"/> Male Homme	<input type="checkbox"/> Female Femme	Height – Grandeur	Weight – Poids	Eye color – Couleur des yeux	Hair color Couleur des cheveux
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C. ADDRESS – ADRESSE

Street – Rue	City/Town – Ville ou municipalité	Province	Postal Code - Code postal	Telephone number – Numéro de téléphone Home – Domicile	Work – Bureau
Representing (name of company/organization) – Représente (nom de la compagnie ou de l'organisation)					

D. GENERAL INFORMATION – RENSEIGNEMENTS GÉNÉRAUX

1.	Have you ever been convicted of a criminal offence for which you have not been granted a pardon, or an offence for which you have been granted a pardon and such a pardon has been revoked? Avez-vous déjà été reconnu coupable d'une infraction criminelle pour laquelle on ne vous a pas octroyé un pardon ou d'une infraction pour laquelle on vous a octroyé un pardon qui a été révoqué?	<input type="checkbox"/> Yes Oui	<input type="checkbox"/> No Non
2.	Do you personally know of any person incarcerated in a correctional facility? Connaissez-vous personnellement une personne qui est incarcérée dans un établissement correctionnel?	<input type="checkbox"/> Yes Oui	<input type="checkbox"/> No Non
3.	Do you have any reason to believe coming into contact with this person could pose a risk to your or their personal safety? Avez-vous des raisons de croire que le fait d'entrer en contact avec cette personne pourrait présenter un risque pour votre sécurité personnelle ou la sienne ?	<input type="checkbox"/> Yes Oui	<input type="checkbox"/> No Non
4.	Are you related/associated to an inmate or on an inmate's visiting list? Êtes-vous apparenté ou associé à un détenu ou inscrit sur la liste des visiteurs d'un détenu?	<input type="checkbox"/> Yes Oui	<input type="checkbox"/> No Non

If you have answered YES to any of the above, please explain below. – Si vous avez répondu OUI à une des questions ci-dessus, veuillez fournir une explication ci-après.



E. SIGNATURE (When sections A to E are filled out completely, please return the completed form to the institution for approval.)

(Une fois que les sections A à E ont été remplies, veuillez retourner le formulaire dûment rempli à l'établissement aux fins d'approbation.)

In making this application, I hereby give the Correctional Service of Canada my consent to use the information provided on this form to conduct such inquiries with police authorities as may be necessary to ascertain my suitability. Finally, I acknowledge that the Correctional Service of Canada has no responsibility for any harm that may come to me in the course of my activities, except where such harm is a direct result of negligence on the part of an employee(s) of the Service.

NOTE: Access may be denied for submitting false information. Passes may be issued for those receiving clearance and approval.

En soumettant la présente demande, j'autorise le Service correctionnel du Canada à se servir des renseignements fournis dans le formulaire afin de mener, auprès des services de police, toute enquête jugée nécessaire pour vérifier mon admissibilité. Par ailleurs, je conviens que le Service correctionnel du Canada ne peut être tenu responsable d'un préjudice subi dans le cadre de mes activités sauf si ce préjudice est directement attribuable à la négligence d'un ou de plusieurs employés du Service. NOTA : Tout demandeur qui fournit de faux renseignements peut se voir refuser l'accès à l'établissement. Un laissez-passez peut être émis aux demandeurs dont la demande d'accès est approuvée.

Applicant's signature – Signature du demandeur

Date (YYAA-MM-DJ)

F. FOR OFFICE USE ONLY – RÉSERVÉ AU SCC

Reason for clearance – Motif justifiant la demande d'accès

Department making the request (please print) Unité qui soumet la demande (en lettres moulées s.v.p.)	Signature of Division Head Signature du chef de la division	Date (YYAA-MM-DJ)
<input type="checkbox"/> No criminal record Aucun casier	<input type="checkbox"/> A possible criminal record #: Numéro du casier judiciaire	Last entry: Dernière entrée :
<input type="checkbox"/> An outstanding warrant/charge held by: Auteur du mandat non exécuté/accusation en instance :		
SIGNATURES		
<input type="checkbox"/> Approved Approuvée	<input type="checkbox"/> Not approved Non approuvée	The individual has been advised. – Le demandeur a été informé de la décision.
Security Intelligence Officer Agent de renseignements de sécurité	Institutional Head Directeur de l'établissement	Visit Review Board Comité des visites
Date (YYAA-MM-DJ)	Date (YYAA-MM-DJ)	Date (YYAA-MM-DJ)

**Part 1            General**

**1.1            REFERENCES**

- .1      Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations.
- .2      Province of Alberta.
- .3      Occupational Health and Safety Act, R.S.A. - Updated 2013.
- .4      Health Canada/Workplace Hazardous Materials Information System (WHMIS).
- .5      Material Safety Data Sheets (MSDS).

**1.2            ACTION AND INFORMATIONAL SUBMITTALS**

- .1      Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2      Submit site-specific Health and Safety Plan: Within 7 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
  - .1      Results of site specific safety hazard assessment.
  - .2      Results of safety and health risk or hazard analysis for site tasks and operation found in work plan.
  - .3      Submit 2 copies of Contractor's authorized representative's work site health and safety inspection reports to Departmental Representative, weekly.
  - .4      Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.
  - .5      Submit copies of incident and accident reports.
  - .6      Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 7 days after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative within 7 days after receipt of comments from Departmental Representative.
  - .7      Departmental Representative's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.
  - .8      Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Departmental Representative.
  - .9      On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.

**1.3            FILING OF NOTICE**

- .1      File Notice of Project with Provincial authorities prior to beginning of Work.
- .2      Contractor shall agree to install proper site separation and identification in order to maintain time and space at all times throughout life of project.

**1.4 SAFETY ASSESSMENT**

- .1 Perform site specific safety hazard assessment related to project.

**1.5 MEETINGS**

- .1 Schedule and administer Health and Safety meeting with Departmental Representative prior to commencement of Work.

**1.6 REGULATORY REQUIREMENTS**

- .1 Do Work in accordance with Section 01 41 00 - Regulatory Requirements.

**1.7 GENERAL REQUIREMENTS**

- .1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.
- .2 Departmental Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

**1.8 RESPONSIBILITY**

- .1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

**1.9 COMPLIANCE REQUIREMENTS**

- .1 Comply with Occupational Health and Safety Act, General Safety Regulation, Alberta Reg.
- .2 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

**1.10 UNFORESEEN HAZARDS**

- .1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Province having jurisdiction and advise Departmental Representative verbally and in writing.

**1.11 POSTING OF DOCUMENTS**

- .1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Province having jurisdiction, and in consultation with Departmental Representative.

**1.12 CORRECTION OF NON-COMPLIANCE**

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Departmental Representative.

- .2 Provide Departmental Representative with written report of action taken to correct non-compliance of health and safety issues identified.
- .3 Departmental Representative may stop Work if non-compliance of health and safety regulations is not corrected.

**1.13 BLASTING**

- .1 Blasting or other use of explosives is not permitted.

**1.14 POWDER ACTUATED DEVICES**

- .1 Use powder actuated devices only after receipt of written permission from Departmental Representative.

**1.15 WORK STOPPAGE**

- .1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

**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            REFERENCE STANDARDS**

- .1 U.S. Environmental Protection Agency (EPA)/Office of Water
  - .1 EPA 832/R-92-005, Storm Water Management for Construction Activities, Chapter 3.
  - .2 EPA General Construction Permit (GCP).
- .2 Canada Federal Halocarbon Regulations, 2003
- .3 Canadian Correctional Service Canada
  - .1 Internal Service Directive 318-4 – Environmental Management of Halocarbons
- .4 Environment Canada (EC)
  - .1 Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems. (2015)

**1.2            DEFINITIONS**

- .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humans; or degrade environment aesthetically, culturally and/or historically.
- .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction.

**1.3            ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Before commencing construction activities or delivery of materials to site, submit Environmental Protection Plan for review and approval by Departmental Representative.
- .4 Environmental Protection Plan must include comprehensive overview of known or potential environmental issues to be addressed during construction.
- .5 Address topics at level of detail commensurate with environmental issue and required construction task[s].
- .6 Include in Environmental Protection Plan:
  - .1 Name[s] of person[s] responsible for ensuring adherence to Environmental Protection Plan.
  - .2 Name[s] and qualifications of person[s] responsible for manifesting hazardous waste to be removed from site.
  - .3 Name[s] and qualifications of person[s] responsible for training site personnel.



- .4 Descriptions of environmental protection personnel training program.
- .5 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use.
  - .1 Plan to include measures for marking limits of use areas and methods for protection of features to be preserved within authorized work areas.
- .6 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.
- .7 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, are contained on project site.
- .8 Contaminant Prevention Plan identifying potentially hazardous substances to be used on job site; intended actions to prevent introduction of such materials into air, water, or ground; and detailing provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.

#### **1.4 FIRES**

- .1 Fires and burning of rubbish on site is not permitted.

#### **1.5 POLLUTION CONTROL**

- .1 Maintain temporary erosion and pollution control features installed under this Contract.
- .2 Control emissions from equipment and plant in accordance with local authorities' emission requirements.
- .3 Prevent sandblasting and other extraneous materials from contaminating air and waterways beyond application area.
  - .1 Provide temporary enclosures where directed by Departmental Representative.
- .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

#### **1.6 NOTIFICATION**

- .1 Departmental Representative will notify Contractor in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan.
- .2 Contractor: after receipt of such notice, inform Departmental Representative of proposed corrective action and take such action for approval by Departmental Representative.
  - .1 Take action only after receipt of written approval by Departmental Representative.
- .3 Departmental Representative will issue stop order of work until satisfactory corrective action has been taken.
- .4 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

**Part 2            Products**

**2.1            NOT USED**

- .1       Not Used.

**Part 3            Execution**

**3.1            CLEANING**

- .1       Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1       Leave Work area clean at end of each day to the Satisfaction of the Departmental Representative.
- .2       Bury rubbish and waste materials on site where directed after receipt of written approval from Departmental Representative.
- .3       Ensure public waterways, storm and sanitary sewers remain free of waste and volatile materials disposal.
- .4       Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .5       Waste Management: separate waste materials for recycling/reuse in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1       Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

**Part 1           General**

**1.1           REFERENCES TO REGULATORY REQUIREMENTS**

- .1 Perform Work in accordance with National Building Code of Canada (NBC) 2015.
- .2 Specific design and performance requirements listed in the specifications or indicated on the Drawings may exceed the minimum requirements established by the referenced Building Code; these requirements will govern over the minimum requirements listed in the Building Code
  - .1 Meet or exceed requirements of:
    - .1 Contract documents.
    - .2 Specified standards, codes and referenced documents.

**1.2           HAZARDOUS MATERIAL DISCOVERY**

- .1 Asbestos: demolition of spray or trowel-applied asbestos is hazardous to health. Stop work immediately when material resembling spray or trowel-applied asbestos is encountered during demolition work. Notify Departmental Representative.
- .2 PCB: Polychlorinated Biphenyl: stop work immediately when material resembling Polychlorinated Biphenyl is encountered during demolition work. Notify Departmental Representative.
- .3 Mould: stop work immediately when material resembling mould is encountered during demolition work. Notify Departmental Representative.

**1.3           BUILDING SMOKING ENVIRONMENT**

- .1 Comply with smoking restrictions and municipal by-laws.

**1.4           QUALITY ASSURANCE**

- .1 Regulatory Requirements: Except as otherwise specified, Constructor shall apply for, obtain, and pay all fees associated with, permits, licenses, certificates, and approvals required by regulatory requirements and Contract Documents, based on General Conditions of Contract and the following:
  - .1 Regulatory requirements and fees in force on date of Bid submission; and
  - .2 Any change in regulatory requirements or fees scheduled to become effective after date of tender submission and of which public notice has been given before date of tender submission.

**Part 2           Products**

**2.1           NOT USED**

- .1 Not Used.

**2.2 EASEMENTS AND NOTICES**

- .1 Constructor shall give notices required by regulatory requirements.

**2.3 PERMITS**

- .1 Building Permit:
  - .1 Constructor shall apply for, obtain and pay for building permit on behalf of Department Representative, and other permits required for Work and its various parts.
  - .2 Constructor will require that specific Subcontractor's obtain and pay for permits required by authorities having jurisdiction, where their Work is affected by Work requiring permits.
  - .3 Constructor will display building permit and other permits in a conspicuous location at Place of Work.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1            General**

**1.1            INSPECTION**

- .1    Allow Departmental Representative 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.

**1.2            INDEPENDENT INSPECTION AGENCIES**

- .1    Independent Inspection/Testing Agencies will be engaged by the Contractor purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by the Contractor.
- .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 re-testing and re-inspection.

**1.3            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.

**1.4            PROCEDURES**

- .1    Submit quality control procedures, forms and reports to Department Representatives.
- .2    Notify appropriate agency and Departmental Representative in advance of requirement for tests, in order that attendance arrangements can be made.
- .3    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.

- .4 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

## **1.5 REJECTED WORK**

- .1 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.
- .2 Make good other Contractor's work damaged by such removals or replacements promptly.
- .3 If in opinion of Departmental Representative, it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Department Representative 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.

## **1.6 REPORTS**

- .1 Submit 4 copies of inspection and test reports to Departmental Representative.
- .2 Provide copies to subcontractor of work being inspected or tested, manufacturer or fabricator of material being inspected or tested.
- .3 Post copies of inspection and test reports to Buzzsaw using the following naming convention "General Area Description\_Specific Inspection Area or Equipment\_Date of Inspection or Test". Notify Departmental Representative by email when new inspection and/or test report has been posted.

## **1.7 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.

## **1.8 MOCK-UPS**

- .1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of Sections required to provide mock-ups.
- .2 Construct in locations as specified in specific Section and acceptable to Departmental Representative.
- .3 Prepare mock-ups for Departmental Representative 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 Remove mock-up at conclusion of Work or when acceptable to Departmental Representative.

**1.9 MILL TESTS**

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

**1.10 EQUIPMENT AND SYSTEMS**

- .1 Submit adjustment and balancing reports for mechanical, electrical and building equipment systems.
- .2 Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

**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                ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.2                INSTALLATION AND REMOVAL**

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

**1.3                WATER SUPPLY**

- .1        Provide temporary utilities controls in order to execute work expeditiously.
- .2        Remove from site all such work after use.
- .3        Water service throughout the building must be maintained operational throughout the day. All interruptions to water service must be coordinated with the Departmental Representative and should be limited to evenings as required by the facilities.
- .4        If the contractor seeks to use the existing water infrastructure on site for their own use, and this does not interrupt or jeopardize institutional operations, contractor may use their own means to tie-into existing water infrastructure and the contractor will not be charged for the use. Contractor to return modified infrastructure to its original condition before project completion.
- .5        There are hose Bibbs on the exterior of the building. Any temporary use of institutional infrastructure must be approved by the Departmental Representative before use and can be disallowed at any time for any reason, even after approval is given. All temporary infrastructure connections must be removed at the end of the project; brought back to its original condition.

**1.4                TEMPORARY HEATING AND VENTILATION**

- .1        Provide temporary heating required during construction period, including attendance, maintenance and fuel.
- .2        Construction heaters used inside building must be vented to outside or be flameless type. Solid fuel salamanders are not permitted.
- .3        Provide temporary heat and ventilation in enclosed areas as required to:
  - .1        Allow continued occupancy without loss of heat. Provisions for temporary heat shall be installed such that use of temporary heat is available within 4 hours.
  - .2        Facilitate progress of Work.
  - .3        Protect Work and products against dampness and cold.
  - .4        Prevent moisture condensation on surfaces.
  - .5        Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
  - .6        Provide adequate ventilation to meet health regulations for safe working environment.



- .4 Maintain temperatures of minimum 20 degrees C in areas where construction is in progress.
- .5 Ventilating:
  - .1 Allow continued occupancy without loss of ventilation. Provisions for temporary ventilation shall be installed such that use of temporary ventilation is available whenever the building ventilation system is not operational for more than 24 hours.
  - .2 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.
  - .3 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
  - .4 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
  - .5 Ventilate storage spaces containing hazardous or volatile materials.
  - .6 Ventilate temporary sanitary facilities.
  - .7 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.
- .6 Pay costs for maintaining temporary heat, when using permanent heating system  
Departmental Representative will pay utility charges when temporary heat source is existing building equipment.
- .7 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
  - .1 Conform with applicable codes and standards.
  - .2 Enforce safe practices.
  - .3 Prevent abuse of services.
  - .4 Prevent damage to finishes.
  - .5 Vent direct-fired combustion units to outside.
- .8 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.
- .9 Use of final equipment as temporary shall not start warrantee.

## **1.5 TEMPORARY POWER AND LIGHT**

- .1 Provide and pay for temporary power during construction as needed.
- .2 Provide and maintain temporary lighting throughout project. Ensure level of illumination on all floors and stairs is not less than 162lx.
- .3 Electrical power and lighting systems installed under this Contract may be used for construction requirements only with prior approval of Departmental Representative provided that guarantees are not affected. Make good damage to electrical system caused by use under this Contract.
- .4 Temp power and light is the responsibility of the contractor. If the contractor seeks to use the departmental representative's existing electrical infrastructure on site for their own use, and this does not interrupt or jeopardize institutional operations, contractor may use

their own means to tie-into departmental representatives existing electrical infrastructure and the contractor will not be charged extra for this power use.

- .5 No power outlets are available on the exterior of the building. Any temporary use of institutional electrical infrastructure must be approved by the Departmental Representative before use and can be disallowed at any time for any reason, even after approval is given. All temporary electrical infrastructure additions must be removed at the end of the project; brought back to its original condition.

## **1.6 TEMPORARY COMMUNICATION FACILITIES**

- .1 Provide and pay for temporary data hook up, necessary for own use.

## **1.7 FIRE PROTECTION**

- .1 Provide and maintain temporary fire protection equipment during performance of Work required by insurance companies having jurisdiction, governing codes, regulations and bylaws.
- .2 Burning rubbish and construction waste materials is not permitted on site.

## **Part 2 Products**

### **2.1 Temporary Cell Heaters**

- .1 Provide 55 individual electric heaters to be used for temporary cell heating.
- .2 Submit shop draw for heater for review by Department Representative.
- .3 Portable ceramic fan heater
  - .1 Heat output: 1500-watt max (12.5 Amp Max) 120V/60HZ/1 PH
  - .2 High and low settings.
  - .3 Built in adjustable thermostat, tip over off switching and overheat protection.
  - .4 Standard receptacle plug in with 1.8m cord.

## **Part 3 Execution**

### **3.1 Temporary Cell Heaters**

- .1 Store and maintain heaters so that they are available for use for temporary heat in cells.
- .2 Place heaters as required for temporary heating conditions and remove for storage after use.
- .3 Upon completion of project move all heaters to storage location as noted by Department Representative.

**END OF SECTION**

**Part 1            General**

**1.1            REFERENCE STANDARDS**

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

**1.2            ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.3            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, 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.
- .6 Coordinate locations of site trailer and laydown areas with Departmental Representatives.

**1.4            SCAFFOLDING**

- .1 Scaffolding in accordance with CAN/CSA-S269.2.
- .2 Provide and maintain scaffolding, ramps, platforms, ladders, and temporary stairs.

**1.5            HOISTING**

- .1 Provide, operate and maintain hoists and cranes required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for their use of hoists.
- .2 Hoists and cranes to be operated by qualified operator.

**1.6            ELEVATORS**

- .1 Elevators are NOT available on this project.

**1.7 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.
- .3 Contractor laydown will be located north of the G.O. building outside of the main gate

**1.8 CONSTRUCTION PARKING**

- .1 Refer to Section 01 35 13 – Security Requirements.

**1.9 OFFICES**

- .1 Provide office heated to 22 degrees C, lighted 750 lx and ventilated, of sufficient size to accommodate site meetings and furnished with drawing laydown table.
- .2 Provide marked and fully stocked first-aid case in a readily available location.
- .3 Subcontractors to provide their own offices as necessary. Direct location of these offices.

**1.10 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.

**1.11 SANITARY FACILITIES**

- .1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.
- .2 Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.
- .3 Refer to Section 01 35 13 – Security Requirements

**1.12 CONSTRUCTION SIGNAGE**

- .1 No signs or advertisements, other than warning signs, are permitted on site.
- .2 Signs and notices for safety and instruction in both official languages Graphic symbols to CAN/CSA-Z321.
- .3 Maintain approved signs and notices in good condition for duration of project, and dispose of off site on completion of project or earlier if directed Departmental Representative.

**1.13 PROTECTION AND MAINTENANCE OF TRAFFIC**

- .1 Provide access and temporary relocated roads as necessary to maintain traffic.
- .2 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by Departmental Representative.

- .3 Provide measures for protection and diversion of traffic, including provision of watch-persons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs
- .4 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with traffic.
- .5 Verify adequacy of existing roads and allowable load limit on these roads.  
Contractor: responsible for repair of damage to roads caused by construction operations.
- .6 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.
- .7 Dust control: adequate to ensure safe operation at all times.
- .8 Provide snow removal during period of Work.

**1.14 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.

**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 REFERENCE STANDARDS**

- .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.
- .3 Public Works Government Services Canada (PSPC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C', In Effect as of: May 14, 2004.
- .4 Correctional Services Canada (CSC) technical Criteria.

**1.2 INSTALLATION AND REMOVAL**

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

**1.3 HOARDING**

- .1 Erect temporary site enclosures using 38 x 89 mm construction grade lumber framing at 600 mm centres and 1200 x 2400 x 13 mm exterior grade fir plywood to CSA O121.
- .2 Apply plywood panels vertically flush and butt jointed.

**1.4 GUARD RAILS AND BARRICADES**

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

**1.5 WEATHER ENCLOSURES**

- .1 Provide weather tight closures to unfinished door and window openings, 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.

**1.6 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.

**1.7 ACCESS TO SITE**

- .1 Provide and maintain access roads, sidewalk crossings, ramps and construction runways as may be required for access to Work.

**1.8 FIRE ROUTES**

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

**1.9 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.

**1.10 WASTE MANAGEMENT AND DISPOSAL**

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

**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            REFERENCE STANDARDS**

- .1      Conform to reference standards, in whole or in part as specifically requested in specifications.
- .2      If there is question as to whether products or systems are in conformance with applicable standards, Departmental Representative reserves right to have such products or systems tested to prove or disprove conformance.
- .3      Cost for such testing will be born by Departmental Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.

**1.2            QUALITY**

- .1      Products, materials, equipment and articles incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- .2      Procurement policy is to acquire, in cost effective manner, items containing highest percentage of recycled and recovered materials practicable consistent with maintaining satisfactory levels of competition. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of work.
- .3      Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- .4      Should disputes arise as to quality or fitness of products, decision rests strictly with Departmental Representative based upon requirements of Contract Documents.
- .5      Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .6      Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

**1.3            STORAGE, HANDLING AND PROTECTION**

- .1      Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
- .2      Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
- .3      Store products subject to damage from weather in weatherproof enclosures.
- .4      Store cementitious products clear of earth or concrete floors, and away from walls.



- .5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- .6 Store sheet materials, lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- .8 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.
- .9 Touch-up damaged factory finished surfaces to Departmental Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

#### **1.4 TRANSPORTATION**

- .1 Pay costs of transportation of products required in performance of Work.

#### **1.5 MANUFACTURER'S INSTRUCTIONS**

- .1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.
- .2 Notify Departmental Representative in writing, of conflicts between specifications and manufacturer's instructions, so Departmental Representative will establish course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Departmental Representative to require removal and re-installation at no increase in Contract Price or Contract Time.

#### **1.6 QUALITY OF WORK**

- .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Departmental Representative if required Work is such as to make it impractical to produce required results.
- .2 Do not employ anyone unskilled in their required duties. Departmental Representative reserves right to require dismissal from site, workers deemed incompetent or careless.
- .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Departmental Representative, whose decision is final.

#### **1.7 CO-ORDINATION**

- .1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.
- .2 Be responsible for coordination and placement of openings, sleeves and accessories.

**1.8 CONCEALMENT**

- .1 In finished areas conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
- .2 Before installation inform Departmental Representative if there is interference. Install as directed Departmental Representative.

**1.9 REMEDIAL WORK**

- .1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Co-ordinate adjacent affected Work as required.
- .2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

**1.10 LOCATION OF FIXTURES**

- .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.
- .2 Inform Departmental Representative of conflicting installation. Install as directed.

**1.11 FASTENINGS**

- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
- .2 Prevent electrolytic action between dissimilar metals and materials.
- .3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.
- .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.
- .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.
- .7 Fasteners in inmate accessible areas must have tamper resistant fastenings

**1.12 FASTENINGS - EQUIPMENT**

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.
- .3 Bolts may not project more than one diameter beyond nuts.
- .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

**1.13 PROTECTION OF WORK IN PROGRESS**

- .1 Prevent overloading of parts of building. Do not cut, drill or sleeve load bearing structural member, unless specifically indicated without written approval of Departmental Representative.

**1.14 EXISTING UTILITIES**

- .1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work and/or building occupants.
- .2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

**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                REFERENCE STANDARDS**

- .1      Department Representative's identification of existing survey control points and property limits.

**1.2                EXISTING SERVICES**

- .1      Before commencing work, establish location and extent of service lines in area of Work and notify Departmental Representative of findings.

**1.3                LOCATION OF EQUIPMENT AND FIXTURES**

- .1      Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.
- .2      Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.
- .3      Inform Departmental Representative of impending installation and obtain approval for actual location.
- .4      Submit field drawings to indicate relative position of various services and equipment when required by Departmental Representative.

**1.4                RECORDS**

- .1      Maintain a complete, accurate log of work as it progresses.
- .2      Record locations of maintained, re-routed and abandoned service lines.

**1.5                ACTION AND INFORMATIONAL SUBMITTALS**

- .1      On request of Departmental Representative, submit documentation to verify accuracy of field engineering work.

**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 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit written request in advance of cutting or alteration which affects:
  - .1 Structural integrity of elements of project.
  - .2 Integrity of weather-exposed or moisture-resistant elements.
  - .3 Efficiency, maintenance, or safety of operational elements.
  - .4 Visual qualities of sight-exposed elements.
  - .5 Work of Department Representative or separate contractor.
- .3 Include in request:
  - .1 Identification of project.
  - .2 Location and description of affected Work.
  - .3 Statement on necessity for cutting or alteration.
  - .4 Description of proposed Work, and products to be used.
  - .5 Alternatives to cutting and patching.
  - .6 Effect on Work of Department Representative or separate contractor.
  - .7 Written permission of affected separate contractor.
  - .8 Date and time work will be executed.

**1.2 PREPARATION**

- .1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
- .2 After uncovering, inspect conditions affecting performance of Work.
- .3 Beginning of cutting or patching means acceptance of existing conditions.
- .4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.
- .5 Provide protection from elements for areas which are to be exposed by uncovering work; maintain excavations free of water.
- .6 Contractor must protect existing equipment in operation from dust/debris/or-other-incidental-damage resulting from construction activities, including newly commissioned units in operation and equipment/material on site but not yet installed

**1.3 EXECUTION**

- .1 Execute cutting, fitting, and patching to complete Work.
- .2 Fit several parts together, to integrate with other Work.
- .3 Uncover Work to install ill-timed Work.
- .4 Remove and replace defective and non-conforming Work.

- .5 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.
  - .1 Provide temporary secure closures to openings in secure walls.
- .6 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.
- .7 Employ manufacturer authorized installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
- .8 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.
- .9 Restore work with new products in accordance with requirements of Contract Documents.
- .10 Fit Work to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .11 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with firestopping material in accordance with Section 07 84 00 - Firestopping, full thickness of the construction element.
- .12 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.
- .13 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

#### **1.4 WASTE MANAGEMENT AND DISPOSAL**

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

#### **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            PROJECT CLEANLINESS**

- .1      Maintain Work in tidy condition, free from accumulation of waste products and debris, other than that caused by Department Representative 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 laydown area, site trailer, from access to building and work areas as required to perform the work. Bank/pile snow in designated areas only.
- .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. Containers to be secured and locked at all times when not in use.
- .6      Work areas must be cleaned to the satisfaction of the Departmental Representative at the end of each work day. Remove waste material and debris from site and deposit in waste container at end of each working day.
- .7      Provide and use marked separate bins for recycling. Refer to Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .8      Dispose of waste materials and debris off site.
- .9      Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.
- .10     Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .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 or 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.

**1.2            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 to the Satisfaction of the Departmental Representative.
- .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 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fittings, walls, and floors.
- .7 Vacuum, clean, and dust building interiors, behind grilles, louvres, and screens.
- .8 Inspect finishes, fittings and equipment and ensure specified workmanship and operation.
- .9 Broom clean and wash exterior walks, steps and surface; rake clean other surfaces in work areas.
- .10 Remove dirt and other disfiguration from exterior surfaces.
- .11 Sweep and wash clean paved areas.
- .12 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.
- .13 Clean roof near work areas.
- .14 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.
- .15 Remove snow and ice from access to building.

**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            REFERENCE STANDARDS**

- .1 Canadian Construction Association (CCA)
  - .1 CCA 81-2001: A Best Practices Guide to Solid Waste Reduction.
- .2 Public Works and Government Services Canada (PSPC)
  - .1 2002 National Construction, Renovation and Demolition Non-Hazardous Solid Waste Management Protocol.

**1.2            DEFINITIONS**

- .1 Approved/Authorized recycling facility: waste recycler approved by applicable provincial authority or other users of material for recycling approved by the Departmental Representative.
- .2 Class III: non-hazardous waste - construction renovation and demolition waste.
- .3 Construction, Renovation and/or Demolition (CRD) Waste: Class III solid, non-hazardous waste materials generated during construction, demolition, and/or renovation activities
- .4 Inert Fill: inert waste - exclusively asphalt and concrete.
- .5 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.
- .6 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
- .7 Recycling: process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- .8 Reuse: repeated use of product in same form but not necessarily for same purpose. Reuse includes:
  - .1 Salvaging reusable materials from re-modelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.
  - .2 Returning reusable items including pallets or unused products to vendors.
- .9 Salvage: removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.
- .10 Separate Condition: refers to waste sorted into individual types.
- .11 Source Separation: act of keeping different types of waste materials separate beginning from the point they became waste.

**1.3            USE OF SITE AND FACILITIES**

- .1 Execute Work with minimal interference and disturbance to normal use of premises.
- .2 Maintain security measures established by facility provide temporary security measures approved by Departmental Representative.

#### **1.4 WASTE PROCESSING SITES**

- .1 Contractor is responsible to research and locate waste diversion resources and service providers. Salvaged materials are to be transported off site to approved and/or authorized recycling facilities or to users of material for recycling.
- .2 Province of: Alberta
  - .1 Name: Alberta Environment  
Construction, Renovation and Demolition Waste Reduction Recycling Branch  
Phone: (780) 427-6982 or 1-800-463-6326

#### **1.5 STORAGE, HANDLING AND PROTECTION**

- .1 Store, materials to be reused, recycled and salvaged in locations as directed by Departmental Representative.
- .2 Unless specified otherwise, materials for removal become Contractor's property.
- .3 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.
- .4 Protect structural components not removed and salvaged materials from movement or damage.
- .5 Support affected structures. If safety of building is endangered, cease operations and immediately notify Departmental Representative.
- .6 Protect surface drainage, mechanical and electrical from damage and blockage.
- .7 Provide on-site facilities and containers for collection and storage of reusable and recyclable materials. Containers to be secured and locked at all times when not in use.
- .8 Separate and store materials produced during project in designated areas.
- .9 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated processing facilities.
  - .1 On-site source separation is recommended.
  - .2 Remove co-mingled materials to off site processing facility for separation.
  - .3 Obtain waybills, receipts and/or scale tickets for separated materials removed from site.
  - .4 Materials reused on-site are considered to be diverted from landfill and as such are to be included in all reporting.

#### **1.6 DISPOSAL OF WASTES**

- .1 Do not bury rubbish or waste materials.
- .2 Do not dispose of oil, mineral spirits, volatile materials, waste, or paint thinner into waterways or sanitary sewers.
- .3 Keep records of construction waste including:
  - .1 Number and size of bins.
  - .2 Waste type of each bin.
  - .3 Total tonnage generated.

- .4 Tonnage reused or recycled.
    - .5 Reused or recycled waste destination.
  - .4 Remove materials on-site as Work progresses.
  - .5 Prepare project summary to verify destination and quantities on a material-by-material basis as identified in the waste audit.
- 1.7 SCHEDULING**
  - .1 Co-ordinate Work with other activities at site to ensure timely and orderly progress of Work.
- Part 2 Products**
- 2.1 NOT USED**
  - .1 Not Used.
- Part 3 Execution**
- 3.1 APPLICATION**
  - .1 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.
- 3.2 CLEANING**
  - .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
    - .1 Leave Work area clean at end of each day to the satisfaction of the Departmental Representative.
  - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.
  - .3 Waste Management: separate waste materials for reuse and/or recycling.
    - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
    - .2 Source separate materials to be reused/recycled into specified sort areas.
- 3.3 DIVERSION OF MATERIALS**
  - .1 From following list, separate materials from general waste stream and stockpile in separate piles or containers, as reviewed by Departmental Representative, and consistent with applicable fire regulations.
    - .1 Mark containers or stockpile areas.
    - .2 Provide instruction on disposal practices.
  - .2 On-site sale of recovered material is not permitted.

**END OF SECTION**

**Part 1 General**

**1.1 ADMINISTRATIVE REQUIREMENTS**

- .1 Acceptance of Work Procedures:
  - .1 Contractor's Inspection: Contractor: conduct inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
    - .1 Notify Departmental Representative and Commissioning Agent in writing of satisfactory completion of Contractor's inspection and submit verification that corrections have been made.
    - .2 Request Departmental Representative inspection.
  - .2 Departmental Representative Inspection:
    - .1 Departmental Representative and Contractor to inspect Work and identify defects and deficiencies.
    - .2 Contractor to correct Work as directed.
  - .3 Completion Tasks: submit written certificates in English that tasks have been performed as follows:
    - .1 Work: completed and inspected for compliance with Contract Documents.
    - .2 Defects: corrected and deficiencies completed.
    - .3 Equipment and systems: tested, balanced adjusted and fully operational.
    - .4 Certificates required by Fire Commissioner: submitted.
    - .5 Commissioning of mechanical systems: completed in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements and Departmental Representative.
      - .1 Work will not be accepted until Commissioning Requirements are met.
    - .6 Operation of systems: Training to Department Representative's personnel.
    - .7 Work: complete and ready for final inspection.
      - .1 Completion must be signed off by two Authorized Department Representatives.
  - .4 Final Inspection:
    - .1 When completion tasks are done, request final inspection of Work by Departmental Representative, and Contractor.
    - .2 When Work incomplete according Departmental Representative, complete outstanding items and request re-inspection.

**1.2 FINAL CLEANING**

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

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

**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        ADMINISTRATIVE REQUIREMENTS**

- .1    Pre-warranty Meeting:
  - .1    Convene meeting one week prior to contract completion with Departmental Representative, in accordance with Section 01 31 19 - Project Meetings to:
    - .1    Verify Project requirements.
    - .2    Review warranty requirements.
  - .2    Departmental Representative to establish communication procedures for:
    - .1    Notifying construction warranty defects.
    - .2    Determine priorities for type of defects.
    - .3    Determine reasonable response time.
  - .3    Contact information for bonded and licensed company for warranty work action: provide name, telephone number and address of company authorized for construction warranty work action.
  - .4    Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work action.

**1.2        ACTION AND INFORMATIONAL SUBMITTALS**

- .1    Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2    Two weeks prior to Substantial Performance of the Work, submit to the Departmental Representative, four final copies of operating and maintenance manuals in English.
- .3    Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.
- .4    Provide evidence, if requested, for type, source and quality of products supplied.

**1.3        FORMAT**

- .1    Organize data as instructional manual.
- .2    Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.
- .3    When multiple binders are used correlate data into related consistent groupings.
  - .1    Identify contents of each binder on spine.
- .4    Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .5    Arrange content by systems, under Section numbers and sequence of Table of Contents.
- .6    Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .7    Text: manufacturer's printed data, or typewritten data.

- .8 Drawings: provide with reinforced punched binder tab.
  - .1 Bind in with text; fold larger drawings to size of text pages.
- .9 Provide 1:1 scaled CAD files in pdf format on CD.

#### **1.4 CONTENTS - PROJECT RECORD DOCUMENTS**

- .1 Table of Contents for Each Volume: provide title of project;
  - .1 Date of submission; names.
  - .2 Addresses, and telephone numbers of Consultant and Contractor with name of responsible parties.
  - .3 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system:
  - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .5 Typewritten Text: as required to supplement product data.
  - .1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.
- .6 Training: refer to Section 01 79 00 - Demonstration and Training.

#### **1.5 AS -BUILT DOCUMENTS AND SAMPLES**

- .1 Maintain, at site one record copy of:
  - .1 Contract Drawings.
  - .2 Specifications.
  - .3 Addenda.
  - .4 Change Orders and other modifications to Contract.
  - .5 Reviewed shop drawings, product data, and samples.
  - .6 Field test records.
  - .7 Inspection certificates.
  - .8 Manufacturer's certificates.
- .2 Store record documents and samples in field office apart from documents used for construction.
  - .1 Provide files, racks, and secure storage.
- .3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual.
  - .1 Label each document "PROJECT RECORD" in neat, large, printed letters.
- .4 Maintain record documents in clean, dry and legible condition.

- .1 Do not use record documents for construction purposes.
- .5 Keep record documents and samples available for inspection Departmental Representative.

## **1.6 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS**

- .1 Record information on a full-sized copy of the contract drawings.
- .2 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.
- .3 Record information concurrently with construction progress.
  - .1 Do not conceal Work until required information is recorded.
- .4 Contract Drawings and shop drawings: mark each item to record actual construction, including:
  - .1 Measured depths of elements of foundation in relation to finish first floor datum.
  - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
  - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
  - .4 Field changes of dimension and detail.
  - .5 Changes made by change orders.
  - .6 Details not on original Contract Drawings.
  - .7 Referenced Standards to related shop drawings and modifications.
- .5 Specifications: mark each item to record actual construction, including:
  - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
  - .2 Changes made by Addenda and change orders.
- .6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.
- .7 Provide digital photos, if requested, for site records.

## **1.7 EQUIPMENT AND SYSTEMS**

- .1 For each item of equipment and each system include description of unit or system, and component parts.
  - .1 Give function, normal operation characteristics and limiting conditions.
  - .2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.



- .1 Include regulation, control, stopping, shut-down, and emergency instructions.
- .2 Include summer, winter, and any special operating instructions.
- .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include test and balancing reports as specified in Section 01 45 00 - Quality Control 01 91 13 - General Commissioning (Cx) Requirements.
- .15 Additional requirements: as specified in individual specification sections.

## **1.8 MATERIALS AND FINISHES**

- .1 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .2 Moisture-protection and weather-exposed products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 Additional requirements: as specified in individual specifications sections.

## **1.9 MAINTENANCE MATERIALS**

- .1 Spare Parts:
  - .1 Provide spare parts, in quantities specified in individual specification sections.
  - .2 Provide items of same manufacture and quality as items in Work.
  - .3 Deliver to location as directed; place and store.
  - .4 Receive and catalogue items.
    - .1 Submit inventory listing to Departmental Representative.
    - .2 Include approved listings in Maintenance Manual.
  - .5 Obtain receipt for delivered products and submit prior to final payment.

- .2 Extra Stock Materials:
  - .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
  - .2 Provide items of same manufacture and quality as items in Work.
  - .3 Deliver to location as directed; place and store.
  - .4 Receive and catalogue items.
    - .1 Submit inventory listing to Departmental Representative.
    - .2 Include approved listings in Maintenance Manual.
  - .5 Obtain receipt for delivered products and submit prior to final payment.
- .3 Special Tools:
  - .1 Provide special tools, in quantities specified in individual specification section.
  - .2 Provide items with tags identifying their associated function and equipment.
  - .3 Deliver to location as directed; place and store.
  - .4 Receive and catalogue items.
    - .1 Submit inventory listing to Departmental Representative.
    - .2 Include approved listings in Maintenance Manual.

#### **1.10 DELIVERY, STORAGE AND HANDLING**

- .1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.
- .2 Store in original and undamaged condition with manufacturer's seal and labels intact.
- .3 Store components subject to damage from weather in weatherproof enclosures.
- .4 Store paints and freezable materials in a heated and ventilated room.
- .5 Remove and replace damaged products at own expense and for review Departmental Representative.

#### **1.11 WARRANTIES AND BONDS**

- .1 Develop warranty management plan to contain information relevant to Warranties.
  - .1 Contractor shall respond to maintenance issues within 3 hours of notification.
- .2 Submit warranty management plan, 30 days before planned pre-warranty conference, to Departmental Representative approval.
- .3 Warranty management plan to include required actions and documents to assure that Departmental Representative receives warranties to which it is entitled.
- .4 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.
- .5 Submit, warranty information made available during construction phase, to Departmental Representative for approval prior to each monthly pay estimate.
- .6 Assemble approved information in binder, submit upon acceptance of work and organize binder as follows:

- .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
- .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
- .3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.
- .4 Verify that documents are in proper form, contain full information, and are notarized.
- .5 Co-execute submittals when required.
- .6 Retain warranties and bonds until time specified for submittal.
- .7 Except for items put into use with Department Representative's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.
- .8 Conduct joint 4 month and 9 month warranty inspection, measured from time of acceptance, by Departmental Representative.
- .9 Include information contained in warranty management plan as follows:
  - .1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, subcontractors, manufacturers or suppliers involved.
  - .2 Listing and status of delivery of Certificates of Warranty for extended warranty items, to include transformers, HVAC balancing, pumps, motors, commissioned systems,
  - .3 Provide list for each warranted equipment, item, feature of construction or system indicating:
    - .1 Name of item.
    - .2 Model and serial numbers.
    - .3 Location where installed.
    - .4 Name and phone numbers of manufacturers or suppliers.
    - .5 Names, addresses and telephone numbers of sources of spare parts.
    - .6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.
    - .7 Cross-reference to warranty certificates as applicable.
    - .8 Starting point and duration of warranty period.
    - .9 Summary of maintenance procedures required to continue warranty in force.
    - .10 Cross-Reference to specific pertinent Operation and Maintenance manuals.
    - .11 Organization, names and phone numbers of persons to call for warranty service.
    - .12 Typical response time and repair time expected for various warranted equipment.
- .4 Contractor's plans for attendance at 4 and 9 month post-construction warranty inspections.

- .5 Procedure and status of tagging of equipment covered by extended warranties.
- .6 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.
- .10 Respond in timely manner to oral or written notification of required construction warranty repair work.
- .11 Written verification to follow oral instructions.
- .1 Failure to respond will be cause for the Departmental Representative to proceed with action against Contractor.

#### **1.12 WARRANTY TAGS**

- .1 Tag, at time of installation, each warranted item. Provide durable, oil and water resistant tag approved by Departmental Representative.
- .2 Attach tags with copper wire and spray with waterproof silicone coating.
- .3 Leave date of acceptance until project is accepted for occupancy.
- .4 Indicate following information on tag:
  - .1 Type of product/material.
  - .2 Model number.
  - .3 Serial number.
  - .4 Contract number.
  - .5 Warranty period.
  - .6 Inspector's signature.
  - .7 Construction Contractor.

#### **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        ADMINISTRATIVE REQUIREMENTS**

- .1    Demonstrate operation and maintenance of equipment and systems to Department Representative two weeks prior to date of substantial completion.
- .2    Department Representative: provide list of personnel to receive instructions, and co-ordinate their attendance at agreed-upon times.
- .3    Preparation:
  - .1    Verify conditions for demonstration and instructions comply with requirements.
  - .2    Verify designated personnel including but not limited to mechanical trade, controls trade, all other applicable trades and manufacturer representatives are present.
  - .3    Ensure equipment has been inspected and put into operation in accordance with Section 01 91 13 - General Commissioning Requirements. Ensure testing, adjusting, and balancing has been performed in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements and equipment and systems are fully operational.
- .4    Demonstration and Instructions:
  - .1    Demonstrate start-up, operation, control, adjustment, trouble-shooting, at the agreed upon, scheduled location.
  - .2    Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.
  - .3    Review contents of manual in detail to explain aspects of operation and maintenance.
  - .4    Prepare and insert additional data in operations and maintenance manuals when needed during instructions.

**1.2        ACTION AND INFORMATIONAL SUBMITTALS**

- .1    Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2    Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to designated dates, for Departmental Representative's approval.
- .3    Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- .4    Give time and date of each demonstration, with list of persons present.
- .5    Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

**1.3        QUALITY ASSURANCE**

- .1    When specified in individual Sections requiring manufacturer to provide authorized representative to demonstrate operation of equipment and systems:

- .1 Instruct Department Representative.
- .2 Provide written report that demonstration and instructions have been completed.

**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 GENERAL**

- .1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved. Objectives:
  - .1 Verify installed equipment, systems and integrated systems operate in accordance with Contract Documents and design criteria and intent.
  - .2 Ensure appropriate documentation is compiled into the BMM.
  - .3 Effectively train O&M staff.
- .2 Contractor shall provide the necessary trades, equipment and instruments to assist in Cx process, operating equipment and systems, troubleshooting and making adjustments as required.
  - .1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be interactively with each other as intended in accordance with Contract Documents and design criteria.
  - .2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.
- .3 Acronyms:
  - .1 AFD - Alternate Forms of Delivery, service provider.
  - .2 BMM - Building Management Manual.
  - .3 Cx - Commissioning.
  - .4 CxA - Commissioning Agent
  - .5 EMCS - Energy Monitoring and Control Systems.
  - .6 MSDS - Material Safety Data Sheets.
  - .7 O&M - Operation and Maintenance.
  - .8 PFC - Pre-Functional Check.
  - .9 PI - Product Information.
  - .10 PV - Performance Verification.
  - .11 FPT - Functional Performance Test
  - .12 GIT - Global Integration Test
  - .13 TAB - Testing, Adjusting and Balancing.
  - .14 WHMIS - Workplace Hazardous Materials Information System.
- .4 Commissioning terms used in this Section:
  - .1 Bumping: short term start-up to prove ability to start and prove correct rotation.
  - .2 Deferred Cx - Cx activities delayed for reasons beyond Contractor's control due to lack of occupancy, weather conditions, need for heating/cooling loads.

- .5 Commissioning documentation shall be posted to Project Buzzsaw Directory and shall be organized and named by specification section. Refer to section 01 33 00 – Submittals.
  - .1 Naming convention shall be “Specification Number\_Shop Drawing Description\_Date of Submission”.
  - .2 Once uploaded, a separate email notification indicating that the submission has been posted shall be sent from the contractor to the Departmental Representative.

## **1.2 COMMISSIONING OVERVIEW**

- .1 As per Appendix A - Commissioning (Cx) Plan.
- .2 For Cx responsibilities refer to Appendix A - Commissioning (Cx) Plan.
- .3 Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .4 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the facility is constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.
- .5 Departmental Representative will issue Interim Acceptance Certificate when:
  - .1 Completed Cx documentation has been received, reviewed for suitability, and approved by Departmental Representative.
  - .2 Equipment, components, systems and integrated systems have been fully commissioned and functional as per design intent within the context of the Department Representative Project requirement.
  - .3 Final O & M and Training and Manual received, reviewed and approved by Departmental Representative for suitability.
  - .4 Completion of Training sessions to all Operational and Maintenance staff.
- .6 Equipment commissioning must be completed individually to minimize interruption of operation.

## **1.3 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS**

- .1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Cx, correct deficiencies, re-verify equipment and components within the unfunctional system, including related systems as deemed required by Departmental Representative, to ensure effective performance.
- .2 Costs for corrective work, additional tests, inspections, to determine acceptability and proper performance of such items to be borne by Contractor. Above costs to be in form of progress payment reductions or holdback assessments.

## **1.4 PRE-CX REVIEW**

- .1 Before Construction:



- .1 Review Contract Documents, confirm by writing to Departmental Representative.
  - .1 Adequacy of provisions for Cx.
  - .2 Aspects of design and installation pertinent to success of Cx.
- .2 During Construction:
  - .1 Co-ordinate provision, location and installation of provisions for Cx.
- .3 Before start of Cx:
  - .1 Review of up-to-date Cx Plan.
  - .2 Ensure installation of related components, equipment, sub-systems, systems is complete.
  - .3 Fully understand Cx requirements and procedures.
  - .4 Have Cx forms and documentation ready.
  - .5 Understand completely design criteria and intent and special features.
  - .6 Update construction schedule with Cx activities.
  - .7 Submit complete PFC documentation to CxA.
  - .8 Ensure systems have been cleaned thoroughly.
  - .9 Complete TAB procedures on systems, submit TAB reports to Departmental Representative for review and approval.
  - .10 Ensure "As-Built" system schematics are available.
- .4 Inform Departmental Representative in writing of discrepancies and deficiencies on finished works.

## **1.5 CONFLICTS**

- .1 Report conflicts between requirements of this section and other sections to Departmental Representative before start-up and obtain clarification.
- .2 Failure to report conflict and obtain clarification will result in application of most stringent requirement.

## **1.6 COMMISSIONING DOCUMENTATION**

- .1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Pre-Functional Check Sheets (PFC) / Performance Verification (PV) Forms for requirements and instructions for use.
- .2 Provide completed forms and reports to CxA.

## **1.7 COMMISSIONING SCHEDULE**

- .1 Include Cx activities within the construction schedule.
  - .1 Include for separate individual commissioning of each equipment and system to minimize interruption to operation.
- .2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
  - .1 Static Checks / Product information noted on PFC-Part A

- .2 Pre-Functional Start-up
- .3 Functional Testing of Controls
- .4 Functional Performance Testing by CxA
- .5 Repairs, retesting, re-commissioning, re-verification.
- .6 Training.

## **1.8 COMMISSIONING MEETINGS**

- .1 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.
- .2 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.
- .3 Before 80% construction completion stage for each phase. Call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:
  - .1 Review duties and responsibilities of Contractor. Contractor specialty and major subcontractors must be in attendance, to facilitate a thorough understanding of specialty and major subcontractors duties and responsibilities to the Contractor, to ensure correctly and fully commissioned systems, while also addressing any delays or potential problems.
  - .2 Re-iterate the degree of involvement of subcontractor and manufacturer's representatives in the commissioning process.
- .4 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.
- .5 Meeting will be chaired by Cx Agent, who will record and distribute minutes.
- .6 Ensure subcontractors and relevant manufacturer representatives are present at 80% and subsequent Cx meetings and as required.

## **1.9 STARTING AND TESTING**

- .1 Contractor assumes liabilities and costs for inspections. Including disassembly and re-assembly after approval, starting, testing and adjusting, including supply of testing equipment.

## **1.10 WITNESSING OF STARTING AND TESTING**

- .1 Provide 10 days' notice to prior to commencement.
- .2 Confirm with Departmental Representative and Cx Agent of their attendance to witness of start-up and testing.
- .3 Failure to accommodate the Departmental Representative and Cx Agent in tests and start-ups shall not result in extra cost or delay to the project.
- .4 Contractor to be present at tests performed and documented by sub-trades, suppliers, and equipment manufacturers.

## **1.11 MANUFACTURER'S INVOLVEMENT**

- .1 Factory testing: manufacturer to:
  - .1 Coordinate time and location of testing.
  - .2 Notify Departmental Representative and CxA at least 1 week in advance of tests.
  - .3 Provide testing documentation for approval by CxA.
- .2 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with CxA.
  - .1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
  - .2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.
- .3 Integrity of warranties:
  - .1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.
  - .2 Verify with manufacturer that testing as specified will not void warranties.
- .4 Qualifications of manufacturer's personnel:
  - .1 Experienced in design, installation and operation of equipment and systems.
  - .2 Ability to interpret test results accurately.
  - .3 To report results in clear, concise, logical manner.

## **1.12 PROCEDURES**

- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and FPT.
- .2 Conduct start-up and testing in following distinct phases for each equipment and system:
  - .1 Included in delivery and installation:
    - .1 Verification of conformity to specification, approved shop drawings and completion of PI on the PFC sheets Part -1.
    - .2 Complete any manufactures Installation sheets and submit to CxA.
  - .2 Upon completion of installation perform follow accepted start-up procedures:
    - .1 Complete manufacturers start-up sheets
    - .2 Complete PFC sheets Part 2.
    - .3 Verification of conformity to specification and submit documentation to CxA.
  - .3 Operational testing:
    - .1 Confirm the controls work is complete and verified by the controls contractor(s) and document equipment performance.
    - .2 Verify the sequence of operation is met and submit test reports to CxA .
  - .4 Functional Performance Test (FPT). (System PV):

- .1 Once the CxA has received all the PFC sheets (Part A and B) and there are no deficiencies impacting the operation a FPT can be scheduled.
- .2 Coordinate the necessary trades and suppliers to facilitate the FPT.
- .5 Post-substantial performance verification: to include fine-tuning.
- .3 Correct deficiencies and obtain approval from Departmental Representative after distinct phases have been completed and before commencing next phase.
- .4 Document require tests on approved forms.
- .5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by Departmental Representative. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:
  - .1 Minor equipment/systems: implement corrective measures approved by Departmental Representative.
  - .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Departmental Representative.
  - .3 If evaluation report concludes that major damage has occurred, Departmental Representative shall reject equipment.
    - .1 Rejected equipment to be remove from site and replace with new.
    - .2 Subject new equipment/systems to specified start-up procedures.

#### **1.13 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS**

- .1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.
- .2 With assistance of manufacturer develop written maintenance program and submit Departmental Representative for approval before implementation.
- .3 Operate and maintain systems for length of time required for commissioning to be completed.
- .4 After completion of commissioning, operate and maintain systems until issuance of certificate of interim acceptance.

#### **1.14 TEST RESULTS**

- .1 If start-up, testing and/or PV produce unacceptable results, repair, replace or repeat specified starting and/or PV procedures until acceptable results are achieved.
- .2 Provide manpower and materials, assume costs for re-commissioning.

#### **1.15 START OF COMMISSIONING**

- .1 Notify Departmental Representative at least 15 working days prior to start of Cx.
- .2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

#### **1.16 INSTRUMENTS / EQUIPMENT**

- .1 Submit to Departmental Representative for review and approval:
  - .1 Complete list of instruments proposed to be used.
  - .2 Listed data including, serial number, current calibration certificate, calibration date, calibration expiry date and calibration accuracy.
- .2 Provide the following equipment as required:
  - .1 Two-way radios.
  - .2 Ladders.
  - .3 Equipment as required to complete work.

#### **1.17 FUNCTIONAL PERFORMANCE VERIFICATION**

- .1 Provide subtrades, tools and equipment necessary for the FPV as out lined in the Cx Plan.
- .2 Schedule sufficient time in coordination with the CxA to perform the FPV:
  - .1 Under accepted simulated or actual operating conditions, over entire operating range, in all modes.
  - .2 On independent systems and interacting systems.
- .3 Results of the verification must be repeatable and reported results are to be verifiable.
- .4 EMCS trending to be available as supporting documentation for performance verification.

#### **1.18 WITNESSING COMMISSIONING**

- .1 Departmental Representative may witness activities and verify results.

#### **1.19 AUTHORITIES HAVING JURISDICTION**

- .1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of authority having jurisdiction, arrange for authority to witness procedures so as to avoid duplication of tests and to facilitate expedient acceptance of facility.
- .2 Obtain certificates of approval, acceptance and compliance with rules and regulation of authority having jurisdiction.
- .3 Provide copies to Departmental Representative within 5 days of test and with Cx report.

#### **1.20 COMMISSIONING CONSTRAINTS**

- .1 Since access into secure or sensitive areas will be very difficult after occupancy it is necessary to complete Cx of occupancy, weather, and seasonal sensitive equipment and systems in these areas before issuance of the Interim Certificate, using, if necessary, simulated thermal loads.

#### **1.21 EXTRAPOLATION OF RESULTS**

- .1 Where Cx of weather, occupancy, or seasonal-sensitive equipment or systems cannot be conducted under near-rated or near-design conditions, extrapolate part-load results to design conditions when approved Departmental Representative in accordance with

equipment manufacturer's instructions, using manufacturer's data, with manufacturer's assistance and using approved formulae.

#### **1.22 EXTENT OF VERIFICATION**

- .1 Provide manpower and instrumentation to verify up to 100% of reported results, unless specified otherwise in other sections.
- .2 Number and location to be at discretion of Departmental Representative.
- .3 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.
- .4 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.
- .5 Perform additional commissioning until results are acceptable to Departmental Representative.

#### **1.23 REPEAT VERIFICATIONS**

- .1 Assume costs incurred by Departmental Representative for third and subsequent verifications where:
  - .1 Verification of reported results fail to receive Departmental Representative's approval.
  - .2 Repetition of second verification again fails to receive approval.
  - .3 Departmental Representative deems Contractor's request for second verification was premature.

#### **1.24 SUNDRY CHECKS AND ADJUSTMENTS**

- .1 Make adjustments and changes which become apparent as Cx proceeds.
- .2 Perform static and operational checks as applicable and as required.

#### **1.25 DEFICIENCIES, FAULTS, DEFECTS**

- .1 Correct deficiencies found during start-up and Cx to satisfaction of Departmental Representative.
- .2 Report problems, faults or defects affecting Cx to Departmental Representative. in writing. Stop Cx until problems are rectified. Proceed with written approval from Departmental Representative.

#### **1.26 COMPLETION OF COMMISSIONING**

- .1 Upon completion of Cx leave systems in normal operating mode.
- .2 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by Departmental Representative.

#### **1.27 ACTIVITIES UPON COMPLETION OF COMMISSIONING**

- .1 When changes are made to baseline components or system settings established during Cx process, provide updated Cx form for affected item.

**1.28 TRAINING**

- .1 In accordance with Section 01 91 41 - Commissioning (Cx) - Training.

**1.29 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS**

- .1 Supply, deliver, and document maintenance materials, spare parts, and special tools as specified in contract.

**1.30 OCCUPANCY**

- .1 Cooperate fully with Departmental Representative during stages of acceptance and occupancy of facility.

**1.31 INSTALLED INSTRUMENTATION**

- .1 Use instruments installed under Contract for TAB and PV if:
  - .1 Accuracy complies with these specifications.
  - .2 Calibration certificates have been deposited with Departmental Representative.
- .2 Calibrated EMCS sensors may be used to obtain performance data provided that sensor calibration has been completed and accepted.

**1.32 PERFORMANCE VERIFICATION TOLERANCES**

- .1 Application tolerances:
  - .1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. Except for special areas, to be within +/- 10% of specified values.
- .2 Instrument accuracy tolerances:
  - .1 To be of higher order of magnitude than equipment or system being tested.
- .3 Measurement tolerances during verification:
  - .1 Unless otherwise specified actual values to be within +/- 2% of recorded values.

**1.33 DEPARTMENT REPRESENTATIVE'S PERFORMANCE TESTING**

- .1 Performance testing of equipment or system by Departmental Representative will not relieve Contractor from compliance with specified start-up and testing procedures.

**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            REFERENCES**

- .1      ASHRAE Guideline 1.1-2007, HVAC&R Technical Requirements for The Commissioning Process
- .2      ASHRAE Standard 202-2013, Commissioning Process for Buildings and Systems
- .3      CSA Z320-11, Building Commissioning Standard and Check sheets
- .4      Public Works and Government Services Canada (PWGSC)
  - .1      PWGSC - Commissioning Guidelines CP.4 -3rd edition-03.
- .5      CAN/ULC-S1001-11, Integrated Systems Testing of Fire protection and Life Safety Systems

**1.2            GENERAL**

- .1      The attached Cx Plan is 95% completed at time of tender. Refer to Appendix A - Commissioning (Cx) Plan.
- .2      Cx Plan is a dynamic document which will be revised throughout the Cx process in coordination with the contractor, CxA and Department Representative.
- .3      Live document for inclusion during Construction:
  - .1      Approved shop drawings and product data.
  - .2      Approved changes to contract.
  - .3      Contractor's project schedule.
  - .4      Contractor's, sub-contractor's, suppliers' requirements.
  - .5      Project construction team's and Cx team's requirements.
- .4      Term "Cx" in this section means "Commissioning".
- .5      Acronyms:
  - .1      AFD - Alternate Forms of Delivery, service provider.
  - .2      BMM - Building Management Manual.
  - .3      Cx - Commissioning.
  - .4      CxA - Commissioning Agent
  - .5      EMCS - Energy Monitoring and Control Systems.
  - .6      MSDS - Material Safety Data Sheets.
  - .7      O&M - Operation and Maintenance.
  - .8      PFC - Pre-Functional Check.
  - .9      PI - Product Information.
  - .10     PV - Performance Verification.
  - .11     FPT - Functional Performance Test
  - .12     GIT - Global Integration Test

- .13 TAB - Testing, Adjusting and Balancing.
- .14 WHMIS - Workplace Hazardous Materials Information System.
- .6 Commissioning terms used in this Section:
  - .1 Bumping: short term start-up to prove ability to start and prove correct rotation.
  - .2 Deferred Cx - Cx activities delayed for reasons beyond Contractor's control due to lack of occupancy, weather conditions, need for heating/cooling loads.

### **1.3 REFINEMENT OF CX PLAN**

- .1 During construction phase the contractor shall meet and coordinate with CxA to revise, refine and update Cx Plan to include:
  - .1 Changes resulting from Client program modifications.
  - .2 Approved design and construction changes.
  - .3 Finalized Functional Performance Testing Process to include finalized control sequences as part of the controls submittal process.

### **1.4 COMPOSITION, ROLES, AND RESPONSIBILITIES OF CX TEAM**

- .1 The CxA has been selected and has developed the Cx Plan.
- .2 For Cx responsibilities refer to Appendix A - Commissioning (Cx) Plan.
- .3 Contractor is responsible for:
  - .1 Review the Cx Plan and updates to the plan.
  - .2 Coordinate/schedule CX activities for PFC and FPV.
  - .3 Ensure subtrades perform their responsibilities relating to the Cx Plan.
  - .4 Ensure all required subtrades are in attendance of FPV to facilitate the required testing.
  - .5 Monitoring Cx activities.
  - .6 Attend Cx Meetings and FPV
  - .7 Witnessing, certifying accuracy of reported results.
  - .8 Witnessing and verify TAB and other tests.
  - .9 Performing verification of performance of installed systems and equipment.
  - .10 Developing BMM.
  - .11 Ensure all documentation for the CX plan is submitted and complete.
  - .12 Implementation of Contractors Training Plan.
  - .13 Notify CxA of any Cx related issues raised during construction.
  - .14 Notify Department Representative of Cx Milestones.
- .4 Building Operator: represents lead role in Operation Phase and onwards and is responsible for:
  - .1 Receiving the installation.
  - .2 Day-To-Day operation and maintenance of facility.

## **1.5 OTHER CX PARTICIPANTS**

- .1 Employ the following Cx participants to verify performance of equipment and systems:
  - .1 Installation contractor/subcontractor including but not limited to controls and mechanical contractor
    - .1 Equipment and systems except as noted.
  - .2 Equipment manufacturer: equipment specified to be installed and started by manufacturer.
  - .3 Specialist subcontractor: equipment and systems supplied and installed by specialist subcontractor.
  - .4 Ensure that Cx participant:
    - .1 Could complete work within scheduled timeframe.
  - .5 Provide names of participants to CxA and details of instruments and procedures to be followed for Cx 1 months prior to starting date of Cx for review and approval.

## **1.6 RISK ASSESSMENT**

- .1 Contractor shall ensure that the appropriate risks are identified to the Departmental Representative and implement adequate mitigation methods in conjunction with the Departmental Representative to prevent an emergency situation.

## **1.7 EXTENT OF CX**

- .1 Commission mechanical systems and associated equipment listed in the Commissioning (Cx) Plan. (See Appendix A)
- .2 Commission electrical systems and equipment:
  - .1 New and modified Fire alarm systems, equipment:
    - .1 equipment devices, i.e. smoke detection cut off.

## **1.8 PROCEDURES**

- .1 Construction
  - .1 Review the latest Cx Plan.
  - .2 Provide list of contacts for the individuals to be included in the Cx Team. Including:
    - .1 Manufacturers Representatives who will be performing equipment start-ups
    - .2 TAB Agency
    - .3 Mechanical and Electrical subtrades.
    - .4 Controls Contractor.
    - .5 Fire Alarm contractor
    - .6 Specialty systems contractors.
  - .3 Meet with the CxA to coordinate requirements of Cx Plan and develop a process to implement the FPT.

- .2 Shop drawings
  - .1 Provide a shop drawing log
  - .2 Submit shop drawings for review by Department Representative and CxA.
  - .3 Include manufactures installation and start-up procedures and checklists.
  - .4 Address and respond to comments made by the Department Representative and CxA prior to ordering equipment.
- .3 Pre-functional Checks – Installation (Static) Checks – Part A
  - .1 Verification of conformity to specification and shop drawing data for all the components of the system.
  - .2 In addition to manufacturers installation check sheets complete Installation PFC form and submit to CxA after contractor has verified that the installation is as per the contract documents.
  - .3 Address deviations and deficiencies between received equipment and shop drawing.
  - .4 Notify any the Department Representative and CxA of issues which may impact the Cx process.
- .4 Pre-functional Checks – Start-Up Checks – Part B
  - .1 Upon completion of installation checks coordinate/schedule start-up testing including manufactures start-up services.
  - .2 Equipment manufacturer, supplier, installing specialist sub-contractor, as appropriate, to start-up, under Contractor's direction.
  - .3 Notify the Department Representative and CxA of scheduled start-up activities.
  - .4 Upon pre-functional start-up resolve issues preventing a complete start-up prior to calling for CxA witness of start-up.
  - .5 Complete manufactures start-up forms or obtain manufacturers start-up report.
  - .6 Conduct pre-start-up tests: conduct pressure, static, flushing, cleaning, and "bumping" during construction as specified in technical sections.
  - .7 Mechanical:
    - .1 Plumbing systems:
      - .1 "Bump" each item of equipment in its "stand-alone" mode.
      - .2 Complete pre-start-up checks and complete relevant documentation.
      - .3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.
    - .2 HVAC equipment and systems:
      - .1 "Bump" each item of equipment in its "stand-alone" mode.
      - .2 Complete pre-start-up checks and complete relevant documentation.
      - .3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.

- .4 Perform TAB on systems. TAB reports to be approved by Departmental Representative.
- .8 Electrical:
  - .1 Low voltage distribution systems under 750 V:
    - .1 Requires independent testing agency to perform pre-energization and post-energization tests.
    - .2 Fire alarm systems: test after other safety and security systems are completed. Testing to include a complete verification in accordance with ULC requirements. Departmental Representatives has witnessed and certified report, demonstrate devices to Departmental Representative.
    - .3 Low voltage systems: these include:
      - .1 Communications, low voltage lighting control systems and data communications systems.
  - .9 Address deficiencies noted by manufactures start up process.
  - .10 Complete PFC Start-up form and submit to CxA after contractor has verified that the installation is as per the contract documents.
  - .11 Start-up documentation to include:
    - .1 Factory and on-site test certificates for specified equipment;
    - .2 Pre-start-up inspection reports;
    - .3 Signed installation/start-up checklists;
    - .4 Start-up reports; and
    - .5 Step-by-step description of complete start-up procedures, to permit Departmental Representative to repeat start-up at any time.
  - .12 Address deviations and deficiencies noted by the Department Representative and CxA.
- .5 Functional Verifications:
  - .1 Upon completion of equipment start-up coordinate/schedule controls Functional Verification. The completion of the TAB should be coordinated with the controls verification to meet the functional requirements as note in the contract documents.
  - .2 Notify the Department Representative and CxA of scheduled TAB and controls verification activities.
  - .3 The contractor shall confirm that the TAB and controls work for the equipment is complete and verified by the controls contractor(s).
  - .4 Address any deficiencies discovered during TAB and controls verification prior to scheduling FPT.
  - .5 Verify the sequence of operation is met and submit the controls verification form/report to the Department Representative and CxA.

- .6 Functional Performance Test (FPT). (System PV):
  - .1 FPT can be scheduled when the following is complete and submitted to CxA:
    - .1 PFC sheets (Part A and B);
    - .2 TAB Report;
    - .3 Controls Verification Report/Form;
    - .4 FPT forms for prerequisite; and
    - .5 Confirmation that there are no deficiencies impacting the operation.
  - .2 Coordinate and provide the necessary trades, suppliers, tools and instrumentation, to facilitate the FPT.
  - .3 The FPT forms and process will be updated during construction to reflect changes, submittals and finalized control sequences approved through the controls submittal process.
  - .4 During the FPT the CxA will review the items noted on the FPV Forms. The contractor shall facilitate the operation and measurement of the performance parameters of the system which includes:
    - .1 TAB verification;
    - .2 Interlocks;
    - .3 Equipment interface and controls;
    - .4 EMCS interface;
    - .5 Controls sequence;
    - .6 Fire Alarm interlocks;
    - .7 Security Interlocks; and
    - .8 User Requirements.
  - .5 Address any deficiencies noted during the FPT.
- .7 Correct deficiencies and obtain approval from Departmental Representative after distinct phases have been completed and before commencing next phase.
- .8 The system will not be accepted as complete until the deficiencies from the FPT have been addressed.
- .9 Failure to follow accepted procedures will result in re-evaluation of equipment by an independent testing agency selected by Departmental Representative. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:
  - .1 Minor equipment/systems: implement corrective measures approved by Departmental Representative.
  - .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Departmental Representative.
  - .3 If evaluation report concludes that major damage has occurred, Departmental Representative shall reject equipment.
    - .1 Rejected equipment to be remove from site and replace with new.
    - .2 Subject new equipment/systems to specified start-up procedures.

**1.9 DELIVERABLES RELATING TO THE CX PROCESS**

- .1 Provide the following for completed documentation for Cx manual:
  - .1 Construction/Commissioning Schedule;
  - .2 Shop Drawing Log;
  - .3 Pre-Functional Check Sheets/Static Check Sheets. (Part A);
  - .4 Pre-Functional Check Start-Up check sheet (Part B); and
    - .1 Manufacturers Start-up sheets/report, where applicable.
  - .5 TAB reports.
    - .1 Completed performance verification (PV) report forms (Controls).

**1.10 ACCEPTANCE**

- .1 Cx activities must be completed before issuance of Substantial Performance, it is anticipated that certain Cx activities may be necessary during Warranty Period, including:
  - .1 Fine tuning of HVAC systems.

**1.11 TRAINING PLANS**

- .1 Refer to Section 01 91 41 - Commissioning (Cx) - Training.

**1.12 FINAL SETTINGS**

- .1 Upon completion of Cx to satisfaction of Departmental Representative, lock control devices in their final positions, indelibly mark settings marked and include in Cx Reports.

**1.13 COSTS FOR CX**

- .1 Contractor shall include costs associated with Cx activities.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**



# COMMISSIONING PLAN

## Edmonton Maximum Security Institution

September 5<sup>th</sup> 2017

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Rev.	Date	Issue
0	2017-05-15	DRAFT Issued for review
1	2017-06-06	Revised DRAFT Issued for review
2	2017-08-28	Revised Draft Issue with reference to Departmental representative wording
4	2017-09-05	Issued for Tender



## Executive Summary

The purpose of this document is to describe how commissioning will be undertaken during the construction, acceptance, and warranty phases. The Commissioning Plan outlines the process, procedures, and standards for all parties involved in the process.

CDML has been employed by the Associated Engineering to act on their behalf to oversee the start-up, testing, adjusting and balancing operation, and to verify that the equipment and systems are working as specified and conform the owners' project requirements and the contract documentation.

The goals of this Commissioning Plan is to identify and define the following

- ☐ Commissioning Team Members
- ☐ Commissioning Team Members responsibilities for each Commissioning Phase activity
- ☐ Commissioning activities to be conducting during the construction, acceptance, and warranty phases of the project
- ☐ Systems to be commissioned
- ☐ Acceptance criteria for the completion of commissioning.

CDML milestones:

1. Review the design and submittal documents
2. Develop the project specific Commissioning Plan
3. Provide contractors construction checklists to support their QA/QC program
4. Provide system contractor functional performance test sheets for the contractors use
5. Conduct regular commissioning meetings
6. Conduct periodic construction installation inspections
7. Develop and continually maintain the project commissioning issues log
8. Verify construction is complete prior to equipment start-up
9. Verify major system start-up
10. Verify contractor functional performance testing via sample witnessing of systems and equipment
11. Monitor O&M personnel training
12. Conduct seasonal or deferred functional performance testing in conjunction with the operations team
13. Provide a Commissioning Report

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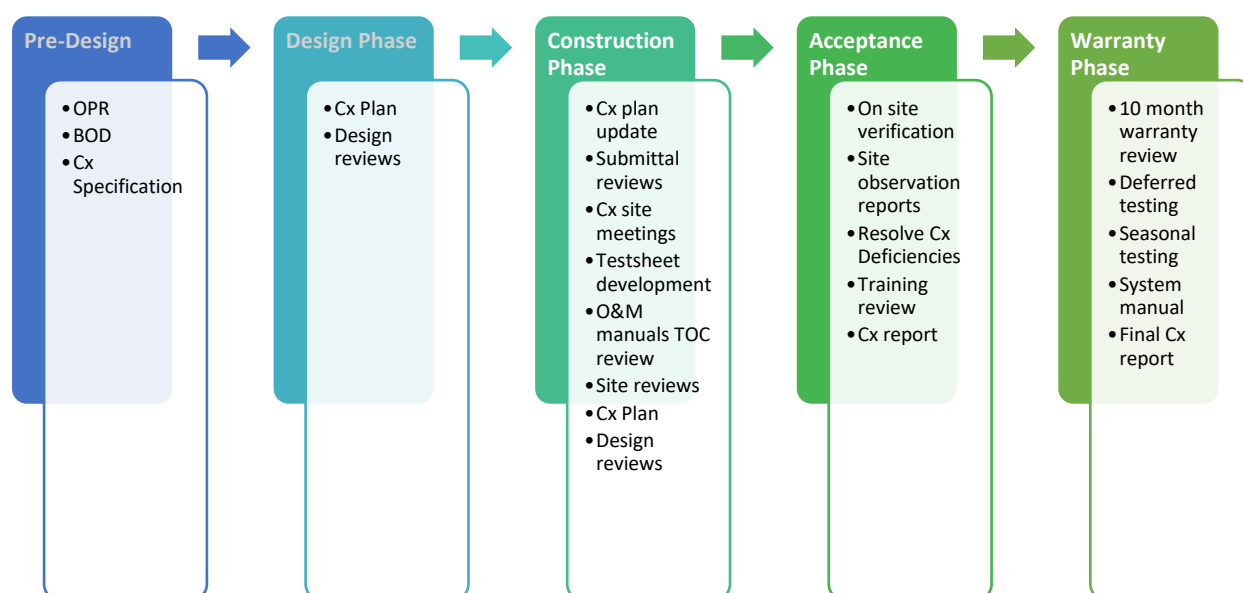
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## 1 Introduction

The Commissioning Process Flowchart and Matrix graphically depicts the commissioning process and its flow from the Pre-Design Phase through to the Warranty Phase. These are intended to be a quick reference for identifying the fundamental components of commissioning and their relationship to each other. The main narrative provides more detail regarding the activities, responsibilities, and deliverables associated with each activity in the Commissioning Process Flowchart and Matrix. For each Matrix row and Flowchart box, there is a corresponding narrative description.

## 2 Commissioning Process Flowchart

The commissioning process will be conducted from the Construction Phase to the Warranty Phase and will include a Mechanical & Electrical design review.



## 3 Responsibility Matrix

The following matrix tabulates the major commissioning activities when they occur during the project and the commissioning team member roles and responsibilities for each activity. Additional information on each activity is detailed further in this document.

The responsibility chart below is intended to provide an organizationally practical means for commissioning responsibility coordination, to aid the Contractor with managing the commissioning process with major subcontractors and various trades, but is not intended to otherwise alleviate the Contractor from contractual obligations for the performance and coordination of The Work. Ultimately the Contractor is responsible to ensure the successful performance of The Work, and in turn the Contractor is responsible for commissioning. All references to Sub-contractors, Mechanical Contractor, Electrical Contractor, TAB contractor, etc. shall ultimately be interpreted as being the contractual responsibility of the Contractor in contract with Public Works Government Services Canada (otherwise known as Public Services and Procurement Canada).

R = Responsible team member

✓ = Team member participation

ACTIVITIES	PROJECT PHASES				COMMISSIONING TEAM MEMBERS								
	Pre-Design	Design	Construction	Acceptance	Departmental Rep	Architect	Mechanical Consultant	Electrical Consultant	General Contractor	Mechanical Contractor	Electrical Contractor	Controls Contractor	CxA
Owners Project Requirements (OPR)	✓		✓		R	✓	✓	✓					✓
Basis Of Design (BOD)	✓					✓	R	R					✓
Commissioning Specification	✓				✓	✓							R
Design Phase Commissioning Meeting	✓				✓	✓	✓	✓					R
Commissioning Plan		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	R
Commissioning Design Reviews		✓				✓	✓	✓					R
On Site Commissioning Meeting			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	R
Shop Drawing Commissioning Reviews			✓			✓	✓	✓					R
Project Tracking Sheet *			✓	✓					✓	✓	✓	✓	R
Pre-Functional Check Sheets *		✓	✓	✓					✓	✓	✓		R
Equipment Start-Ups			✓							R	R		✓
Functional Performance Test Development *			✓				✓	✓					R
Commissioning Issues Log		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	R
TAB Report Acceptance				✓			R			✓			✓
Functional Performance Testing (On Site Verification) **				✓	✓		✓	✓	✓	✓	✓	✓	R
Commissioning Report					✓								R
*Supplied by CxA, filled out and signed by the Contractor/Sub-Contractors, monitored and managed by the Contractors Commissioning Coordinator.													
**Scheduled and Organized by the Contractors Commissioning Coordinator													

## 4 Commissioned Systems

The commissioning process described in this Commissioning Plan is applicable (but not limited) to the following systems.

### 4.1 Mechanical Systems

---

Air Handling Units (AHU)
Direct Expansion Cooling Systems (Dx)
Roof Top Air Conditioning Units (RTU)
Make Up Air Units (MUA)
Variable Air Volume Boxes (VAV)
Computer Room Air Conditioning Units (CRAC)
Transfer Fans
Exhaust Air Fans
Supply Air Fans

---

### 4.2 Plumbing Systems

---

Heating Boilers
Pumps
Domestic Hot Water Heaters
Radiant Panels
Re-heat Coils
Unit Heaters

---

### 4.3 Building Automation System (BAS)

---

Individual System Control Sequences
Graphics

---

## 5 Construction Phase Activities

### 5.1 Site Commissioning Meetings

Commissioning (Cx) team meetings will be used to plan, coordinate, schedule, track deliverables, review future activities, and discuss/resolve issues.

A Cx kick-off meeting will be conducted early in the project construction phase, this will be followed by monthly meetings facilitated by CDML where the commissioning process is reviewed with the commissioning team members, electrical, mechanical and controls subcontractors.

CDML will participate in some contractor meetings to review Building Automation Sequence of Operation and/or Integrated Systems Testing (IST) as deemed necessary by the Departmental Representative.

### 5.2 Design/Commissionability Reviews

CDML will conduct a commissionability review on the project documentation. It is CDML's belief that the commissionability review will aid in the following:

- To ensure that the design information is reliable, accurate and complete
- To improve the commissionability of the systems, and reduce life-cycle costs by making appropriate changes at a pre-installation stage
- To assist in the reduction of the cost of systems, for example by removing commissioning valves and dampers where they are not needed, and ensuring that they are present where they are needed

To minimise the potential for subsequent design and installation defects. CDML is not responsible for the design concept, design criteria or compliance with codes. CDML uses industry experience and knowledge to ensure that the design information is reliable, accurate and complete.

Design review comments will be issued in a spreadsheet format, detailing the drawing/specification reviewed and the issue noted. Issues resolution will be tracked until a satisfactory response is received.

### 5.3 Project Tracking Sheet

The project tracking sheet consists of a list of all equipment to be commissioned as part of the project and the status of each piece of equipment with regards to the major commissioning steps. These steps include the status of shop drawing reviews, installation check sheets, air and water balancing, functional performance testing, training, and O&M manuals issue. Once all steps are completed the system/equipment is then considered commissioned.

### 5.4 Construction Checklists

Construction checklists are important to ensure that the equipment and systems are energized and operational and that the contractor's functional performance testing may proceed. Each piece of equipment receives full QA/QC checkout by the contractor. No sampling strategies are used. In general, the contractor will complete construction checklists for all equipment and systems prior to formal functional performance testing of equipment or subsystems of the given system. The checklists will be monitored/verified by the Contractors Cx Coordinator and CDML during the construction phase.

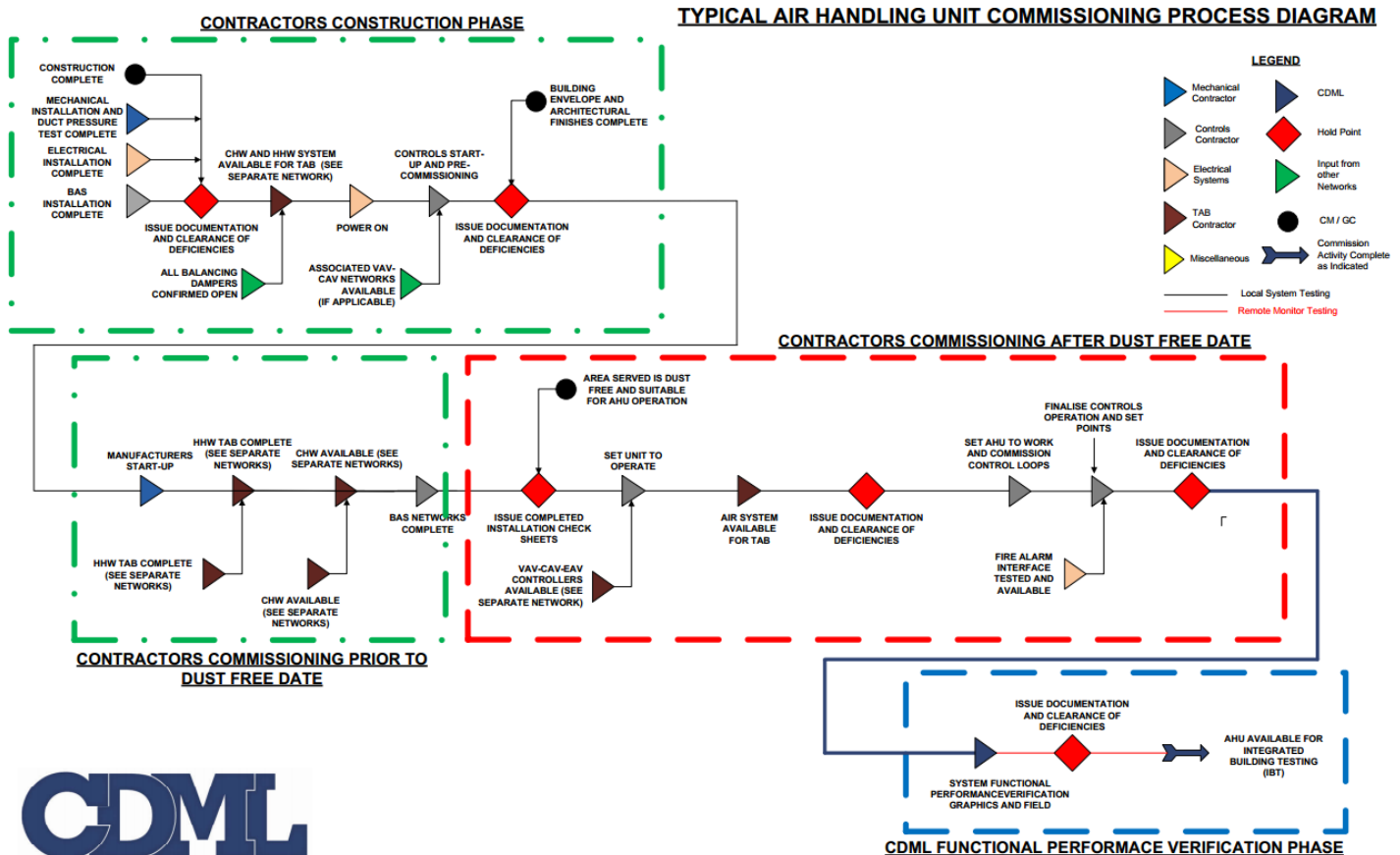
CDML will provide the Construction checklists in electronic format for the project. They detail the general construction installation checklists must be done on each piece of equipment associated with systems to be commissioned once installation is deemed complete. These sheets also detail the pre-requisites for

functional performance testing. These will be included in the appendix of this plan. Additional checklists will be added as necessary. However, if the construction team have their own construction checklists, these may be used once reviewed and accepted by the commissioning team.

## 5.5 Submittal Reviews

As part of the standard submittal review process, CDML will identify submittals associated with systems to be commissioned that need to be reviewed. CDML will issue our comments to the relevant design team member following the agreed communications protocol. The Design team will incorporate the commissioning comments, at their discretion. Commissioning submittal review comments will focus on the same areas as the commissioning design reviews e.g. compliance with the Owners' Project Requirements (OPR), clarity of the design, integration coordination, accessibility and maintainability, O&M training and documentation requirements, and the ability to test and validate system operation. CDML will be given access to all reviewed submittals after processing by the Design Team.

## 5.6 Commissioning Process Management Tools and Scheduling



CDML utilizes network diagrams to visualise how the project will be implemented. A network diagram is a sequence of tasks/activities, which are represented by blocks that are linked together in the logical sequence. Network diagrams are produced for each individual system and for the entire commissioning process. Once the logic diagrams have been completed, the commissioning team have a clearer visual picture of the required sequence of events and commissioning critical path related activities that will be required to complete the project.



## 5.7 Site Reviews

CDML will conduct periodic site visits to witness equipment and system installations. Items of concern noted during the review/visit will be documented in the Commissioning Issues Log, distributed to the Departmental Representative and copied to the relevant design and construction team members.

## 5.8 Commissioning Issues Log

During construction phase CDML will document commissioning issues in the Commissioning Issues Log. These issues will be distributed by CDML to the Commissioning Team. The Commissioning Team is expected to implement the necessary secondary circulation as necessary for resolution.

The Contractors Cx Coordinator and CDML will track all issues raised to ensure that they are dealt with in a timely manner and will circulate regular status reports to all members of the Commissioning Team.

During the Acceptance Phase, deficiencies identified during the verification and testing will be documented on the Commissioning Issues Log and reported to the Departmental Representative and commissioning team. The issues log includes all details of the components or systems found to be non-compliant with the parameters of the test plans. The issues log details the responsible party('s) required to comment/address the item raised.

## 5.9 Equipment Start-up

The Contractor shall coordinate equipment and systems start-ups with their mechanical and electrical sub-contractors and their sub-trades such as controls, sheetmetal, fire alarm and the air/ water balancers. Sufficient notice for contractor, sub-contractors, equipment manufactures, and contractors 3<sup>rd</sup> party testing agencies to plan and coordinate work must be provided. CDML may attend equipment start up at our own discretion or as per contract scope.

The Contractor shall submit start up procedures, data sheets and recording forms for review, a minimum of four weeks prior to execution of the start-up verification process. The start-up data sheets shall be in the form supplied by the manufacturer or, if not available, they must record all necessary setting and checks conducted at start up to satisfy the manufactures warranty.

Issues noted during start up must be tracked on the commissioning issues log and addressed by the relative contractor for the start up to be deemed complete.

The Sub-Contractors and their manufacturers or suppliers shall provide all instrumentation and equipment necessary to conduct the tests as specified in the Mechanical Sections. The Contractor shall advise the Departmental Representatives or CDML of instrumentation to be used and the dates the instruments were calibrated.

When the Contractor has tested confirmed that the systems are operating and controlling per the design intent, and all prerequisites have been completed then functional performance verification/testing can be scheduled and coordinated with the parties referenced above, CDML, the Departmental Representatives and Consultants.

## 5.10 Contractor Functional Performance Tests (CFPT)

Based on the reviewed submittal for the BAS controls sequence of operation, functional test documentation will be prepared. These tests will be used to functionally test components, systems and their integration with other systems and equipment. These CFPT checklists will be issued to the

commissioning team for review and comment prior to onsite testing and verification. Note that each CFPT sheet has a list of prerequisites that need to be addressed by the contractors prior to functional performance verification in the Acceptance Phase.

### 5.11 Operation and Maintenance Manual Reviews

As part of the commissioning process, CDML will review the O&M manuals, documentation and redline as-built for systems that were commissioned to verify compliance with the OPR and Specifications. Review comments will be issued to the relevant design team member following the agreed communications protocol. The Design team will incorporate the commissioning comments, at their discretion, into their formal submittal review responses to the Contractor.

### 5.12 Demonstrations and Instruction Plan

Operations & Maintenance (O&M) training delivery per specifications is contractor lead. A training plan that defines the roles and responsibilities of the project's Construction team, Subcontractors, Suppliers, Design Consultants, and end user as they relate to the operation and maintenance of M&E systems and equipment. At a minimum, the plans will include a schedule of training dates, agenda, times, locations, training provider and durations.

#### Common Training Topics

- General purpose of system (design intent)
- Use of O&M manuals
- Review of control drawings and schematics
- Start-up, normal operation, shutdown, unoccupied operation, seasonal changeover, manual operation, control setup and programming troubleshooting and alarms.
- Interactions with other systems
- Adjustments and optimising methods for energy consumption
- Health and safety issues
- Special maintenance and replacement sources
- Occupant interaction issues
- System response to different operating conditions

## 6 Acceptance Phase Activities

### 6.1 TAB Report Review and Acceptance

The TAB Contractor will prepare a balancing report documenting that all air and hydronic systems have been adjusted and are within acceptable design values. Prior to CDML's accuracy check of the flowrates, the Mechanical Consultant will be required to review and accept the report. CDML will verify that all required data has been collected, that the measured results follow the design documents, and that any non-compliance items have been resolved and rebalanced prior to the start of functional performance Testing. This check of accuracy will be conducted in conjunction with the TAB contractors using their instruments.

### 6.2 Functional Performance Test Verification

Functional performance Test Verification is performed by CDML and The Contractor. Coordination and scheduling of the functional performance test verification is the responsibility of The Contractor Cx Coordinator. CDML will direct, and document the functional performance test verification for M&E systems. It is the responsibility of the Contractor to manipulate the systems and controls as per CDML's request.

Prior to functional performance test verification all Construction test sheets, manufacturers start up reports and static tests such as duct pressure tests, pipe pressures tests, BAS point-to-point tests must be submitted to the Consultants for their review and acceptance.

CDML will confirm formal functional performance test verification readiness through field observation, review of start-up reports and construction checklists, contractor pre-requisites, observation of the control system and equipment operation, including trending, and when required will review of contractor's pre-tests and testing regimes as per *Contractor Functional Performance Testing*.

Prior to or at the beginning of functional performance test verification, CDML will confirm with the controls contractor, that critical sensor and actuator calibrations and building automation system graphics accurate, calibrated, and operational.

CDML will direct, execute, and document the verification testing on project specific test forms. Any issues that are found during the testing will be added to the commissioning Issues Log and forwarded to the Contractor and Departmental Representative in a timely manner.

Using the functional performance tests developed, each event in the sequence of operation and other significant modes along with sequences and control strategies not mentioned in the written sequences such as start-up, shutdown, unoccupied and manual modes, modulation, alarms, component staging, backup upon failure and interlocks with other equipment will be verified. CDML will provide step-by-step procedures for testing systems with descriptions for methods of verifying.

Where necessary, main equipment will be individually tested. Similar units that are numerous (e.g., many smaller rooftop packaged units, air terminal units, and exhaust fans) may have an appropriate sampling strategy applied. Heating equipment must be tested during the winter and cooling equipment must be tested during the summer, as appropriate to demonstrate performance under near-design conditions.

The Client and their Facilities Management representatives may witness and participate in the functional performance test verification, as they deem necessary, to understand how the systems operate and how optimal performance can be maintained.

The Contractor and sub contractors shall aid CDML (as required) and they shall provide the necessary personnel and equipment during the testing and verification process.

### **6.2.1 Acceptance Criteria**

For each step of the functional performance verification procedures, IST and power fail tests, there will be a pass/fail definition of acceptable response. This typically is a description of how each device in a system is designed to react to the scripted action imposed on the system. In the interest of field testing efficiency, the acceptance criteria will be clearly defined in terms that everyone can understand and agree on. Valves and dampers should “open” or “close”, fans and pumps shall “start” or “stop”, modulating devices shall “modulate higher” or “modulate lower.” If any test fails to meet the pass/fail criteria the issues will be noted in the commissioning issues log and the system will be retested once the issue/deficiency is resolved.

Tolerance is defined as the permissible deviation from the specified design requirements. For example, air and water systems will be considered as balanced in accordance with the specification or AABC or NEBB good practice, any deficiencies beyond this tolerance should be noted on the TAB report by the TAB contractor and may result in a retest.

### **6.2.2 Re-testing**

The contractor corrects the deficiency and notifies the commissioning team that the equipment is ready to be retested. CDML will direct, and document functional performance re-testing for each system that failed to pass its initial FPT. For systems tested with a sampling strategy, such as VAV’s, additional samples will need to be tested during re-testing if the failures of the initial sample exceed the failure rate threshold. The extent and level of rigor of retesting will be as CDML deems necessary to confirm successful resolution of the initial deficiencies without sacrificing performance elements which had originally passed the system FPT.

## **6.3 Departmental Representatives Demonstrations and Instruction Review**

The Contractor will formally document each training session. Documentation of Facilities Management acceptance will require that someone representing the trainees formally and in writing accept each training session as complying with that session’s Training Agenda. CDML will collect this documentation in the form of fully executed Training Agendas and include them as part of the Final Commissioning Report.

## **6.4 M&E Close-Out List**

The following list is provided as reference to the Contractors and Cx Team. The summary list is generic and some item may not be specific to this project.

Perform and/or provide the following items prior to substantial performance review. Provide confirmation that the applicable items listed are completed:

- Heating and air conditioning systems capable of operation with alarm controls functional performance and automatic controls are in operation
- Equipment testing is complete and includes tests required by authorities and certificates of approval have been obtained and submitted
- Valve tagging completed and equipment identified. Equipment and piping painted and escutcheons installed

- Equipment lubricated as per manufacturer's data. Provide servicing and lubrication schedule, and list of lubricants required
- Warranty forms have been mailed to manufacturer. Submit a copy of the original warranty for equipment which has warranty period longer than one year
- Review and ensure that access doors are suitably located and equipment easily accessible included plumbing cleanouts
- Noise and vibration control devices and flexible connections inspected by the manufacturer's representative and written report submitted
- Equipment alignment carried out by qualified millwright and certified report submitted
- Check operation of plumbing systems and fixtures and ensure that fixtures are solidly supported. Adjust flush rates. Domestic hot water chlorination, flushed and activated for use. Potable/Domestic water service chlorination report submitted.
- Fire Stopping has been reviewed and deemed to be complete
- Fire Damper Drop Testing complete and documentation submitted to the Commissioning Authority and also included in the maintenance manual
- Departmental representative demonstration and instruction of mechanical systems is complete
- Fire sprinkler letter of assurance forwarded and contractor's materials and testing certificate included in the maintenance manuals
- Provide all M&E spare parts. Provide a transmittal of spare parts turned over to the Departmental representative
- Record drawings (Red-Line/As-Built/Revit) provided to the consultant and Departmental representative
- Controls system final electrical approval certificate
- Registration certificates for all pressure vessels
- Pressure test reports for heating, chilled and refrigeration lines have been added to O&M's
- Final plumbing acceptance inspection report from authority with authority accepted report to be in O&M's
- Final natural gas acceptance inspection report/certificate included in O&M's
- M&E equipment cleaned inside and out.
- System startup check lists completed and submitted to Cx Authority
- Fan plenums cleaned and temporary filters removed and permanent filters installed
- Back flow prevention test reports included in O&M's
- Final balancing is complete and final data of air and water reports submitted
- Final calibration of controls completed
- Maintenance manual and instructions given to the Departmental representative

## **7 Warranty Phase Activities**

### **7.1 Post Occupancy Commissioning**

Seasonal testing, deferred testing, and the 10-month on-site review form ‘post occupancy commissioning’. CDML will verify that all commissioning related issues have been cleared, and the project is free from deficiencies would also be conducted during this period. CDML believe that seasonal testing of the systems and equipment is paramount in ensuring a stable, optimized system operation in all ambient conditions.

Fine-tuning of the integrated systems as well as any specific operator or graphical user interface display requirements or amendments will be undertaken under the direction of the CDML commissioning manager during this phase.

### **7.2 Deferred / Seasonal Testing**

Functional Performance Tests (FPTs) may need to be deferred until after Substantial Completion for a variety of reasons. The most common reasons include HVAC systems may need to have different weather conditions than those at the end of construction or commissioned systems may need to have a load put on them before testing can be considered meaningful. FPTs that occur after Substantial Completion will be conducted, documented, and tracked during the warranty phase.

#### **7.2.1 Unforeseen Deferred Tests**

If any test cannot be completed due to the building structure, required occupancy condition, or other deficiency, the functional performance testing may be delayed upon approval of the Departmental representative. These tests are conducted in the same manner as the seasonal tests, as soon as possible.

#### **7.2.2 Seasonal Testing**

Seasonal variation in operations or control strategies may require additional testing during the opposite season to verify performance of the HVAC system and controls in heating or cooling mode. Trends set up during the acceptance phase testing will be reviewed. Tests are executed and documented, with deficiencies corrected by the Contractor. Any final adjustments to the O&M manuals and as-built drawings due to the testing are also completed.

### 7.3 Final Commissioning Report

After completion of all commissioning activities, CDML will write a final report documenting the overall results of the commissioning process and recommending acceptance of the commissioning process and related documentation to the Departmental representative.

The final commissioning report provide a summary of the commissioning process and include the project applicable information outlined as follows:

- Commissionability Review Reports
- Commissioning Networks
- Cx Submittal Reviews
- Commissioning Meeting Minutes
- Site Review/Observation Reports
- Construction Checklists (Completed and Signed)
- Manufacturers Start-up Sheets
- Functional Performance Test Sheets (Completed and Signed)
- Integrated Building Test Plan & Matrix
- TAB Reports
- Commissioning Issues Log
- Commissioning Plan

## 8 Commissioning Team Member Contact List

ROLE	NAME	COMPANY	EMAIL
Client			
Client			
Project Manager			
Architect			
Mechanical consultant			
Electrical consultant			
General contractor			
Mechanical contractor			
Electrical contractor			
Controls contractor			
TAB Contractor			

## 9 List of Appendices

- Appendix A - Commissioning Meeting Minutes**
- Appendix A - Commissioning Networks**
- Appendix B - Contractor Equipment Cx Tracking Sheet**
- Appendix C - Commissioning Issues Log**
- Appendix D - Construction Installation Check Sheets**
- Appendix E - Functional Performance Test Sheets**



# **APPENDIX A**

## **COMMISSIONING MEETING MINUTES (SAMPLE)**

# Cx Meeting Minutes



Project:  
Date & Time:  
Venue:  
Recorder: Dan Popa  
Meeting No: 1  
Next Meeting:

Name	Company	Email	Ref.	Attendees	Distribution
Dan Popa	CDML	<a href="mailto:dpopa@cdml.ca">dpopa@cdml.ca</a>	CDML	✓	✓
Dean Willows	CDML	<a href="mailto:DWillows@cdml.ca">DWillows@cdml.ca</a>	CDML		✓

Ref	Item	Action
1.1	<b><u>Introductions</u></b>	Info
1.2	<b><u>Commissioning Overview</u></b>  When a building is initially commissioned it undergoes an intensive quality assurance process that begins during design and continues through construction, occupancy, and operations. LEED Commissioning ensures that the new building energy related systems are installed, calibrated and perform as the owner intended and that building staff are prepared to operate and maintain its systems and equipment.	Info
1.3	<b><u>Commissioning Plan</u></b>  A draft of Cx Plan was included in the tender package This document outlines the roles and responsibilities of the Cx team and an overview of the Cx process. The plan shall be updated with contact information and will be reissued. A draft document will be issued for review by CDML and any comments will be discussed in the next Commissioning Meeting.  Construction Manager (CM): Mechanical Contractor: Electrical Contractor: Controls Contractor: TAB Contractor: <i>TBC by the Mechanical Contractor</i>	
1.4	<b><u>Construction Schedule &amp; Commissioning Networks</u></b>  Sample 'Networks' are attached as an illustration of tasks and predecessors related to mechanical and electrical system construction. Networks identify the typical interconnecting systems and services required/recommended for the successful flow of start-up and verification activities. These networks can be used effectively to assist in the construction scheduling process. The Construction Manager and Contractors are encouraged to use System Networks in conjunction with their construction scheduling.  The projected date that CDML will be required for functional verification is MM/YYYY, and the following items outline some of the process steps to be considered: <ul style="list-style-type: none"> <li>• Equipment is not started for heating or cooling, until installation checklist items and all manufacturers' pre-start procedures are completed. Please ensure that building integrity issues like moisture, dust and other environmental items are suitable for start-ups.</li> <li>• Pre-requisites for system verification and/or functional performance testing (FPT) are:               <ul style="list-style-type: none"> <li>- complete equipment Contractor QA/QC Installation Check sheets are deficiency free and have been submitted</li> <li>- manufactures installation and start-up sheets are deficiency free and have been submitted</li> <li>- all points on the controls system have been calibrated and the sequence of operation has been contractor tested</li> <li>- TAB reports have been submitted and accepted by the Mechanical engineer.</li> </ul> </li> </ul>	
1.5	<b><u>M&amp;E Contractors Project tracking sheet</u></b>  CDML will provide the Construction Manager (CM) with a spreadsheet to track relevant Cx construction tasks/milestones and required documentation submissions. CDML will populate	

Ref	Item	Action
	<p>the spreadsheet with the equipment information. It will then be turned over to Construction Manager for their use as a Commissioning management tool.</p> <p>On a regular basis CDML and the Construction Manager will review the tracking sheet.</p>	
1.6	<p><b><u>Contractors Construction Check sheets – QA/QC</u></b></p> <p>These sheets provide an item by item check list of completed works associated with each piece of mechanical and electrical equipment. They also give a clear picture of when the equipment is ready to be started and commissioned and ultimately provide the client with a complete inventory of the systems installed.</p> <p>If either the Mechanical or Electrical contractors have forms that they typically use this is acceptable by CDML if the contractors' forms are compared to CDML and/or forms in the specification to ensure that all items are covered.</p> <p>These sheets need to be filled out as equipment is delivered to site and not towards the end of construction period. Some of the forms are generic, therefore if the forms contain a non-applicable item then fill them as applicable.</p> <p>A copy of the Contractors Construction Check sheets shall be provided to the respective design consultants and Commissioning Authority for review.</p>	
1.7	<p><b><u>Functional Performance Test (FPT) Sheets</u></b></p> <p>Functional Performance Test Sheets will be submitted to the Project Manager, Mechanical and Electrical Contractors' for comment and use. Mechanically, the controls contractor will focus on mechanical FPT's. These test sheets provide a detailed analysis of the equipment's operational requirements and performance. When complete the FPT sheets provide documented proof that the system is ready for the Integrated Building Testing. The sheets must be filled out prior to Cx verification.</p> <p>Sample FPT sheets will be provided by CDML for review.</p>	
1.8	<p><b><u>Commissioning Issues Log</u></b></p> <p>Items raised throughout Design reviews and shop drawing reviews have been added to the Cx Issues Log for tracking purposes. Items raised through site observation reports will be added to the Cx Issues Log as well. The Cx Issues Log should be discussed at each Cx meeting and an updated copy will be forwarded following a review with M&amp;E Consultants.</p> <p>Throughout the project all site observation items are noted. CDML will address the items with Construction Manager on site at the time of our visit, and will track these on the Cx Issues Log. Any action items that are allocated to CDML will be reviewed during the process of commissioning and through Site visits. These items will remain open until verification.</p>	ALL
1.9		
1.10	<p><b><u>O&amp;M's, Documentation and Training Schedule</u></b></p> <p>Completed Contractor Cx documentation such as: contractor's construction check sheets, start-up forms, manufactures pre-start and startup documentation be distributed for review as it becomes available. The Mechanical and Electrical representative shall provide these documents to the Construction Manager for distribution to CDML and the Consultants.</p>	

Ref	Item	Action
	<p>The following documentation is typical of what is required for review by CDML:</p> <ul style="list-style-type: none"> <li>• M&amp;E Construction Check Sheets</li> <li>• BAS technicians signed off points list</li> <li>• M&amp;E Manufacturers Startup documentation</li> <li>• Chemical Treatment Reports for the hydronic system(s) <i>(if applicable)</i></li> <li>• Duct Cleaning Report <i>(if applicable)</i></li> <li>• TAB Mechanical Air and Water balancing reports reviewed by the Engineer of Record</li> <li>• Electrical Panel test reports reviewed by the Engineer of Record</li> <li>• Lighting control system test reports reviewed by the Engineer of Record</li> <li>• Fire Alarm VI documentation reviewed by the Engineer of Record</li> </ul> <p>O&amp;M's have been submitted and reviewed by the respective Consultants.</p>	
1.11	<p><b><u>Seasonal Testing</u></b></p> <p>Due to time of year &amp; outdoor air temperature, there may be an issue with starting certain systems. Consideration must be given to scheduling a visit for the supplier to verify the operation of the system under a genuine load. The Cx team will identify systems impacted by seasonal constraints.</p>	Info
1.12	<p><b><u>Cx Documentation Representatives</u></b></p> <p><b>Prime Contractor:</b> CELL: EMAIL:</p> <p><b>Mechanical Contractor:</b> CELL: EMAIL:</p> <p><b>Electrical Contractor:</b> CELL: EMAIL:</p>	Info

*If the above minutes are found to be incorrect, please contact me within 5 business days of the date of issue. If notification is not received then these minutes are deemed acceptable by all.*

Best Regards,



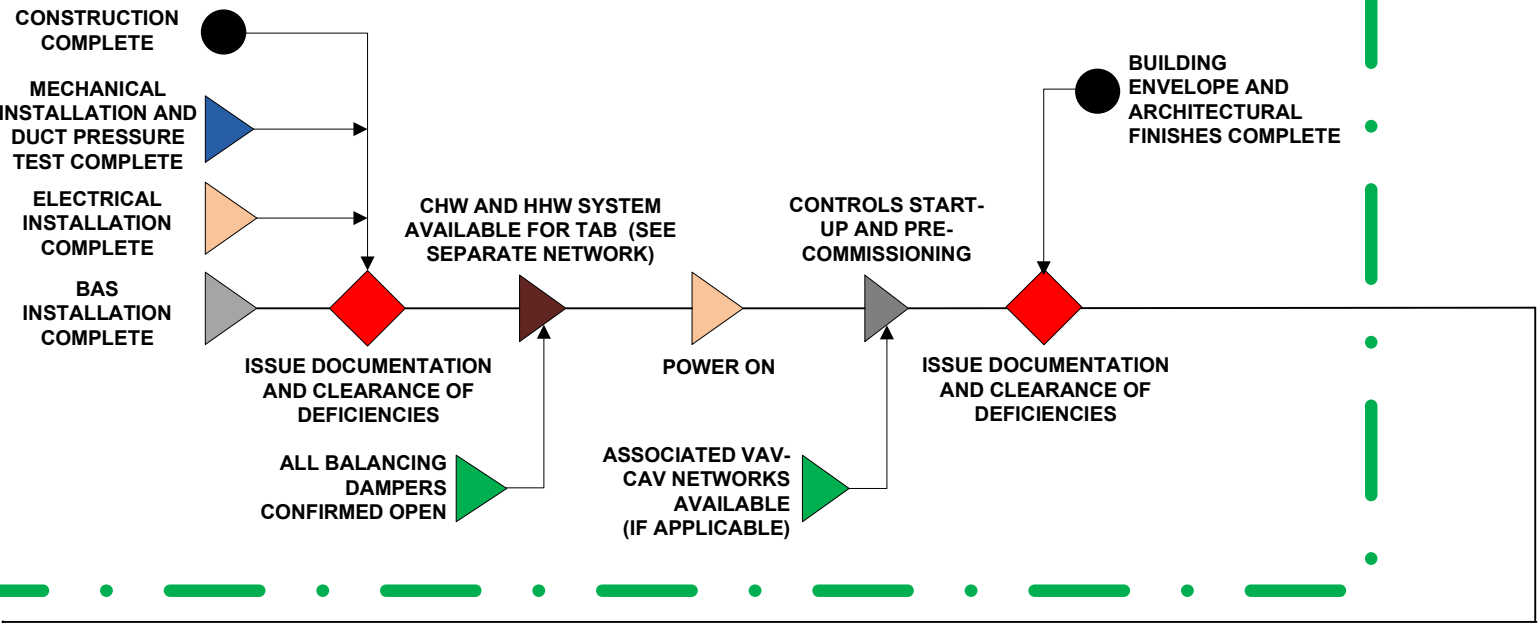
Dan Popa | B.Eng E.i.T. | Senior Commissioning Consultant  
CDML | Advancing the Built Environment  
[www.cdml.ca](http://www.cdml.ca) | [dpopa@cdml.ca](mailto:dpopa@cdml.ca)  
Mobile: 1.587.338.9368 | Office: 1.587.523.7474

# **APPENDIX B**

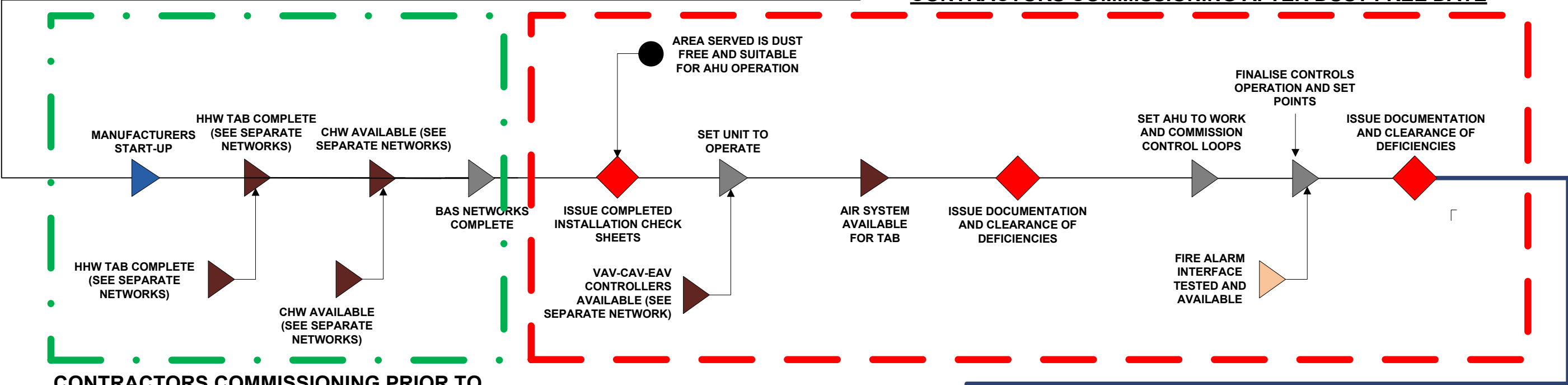
## **COMMISSIONING NETWORKS (SAMPLES)**

TYPICAL AIR HANDLING UNIT COMMISSIONING PROCESS DIAGRAM

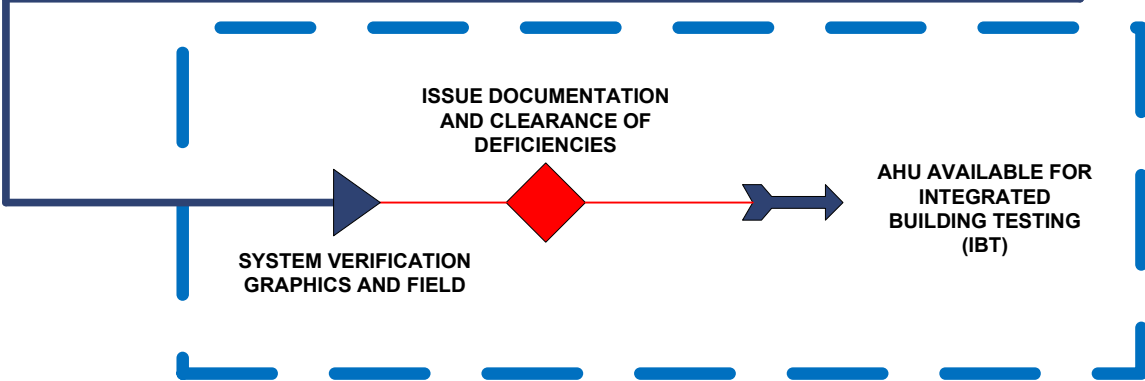
CONTRACTORS CONSTRUCTION PHASE



CONTRACTORS COMMISSIONING AFTER DUST FREE DATE



CONTRACTORS COMMISSIONING PRIOR TO DUST FREE DATE



CDML VERIFICATION & TESTING PHASE

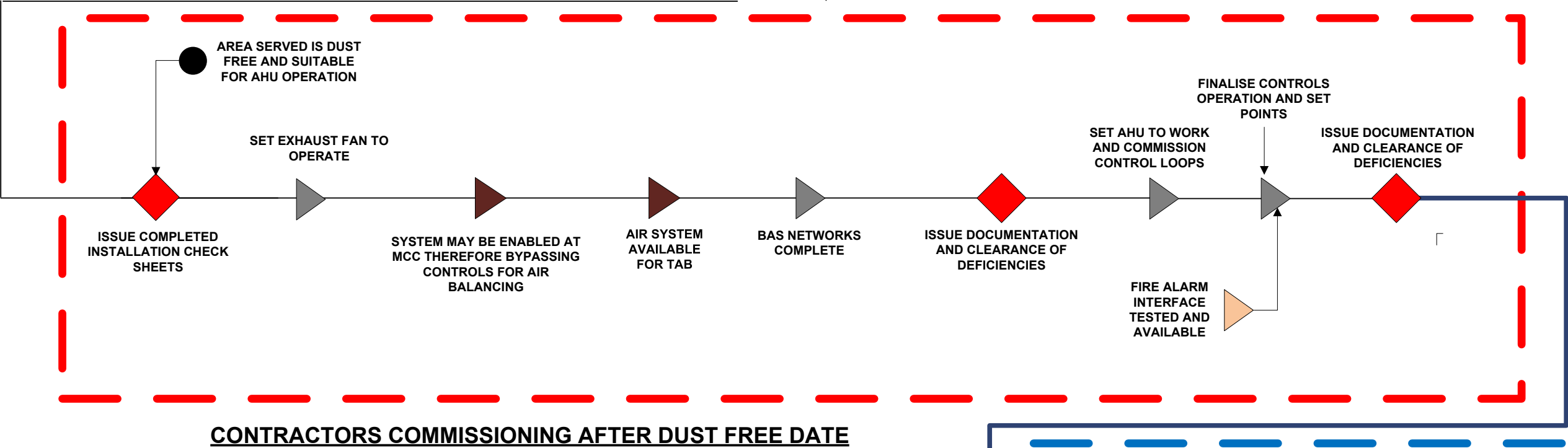
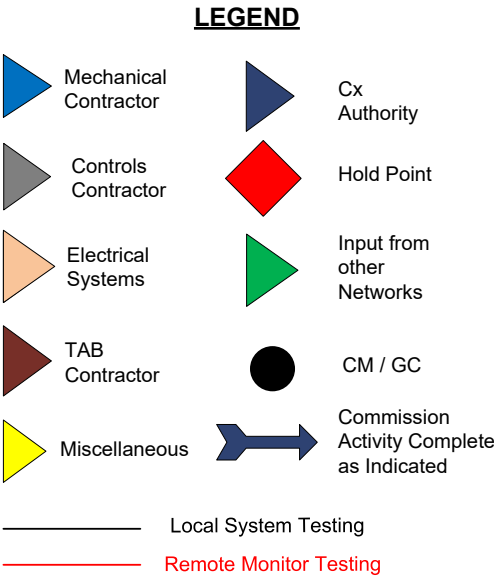
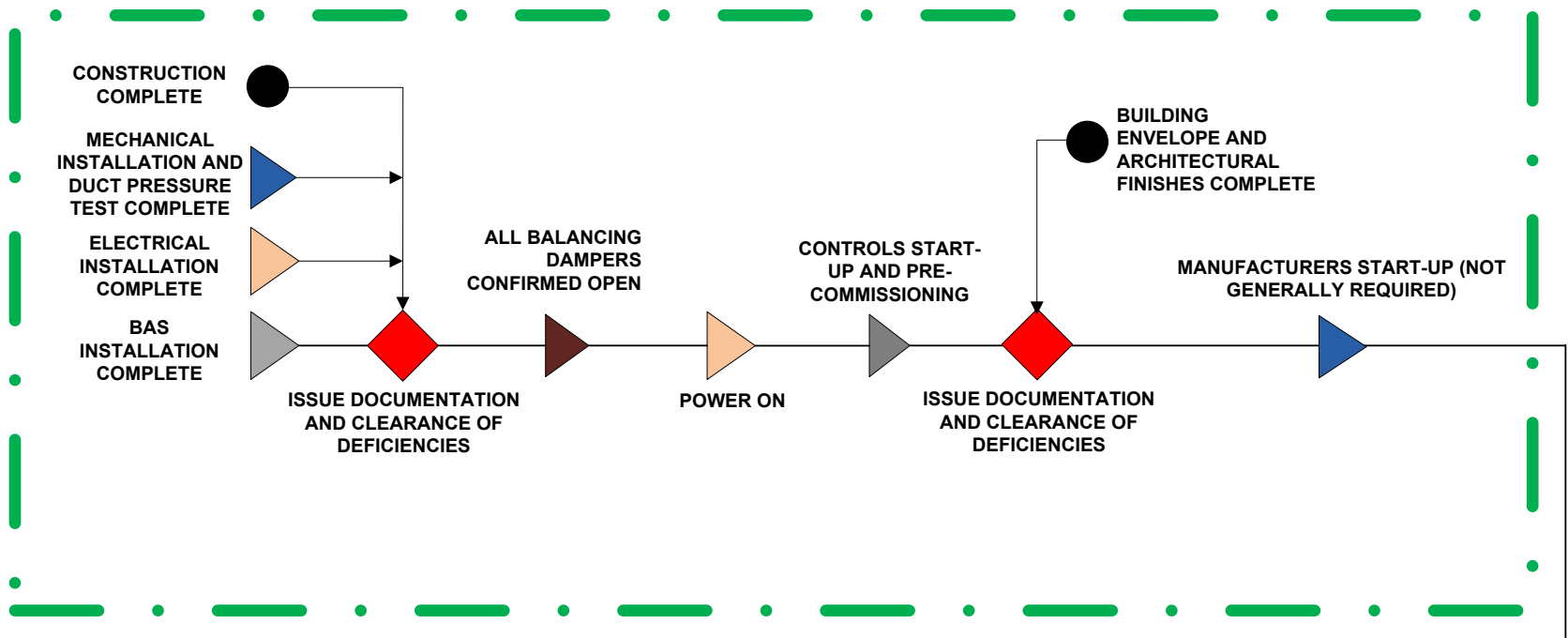
SYSTEM VERIFICATION  
GRAPHICS AND FIELD

AHU AVAILABLE FOR  
INTEGRATED  
BUILDING TESTING  
(IBT)

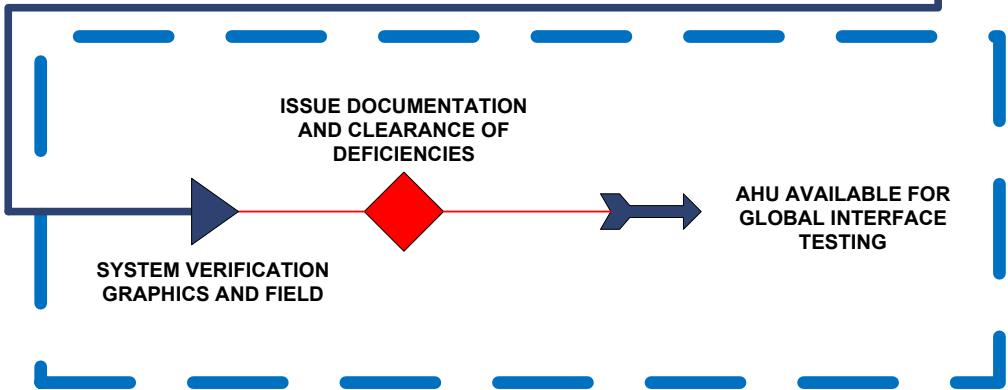


TYPICAL EXHAUST FAN COMMISSIONING PROCESS DIAGRAM

CONTRACTORS CONSTRUCTION PHASE



CONTRACTORS COMMISSIONING AFTER DUST FREE DATE

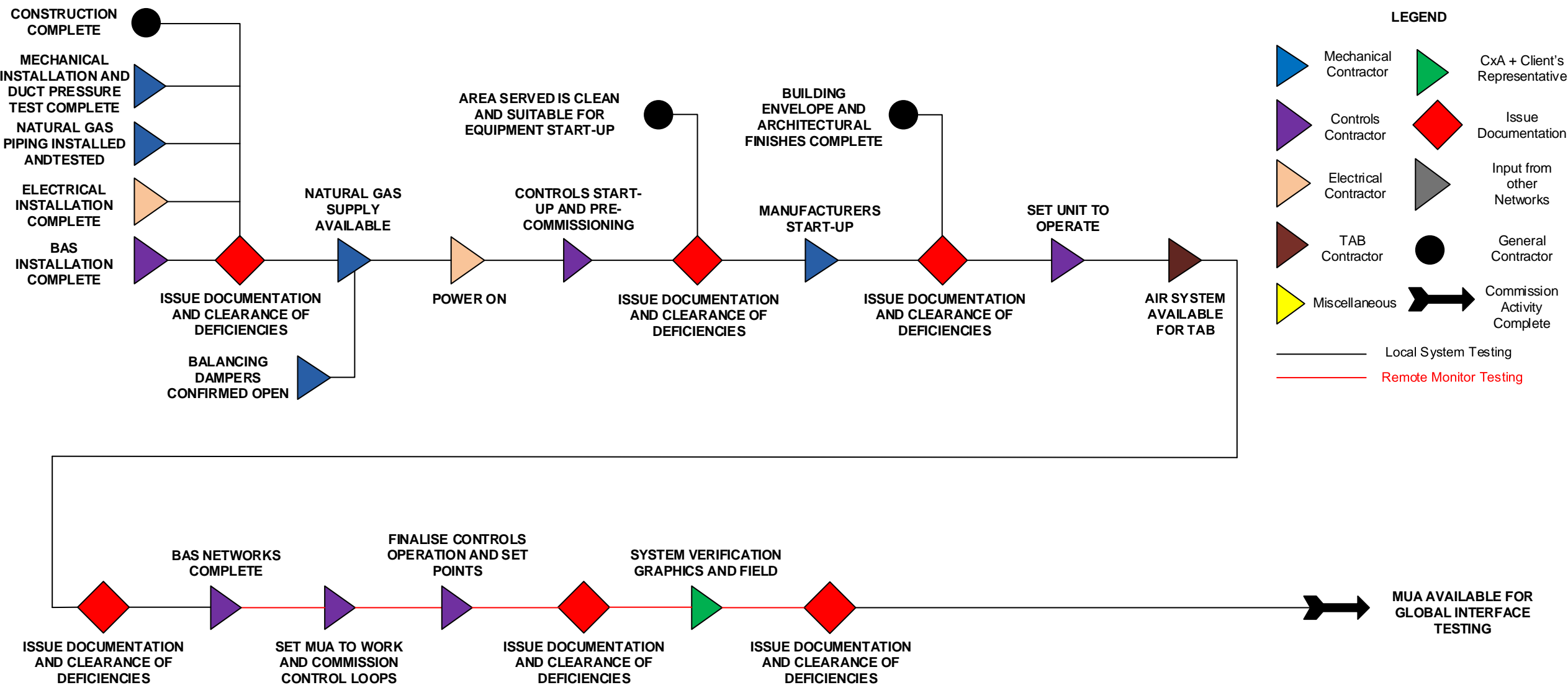


CDML VERIFICATION & TESTING PHASE

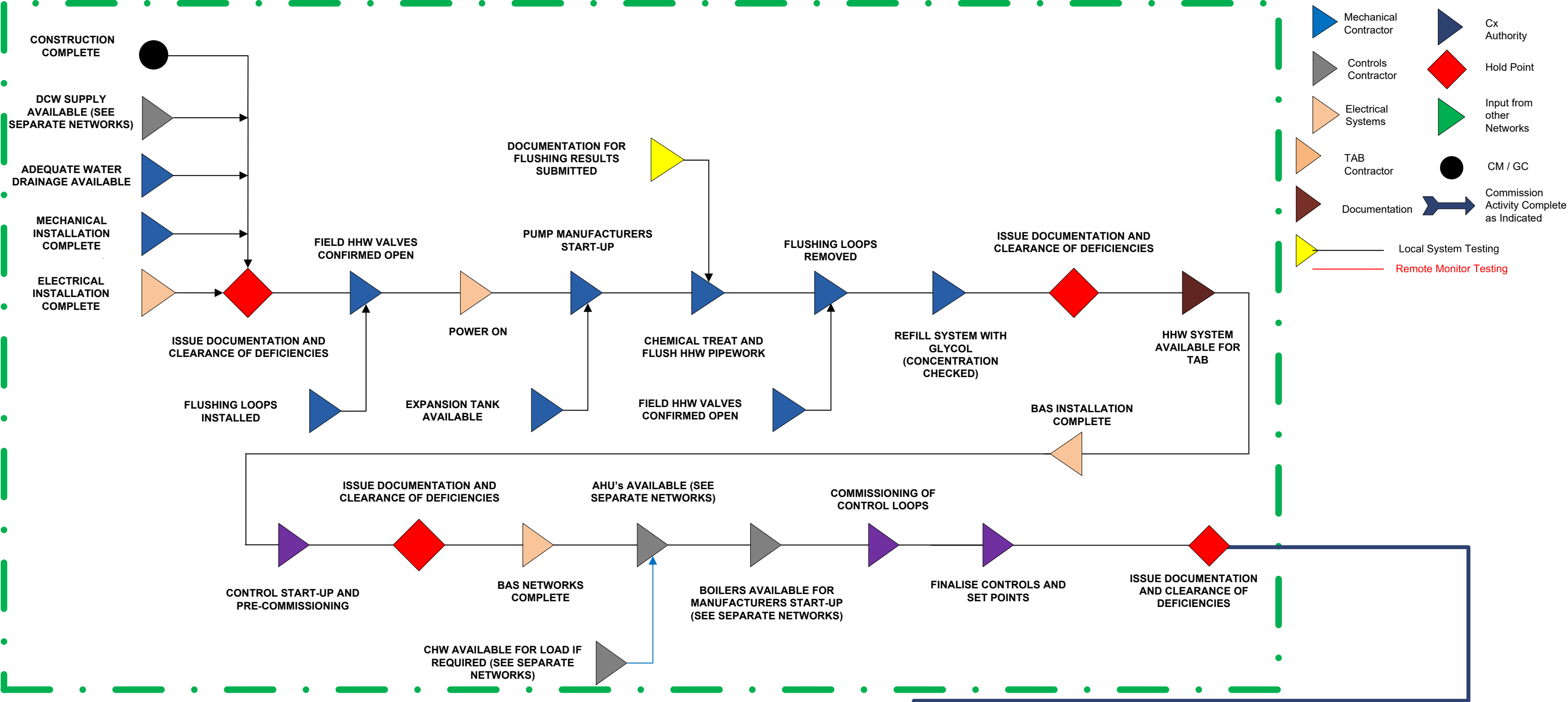




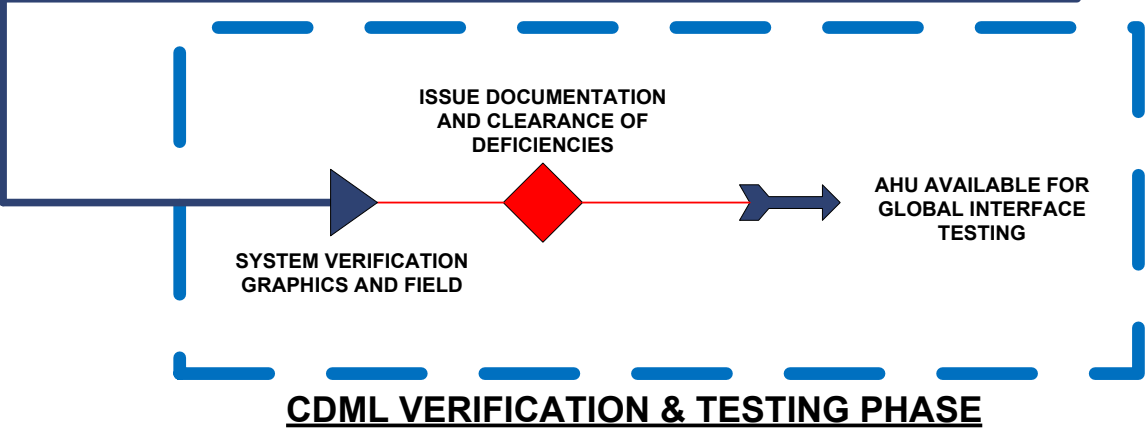
# Make Up Air Unit (MUA) Cx Network



CONTRACTOR'S COMMISSIONING PHASE



TYPICAL HEATING WATER SYSTEM COMMISSIONING PROCESS DIAGRAM



# **APPENDIX C**

## **CONTRACTOR EQUIPMENT**

### **CX TRACKING SHEET**



# APPENDIX D

## COMMISSIONING ISSUES LOG

# Commissioning Issues Log



REVISION: 1

PROJECT:

DATE: 2016-10-07

BUILDING OWNER:

REPORT BY: Dean Willows

The aim of this commissioning issues log is to track commissioning related issues and their resolution noted during the course of the project.

OPEN ITEMS: 5

CLOSED ITEMS: 0

TOTAL ITEMS: 5

ACTION CODE:

MC - HVAC/Mech Contractor  
FS - Fire/Sprinkler Contractor  
DT - Design Team  
ES - Equipment Supplier

CC - Controls Contractor  
PC - Plumbing Contractor  
SC - Security Contractor  
CL - Client

GC - General Contractor  
EC - Electrical Contractor  
DC - Data Contractor

Item Priority: A - High, B - Medium, C - Low

Item	Document Reference	Action	Date Noted	Deficiency / Issue Description	Priority	Recommended Action or Action Taken	Date Resolved	Status	Comment
1									
2									
3									
4									
5									

## Limits of Liability

The review of these documents was of a visual nature only. No load or design calculations were verified. The material in this report reflects our best judgment in light of the information available to us at the time of preparation. All responsibility for the design lies with the engineer or engineers of record, not with CDML.

This report has been prepared for the sole benefit of Client. The contents of this report may not be quoted in whole or in part distributed to any person or entity other than by the Client of those parties possessing a reliance letter. CDML accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or

# **APPENDIX E**

## **CONSTRUCTION INSTALLATION**

### **CHECK SHEETS**

# PUMP

## PART A: INSTALLATION CHECKSHEET



<b>Project:</b>	
<b>Equipment Tag:</b>	<b>Equipment Description:</b>
<b>Location:</b>	<b>System/Area Served:</b>

Item	Cx Comment	Contractor Site Review
Manufacturer*	Contractor submitted shop drawing is consistent with design documentation and/or the Owner Project Requirements (OPR).	Delivered equipment matches the reviewed shop drawing submission.  <input type="checkbox"/> Yes
Model*		
Flow Rates L/S or GPM*		
Head Kpa or Ft*		
*Specific detailed data is available in Design Documents, Shop Drawing Submissions, TAB Reports, O&M's and on Automation System		

CHECKS	APPLICABLE/ COMPLETE	NOT APPLICABLE	COMMENT
Pump: matches shop drawing, all packing & shipping material removed, free of shipping damage.	<input type="checkbox"/>	<input type="checkbox"/>	
Pump installed to Manufacturers recommendations	<input type="checkbox"/>	<input type="checkbox"/>	
All maintenance access requirements met	<input type="checkbox"/>	<input type="checkbox"/>	
Approved Electrical isolation installed	<input type="checkbox"/>	<input type="checkbox"/>	
Vibration Isolators checked	<input type="checkbox"/>	<input type="checkbox"/>	
Condensate/Safe trays fitted and drains connected to waste	<input type="checkbox"/>	<input type="checkbox"/>	
Condensate/Safe trays drains tested	<input type="checkbox"/>	<input type="checkbox"/>	
System Pipework installation complete	<input type="checkbox"/>	<input type="checkbox"/>	
System Pipework pressure test requirements met.	<input type="checkbox"/>	<input type="checkbox"/>	
Pipework Thermal insulation complete.	<input type="checkbox"/>	<input type="checkbox"/>	
Pipework flushing and treatment complete	<input type="checkbox"/>	<input type="checkbox"/>	
Strainers and side stream filters clean	<input type="checkbox"/>	<input type="checkbox"/>	



# PUMP

## PART A: INSTALLATION CHECKSHEET



CHECKS	APPLICABLE/ COMPLETE	NOT APPLICABLE	COMMENT
System drained and filled with Glycol	<input type="checkbox"/>	<input type="checkbox"/>	
Glycol concentration confirmed as per the specification	<input type="checkbox"/>	<input type="checkbox"/>	
System static pressure set point confirmed	<input type="checkbox"/>	<input type="checkbox"/>	
Expansion Tank pressure set to system pressure and open to the system	<input type="checkbox"/>	<input type="checkbox"/>	
Pressure gauges and thermometers installed	<input type="checkbox"/>	<input type="checkbox"/>	
BAS wiring complete	<input type="checkbox"/>	<input type="checkbox"/>	
Electrical wiring complete and tested.	<input type="checkbox"/>	<input type="checkbox"/>	
Equipment labels and valve tags installed	<input type="checkbox"/>	<input type="checkbox"/>	
Pipe identification labels installed	<input type="checkbox"/>	<input type="checkbox"/>	

General Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Mechanical Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Electrical Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

BAS Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Cx Authority: \_\_\_\_\_ Date: \_\_\_\_\_

Comments:

# PUMP

## PART B: START-UP CHECKSHEET



**INTENT: To verify the start-up of systems prior to functional performance tests**

<i>CHECKS</i>	<i>INITIALS</i>	<i>COMMENTS</i>
Pump system installation check sheet signed off		
Power available to the Pump		
BAS controls power available		
BAS point to point complete		
Manufacturer start-up complete.		
TAB hydronic balancing complete.		
BAS controls commissioning complete.		
Approved Sequence of Operation available		

**General Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Mechanical Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Electrical Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**BAS Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Cx Authority:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Comment:**

# ROOF TOP UNIT (RTU) PART A: INSTALLATION CHECKSHEET



<b>Project:</b>	
<b>Equipment Tag:</b>	<b>Equipment Description: ROOF TOP UNIT</b>
<b>Location:</b>	<b>System/Area Served:</b>

Item	Cx Comment	Contractor Site Review
Manufacturer*	Contractor submitted shop drawing is consistent with design documentation and/or the Owner Project Requirements (OPR).	Delivered equipment matches the reviewed shop drawing submission.  <input type="checkbox"/> Yes
Model*		
Cooling Capacity *		
Heating Capacity *		
Fan Volume*		
Fan Static Pressure*		
*Specific detailed data is available in Design Documents, Shop Drawing Submissions, TAB Reports, O&M's and on Automation System		

CHECKS	APPLICABLE/ COMPLETE	NOT APPLICABLE	COMMENT
Unit installed to Manufacturers recommendations	<input type="checkbox"/>	<input type="checkbox"/>	
All maintenance access requirements met	<input type="checkbox"/>	<input type="checkbox"/>	
Approved Electrical isolation installed	<input type="checkbox"/>	<input type="checkbox"/>	
Unit Transit bolts removed	<input type="checkbox"/>	<input type="checkbox"/>	
Supply fan drive assembly checked i.e. belt tension, lubrication, guards etc.	<input type="checkbox"/>	<input type="checkbox"/>	
Return fan drive assembly checked i.e. belt tension, lubrication, guards etc.	<input type="checkbox"/>	<input type="checkbox"/>	
Unit Interior/Exterior as new condition, clean and free of debris	<input type="checkbox"/>	<input type="checkbox"/>	
Evaporator/Condenser Coils as new condition	<input type="checkbox"/>	<input type="checkbox"/>	
Condenser Coil Protection/Louvre installed	<input type="checkbox"/>	<input type="checkbox"/>	
Supply/Return air filters installed and clean	<input type="checkbox"/>	<input type="checkbox"/>	
Temporary air filter media installed and clean	<input type="checkbox"/>	<input type="checkbox"/>	

# ROOF TOP UNIT (RTU) PART A: INSTALLATION CHECKSHEET



CHECKS	APPLICABLE/ COMPLETE	NOT APPLICABLE	COMMENT
Gas pipework installed and pressure test requirements achieved	<input type="checkbox"/>	<input type="checkbox"/>	
Gas Supply Available	<input type="checkbox"/>	<input type="checkbox"/>	
Gas Heating assembly complete	<input type="checkbox"/>	<input type="checkbox"/>	
Combustion air available	<input type="checkbox"/>	<input type="checkbox"/>	
Flue installation meets manufacturers requirements	<input type="checkbox"/>	<input type="checkbox"/>	
All duct connections complete and sealed to unit	<input type="checkbox"/>	<input type="checkbox"/>	
System ductwork and thermal insulation complete	<input type="checkbox"/>	<input type="checkbox"/>	
System ductwork Pressure test requirements achieved	<input type="checkbox"/>	<input type="checkbox"/>	
System ductwork cleaning Complete	<input type="checkbox"/>	<input type="checkbox"/>	
Smoke/Fire damper drop test performed, documentation available	<input type="checkbox"/>	<input type="checkbox"/>	
Pressure gauges and thermometers installed	<input type="checkbox"/>	<input type="checkbox"/>	
Condensate pipework and trap installation complete.	<input type="checkbox"/>	<input type="checkbox"/>	
Condensate drain tested	<input type="checkbox"/>	<input type="checkbox"/>	
BAS wiring complete	<input type="checkbox"/>	<input type="checkbox"/>	
Electrical wiring complete and tested.	<input type="checkbox"/>	<input type="checkbox"/>	
Duct smoke detectors installed	<input type="checkbox"/>	<input type="checkbox"/>	
Equipment labels and valve tags installed	<input type="checkbox"/>	<input type="checkbox"/>	
Pipe and duct identification labels installed	<input type="checkbox"/>	<input type="checkbox"/>	

# ROOF TOP UNIT (RTU) PART A: INSTALLATION CHECKSHEET



General Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Mechanical Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Electrical Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

BAS Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Cx Authority: \_\_\_\_\_ Date: \_\_\_\_\_

Comments:

# ROOF TOP UNIT (RTU) PART B: START-UP CHECKSHEET



**INTENT: To verify the start-up of systems prior to functional performance tests**

<i>CHECKS</i>	<i>INITIALS</i>	<i>COMMENTS</i>
RTU system installation check sheet signed off		
Uninterrupted gas supply available		
Power available to the RTU		
BAS controls power available		
BAS point to point complete including high level interface		
Manufacturer start-up complete and documentation available		
TAB air balancing complete		
BAS controls commissioning complete		
Approved Sequence of Operation available		

**General Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Mechanical Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Electrical Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**BAS Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Cx Authority:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Comment:**

# MAKE UP AIR UNIT (MUA)

## PART A: INSTALLATION CHECKSHEET



<b>Project:</b>	
<b>Equipment Tag:</b>	<b>Equipment Description: MAKE UP AIR UNIT</b>
<b>Location:</b>	<b>System/Area Served:</b>

Item	Cx Comment	Contractor Site Review
Manufacturer*	Contractor submitted shop drawing is consistent with design documentation and/or the Owner Project Requirements (OPR).	Delivered equipment matches the reviewed shop drawing submission.  <input type="checkbox"/> Yes
Model*		
Heating Capacity *		
Fan Volume*		
Fan Static Pressure*		
*Specific detailed data is available in Design Documents, Shop Drawing Submissions, TAB Reports, O&M's and on Automation System		

CHECKS	APPLICABLE/ COMPLETE	NOT APPLICABLE	COMMENT
Unit installed to Manufacturers recommendations	<input type="checkbox"/>	<input type="checkbox"/>	
All maintenance access requirements met	<input type="checkbox"/>	<input type="checkbox"/>	
Approved Electrical isolation installed	<input type="checkbox"/>	<input type="checkbox"/>	
Unit Transit bolts removed	<input type="checkbox"/>	<input type="checkbox"/>	
Fan drive assemblies checked i.e. belt tension, lubrication, guards etc.	<input type="checkbox"/>	<input type="checkbox"/>	
Unit Interior/Exterior as new condition, clean and free of debris	<input type="checkbox"/>	<input type="checkbox"/>	
Air filters installed Summer/Winter position and clean	<input type="checkbox"/>	<input type="checkbox"/>	
Temporary air filter media installed and clean	<input type="checkbox"/>	<input type="checkbox"/>	
Heating Coils as new condition	<input type="checkbox"/>	<input type="checkbox"/>	
Drainage pipework, trap installation complete and tested	<input type="checkbox"/>	<input type="checkbox"/>	
Motorized Valves installed and wired HTG / CHG	<input type="checkbox"/>	<input type="checkbox"/>	
Gas pipework installed and pressure test requirements achieved	<input type="checkbox"/>	<input type="checkbox"/>	

# MAKE UP AIR UNIT (MUA)

## PART A: INSTALLATION CHECKSHEET



CHECKS	APPLICABLE/ COMPLETE	NOT APPLICABLE	COMMENT
Gas Supply Available	<input type="checkbox"/>	<input type="checkbox"/>	
Gas Heating assembly complete	<input type="checkbox"/>	<input type="checkbox"/>	
Combustion air available	<input type="checkbox"/>	<input type="checkbox"/>	
Flue installation meets manufacturers requirements	<input type="checkbox"/>	<input type="checkbox"/>	
System ductwork and thermal insulation complete	<input type="checkbox"/>	<input type="checkbox"/>	
System ductwork Pressure test requirements achieved	<input type="checkbox"/>	<input type="checkbox"/>	
System ductwork cleaning Complete	<input type="checkbox"/>	<input type="checkbox"/>	
Motorized Dampers installed and wired.	<input type="checkbox"/>	<input type="checkbox"/>	
Smoke/Fire damper drop test performed, documentation available	<input type="checkbox"/>	<input type="checkbox"/>	
Pressure gauges and thermometers installed	<input type="checkbox"/>	<input type="checkbox"/>	
BAS wiring complete	<input type="checkbox"/>	<input type="checkbox"/>	
Electrical wiring complete and tested.	<input type="checkbox"/>	<input type="checkbox"/>	
All safety interlocks are wired. High Pressure switches, Freeze protection, Smoke sensors, etc.	<input type="checkbox"/>	<input type="checkbox"/>	
Equipment labels and valve tags installed	<input type="checkbox"/>	<input type="checkbox"/>	
Pipe and duct identification labels installed	<input type="checkbox"/>	<input type="checkbox"/>	



# MAKE UP AIR UNIT (MUA)

## PART A: INSTALLATION CHECKSHEET



General Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Mechanical Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Electrical Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

BAS Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Cx Authority: \_\_\_\_\_ Date: \_\_\_\_\_

Comments:

# MAKE UP AIR UNIT UNIT (MUA)

## PART B: START-UP CHECKSHEET



**INTENT: To verify the start-up of systems prior to functional performance tests**

CHECKS	INITIALS	COMMENTS
MUA system installation check sheet signed off		
Uninterrupted gas supply available		
Heating Glycol/Water supply available and correct temperature		
Power available to the MUA		
BAS controls power available		
BAS point to point complete including high level interface		
Manufacturer start-up complete and documentation available		
TAB air and hydronic balancing complete		
BAS controls commissioning complete		
Approved Sequence of Operation available		

**General Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Mechanical Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Electrical Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**BAS Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Cx Authority:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Comment:**

# AIR HANDLING UNIT (AHU) Dx COOLING PART A: INSTALLATION CHECKSHEET



<b>Project:</b>	
<b>Equipment Tag:</b>	<b>Equipment Description: AHU-Direct Expansion Cooling</b>
<b>Location:</b>	<b>System/Area Served:</b>

Item	Cx Comment	Contractor Site Review
Manufacturer*	Contractor submitted shop drawing is consistent with design documentation and/or the Owner Project Requirements (OPR).	Delivered equipment matches the reviewed shop drawing submission.  <input type="checkbox"/> Yes
Model*		
Cooling Capacity *		
Heating Capacity *		
Fan Volume*		
Fan Static Pressure*		
Condensing Unit Low Ambient Kit*		
*Specific detailed data is available in Design Documents, Shop Drawing Submissions, TAB Reports, O&M's and on Automation System		

CHECKS	APPLICABLE/ COMPLETE	NOT APPLICABLE	COMMENT
Outdoor Unit installed to Manufacturers recommendations	<input type="checkbox"/>	<input type="checkbox"/>	
Indoor Unit installed to Manufacturers recommendations	<input type="checkbox"/>	<input type="checkbox"/>	
All maintenance access requirements met	<input type="checkbox"/>	<input type="checkbox"/>	
Approved Electrical isolation installed	<input type="checkbox"/>	<input type="checkbox"/>	
Indoor/Outdoor Unit Transit bolts removed	<input type="checkbox"/>	<input type="checkbox"/>	
Indoor/Outdoor Units clean and free of debris	<input type="checkbox"/>	<input type="checkbox"/>	
Indoor Unit Heating/Outdoor Unit Condensing coils combed	<input type="checkbox"/>	<input type="checkbox"/>	
Outdoor Unit Condenser Coil hail protection fitted	<input type="checkbox"/>	<input type="checkbox"/>	
Indoor Unit Clean Filters installed	<input type="checkbox"/>	<input type="checkbox"/>	
Motorized Valves installed and wired	<input type="checkbox"/>	<input type="checkbox"/>	
Motorized Dampers installed and wired.	<input type="checkbox"/>	<input type="checkbox"/>	

# AIR HANDLING UNIT (AHU) Dx COOLING

## PART A: INSTALLATION CHECKSHEET



CHECKS	APPLICABLE/ COMPLETE	NOT APPLICABLE	COMMENT
All duct connections complete.	<input type="checkbox"/>	<input type="checkbox"/>	
System ductwork installation complete	<input type="checkbox"/>	<input type="checkbox"/>	
System ductwork Pressure test requirements achieved.	<input type="checkbox"/>	<input type="checkbox"/>	
System ductwork cleaning Complete	<input type="checkbox"/>	<input type="checkbox"/>	
Ductwork Thermal insulation complete.	<input type="checkbox"/>	<input type="checkbox"/>	
Pressure gauges and thermometers installed	<input type="checkbox"/>	<input type="checkbox"/>	
Work will be completed per Environmental Management of Halocarbons - INTERNAL SERVICES DIRECTIVE 318-4 found in the specification.	<input type="checkbox"/>	<input type="checkbox"/>	
Refrigeration pipework installed and leak tested (document pressure and duration)	<input type="checkbox"/>	<input type="checkbox"/>	
Refrigeration system Evacuation test (document micron level achieved and duration)	<input type="checkbox"/>	<input type="checkbox"/>	
Refrigeration system pre-charged after evacuation	<input type="checkbox"/>	<input type="checkbox"/>	
Heating pipework connected	<input type="checkbox"/>	<input type="checkbox"/>	
Heating pipework Pressure test requirements met	<input type="checkbox"/>	<input type="checkbox"/>	
Condensate pipework and trap installation complete.	<input type="checkbox"/>	<input type="checkbox"/>	
Condensate drain tested	<input type="checkbox"/>	<input type="checkbox"/>	
BAS wiring complete	<input type="checkbox"/>	<input type="checkbox"/>	
Electrical wiring complete and tested.	<input type="checkbox"/>	<input type="checkbox"/>	

# AIR HANDLING UNIT (AHU) Dx COOLING

## PART A: INSTALLATION CHECKSHEET



CHECKS	APPLICABLE/ COMPLETE	NOT APPLICABLE	COMMENT
All safety interlocks are wired. High Pressure switches, Freeze protection, smoke sensors, etc.	<input type="checkbox"/>	<input type="checkbox"/>	
Equipment labels and valve tags installed	<input type="checkbox"/>	<input type="checkbox"/>	
Pipe and duct identification labels installed	<input type="checkbox"/>	<input type="checkbox"/>	

General Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Mechanical Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Electrical Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

BAS Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Cx Authority: \_\_\_\_\_ Date: \_\_\_\_\_

Comments:

# AIR HANDLING UNIT (AHU) Dx COOLING

## PART B: START-UP CHECKSHEET



**INTENT: To verify the start-up of systems prior to functional performance tests**

<i>CHECKS</i>	<i>INITIALS</i>	<i>COMMENTS</i>
System installation check sheet signed off		
Power available to the Indoor and Outdoor Units		
BAS controls power available		
BAS point to point complete		
Manufacturer start-up complete		
TAB air and hydronic balancing complete.		
BAS controls commissioning complete.		
Approved Sequence of Operation available		

**General Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Mechanical Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Electrical Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**BAS Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Cx Authority:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Comment:**

# AIR HANDLING UNIT (AHU) PART A: INSTALLATION CHECKSHEET



<b>Project:</b>	
<b>Equipment Tag:</b>	<b>Equipment Description: AIR HANDLING UNIT</b>
<b>Location:</b>	<b>System/Area Served:</b>

Item	Cx Comment	Contractor Site Review
Manufacturer*	Contractor submitted shop drawing is consistent with design documentation and/or the Owner Project Requirements (OPR).	Delivered equipment matches the reviewed shop drawing submission.  <input type="checkbox"/> Yes
Model*		
Cooling Capacity *		
Heating Capacity *		
Fan Volume*		
Fan Static Pressure*		

\*Specific detailed data is available in Design Documents, Shop Drawing Submissions, TAB Reports, O&M's and on Automation System

CHECKS	APPLICABLE/ COMPLETE	NOT APPLICABLE	COMMENT
Unit installed to Manufacturers recommendations	<input type="checkbox"/>	<input type="checkbox"/>	
All maintenance access requirements met	<input type="checkbox"/>	<input type="checkbox"/>	
Approved Electrical isolation installed	<input type="checkbox"/>	<input type="checkbox"/>	
Unit Transit bolts removed	<input type="checkbox"/>	<input type="checkbox"/>	
Fan drive assemblies checked i.e. belt tension, lubrication, guards etc.	<input type="checkbox"/>	<input type="checkbox"/>	
Unit Interior clean and free of debris	<input type="checkbox"/>	<input type="checkbox"/>	
Heating/Cooling coils combed	<input type="checkbox"/>	<input type="checkbox"/>	
Air filters installed Summer/Winter position and clean	<input type="checkbox"/>	<input type="checkbox"/>	
Temporary air filter media installed and clean	<input type="checkbox"/>	<input type="checkbox"/>	
Motorized Valves installed and wired Heating/Cooling	<input type="checkbox"/>	<input type="checkbox"/>	
Motorized Dampers installed and wired.	<input type="checkbox"/>	<input type="checkbox"/>	

# AIR HANDLING UNIT (AHU)

## PART A: INSTALLATION CHECKSHEET



CHECKS	APPLICABLE/ COMPLETE	NOT APPLICABLE	COMMENT
System ductwork installation and connections complete	<input type="checkbox"/>	<input type="checkbox"/>	
System ductwork Pressure test requirements achieved.	<input type="checkbox"/>	<input type="checkbox"/>	
System ductwork cleaning Complete	<input type="checkbox"/>	<input type="checkbox"/>	
Ductwork Thermal insulation complete.	<input type="checkbox"/>	<input type="checkbox"/>	
Smoke/Fire damper drop test performed, documentation available	<input type="checkbox"/>	<input type="checkbox"/>	
Pressure gauges and thermometers installed	<input type="checkbox"/>	<input type="checkbox"/>	
Heating and Cooling pipework connected	<input type="checkbox"/>	<input type="checkbox"/>	
Heating and Cooling Pipework Pressure test requirements met	<input type="checkbox"/>	<input type="checkbox"/>	
Condensate pipework, trap installation complete and tested	<input type="checkbox"/>	<input type="checkbox"/>	
BAS wiring complete	<input type="checkbox"/>	<input type="checkbox"/>	
Electrical wiring complete and tested.	<input type="checkbox"/>	<input type="checkbox"/>	
All safety interlocks are wired. High Pressure switches, Freeze protection, Smoke sensors, etc.	<input type="checkbox"/>	<input type="checkbox"/>	
Equipment labels and valve tags installed	<input type="checkbox"/>	<input type="checkbox"/>	
Pipe and duct identification labels installed	<input type="checkbox"/>	<input type="checkbox"/>	



# AIR HANDLING UNIT (AHU) PART A: INSTALLATION CHECKSHEET



General Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Mechanical Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Electrical Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

BAS Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Cx Authority: \_\_\_\_\_ Date: \_\_\_\_\_

Comments:

# AIR HANDLING UNIT (AHU) PART B: START-UP CHECKSHEET



**INTENT: To verify the start-up of systems prior to functional performance tests**

<b>CHECKS</b>	<b>INITIALS</b>	<b>COMMENTS</b>
AHU system installation check sheet signed off		
Cooling Glycol/Water supply available and correct temperature		
Heating Glycol/Water supply available and correct temperature		
Power available to the AHU		
BAS controls power available		
BAS point to point complete		
Manufacturer start-up complete.		
TAB air and hydronic balancing complete.		
BAS controls commissioning complete.		
Approved Sequence of Operation available		

**General Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Mechanical Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Electrical Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**BAS Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Cx Authority:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Comment:**

# HEATING SYSTEM BOILER

## PART A: INSTALLATION CHECKSHEET



<b>Project:</b>	
<b>Equipment Tag:</b>	<b>Equipment Description:</b>
<b>Location:</b>	<b>System/Area Served:</b>

Item	Cx Comment	Contractor Site Review
Manufacturer*	Contractor submitted shop drawing is consistent with design documentation and/or the Owner Project Requirements (OPR).	Delivered equipment matches the reviewed shop drawing submission.  <input type="checkbox"/> Yes
Model*		
Heating Capacity *		
Flow*		
Head*		
*Specific detailed data is available in Design Documents, Shop Drawing Submissions, TAB Reports, O&M's and on Automation System		

CHECKS	APPLICABLE/ COMPLETE	NOT APPLICABLE	COMMENT
Boiler installed to Manufacturers recommendations	<input type="checkbox"/>	<input type="checkbox"/>	
Factory Test documentation available	<input type="checkbox"/>	<input type="checkbox"/>	
All maintenance access requirements met.	<input type="checkbox"/>	<input type="checkbox"/>	
Approved electrical isolation installed	<input type="checkbox"/>	<input type="checkbox"/>	
Boiler clean and free of damage	<input type="checkbox"/>	<input type="checkbox"/>	
Gas pipework installed and pressure test requirements achieved	<input type="checkbox"/>	<input type="checkbox"/>	
Heating pipework installed and pressure test requirements achieved	<input type="checkbox"/>	<input type="checkbox"/>	
Expansion Tank pressure set to system pressure	<input type="checkbox"/>	<input type="checkbox"/>	
Temperature sensors installed	<input type="checkbox"/>	<input type="checkbox"/>	
Thermometers and gauges installed as per design	<input type="checkbox"/>	<input type="checkbox"/>	
Combustion air available	<input type="checkbox"/>	<input type="checkbox"/>	
Flue installation meets manufacturers requirements	<input type="checkbox"/>	<input type="checkbox"/>	

# HEATING SYSTEM BOILER

## PART A: INSTALLATION CHECKSHEET



CHECKS	APPLICABLE/ COMPLETE	NOT APPLICABLE	COMMENT
Electrical wiring complete and tested	<input type="checkbox"/>	<input type="checkbox"/>	
All safety interlocks are wired. Low water, high temperature, flow switch, etc.	<input type="checkbox"/>	<input type="checkbox"/>	
BAS Control wiring complete.	<input type="checkbox"/>	<input type="checkbox"/>	
Glycol concentration level confirmed	<input type="checkbox"/>	<input type="checkbox"/>	
Equipment labels and valve tags installed	<input type="checkbox"/>	<input type="checkbox"/>	
Pipe identification labels installed	<input type="checkbox"/>	<input type="checkbox"/>	

General Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Mechanical Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Electrical Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

BAS Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Cx Authority: \_\_\_\_\_ Date: \_\_\_\_\_

Comments:

# HEATING SYSTEM BOILER

## PART B: START-UP CHECKSHEET



**INTENT: To verify the start-up of systems prior to functional performance tests**

<b>CHECKS</b>	<b>INITIALS</b>	<b>COMMENTS</b>
Boiler system installation check sheet signed off		
Power available to the boiler		
Gas available and metering operational		
Hydronic system flushed and pumps running		
BAS controls power available		
BAS point to point complete		
Manufacturer start-up complete		
TAB air and hydronic balancing complete		
BAS high level interface points verified		
BAS controls commissioning complete		
Approved sequence of operation available		

**General Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Mechanical Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Electrical Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**BAS Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Cx Authority:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Comment:**

# BUILDING AUTOMATION SYSTEM

## PART A: INSTALLATION CHECKSHEET



**Project:**

**Equipment Description:** BUILDING AUTOMATION SYSTEM

CHECKS	APPLICABLE/ COMPLETE	NOT APPLICABLE	COMMENT
Maintenance access requirements met to panels and doors	<input type="checkbox"/>	<input type="checkbox"/>	
Layout and location of control panels as per drawings	<input type="checkbox"/>	<input type="checkbox"/>	
Duct static pressure sensor located 2/3 down index run	<input type="checkbox"/>	<input type="checkbox"/>	
Hydronic system differential pressure sensors located 2/3 down index run	<input type="checkbox"/>	<input type="checkbox"/>	
Wiring labels attached inside panels	<input type="checkbox"/>	<input type="checkbox"/>	
Location of outdoor sensor on north side out of direct sunlight	<input type="checkbox"/>	<input type="checkbox"/>	
Shielded wiring used on electronic sensors	<input type="checkbox"/>	<input type="checkbox"/>	
Battery/UPS back up available	<input type="checkbox"/>	<input type="checkbox"/>	
Surge suppression available	<input type="checkbox"/>	<input type="checkbox"/>	
Panels properly grounded	<input type="checkbox"/>	<input type="checkbox"/>	
Power available	<input type="checkbox"/>	<input type="checkbox"/>	
Front end graphics available	<input type="checkbox"/>	<input type="checkbox"/>	
BAS control computer location agreed	<input type="checkbox"/>	<input type="checkbox"/>	
Work Station location environment as per manufacturers guidelines	<input type="checkbox"/>	<input type="checkbox"/>	
Control panel identification labels and wire numbers fitted	<input type="checkbox"/>	<input type="checkbox"/>	
Field equipment identification labels and wire numbers fitted	<input type="checkbox"/>	<input type="checkbox"/>	

**General Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Mechanical Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**BAS Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Cx Authority:** \_\_\_\_\_ **Date:** \_\_\_\_\_

# BUILDING AUTOMATION SYSTEM

## PART B: START-UP CHECKSHEET



**INTENT: To verify the start up of systems prior to functional performance tests**

<b>CHECKS</b>	<b>INITIALS</b>	<b>COMMENTS</b>
Approved sequence of operations available		
Equipment controls complete (third party)		
BAS point to point complete and documentation attached		
BAS controls Network complete and all controllers online		
Time schedules have been set to owners requirements		
Correct trends have been set up on all relative points		
Alarm Priorities applied to all relative points		
All sensors/transmitters have been calibrated (pressure/temperature/kw/etc.)		
Flow meters calibration has been coordinated with the balancer		
Remote access to the BMS available		
Remote alarm monitoring operational		

**General Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Mechanical Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**BAS Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Cx Authority:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Comment:**

# DOMESTIC WATER HEATER

## PART A: INSTALLATION CHECKSHEET



<b>Project:</b>	
<b>Equipment Tag:</b>	<b>Equipment Description: DOMESTIC WATER HEATER</b>
<b>Location:</b>	<b>System/Area Served:</b>

Item	Cx Comment	Contractor Site Review
Manufacturer*	Contractor submitted shop drawing is consistent with design documentation and/or the Owner Project Requirements (OPR).	Delivered equipment matches the reviewed shop drawing submission.  <div><input type="checkbox"/> Yes</div>
Model*		
Heating Capacity *		
Recovery Rate*		
*Specific detailed data is available in Design Documents, Shop Drawing Submissions, TAB Reports, O&M's and on Automation System		

CHECKS	APPLICABLE/ COMPLETE	NOT APPLICABLE	COMMENT
DWH installed to Manufacturers recommendations	<input type="checkbox"/>	<input type="checkbox"/>	
All maintenance access requirements met.	<input type="checkbox"/>	<input type="checkbox"/>	
Approved electrical isolation installed	<input type="checkbox"/>	<input type="checkbox"/>	
DWH clean and free of damage	<input type="checkbox"/>	<input type="checkbox"/>	
Gas pipework installed and pressure test requirements achieved	<input type="checkbox"/>	<input type="checkbox"/>	
DHW pipework installation complete and pressure test requirements achieved.	<input type="checkbox"/>	<input type="checkbox"/>	
Recirculation Pumps installed and wired	<input type="checkbox"/>	<input type="checkbox"/>	
System Pressure Relief Valves installed	<input type="checkbox"/>	<input type="checkbox"/>	
Domestic water supply Pressure Regulation Valves installed and set	<input type="checkbox"/>	<input type="checkbox"/>	
Expansion Tank pressure set to system pressure	<input type="checkbox"/>	<input type="checkbox"/>	
Temperature sensors installed	<input type="checkbox"/>	<input type="checkbox"/>	
Thermometers and gauges installed as per design	<input type="checkbox"/>	<input type="checkbox"/>	



# DOMESTIC WATER HEATER PART A: INSTALLATION CHECKSHEET



CHECKS	APPLICABLE/ COMPLETE	NOT APPLICABLE	COMMENT
Combustion air available	<input type="checkbox"/>	<input type="checkbox"/>	
Flue installation meets manufacturers requirements	<input type="checkbox"/>	<input type="checkbox"/>	
DHW Disinfection/Chlorination report available	<input type="checkbox"/>	<input type="checkbox"/>	
Electrical wiring complete and tested	<input type="checkbox"/>	<input type="checkbox"/>	
All safety interlocks are wired. Low water, high temperature, etc.	<input type="checkbox"/>	<input type="checkbox"/>	
BAS Control wiring complete.	<input type="checkbox"/>	<input type="checkbox"/>	
Equipment labels and valve tags installed	<input type="checkbox"/>	<input type="checkbox"/>	
Pipe identification labels installed	<input type="checkbox"/>	<input type="checkbox"/>	

General Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Mechanical Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Electrical Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

BAS Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Cx Authority: \_\_\_\_\_ Date: \_\_\_\_\_

Comments:

# DOMESTIC WATER HEATER PART B: START-UP CHECKSHEET



**INTENT: To verify the start-up of systems prior to functional performance tests**

<i>CHECKS</i>	<i>INITIALS</i>	<i>COMMENTS</i>
DWH system installation check sheet signed off		
Power available to the DWH		
Gas available and metering operational		
Domestic Water Supply Available		
Recirculation Pumps operational		
BAS controls power available		
BAS point to point complete		
Manufacturer start-up complete		
BAS controls commissioning complete		
Approved sequence of operation available		

**General Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Mechanical Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Electrical Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**BAS Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Cx Authority:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Comment:**

# TRANSFER FAN PART A: INSTALLATION CHECKSHEET



<b>Project:</b>	
<b>Equipment Tag:</b>	<b>Equipment Description: TRANSFER FAN</b>
<b>Location:</b>	<b>System/Area Served:</b>

Item	Cx Comment	Contractor Site Review
Manufacturer*	Contractor submitted shop drawing is consistent with design documentation and/or the Owner Project Requirements (OPR).	Delivered equipment matches the reviewed shop drawing submission.  <input type="checkbox"/> Yes
Model*		
Fan Volume*		
Fan Static Pressure*		
*Specific detailed data is available in Design Documents, Shop Drawing Submissions, TAB Reports, O&M's and on Automation System		

CHECKS	APPLICABLE/ COMPLETE	NOT APPLICABLE	COMMENT
Fan installed to Manufacturers recommendations	<input type="checkbox"/>	<input type="checkbox"/>	
All maintenance access requirements met	<input type="checkbox"/>	<input type="checkbox"/>	
Approved Electrical isolation installed	<input type="checkbox"/>	<input type="checkbox"/>	
Fan Transit bolts removed	<input type="checkbox"/>	<input type="checkbox"/>	
Fan drive assemblies checked i.e. belt tension, lubrication, guards etc.	<input type="checkbox"/>	<input type="checkbox"/>	
Fan Interior clean and free of debris	<input type="checkbox"/>	<input type="checkbox"/>	
Motorized Dampers installed and wired. (if applicable)	<input type="checkbox"/>	<input type="checkbox"/>	
All duct installation and connections complete	<input type="checkbox"/>	<input type="checkbox"/>	
Smoke/Fire damper drop test performed, documentation available	<input type="checkbox"/>	<input type="checkbox"/>	
System ductwork Pressure test requirements achieved	<input type="checkbox"/>	<input type="checkbox"/>	
System ductwork cleaning Complete	<input type="checkbox"/>	<input type="checkbox"/>	
Ductwork Thermal insulation complete	<input type="checkbox"/>	<input type="checkbox"/>	

# TRANSFER FAN PART A: INSTALLATION CHECKSHEET



CHECKS	APPLICABLE/ COMPLETE	NOT APPLICABLE	COMMENT
BAS wiring complete	<input type="checkbox"/>	<input type="checkbox"/>	
Electrical wiring complete and tested.	<input type="checkbox"/>	<input type="checkbox"/>	
Equipment labels installed	<input type="checkbox"/>	<input type="checkbox"/>	
Duct identification labels installed	<input type="checkbox"/>	<input type="checkbox"/>	

General Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Mechanical Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Electrical Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

BAS Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Cx Authority: \_\_\_\_\_ Date: \_\_\_\_\_

Comments:

# TRANSFER FAN PART B: START-UP CHECKSHEET



**INTENT: To verify the start-up of systems prior to functional performance tests**

<i>CHECKS</i>	<i>INITIALS</i>	<i>COMMENTS</i>
Transfer Fan installation check sheet signed off		
Power available to the Transfer Fan		
BAS controls power available		
BAS point to point complete		
Manufacturer start-up complete.		
TAB air balancing complete.		
BAS controls commissioning complete.		
Approved Sequence of Operation available		

**General Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Mechanical Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Electrical Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**BAS Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Cx Authority:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Comment:**

# EXHAUST VENTILATION FAN PART A: INSTALLATION CHECKSHEET



<b>Project:</b>	
<b>Equipment Tag:</b>	<b>Equipment Description: EXHAUST VENTILATION FAN</b>
<b>Location:</b>	<b>System/Area Served:</b>

Item	Cx Comment	Contractor Site Review
Manufacturer*	Contractor submitted shop drawing is consistent with design documentation and/or the Owner Project Requirements (OPR).	Delivered equipment matches the reviewed shop drawing submission.  <input type="checkbox"/> Yes
Model*		
Fan Volume*		
Fan Static Pressure*		
*Specific detailed data is available in Design Documents, Shop Drawing Submissions, TAB Reports, O&M's and on Automation System		

CHECKS	APPLICABLE/ COMPLETE	NOT APPLICABLE	COMMENT
Fan installed to Manufacturers recommendations	<input type="checkbox"/>	<input type="checkbox"/>	
All maintenance access requirements met	<input type="checkbox"/>	<input type="checkbox"/>	
Approved Electrical isolation installed	<input type="checkbox"/>	<input type="checkbox"/>	
Fan Transit bolts removed	<input type="checkbox"/>	<input type="checkbox"/>	
Fan drive assemblies checked i.e. belt tension, lubrication, guards etc.	<input type="checkbox"/>	<input type="checkbox"/>	
Fan Interior clean and free of debris	<input type="checkbox"/>	<input type="checkbox"/>	
Motorized Dampers installed and wired. (if applicable)	<input type="checkbox"/>	<input type="checkbox"/>	
All duct installation and connections complete	<input type="checkbox"/>	<input type="checkbox"/>	
Smoke/Fire damper drop test performed, documentation available	<input type="checkbox"/>	<input type="checkbox"/>	
System ductwork Pressure test requirements achieved.	<input type="checkbox"/>	<input type="checkbox"/>	
System ductwork cleaning Complete	<input type="checkbox"/>	<input type="checkbox"/>	
Ductwork Thermal insulation complete.	<input type="checkbox"/>	<input type="checkbox"/>	

# EXHAUST VENTILATION FAN PART A: INSTALLATION CHECKSHEET



CHECKS	APPLICABLE/ COMPLETE	NOT APPLICABLE	COMMENT
BAS wiring complete	<input type="checkbox"/>	<input type="checkbox"/>	
Electrical wiring complete and tested.	<input type="checkbox"/>	<input type="checkbox"/>	
Equipment labels installed	<input type="checkbox"/>	<input type="checkbox"/>	
Duct identification labels installed	<input type="checkbox"/>	<input type="checkbox"/>	

General Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Mechanical Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Electrical Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

BAS Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Cx Authority: \_\_\_\_\_ Date: \_\_\_\_\_

Comments:

# EXHAUST VENTILATION FAN PART B: START-UP CHECKSHEET



**INTENT: To verify the start-up of systems prior to functional performance tests**

<b>CHECKS</b>	<b>INITIALS</b>	<b>COMMENTS</b>
Exhaust Fan installation check sheet signed off		
Power available to the Exhaust Fan		
BAS controls power available		
BAS point to point complete		
Manufacturer start-up complete.		
TAB air balancing complete.		
BAS controls commissioning complete.		
Approved Sequence of Operation available		

**General Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Mechanical Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Electrical Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**BAS Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Cx Authority:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Comment:**



# SUPPLY VENTILATION FAN

## PART A: INSTALLATION CHECKSHEET



<b>Project:</b>	
<b>Equipment Tag:</b>	<b>Equipment Description: SUPPLY VENTILATION FAN</b>
<b>Location:</b>	<b>System/Area Served:</b>

Item	Cx Comment	Contractor Site Review
Manufacturer*	Contractor submitted shop drawing is consistent with design documentation and/or the Owner Project Requirements (OPR).	Delivered equipment matches the reviewed shop drawing submission.  <input type="checkbox"/> Yes
Model*		
Heating Capacity *		
Fan Volume*		
Fan Static Pressure*		
*Specific detailed data is available in Design Documents, Shop Drawing Submissions, TAB Reports, O&M's and on Automation System		

CHECKS	APPLICABLE/ COMPLETE	NOT APPLICABLE	COMMENT
Fan installed to Manufacturers recommendations	<input type="checkbox"/>	<input type="checkbox"/>	
All maintenance access requirements met	<input type="checkbox"/>	<input type="checkbox"/>	
Approved Electrical isolation installed	<input type="checkbox"/>	<input type="checkbox"/>	
Fan Transit bolts removed	<input type="checkbox"/>	<input type="checkbox"/>	
Fan drive assemblies checked i.e. belt tension, lubrication, guards etc.	<input type="checkbox"/>	<input type="checkbox"/>	
Fan Interior clean and free of debris	<input type="checkbox"/>	<input type="checkbox"/>	
Motorized Valves installed and wired Heating Coil	<input type="checkbox"/>	<input type="checkbox"/>	
Motorized Dampers installed and wired. (if applicable)	<input type="checkbox"/>	<input type="checkbox"/>	
All duct installation and connections complete	<input type="checkbox"/>	<input type="checkbox"/>	
Smoke/Fire damper drop test performed, documentation available	<input type="checkbox"/>	<input type="checkbox"/>	
System ductwork Pressure test requirements achieved.	<input type="checkbox"/>	<input type="checkbox"/>	
System ductwork cleaning Complete	<input type="checkbox"/>	<input type="checkbox"/>	

# SUPPLY VENTILATION FAN

## PART A: INSTALLATION CHECKSHEET



CHECKS	APPLICABLE/ COMPLETE	NOT APPLICABLE	COMMENT
Ductwork Thermal insulation complete.	<input type="checkbox"/>	<input type="checkbox"/>	
Pressure gauges and thermometers installed	<input type="checkbox"/>	<input type="checkbox"/>	
Heating pipework connected	<input type="checkbox"/>	<input type="checkbox"/>	
Heating Pipework Pressure test requirements met	<input type="checkbox"/>	<input type="checkbox"/>	
BAS wiring complete	<input type="checkbox"/>	<input type="checkbox"/>	
Electrical wiring complete and tested.	<input type="checkbox"/>	<input type="checkbox"/>	
All safety interlocks are wired. High Pressure switches, Freeze protection, Smoke sensors, etc.	<input type="checkbox"/>	<input type="checkbox"/>	
Equipment labels installed	<input type="checkbox"/>	<input type="checkbox"/>	
Duct identification labels installed	<input type="checkbox"/>	<input type="checkbox"/>	

General Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Mechanical Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Electrical Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

BAS Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Cx Authority: \_\_\_\_\_ Date: \_\_\_\_\_

Comments:

# SUPPLY VENTILATION FAN

## PART B: START-UP CHECKSHEET



**INTENT: To verify the start-up of systems prior to functional performance tests**

<i>CHECKS</i>	<i>INITIALS</i>	<i>COMMENTS</i>
Supply Fan installation check sheet signed off		
Heating Glycol/Water supply available and correct temperature		
Power available to the Supply Fan		
BAS controls power available		
BAS point to point complete		
Manufacturer start-up complete.		
TAB air balancing complete.		
BAS controls commissioning complete.		
Approved Sequence of Operation available		

**General Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Mechanical Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Electrical Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**BAS Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Cx Authority:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Comment:**

# UNIT HEATER PART A: INSTALLATION CHECKSHEET



<b>Project:</b>	
<b>Equipment Tag:</b>	<b>Equipment Description: UNIT HEATER</b>
<b>Location:</b>	

Item	Cx Comment	Contractor Site Review
Manufacturer*	Contractor submitted shop drawing is consistent with design documentation and/or the Owner Project Requirements (OPR).	Delivered equipment matches the reviewed shop drawing submission.  <input type="checkbox"/> Yes
Model*		
Heating Capacity*		
Fan Volume*		
*Specific detailed data is available in Design Documents, Shop Drawing Submissions, TAB Reports, O&M's and on Automation System		

CHECKS	APPLICABLE/ COMPLETE	NOT APPLICABLE	COMMENT
Unit installed to Manufacturers recommendations	<input type="checkbox"/>	<input type="checkbox"/>	
All maintenance access requirements met	<input type="checkbox"/>	<input type="checkbox"/>	
Approved Electrical isolation installed	<input type="checkbox"/>	<input type="checkbox"/>	
Unit Interior clean and free of debris	<input type="checkbox"/>	<input type="checkbox"/>	
Heating coil combed	<input type="checkbox"/>	<input type="checkbox"/>	
Motorized Valves installed and wired	<input type="checkbox"/>	<input type="checkbox"/>	
Heating pipework connected	<input type="checkbox"/>	<input type="checkbox"/>	
Heating pipework Pressure test requirements met	<input type="checkbox"/>	<input type="checkbox"/>	
BAS wiring complete	<input type="checkbox"/>	<input type="checkbox"/>	
Electrical wiring complete and tested.	<input type="checkbox"/>	<input type="checkbox"/>	
Equipment labels and valve tags installed	<input type="checkbox"/>	<input type="checkbox"/>	
Pipe identification labels installed	<input type="checkbox"/>	<input type="checkbox"/>	

# UNIT HEATER PART A: INSTALLATION CHECKSHEET



CHECKS	APPLICABLE/ COMPLETE	NOT APPLICABLE	COMMENT
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General Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Mechanical Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Electrical Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

BAS Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Cx Authority: \_\_\_\_\_ Date: \_\_\_\_\_

Comments:

# UNIT HEATER PART B: START-UP CHECKSHEET



**INTENT: To verify the start-up of systems prior to functional performance tests**

<b>CHECKS</b>	<b>INITIALS</b>	<b>COMMENTS</b>
UH installation check sheet signed off		
Power available to the UH		
BAS controls power available		
BAS point to point complete		
TAB hydronic balancing complete		
BAS controls commissioning complete		
Approved Sequence of Operation available		

**General Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Mechanical Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Electrical Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**BAS Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Cx Authority:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Comment:**

# COMPUTER ROOM AC SYSTEM (CRAC) PART A: INSTALLATION CHECKSHEET



<b>Project:</b>	
<b>Equipment Tag:</b>	<b>Equipment Description: COMPUTER ROOM AC SYSTEM</b>
<b>Location:</b>	<b>System/Area Served:</b>

Item	Cx Comment	Contractor Site Review
Manufacturer*	Contractor submitted shop drawing is consistent with design documentation and/or the Owner Project Requirements (OPR).	Delivered equipment matches the reviewed shop drawing submission.  <div><input type="checkbox"/> Yes</div>
Evaporator & Condenser Model*		
Cooling Capacity *		
Heating Capacity *		
Humidifier Capacity kg/hr*		
Fan Volume*		
Low Ambient Kit*		
*Specific detailed data is available in Design Documents, Shop Drawing Submissions, TAB Reports, O&M's and on Automation System		

CHECKS	APPLICABLE/ COMPLETE	NOT APPLICABLE	COMMENT
Outdoor unit installed to Manufacturers recommendations	<input type="checkbox"/>	<input type="checkbox"/>	
Indoor unit installed to Manufacturers recommendations	<input type="checkbox"/>	<input type="checkbox"/>	
All maintenance access requirements met	<input type="checkbox"/>	<input type="checkbox"/>	
Approved Electrical isolation installed	<input type="checkbox"/>	<input type="checkbox"/>	
Work will be completed per Environmental Management of Halocarbons - INTERNAL SERVICES DIRECTIVE 318-4 found in the specification.	<input type="checkbox"/>	<input type="checkbox"/>	
Refrigeration pipework installed and leak tested (document pressure and duration)	<input type="checkbox"/>	<input type="checkbox"/>	
Refrigeration system Evacuation test (document micron level achieved and duration)	<input type="checkbox"/>	<input type="checkbox"/>	
Refrigeration system pre-charged after evacuation	<input type="checkbox"/>	<input type="checkbox"/>	

# COMPUTER ROOM AC SYSTEM (CRAC) PART A: INSTALLATION CHECKSHEET



CHECKS	APPLICABLE/ COMPLETE	NOT APPLICABLE	COMMENT
Indoor/Outdoor units clean and free of debris	<input type="checkbox"/>	<input type="checkbox"/>	
Softened Domestic Cold Water supply required	<input type="checkbox"/>	<input type="checkbox"/>	
Domestic Cold Water pipework installed and connected	<input type="checkbox"/>	<input type="checkbox"/>	
Back Flow Prevention valve installed	<input type="checkbox"/>	<input type="checkbox"/>	
Clean Filters installed on indoor unit	<input type="checkbox"/>	<input type="checkbox"/>	
Indoor unit condensate pipework installation complete and tested	<input type="checkbox"/>	<input type="checkbox"/>	
Coils combed where necessary	<input type="checkbox"/>	<input type="checkbox"/>	
BAS wiring complete	<input type="checkbox"/>	<input type="checkbox"/>	
Electrical wiring complete and tested.	<input type="checkbox"/>	<input type="checkbox"/>	
Equipment labels and valve tags installed	<input type="checkbox"/>	<input type="checkbox"/>	
Pipe identification labels installed	<input type="checkbox"/>	<input type="checkbox"/>	

General Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Mechanical Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Electrical Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

BAS Contractor: \_\_\_\_\_ Date: \_\_\_\_\_

Cx Authority: \_\_\_\_\_ Date: \_\_\_\_\_

Comments:



# DIRECT EXPANSON SYSTEMS

## PART B: START-UP CHECKSHEET



**INTENT: To verify the start-up of systems prior to functional performance tests**

<i>CHECKS</i>	<i>INITIALS</i>	<i>COMMENTS</i>
Dx System installation check sheet signed off		
Power available to the Indoor and Outdoor units		
Domestic Water Supply Available		
BAS controls power available		
BAS point to point complete		
Manufacturer start-up complete.		
BAS controls commissioning complete.		
Approved Sequence of Operation available		

**General Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Mechanical Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Electrical Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**BAS Contractor:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Cx Authority:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Comment:**

# VAV/CAV TERMINAL AIR BOX

## PART A: INSTALLATION CHECKSHEET



Project:

<b>TERMINAL UNIT TAG</b>										
<b>Manufacturer, Model &amp; Type</b>										
Box Size matches shop drawing										
Box Air Flows match shop drawing										
Straight Duct to box inlet met										
Silencer/Acoustic Duct Installed										
Unit Undamaged										
Unit Supported Correctly										
Identification Tags Visible										
Controls Accessible										
<b>REHEAT COILS</b>										
Coil matches shop drawing										
Piping Correct										
Piping Identified										
Piping Insulated										
Drain Installed										
Air Vent Installed										
Valves Installed										
Access Doors Installed										
<b>OPERATIONAL CHECKS</b>										
Control Valve Operation										
Controls Verified										

CM/GC Representative

Signature

Date

Mechanical Contractors Representative

Signature

Date



# VAV/CAV TERMINAL AIR BOX

## PART A: START-UP CHECKSHEET

Installation Check sheet signed-off & documentation submitted.	
BAS point to point complete & documentation submitted.	
Ductwork cleaning complete & documentation submitted.	
TAB complete & report submitted.	
BAS commissioning complete & documentation submitted.	
Approved Sequence of Operation	
Equipment, controls and valve labelling and identification complete	

CM/GC Representative	Signature	Date
Mechanical Contractors Representative	Signature	Date

# APPENDIX F

## FUNCTIONAL TEST SHEETS

# Make-up Air Unit Functional Performance Sheet



Project: \_\_\_\_\_ System Type: \_\_\_\_\_  
Date: \_\_\_\_\_ System #: \_\_\_\_\_

## Functional Performance Test Sheet Intent:

To verify the operation of the system against the sequence of operation. Including start-up, shutdown, unoccupied, power failure, and interlocks with other equipment, and sensor/actuator calibration.

## Functional Performance Test Sheet Pre-requisites:

Item	Yes	No	Comments
Installation check sheet attached	<input type="checkbox"/>	<input type="checkbox"/>	
Uninterrupted gas supply available	<input type="checkbox"/>	<input type="checkbox"/>	
Air Balancing report attached	<input type="checkbox"/>	<input type="checkbox"/>	
Manufacturer's start up report attached with deficiencies cleared	<input type="checkbox"/>	<input type="checkbox"/>	
Technicians BAS point to point check list attached	<input type="checkbox"/>	<input type="checkbox"/>	
Approved sequence of operation attached	<input type="checkbox"/>	<input type="checkbox"/>	

Deficiencies - Mark "Y" = Yes its operational, installed or complete

"N" = No work not done or not installed

"N/A" = Not Applicable

<b>Static Verification</b> <small>(Some items may not be applicable)</small>	<b>Visual Check</b>							
	Physical Integrity	→	Clear of dirt/debris	<input type="checkbox"/>	Unit Installed correctly	<input type="checkbox"/>	Unit labeled correctly	<input type="checkbox"/>
	Filter condition	→	Temporary Filter Media Fitted			<input type="checkbox"/>	Insulation complete	<input type="checkbox"/>
	Remote items operational	→	Isolation Dampers	<input type="checkbox"/>	Associated Exh Fans	<input type="checkbox"/>		
<b>Dynamic Verification</b> <small>(Some items may not be applicable)</small>	<b>Operational Check</b>							
	TAB Verification	→	O.L Set to motor name plate rating			<input type="checkbox"/>		
			VSD settings based on motor name plate rating			<input type="checkbox"/>		
			Check fan volume & SP @ design conditions				<input type="checkbox"/>	
			Area served by MUA operating at a Positive Pressure				<input type="checkbox"/>	
			Area served by MUA operating at a Negative Pressure				<input type="checkbox"/>	
			Check volume of terminals against TAB Report				<input type="checkbox"/>	
	Hard wire interlocks	→	Freeze Stat	<input type="checkbox"/>	Supply Fan shutdown	<input type="checkbox"/>	Dampers Close	<input type="checkbox"/>
			Fire Alarm	<input type="checkbox"/>	Supply Fan shutdown	<input type="checkbox"/>	BAS Annunciation	<input type="checkbox"/>
			Supply Fan damper interlocks operational			<input type="checkbox"/>	BAS Annunciation	<input type="checkbox"/>
Soft wire interlocks	→	Check default settings on sensors and alarms through BAS				<input type="checkbox"/>		
		Supply Fan Fail	<input type="checkbox"/>	Assoc Exhaust shutdown	<input type="checkbox"/>	BAS Annunciation	<input type="checkbox"/>	
		Exhaust Fan Fail	<input type="checkbox"/>	Supply Fan shutdown	<input type="checkbox"/>	BAS Annunciation	<input type="checkbox"/>	
		Confirm BAS annunciation when fans are operated in hand				<input type="checkbox"/>		

# Make-up Air Unit

## Functional Performance Sheet



<b>Dynamic Verification</b> <small>(Continued)</small>	BAS Commands	→	Check output to VFD's	<input type="checkbox"/>	Check stroke of dampers	<input type="checkbox"/>
		↓				
				Verify system enabled by field demand		<input type="checkbox"/>
				Verify system unoccupied temperature initiated operation of plant		<input type="checkbox"/>
				Check positions of motorized dampers on unit shutdown.		<input type="checkbox"/>
	BAS Control Verification	→	<b>Note:</b> System to be tested against the BAS Sequence of operation, a signed copy of the verified sequence will be provided with this documentation			
			Verify and document differential between supply and Exhaust air flow			<input type="checkbox"/>
			Verify SA temperature control stable at varied set points			<input type="checkbox"/>
			Verify Calibration of all temperature and pressure sensors			<input type="checkbox"/>

Comments:

Further work required:

<b>Contractor</b>	Sign: _____	Print: _____	Date: _____
<b>Cx Authority</b>	Sign: _____	Print: _____	Date: _____

# Air Handling Unit (AHU) with Dx Cooling Functional Performance Sheet



Project: \_\_\_\_\_ System Type: AHU with Direct Expansion Cooling

Date: \_\_\_\_\_ System #: \_\_\_\_\_

## Functional Performance Test Sheet Intent:

To verify the operation of the system against the sequence of operation. Including start-up, shutdown, unoccupied, power failure, and interlocks with other equipment, and sensor/actuator calibration.

## Functional Performance Test Sheet Pre-requisites:

Item	Yes	No	Comments
Installation check sheet attached	<input type="checkbox"/>	<input type="checkbox"/>	
Air Balancing report reviewed	<input type="checkbox"/>	<input type="checkbox"/>	
Hydronic balancing report reviewed	<input type="checkbox"/>	<input type="checkbox"/>	
Manufacturer's start up report attached with deficiencies cleared	<input type="checkbox"/>	<input type="checkbox"/>	
Technicians BAS point to point check list attached	<input type="checkbox"/>	<input type="checkbox"/>	
Approved sequence of operation attached	<input type="checkbox"/>	<input type="checkbox"/>	

**Static Verification**  
(Some items may not be applicable)

**Visual Check**

Physical Integrity → Clear of dirt/debris ☐ Units Installed correctly ☐ Units labeled correctly ☐  
 Drainage Check ☐ Insulation complete ☐

Filter condition → AHU Permanent Filters Fitted ☐  
 Temporary Filter Media Fitted ☐

Remote items operational → Heating Gly/Water ☐ Dx Cooling ☐ Assoc VAV Terminals ☐  
 Humidifier ☐

**Dynamic Verification**  
(Some items may not be applicable)

**Operational Check**

TAB Verification → O.L Set to motor name plate rating ☐  
 VSD settings based on motor name plate rating ☐

Check fan volume & SP @ design conditions ☐  
 Area served by AHU operating at a Positive Pressure ☐  
 Area served by AHU operating at a Negative Pressure ☐  
 Check volume of terminals against TAB Report ☐

Hard wire interlocks → Freeze Stat ☐ Fans shutdown ☐ Dampers Close ☐  
 Dx shutdown ☐ Heating valve fully open ☐ BAS Annunciation ☐

Fire Alarm ☐ Supply/Return shutdown ☐ BAS Annunciation ☐  
 Dx Cooling Alarm ☐ BAS Annunciation ☐

Supply Fan damper interlocks operational ☐  
 Return/Exhaust Fan damper interlocks operational ☐

Soft wire interlocks → Check default settings on sensors and alarms through BAS ☐

Supply Fan Fail ☐ Ret/Exh shutdown ☐ BAS Annunciation ☐  
 Ret/Exh Fan Fail ☐ Supply shutdown ☐ BAS Annunciation ☐  
 Confirm BAS annunciation when fans are operated in hand ☐

# Air Handling Unit (AHU) with Dx Cooling

## Functional Performance Sheet



Dynamic Verification (Continued)	BAS Commands	Check stroke of valves Check output to VFD's	<input type="checkbox"/> <input type="checkbox"/>	Check stroke of dampers Check staging of Dx Cooling	<input type="checkbox"/> <input type="checkbox"/>
		Verify system enabled by field demand Verify system unoccupied temperature initiated operation of plant Check control valve positions on unit shutdown. Check positions of motorized dampers on unit shutdown. Check Dx Cooling is disabled on unit shutdown. Verify Minimum Outside Air Requirements			<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
	BAS Control Verification	<b>Note:</b> System to be tested against the BAS Sequence of operation, a signed copy of the verified sequence will be provided with this documentation			
		Verify SA pressure control stable at varied set points Verify location of the SA static pressure sensors Verify SA static pressure sensor is not Network based Verify and document differential between supply and exhaust air flow Verify SA temperature control stable at varied set points Verify Humidity control stable at varied set points Verify Economy Cycle operation of dampers Verify Calibration of all temperature and pressure sensors		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	

Comments:

Further work required:

Contractor	Sign:	Print:	Date:
Cx Authority	Sign:	Print:	Date:



# Air Handling Unit (AHU)

## Functional Performance Sheet



Project: \_\_\_\_\_ System Type: Variable Volume with VAV Terminals

Date: \_\_\_\_\_ System #: \_\_\_\_\_

### Functional Performance Test Sheet Intent:

To verify the operation of the system against the sequence of operation. Including start-up, shutdown, unoccupied, power failure, and interlocks with other equipment, and sensor/actuator calibration.

### Functional Performance Test Sheet Pre-requisites:

Item	Yes	No	Comments
Installation check sheet attached	<input type="checkbox"/>	<input type="checkbox"/>	
Air Balancing report reviewed	<input type="checkbox"/>	<input type="checkbox"/>	
Hydronic balancing report reviewed	<input type="checkbox"/>	<input type="checkbox"/>	
Manufacturer's start up report attached with deficiencies cleared	<input type="checkbox"/>	<input type="checkbox"/>	
Technicians BAS point to point check list attached	<input type="checkbox"/>	<input type="checkbox"/>	
Approved sequence of operation attached	<input type="checkbox"/>	<input type="checkbox"/>	

**Static Verification**  
(Some items may not be applicable)

**Visual Check**

Physical Integrity → Clear of dirt/debris ☐ Unit Installed correctly ☐ Unit labeled correctly ☐  
 Drainage Check ☐ Insulation complete ☐

Filter condition → AHU Permanent Filters Fitted ☐  
 Temporary Filter Media Fitted ☐

Remote items operational → Heating Glycol ☐ Chilled Glycol ☐ Fan Coil Units ☐  
 Assoc VAV Terminals ☐ Humidifier ☐

**Dynamic Verification**  
(Some items may not be applicable)

**Operational Check**

TAB Verification → O.L Set to motor name plate rating ☐  
 VSD settings based on motor name plate rating ☐

Check fan volume & SP @ design conditions ☐  
 Area served by AHU operating at a Positive Pressure ☐  
 Area served by AHU operating at a Negative Pressure ☐  
 Check volume of terminals against TAB Report ☐

Hard wire interlocks → Freeze Stat ☐ Fans shutdown ☐ Dampers Close ☐  
 Heating coil fully open ☐ BAS Annunciation ☐

Fire Alarm ☐ Supply/Return shutdown ☐ BAS Annunciation ☐

Supply Fan damper interlocks operational ☐  
 Return/Exhaust Fan damper interlocks operational ☐

Soft wire interlocks → Check default settings on sensors and alarms through BAS ☐

Supply Fan Fail ☐ Ret/Exh shutdown ☐ BAS Annunciation ☐  
 Ret/Exh Fan Fail ☐ Supply shutdown ☐ BAS Annunciation ☐  
 Confirm BAS annunciation when fans are operated in hand ☐

# Air Handling Unit (AHU)

## Functional Performance Sheet



Dynamic Verification (Continued)	BAS Commands	Check stroke of valves Check output to VFD's	<input type="checkbox"/> Check stroke of dampers <input type="checkbox"/> Heat Wheel Control	<input type="checkbox"/> <input type="checkbox"/>
		Verify system enabled by field demand Verify system unoccupied temperature initiated operation of plant Check control valve positions on unit shutdown. Check positions of motorized dampers on unit shutdown. Verify Minimum Outside Air Requirements		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
	BAS Control Verification	<b>Note:</b> System to be tested against the BAS Sequence of operation, a signed copy of the verified sequence will be provided with this documentation		
		Verify SA pressure control stable at varied set points Verify location of the SA static pressure sensors Verify SA static pressure sensor is not Network based Verify and document differential between supply and exhaust air flow Verify SA temperature control stable at varied set points Verify Humidity control stable at varied set points Verify Economy Cycle operation of dampers Verify Heat Wheel is the first stage of heating/cooling based on RA temp Verify Calibration of all temperature and pressure sensors	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	

Comments:

Further work required:

Contractor	Sign:	Print:	Date:
Cx Authority	Sign:	Print:	Date:

# Heating Water/Glycol Boiler Functional Performance Sheet



Project: \_\_\_\_\_ System Type: Heating Water/Glycol Boiler  
Date: \_\_\_\_\_ System #: \_\_\_\_\_

## Functional Performance Test Sheet Intent:

*To verify the operation of the system against the sequence of operation. Including start-up, shutdown, unoccupied, power failure, and interlocks with other equipment, and sensor/actuator calibration.*

## Functional Performance Test Sheet Pre-requisites:

Item	Yes	No	Comments
Mechanical room clean and dust free	<input type="checkbox"/>	<input type="checkbox"/>	
Installation check sheet attached	<input type="checkbox"/>	<input type="checkbox"/>	
Uninterrupted gas supply available	<input type="checkbox"/>	<input type="checkbox"/>	
Current pipe work inhibitor adjustment report reviewed	<input type="checkbox"/>	<input type="checkbox"/>	
Glycol concentration level report reviewed	<input type="checkbox"/>	<input type="checkbox"/>	
Hydronic balancing report reviewed	<input type="checkbox"/>	<input type="checkbox"/>	
Manufacturer's start up report attached with deficiencies cleared	<input type="checkbox"/>	<input type="checkbox"/>	
Technicians BAS point to point check list reviewed	<input type="checkbox"/>	<input type="checkbox"/>	
Documented list of Boiler controller interface points with the BAS	<input type="checkbox"/>	<input type="checkbox"/>	
HHG system and Expansion Tank pressure settings confirmed	<input type="checkbox"/>	<input type="checkbox"/>	
Adequate load available to operate Boiler at full capacity	<input type="checkbox"/>	<input type="checkbox"/>	

**Static Verification**  
(Some items may not be applicable)

**Visual Check**

Physical Integrity →

Strainers and Gauges →

Remote items operational →

**Operational Check**

TAB Verification →

Integral Controller →

**Deficiencies - Mark "Y" = Yes its operational, installed or complete**  
**"N" = No work not done or not installed**  
**"N/A" = Not Applicable**

Clear of dirt/debris ☐

Strainers clean ☐

Boiler primary pump operational ☐

Secondary pumping system operational ☐

Neutralization tank installed ☐

O.L Set to motor name plate rating ☐

VSD settings based on motor name plate rating ☐

Document boiler safety valve setting ☐

Check pump volume & SP @ design condition ☐

Check  $\Delta T$  across Boiler at full load against manufacturers requirements ☐

Verify the boiler enables the dedicated pump ☐

Verify boiler temperature control stable at varied Set Points ☐

Verify Integral controller temperature set point reset through the BAS ☐

Verify primary pump run on timer after boiler is shut down ☐

Unit Installed correctly ☐

Gauges correct range ☐

Unit labeled correctly ☐

Insulation complete ☐

# Heating Water/Glycol Boiler

## Functional Performance Sheet



<div>Dynamic Verification</div> <div>(Continued)</div>	<div>Hard wire interlocks</div> <div>↓</div> <div>Soft wire interlocks</div>	<div>→ Fire Alarm</div> <div>→ Check default settings on sensors and alarms through BAS</div>	<div><input type="checkbox"/> System shutdown</div> <div><input type="checkbox"/> BAS Annunciation</div> <div><input type="checkbox"/> BAS Annunciation</div> <div><input type="checkbox"/> BAS Annunciation</div> <div><input type="checkbox"/> Status Mismatch</div>	<div><input type="checkbox"/></div> <div><input type="checkbox"/></div> <div><input type="checkbox"/></div> <div><input type="checkbox"/></div> <div><input type="checkbox"/></div>
		<div>Boiler common fault/shut down</div> <div>Primary pump shuts down on boiler failure</div> <div>Boiler enabled, no increase in supply temperature</div>		
		<div>Pump failure based on flow</div> <div>Run timers on boiler and pump are represented on graphics</div>		
		<div>Verify Calibration of all temperature and pressure sensors</div>		

Comments:

Further work required:

Contractor	Sign:	Print:	Date:
Cx Authority	Sign:	Print:	Date:

# Domestic Water Heating Functional Performance Sheet



System Type: Domestic Water Heating System

Date:

System #:

## Functional Performance Test Sheet Intent:

To verify the operation of the system against the sequence of operation. Including start-up, shutdown, unoccupied, power failure, and interlocks with other equipment, and sensor/actuator calibration.

## Functional Performance Test Sheet Pre-requisites:

Item	Yes	No	Comments
Installation check sheet attached	<input type="checkbox"/>	<input type="checkbox"/>	
Uninterrupted water supply available	<input type="checkbox"/>	<input type="checkbox"/>	
Uninterrupted gas supply available	<input type="checkbox"/>	<input type="checkbox"/>	
Pipe work flushing and treatment report attached	<input type="checkbox"/>	<input type="checkbox"/>	
Hydronic balancing report attached	<input type="checkbox"/>	<input type="checkbox"/>	
Manufacturer's start up report attached with deficiencies cleared	<input type="checkbox"/>	<input type="checkbox"/>	
BMS point to point check list attached	<input type="checkbox"/>	<input type="checkbox"/>	
Approved sequence of operation attached	<input type="checkbox"/>	<input type="checkbox"/>	
DCW system pressure set through PRV (note set point)	<input type="checkbox"/>	<input type="checkbox"/>	
Expansion Vessel pressure set (note set point)	<input type="checkbox"/>	<input type="checkbox"/>	

Deficiencies - Mark "Y" = Yes its operational, installed or complete  
"N" = No work not done or not installed  
"N/A" = Not Applicable

<b>Static Verification</b> <small>(Some items may not be applicable)</small>	<b>Visual Check</b>								
	Physical Integrity	→	Clear of dirt/debris	<input type="checkbox"/>	Sys Installed correctly	<input type="checkbox"/>	Sys labeled correctly	<input type="checkbox"/>	
					Drainage check	<input type="checkbox"/>	Insulation complete	<input type="checkbox"/>	
	Strainers and Gauges	→	Strainers clean	<input type="checkbox"/>	Gauges correct range	<input type="checkbox"/>			
	Connections complete	→	Electrical	<input type="checkbox"/>	BAS installation	<input type="checkbox"/>			
	Remote items operational	→	Pump P-9	<input type="checkbox"/>	Pump P-10	<input type="checkbox"/>	DHW Tank	<input type="checkbox"/>	
<b>Dynamic Verification</b> <small>(Some items may not be applicable)</small>	<b>Operational Check</b>								
	TAB Verification	→	Pump O.L Set to motor nameplate rating	<input type="checkbox"/>					
			Check pumps volume & SP @ design condition						
			Document DHW safety valve setting						
	Soft wire interlocks	→	Pump failure based on flow	<input type="checkbox"/>	Status Mismatch	<input type="checkbox"/>			
				Run timers on pumps are represented on graphics					
				Confirm BAS annunciation when pumps are operated in hand					
				Check default settings on sensors and alarms through BAS					

# Domestic Water Heating

## Functional Performance Sheet



Dynamic Verification (Cont'd)	DWH Integral Controller	→ Verify DWH temperature control stable at varied Set Points	<input type="checkbox"/>
	BAS Control Verification	→ Verify and document Time Schedule operation P9 and P10 Check System Shutdown - Pumps Check System Shutdown - DHW Verify calibration of Temp sensors	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

Comments:

Further work required:

Contractor	Sign:	Print:	Date:
Cx Authority	Sign:	Print:	Date:

# Transfer Fan Functional Performance Sheet



Project: \_\_\_\_\_ System Type: Transfer Fan

Date: \_\_\_\_\_ System #: \_\_\_\_\_

## Functional Performance Test Sheet Intent:

To verify the operation of the system against the sequence of operation. Including start-up, shutdown, unoccupied, power failure, and interlocks with other equipment, and sensor/actuator calibration.

## Functional Performance Test Sheet Pre-requisites:

Item	Yes	No	Comments
Installation check sheet attached	<input type="checkbox"/>	<input type="checkbox"/>	
Air Balancing report reviewed	<input type="checkbox"/>	<input type="checkbox"/>	
Manufacturer's start up report attached with deficiencies cleared	<input type="checkbox"/>	<input type="checkbox"/>	
Technicians BAS point to point check list reviewed	<input type="checkbox"/>	<input type="checkbox"/>	
Approved sequence of operation attached	<input type="checkbox"/>	<input type="checkbox"/>	

Deficiencies (Mark "Y" = Yes its operational, installed or complete or "N" = No work not done or not installed)

<b>Static Verification</b> <small>(Some items may not be applicable)</small>	<b>Visual Check</b>				
	Physical Integrity	→	Clear of dirt/debris <input type="checkbox"/>	Fan Installed correctly <input type="checkbox"/>	Fan labeled correctly <input type="checkbox"/>
	Filter condition	→	Temporary Filter Media Fitted <input type="checkbox"/>	Insulation complete <input type="checkbox"/>	
	Remote items operational	→	Isolation Dampers <input type="checkbox"/>		
<b>Dynamic Verification</b> <small>(Some items may not be applicable)</small>	<b>Operational Check</b>				
	TAB Verification	→	O.L Set <input type="checkbox"/>	VSD settings <input type="checkbox"/>	
			Check fan volumes & SP @ design conditions		<input type="checkbox"/>
			Check volume of terminals against TAB report		<input type="checkbox"/>
	Hard wire interlocks	→	Fire Alarm <input type="checkbox"/>	Fan shutdown <input type="checkbox"/>	BAS Annunciation <input type="checkbox"/>
			Transfer Fan damper interlocks operational		<input type="checkbox"/>
	Soft wire interlocks	→	Check operation of filter alarms on BAS		<input type="checkbox"/>
			Check default settings on sensors and alarms through BAS		<input type="checkbox"/>
	BAS Commands	→	Confirm BAS annunciation when fans are operated in hand		<input type="checkbox"/>
			Check stroke of dampers <input type="checkbox"/>	Check output to VFD's	<input type="checkbox"/>
		Verify and document Time Schedule operation		<input type="checkbox"/>	
		Verify if fan is operated in conjunction with main air handling plant		<input type="checkbox"/>	
		Verify and document unoccupied temperature initiated operation of fan		<input type="checkbox"/>	
		Check System Shutdown		<input type="checkbox"/>	
		Check positions of motorized dampers on fan shutdown.		<input type="checkbox"/>	
	BAS Control Verification	→	Verify fan is enabled by adjustment of Temp Set Point		<input type="checkbox"/>
			Verify and document temperature differential between fan on/off		<input type="checkbox"/>
			Verify transfer fan minimum run time		<input type="checkbox"/>
			Verify calibration of Temp sensors		<input type="checkbox"/>

# Transfer Fan Functional Performance Sheet



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Comments:

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Further work required:

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<b>Contractor</b>	Sign:	Print:	Date:
<b>Cx Authority</b>	Sign:	Print:	Date:

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# Exhaust Fan Functional Performance Sheet



Project: \_\_\_\_\_ System Type: General Exhaust Fan  
 Date: \_\_\_\_\_ System #: \_\_\_\_\_

## Functional Performance Test Sheet Intent:

To verify the operation of the system against the sequence of operation. Including start-up, shutdown, unoccupied, power failure, and interlocks with other equipment, and sensor/actuator calibration.

## Functional Performance Test Sheet Pre-requisites:

Item	Yes	No	Comments
Installation check sheet attached	<input type="checkbox"/>	<input type="checkbox"/>	
Air Balancing report reviewed	<input type="checkbox"/>	<input type="checkbox"/>	
Manufacturer's start up report attached with deficiencies cleared	<input type="checkbox"/>	<input type="checkbox"/>	
Technicians BAS point to point check list reviewed	<input type="checkbox"/>	<input type="checkbox"/>	
Approved sequence of operation attached	<input type="checkbox"/>	<input type="checkbox"/>	

Deficiencies - Mark "Y" = Yes its operational, installed or complete  
 "N" = No work not done or not installed  
 "N/A" = Not Applicable

<b>Static Verification</b> <small>(Some items may not be applicable)</small>	<b>Visual Check</b>		
	Physical Integrity	Clear of dirt/debris <input type="checkbox"/> Fan Installed correctly <input type="checkbox"/> Fan labeled correctly <input type="checkbox"/> Insulation complete <input type="checkbox"/>	
	Filter condition	Temporary Filter Media Fitted <input type="checkbox"/>	
	Remote items operational	Isolation/Mixing Dampers <input type="checkbox"/>	
<b>Dynamic Verification</b> <small>(Some items may not be applicable)</small>	<b>Operational Check</b>		
	TAB Verification	O.L Set to motor name plate rating <input type="checkbox"/> VSD settings based on motor name plate rating <input type="checkbox"/> Check fan volumes & SP @ design conditions <input type="checkbox"/> Check volume of terminals against TAB Report <input type="checkbox"/>	
	Hard wire interlocks	Fire Alarm <input type="checkbox"/> Exhaust shutdown <input type="checkbox"/> BAS Annunciation <input type="checkbox"/> Exhaust Fan damper interlocks operational <input type="checkbox"/>	
	Soft wire interlocks	Check default settings on sensors and alarms through BAS <input type="checkbox"/> Confirm BAS annunciation when fans are operated in hand <input type="checkbox"/>	
	BAS Commands	Check stroke of dampers <input type="checkbox"/> Check output to VFD's <input type="checkbox"/> Verify and document Time Schedule operation <input type="checkbox"/> Verify if fan is operated in conjunction with main air handling plant <input type="checkbox"/> Verify and document unoccupied temperature initiated operation of plant <input type="checkbox"/> Check positions of motorized dampers on fan shutdown. <input type="checkbox"/>	

# Exhaust Fan Functional Performance Sheet



Dynamic  
Verification

BAS Control Verification

**Note:** System to be tested against the BAS Sequence of operation, a signed copy of the verified sequence will be provided with this documentation

- Verify fan is enabled by adjustment of Temp Set Point
- Verify and document temperature differential between fan on/off
- Verify temperature control stable at varied set points through mixing dampers
- Verify exhaust fan minimum run time
- Verify Calibration of all temperature sensors


Comments:

Further work required:

Contractor	Sign:	Print:	Date:
Cx Authority	Sign:	Print:	Date:

# Supply Fan

## Functional Performance Sheet



Project: \_\_\_\_\_ System Type: Supply Fan with Reheat  
 Date: \_\_\_\_\_ System #: \_\_\_\_\_

### Functional Performance Test Sheet Intent:

*To verify the operation of the system against the sequence of operation. Including start-up, shutdown, unoccupied, power failure, and interlocks with other equipment, and sensor/actuator calibration.*

### Functional Performance Test Sheet Pre-requisites:

Item	Yes	No	Comments
Installation check sheet attached	<input type="checkbox"/>	<input type="checkbox"/>	
Hydronic balancing report reviewed	<input type="checkbox"/>	<input type="checkbox"/>	
Air Balancing report reviewed	<input type="checkbox"/>	<input type="checkbox"/>	
Manufacturer's start up report attached with deficiencies cleared	<input type="checkbox"/>	<input type="checkbox"/>	
Technicians BAS point to point check list reviewed	<input type="checkbox"/>	<input type="checkbox"/>	
Approved sequence of operation attached	<input type="checkbox"/>	<input type="checkbox"/>	

Deficiencies - Mark "Y" = Yes its operational, installed or complete  
 "N" = No work not done or not installed  
 "N/A" = Not Applicable

<b>Static Verification</b> <small>(Some items may not be applicable)</small>	<b>Visual Check</b>				
	Physical Integrity	→	Clear of dirt/debris <input type="checkbox"/>	Fan Installed correctly <input type="checkbox"/>	Fan labeled correctly <input type="checkbox"/> Insulation complete <input type="checkbox"/>
	Filter condition	→	Temporary Filter Media Fitted <input type="checkbox"/>		
	Remote items operational	→	Heating Glycol <input type="checkbox"/>	Associated Exhaust <input type="checkbox"/>	
<b>Dynamic Verification</b> <small>(Some items may not be applicable)</small>	<b>Operational Check</b>				
	TAB Verification	→	O.L Set to motor name plate rating <input type="checkbox"/>		<input type="checkbox"/>
			VSD settings based on motor name plate rating <input type="checkbox"/>		
			Check fan volumes & SP @ design conditions <input type="checkbox"/>		
			Check volume of terminals against TAB Report <input type="checkbox"/>		
	Hard wire interlocks	→	Fire Alarm <input type="checkbox"/>	Fan shutdown <input type="checkbox"/>	BAS Annunciation <input type="checkbox"/>
			Supply Fan damper interlocks operational <input type="checkbox"/>		
	Soft wire interlocks	→	Check default settings on sensors and alarms through BAS <input type="checkbox"/>		
			Confirm BAS annunciation when fans are operated in hand <input type="checkbox"/>		
			Fan failure status mismatch <input type="checkbox"/> BAS Annunciation <input type="checkbox"/>		
BAS Commands	→	Check stroke of valves <input type="checkbox"/>	Check stroke of dampers <input type="checkbox"/>	Check output to VFD's <input type="checkbox"/>	
		Verify and document Time Schedule operation <input type="checkbox"/>			
		Verify and document unoccupied temperature initiated operation <input type="checkbox"/>			
		Check control valve positions on fan shutdown. <input type="checkbox"/>			
		Check positions of motorized dampers on fan shutdown. <input type="checkbox"/>			

# Supply Fan

## Functional Performance Sheet



Dynamic  
Verification

BAS Control Verification

**Note:** System to be tested against the BAS Sequence of operation, a signed copy of the verified sequence will be provided with this documentation

- Verify space temp control stable at varied Set Points through re-heater
- Verify space temp control stable at varied Set Points through damper control
- Verify Calibration of all temperature sensors

☐

☐

☐

Comments:

Further work required:

Contractor	Sign:	Print:	Date:
Cx Authority	Sign:	Print:	Date:

# Forced Flow/Unit Heaters

## Functional Performance Sheet



Project: \_\_\_\_\_ System Type: Forced Flow/Unit Heater

Date: \_\_\_\_\_ System #: \_\_\_\_\_

### Functional Performance Test Sheet Intent:

*To verify the operation of the system against the sequence of operation. Including start-up, shutdown, unoccupied, power failure, and interlocks with other equipment, and sensor/actuator calibration.*

### Functional Performance Test Sheet Pre-requisites:

Item	Yes	No	Comments
Installation check sheet attached	<input type="checkbox"/>	<input type="checkbox"/>	
Hydronic balancing report reviewed	<input type="checkbox"/>	<input type="checkbox"/>	
Manufacturer's start up report attached with deficiencies cleared	<input type="checkbox"/>	<input type="checkbox"/>	
Technicians BAS point to point check list reviewed	<input type="checkbox"/>	<input type="checkbox"/>	
Approved sequence of operation attached	<input type="checkbox"/>	<input type="checkbox"/>	

Deficiencies - Mark "Y" = Yes its operational, installed or complete

"N" = No work not done or not installed

"N/A" = Not Applicable

<b>Static Verification</b> <small>(Some items may not be applicable)</small>	<b>Visual Check</b>				
	Physical Integrity	→	Clear of dirt/debris <input type="checkbox"/>	Unit Installed correctly <input type="checkbox"/>	Unit labeled correctly <input type="checkbox"/> Insulation complete <input type="checkbox"/>
	Filter condition	→	Temporary Filter Media Fitted <input type="checkbox"/>		
	Remote items operational	→	Heating Glycol <input type="checkbox"/>	Control Valve Fitted <input type="checkbox"/>	
<b>Dynamic Verification</b> <small>(Some items may not be applicable)</small>	<b>Operational Check</b>				
	TAB Verification	→	O.L Set to motor name plate rating <input type="checkbox"/>		
	Hard wire interlocks	→	Fire Alarm <input type="checkbox"/>	Fan shutdown <input type="checkbox"/>	BAS Annunciation <input type="checkbox"/>
	Soft wire interlocks	→	Check default settings on sensors and alarms through BAS Confirm BAS annunciation when fans are operated in hand Unit Fan Failure based on flow <input type="checkbox"/> Status mismatch <input type="checkbox"/>		
	BAS Commands	→	Check stroke of valves <input type="checkbox"/>  Verify and document Time Schedule operation <input type="checkbox"/> Verify and document unoccupied temperature initiated operation <input type="checkbox"/> Check control valve positions on unit shutdown. <input type="checkbox"/>		
	BAS Control Verification	→	<b>Note:</b> System to be tested against the BAS Sequence of operation, a signed copy of the verified sequence will be provided with this documentation		
			Verify space temperature control stable at varied Set Points <input type="checkbox"/> Verify fan is cycled off when the heating valve closes <input type="checkbox"/> Verify fan minimum run time <input type="checkbox"/> Verify Calibration of all temperature sensors <input type="checkbox"/>		

# Forced Flow/Unit Heaters

## Functional Performance Sheet



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Comments:

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Further work required:

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Contractor	Sign:	Print:	Date:
Cx Authority	Sign:	Print:	Date:

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# Computer Room Air Conditioning (CRAC) System Functional Performance Sheet



Project: \_\_\_\_\_ System Type: CRAC DX Split System  
Date: \_\_\_\_\_ System #: \_\_\_\_\_

## Functional Performance Test Sheet Intent:

*To verify the operation of the system against the sequence of operation. Including start-up, shutdown, unoccupied, power failure, and interlocks with other equipment, and sensor/actuator calibration.*

## Functional Performance Test Sheet Pre-requisites:

Item	Yes	No	Comments
Installation check sheet attached	<input type="checkbox"/>	<input type="checkbox"/>	
Installers pressure test and evacuation report available	<input type="checkbox"/>	<input type="checkbox"/>	
Manufacturer's start up report attached with deficiencies cleared	<input type="checkbox"/>	<input type="checkbox"/>	
Manufacturer's Operation manual available	<input type="checkbox"/>	<input type="checkbox"/>	
Technicians BAS point to point check list reviewed	<input type="checkbox"/>	<input type="checkbox"/>	

Deficiencies - Mark "Y" = Yes its operational, installed or complete  
"N" = No work not done or not installed  
"N/A" = Not Applicable

<b>Static Verification</b> <small>(Some items may not be applicable)</small>	<b>Visual Check</b>			
	Physical Integrity	→	Clear of dirt/debris <input type="checkbox"/>	Units Installed correctly <input type="checkbox"/> Units labeled correctly <input type="checkbox"/> Insulation complete <input type="checkbox"/>
	Filter condition	→	Unit Permanent Filters fitted <input type="checkbox"/> Temporary filter media fitted <input type="checkbox"/>	
	Remote items operational	→	Condensate Pump <input type="checkbox"/> Condensing Unit <input type="checkbox"/>	
<b>Dynamic Verification</b> <small>(Some items may not be applicable)</small>	<b>Operational Check</b>			
	Integral Controls	→	Check system operation through factory controller Verify temperature control stable at varied Set Points Verify Humidity control stable at varied Set Points Check operation on backup cooling mode Check operation of Condensate Pump Check operation of Condensing Unit	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
	Soft wire interlocks	→	Check default settings on sensors and alarms through BAS DX system general alarm monitored by BAS Verify BAS monitors room temperature and record alarm parameters Verify calibration of Temp sensors	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

# Computer Room Air Conditioning (CRAC) System Functional Performance Sheet



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Comments:

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Further work required:

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<b>Contractor</b>	Sign:	Print:	Date:
<b>Cx Authority</b>	Sign:	Print:	Date:

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# Supply Air VAV Terminal Unit Functional Performance Sheet



Project:

System Type: Variable Supply Air Volume Box with  
Reheat and Radiant Panels

Date:

VAV Served by:

VAV #:

## Functional Performance Test Sheet Intent:

*To verify the operation of the system against the sequence of operation. Including start-up, shutdown, unoccupied, power failure, and interlocks with other equipment, and sensor/actuator calibration.*

## Functional Performance Test Sheet Pre-requisites:

Item	Yes	No	Comments
Installation check sheet attached	<input type="checkbox"/>	<input type="checkbox"/>	
Air Balancing report reviewed	<input type="checkbox"/>	<input type="checkbox"/>	
Hydronic balancing report reviewed	<input type="checkbox"/>	<input type="checkbox"/>	
Technicians BAS point to point check list reviewed	<input type="checkbox"/>	<input type="checkbox"/>	
Spreadsheet of BAS parameters and set points available	<input type="checkbox"/>	<input type="checkbox"/>	
Approved sequence of operation attached	<input type="checkbox"/>	<input type="checkbox"/>	

Deficiencies - Mark "Y" = Yes its operational, installed or complete

"N" = No work not done or not installed

"N/A" = Not Applicable

<b>Static Verification</b> <small>(Some items may not be applicable)</small>	<b>Visual Check</b>				
	Physical Integrity	→	Insulation complete <input type="checkbox"/>	VAV Installed correctly <input type="checkbox"/>	Clear of dirt/debris <input type="checkbox"/>
			Valve tags <input type="checkbox"/>	VAV labeled correctly <input type="checkbox"/>	Maintenance Access <input type="checkbox"/>
	Coil condition	→	Access Provided <input type="checkbox"/>	Combing required <input type="checkbox"/>	
	Connections complete	→	BAS installation <input type="checkbox"/>	Network available <input type="checkbox"/>	
	Remote items operational	→	Hot Water Service <input type="checkbox"/>	Radiant Panels <input type="checkbox"/>	No. of Radiant Panels <input type="checkbox"/>
			AHU serving all associated supply and return/exhaust VAV's <input type="checkbox"/>		
<b>Dynamic Verification</b> <small>(Some items may not be applicable)</small>	<b>Operational Check</b>				
	BAS Commands	→	Check stroke of valves <input type="checkbox"/>	Check stroke of dampers <input type="checkbox"/>	
			Verify Time Schedule operation <input type="checkbox"/>		
	Soft wire interlocks	→	Check default settings on sensors and alarms through BAS <input type="checkbox"/>		
			Verify lighting control interface <input type="checkbox"/>		
	Hard wire interlocks	→	Fire Alarm Interface <input type="checkbox"/>		
	TAB Verification	→	Verify calibration of air volume at maximum flow with TAB Contractor <input type="checkbox"/>		
			Verify calibration of air volume at minimum flow with TAB Contractor <input type="checkbox"/>		
			Check air volume with primary air shut down <input type="checkbox"/>		

## Functional Performance Sheet



## Dynamic Verification

## BAS Control Verification

- Verify SA volume responds to temperature set point changes
- Verify SA volume control stable at varied set points
- Adjust temperature set point until full cooling is achieved
- Verify SA volume at maximum through BAS

- Adjust temperature set point to the current room temperature
- Verify SA volume at minimum through BAS
- Adjust temperature set point to initiate heating
- Verify radiant heating is the first stage
- Verify VAV reheat is the second stage
- Verify SA volume at minimum at full heating through BAS
- Verify unoccupied operation of VAV



**Comments:**

***Further work required:***

**Contractor**

Sign:

Print:

Date:

## Cx Authority

Sign:

Print:

Date:

# Pump(s) Functional Performance Sheet



Project: \_\_\_\_\_ System Type: \_\_\_\_\_  
 Date: \_\_\_\_\_ System #: \_\_\_\_\_

## Functional Performance Test Sheet Intent:

To verify the operation of the system against the sequence of operation. Including start-up, shutdown, unoccupied, power failure, and interlocks with other equipment, and sensor/actuator calibration.

## Functional Performance Test Sheet Pre-requisites:

Item	Yes	No	Comments
Installation check sheet attached	<input type="checkbox"/>	<input type="checkbox"/>	
Hydronic balancing report reviewed	<input type="checkbox"/>	<input type="checkbox"/>	
Manufacturer's start up report attached with deficiencies cleared	<input type="checkbox"/>	<input type="checkbox"/>	
Technicians BAS point to point check list reviewed	<input type="checkbox"/>	<input type="checkbox"/>	
Approved sequence of operation attached	<input type="checkbox"/>	<input type="checkbox"/>	

Deficiencies - Mark "Y" = Yes its operational, installed or complete  
 "N" = No work not done or not installed  
 "N/A" = Not Applicable

<b>Static Verification</b> <small>(Some items may not be applicable)</small>	<b>Visual Check</b>		
	Physical Integrity	Clear of dirt/debris <input type="checkbox"/> Pumps Installed correctly <input type="checkbox"/> Valve Tags installed <input type="checkbox"/> Labeled correctly <input type="checkbox"/> Insulation complete <input type="checkbox"/>	
	Strainers and Gauges	Strainers clean <input type="checkbox"/> Gauges correct range <input type="checkbox"/>	
	Drives and Couplings	Pump rotation <input type="checkbox"/>	
	Remote items operational	Heating Glycol <input type="checkbox"/> Chilled Glycol <input type="checkbox"/> Heating Water <input type="checkbox"/> Chilled Water <input type="checkbox"/> Pipework complete <input type="checkbox"/> Field Control Valves <input type="checkbox"/> Bypass Valve <input type="checkbox"/>	
<b>Dynamic Verification</b> <small>(Some items may not be applicable)</small>	<b>Operational Check</b>		
	TAB Verification	O.L Set to motor name plate rating <input type="checkbox"/> VSD settings based on motor name plate rating <input type="checkbox"/> Check pump volume & SP @ design conditions <input type="checkbox"/> Check Min flow VSD setting <input type="checkbox"/> Check glycol flow at selected field components <input type="checkbox"/> Confirm if Triple Duty valves have been altered for TAB and document setting <input type="checkbox"/>	
	Soft wire interlocks	Lead pump fails <input type="checkbox"/> Lag pump starts <input type="checkbox"/> Pump fail reset <input type="checkbox"/> Lead pump resumes <input type="checkbox"/> Above tests repeated after change of lead pump <input type="checkbox"/> BAS Annunciation <input type="checkbox"/> BAS Annunciation <input type="checkbox"/> Status Mismatch <input type="checkbox"/> Pump failure based on flow <input type="checkbox"/> Run timers on pumps are represented on graphics <input type="checkbox"/> Auto changeover of pumps verified based on run time <input type="checkbox"/> Confirm BAS annunciation when pumps are operated in hand <input type="checkbox"/> Check default settings on sensors and alarms through BAS <input type="checkbox"/>	

# Pump(s) Functional Performance Sheet



Dynamic Verification  
(Continued)

BAS Commands

- Check stroke of bypass valve ☐ Check output to VSD's ☐
- Verify system enable based on field demand/time schedule ☐
- Check bypass valve position on system shutdown ☐

BAS Control Verification

- Note:** System to be tested against the BAS Sequence of operation, a signed copy of the verified sequence will be provided with this documentation
- Verify system pressure/temperature control stable at varied Set Points ☐
  - Verify location of the system pressure sensor ☐
  - Verify system pressure sensor is not Network based ☐
  - Verify system pressure SP against TAB report ☐
  - Verify bypass valve is fully closed with system at full flow ☐
  - Verify Calibration of all temperature and pressure sensors ☐

Comments:

Further work required:

Contractor	Sign:	Print:	Date:
Cx Authority	Sign:	Print:	Date:

# Roof Top Unit (RTU) Functional Performance Sheet



Project: \_\_\_\_\_ System Type: Gas Heat with DX Cooling  
Date: \_\_\_\_\_ System #: \_\_\_\_\_

## Functional Performance Test Sheet Intent:

To verify the operation of the system against the sequence of operation. Including start-up, shutdown, unoccupied, power failure, and interlocks with other equipment, and sensor/actuator calibration.

## Functional Performance Test Sheet Pre-requisites:

Item	Yes	No	Comments
Installation check sheet attached	<input type="checkbox"/>	<input type="checkbox"/>	
Uninterrupted gas supply available	<input type="checkbox"/>	<input type="checkbox"/>	
Air Balancing report reviewed	<input type="checkbox"/>	<input type="checkbox"/>	
Manufacturer's start up report attached with deficiencies cleared	<input type="checkbox"/>	<input type="checkbox"/>	
Technicians BAS point to point check list attached	<input type="checkbox"/>	<input type="checkbox"/>	
Approved sequence of operation attached	<input type="checkbox"/>	<input type="checkbox"/>	

**Static Verification**  
(Some items may not be applicable)

**Visual Check**

Physical Integrity → Clear of dirt/debris ☐ Unit Installed correctly ☐ Unit labeled correctly ☐  
 Drainage Check ☐ Insulation complete ☐

Filter condition → Permanent Filters Fitted ☐  
 Temporary Filter Media Fitted ☐

Remote items operational → Heat Recovery Ventilator ☐

**Dynamic Verification**  
(Some items may not be applicable)

**Operational Check**

TAB Verification → O.L Set to motor name plate rating ☐  
 VSD settings based on motor name plate rating ☐

Check fan volume & SP @ design conditions ☐  
 Area served by RTU operating at a Positive Pressure ☐  
 Area served by RTU operating at a Negative Pressure ☐  
 Check volume of terminals against TAB Report ☐

Hard wire interlocks → Freeze Stat ☐ RTU shutdown ☐ Dampers Close ☐  
 BAS Annunciation ☐

Fire Alarm ☐ RTU shutdown ☐ BAS Annunciation ☐

Supply Fan damper interlocks operational ☐  
 Burner shutdown on Gas failure ☐ BAS Annunciation ☐

Soft wire interlocks → Check default settings on sensors and alarms through BAS ☐  
 RTU system common alarm ☐ BAS Annunciation ☐

# Roof Top Unit (RTU) Functional Performance Sheet



Dynamic Verification (Continued)	BAS Commands	→	Check system enable	<input type="checkbox"/>	Check stroke of dampers	<input type="checkbox"/>
		↓	Verify time schedule operation			<input type="checkbox"/>
			Verify system unoccupied temperature initiated operation of plant			<input type="checkbox"/>
			Check system shutdown including cooling/heating			<input type="checkbox"/>
			Check positions of motorized dampers on unit shutdown.			<input type="checkbox"/>
			Verify Minimum Outside Air Requirements			<input type="checkbox"/>
	BAS Control Verification	→	<b>Note:</b> System to be tested against the BAS Sequence of operation, a signed copy of the verified sequence will be provided with this documentation			
			Verify and document differential between supply and exhaust air flow			<input type="checkbox"/>
			Verify SA temperature control stable at varied set points			<input type="checkbox"/>
			Verify Economy Cycle operation of dampers			<input type="checkbox"/>
		Verify Calibration of all temperature and pressure sensors			<input type="checkbox"/>	

Comments:

Further work required:

Contractor	Sign:	Print:	Date:
Cx Authority	Sign:	Print:	Date:

**Part 1            General**

**1.1            INSTALLATION/START-UP CHECKLISTS**

- .1    Include the following data:
  - .1    Product manufacturer's installation instructions and recommended checks.
  - .2    Special procedures as specified in relevant technical sections.
  - .3    Items considered good installation and engineering industry practices deemed appropriate for proper and efficient operation.
- .2    Equipment manufacturer's installation/start-up checklists are acceptable for use. As deemed necessary by Departmental Representative supplemental additional data lists will be required for specific project conditions.
- .3    Use checklists for equipment installation. Document checklist verifying checks have been made, indicate deficiencies and corrective action taken.
- .4    Installer to sign checklists upon completion, certifying stated checks and inspections have been performed. Return completed checklists to Departmental Representative. Checklists will be required during commissioning.
- .5    Use of checklists will not be considered part of commissioning process but will be stringently used for equipment pre-start and start-up procedures.

**1.2            COMMISSIONING FORMS**

- .1    Refer to the forms attached in Appendix A - Commissioning (Cx) Plan.
- .2    Use Commissioning forms to verify installation and record performance when starting equipment and systems.
- .3    Strategy for Use:
  - .1    Cx Plan has provided Cx forms to supplement the documentation that is require by the contractor.
  - .2    Contractor will meet with the CxA to coordinate documentation requirements and development of the ongoing Cx Plan and Functional Performance Verification Process.
  - .3    Contractor will provide required shop drawings information and verify correct installation and operation of items indicated on these forms.
  - .4    Confirm operation as per design criteria and intent.
  - .5    Identify variances between design and operation and reasons for variances.
  - .6    Verify operation in specified normal and emergency modes and under specified load conditions.
  - .7    Record analytical and substantiating data.
  - .8    Verify reported results.
  - .9    Form to bear signatures of recording technician and reviewed and signed off by Contractor.
  - .10   Submit immediately after tests are performed.

- .11 Reported results in true measured SI unit values.
- .12 Provide Departmental Representative with originals of completed forms.
- .13 Maintain copy on site during start-up, testing and commissioning period.

**1.3 LANGUAGE**

- .1 To suit the language profile of the awarded contract.

**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            TRAINEES**

- .1      Trainees: personnel selected for operating and maintaining this facility. Includes Facility Manager, building operators, maintenance staff, security staff, and technical specialists as required.
- .2      Trainees will be available for training during later stages of construction for purposes of familiarization with systems.

**1.2            INSTRUCTORS**

- .1      Contractor, mechanical contractor, controls contractor and certified factory-trained manufacturers' personnel: to provide instruction on the following:
  - .1          Start-Up, operation, shut-down of equipment, components and systems.
  - .2          Control features, reasons for, results of, implications on associated systems of, adjustment of set points of control and safety devices.
  - .3          Instructions on servicing, maintenance and adjustment of systems, equipment and components.
- .2      Contractor and equipment manufacturer to provide instruction on:
  - .1          Start-up, operation, maintenance and shut-down of equipment they have certified installation, started up and carried out FP tests.

**1.3            TRAINING OBJECTIVES**

- .1      Training to be detailed and duration to ensure:
  - .1          Safe, reliable, cost-effective, energy-efficient operation of systems in normal and emergency modes under all conditions.
  - .2          Effective ongoing inspection, measurements of system performance.
  - .3          Proper preventive maintenance, diagnosis and troubleshooting.
  - .4          Ability to update documentation.
  - .5          Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

**1.4            TRAINING MATERIALS**

- .1      Instructors to be responsible for content and quality.
- .2      Training materials to include:
  - .1          "As-Built" Contract Documents.
  - .2          Operating Manual.
  - .3          Maintenance Manual.
  - .4          TAB and PV Reports.
- .3      Departmental Representative will review training manuals.

- .4 Training materials to be in a format that permits future training procedures to same degree of detail.
- .5 Supplement training materials:
  - .1 Transparencies for overhead projectors.
  - .2 Multimedia presentations.
  - .3 Manufacturer's training videos.
  - .4 Equipment models.

## **1.5 SCHEDULING**

- .1 Include in Construction Schedule time for training.
- .2 Deliver training during regular working hours.
- .3 Time Allocated for Final Training: ensure amount of time required for training on each item of equipment or system as follows:
  - .1 Segregation Wing
    - .1 Boiler system (2 hrs)
    - .2 DHW System (1 hrs)
    - .3 Air Handling System (1.5 hrs per individual unit)
    - .4 Controls (1hrs each air handler, boiler and system)
    - .5 Electrical & Fire Alarm (1 hrs)
    - .6 Miscellaneous (1 hrs)
  - .2 West - Mechanical Room
    - .1 Air Handling System (1.5 hrs per individual unit)
    - .2 Hydronic Pumps (1 hr each)
    - .3 Controls (1hrs each air handler and system)
    - .4 Electrical & Fire Alarm (1 hrs)
    - .5 Miscellaneous (1 hrs)
  - .3 Executive Area
    - .1 Air Handling System (1.5 hrs per individual unit)
    - .2 VAV System (1 hrs)
    - .3 Heating System (1 hrs)
    - .4 Controls (1hrs each air handler and system)
    - .5 Electrical & Fire Alarm (1 hrs)
    - .6 Miscellaneous (1 hrs)
  - .4 Tunnels / Cell Blocks
    - .1 Air Handling System (1.5 hrs per individual unit)
    - .2 Hydronic Pumps (1 hr each)
    - .3 Controls (2 hrs each air handler plus 3 hrs)
    - .4 Electrical & Fire Alarm (1 hrs)
    - .5 Miscellaneous (1 hrs)

- .5 East Mechanical Room – Food Service
  - .1 Air Handling System (1.5 hrs per individual unit)
  - .2 DHW System (2 hrs)
  - .3 Hydronic Pumps (1 hr each)
  - .4 Controls (1hrs each air handler, and system)
  - .5 Electrical & Fire Alarm (1 hrs)
  - .6 Miscellaneous (1 hrs)
- .6 Main Boiler Room – SIS
  - .1 Air Handling System (1.5 hrs per individual unit)
  - .2 Make Up Air system (2 Hrs)
  - .3 Hydronic Pumps (1 hr each)
  - .4 Controls (1hrs each air handler, and system)
  - .5 Electrical & Fire Alarm (1 hrs)
  - .6 Miscellaneous (1 hrs)
- .4 Training to occur after completion of Functional Performance Testing and Submission of Draft O&M manual.
- .5 Training to be completed prior to acceptance of unit or system or work area. Training is a requirement of acceptance by the facility. Each item being turned over must have training completed to be considered substantially complete.

## **1.6 RESPONSIBILITIES**

- .1 Be responsible for:
  - .1 Implementation of training activities,
  - .2 Coordination among instructors,
  - .3 Quality of training, training materials,
- .2 Departmental Representative will evaluate training and materials.
- .3 Upon completion of training, provide written report, signed by Instructors, witnessed by Departmental Representative and Contractor.

## **1.7 TRAINING CONTENT**

- .1 Training to include demonstrations by Instructors using the installed equipment and systems.
- .2 Content includes:
  - .1 Review of facility and occupancy profile.
  - .2 Functional requirements.
  - .3 System philosophy, limitations of systems and emergency procedures.
  - .4 Review of system layout, equipment, components and controls.
  - .5 Equipment and system start-up, operation, monitoring, servicing, maintenance and shut-down procedures.

- .6 System operating sequences, including step-by-step directions for starting up, shut-down, operation of valves, dampers, switches, adjustment of control settings and emergency procedures.
- .7 Maintenance and servicing.
- .8 Trouble-shooting diagnosis.
- .9 Inter-Action among systems during integrated operation.
- .10 Review of O&M documentation.
- .3 Provide specialized training as specified in relevant Technical Sections of the construction specifications.

## **1.8 CONTRACTOR DEMONSTRATION AND TRAINING**

- .1 Mechanical:
  - .1 Thoroughly instruct Facilities Manager in safe operation of systems and equipment after installation of Work. Coordinate with Commissioning Authority and arrange commissioning program and schedule for instruction times. Submit commissioning schedule to Commissioning Authority one week prior to commissioning of each system.
  - .2 Hire qualified service engineers and manufacturers' representatives to instruct Facilities Manager on specialized portions of installation, such as the following:
    - .1 Air Handling Units/Ventilation Systems.
    - .2 Direct Expansion Refrigeration Systems.
    - .3 Exhaust Air Systems.
    - .4 Heating Boiler Systems.
    - .5 Domestic Water Heaters.
    - .6 Pumps.
    - .7 Building Automation System.
    - .8 BAS Sequences of Operation.
  - .3 Submit to Commissioning Authority complete record of instructions as part of maintenance instructions and data book given. For each instructional period, include:
    - .1 Date.
    - .2 System and equipment involved.
    - .3 Names of persons giving instructions.
    - .4 Names of persons being instructed.
    - .5 Other persons present.
  - .4 Carry out training of staff and instruction of Facilities Manager within a period of 30 days unless otherwise agreed with Commissioning Authority.
  - .5 Permit Commissioning Authority and Facilities Manager usage of systems prior to Substantial Performance for testing and learning operational procedures.
  - .6 At end of training, obtain and submit to Commissioning Authority, signed statement of Facilities Manager stating they understand system and equipment installation, operation and maintenance requirements.

- .7 Arrange necessary inspections and obtain written approval and acceptance of equipment and systems requiring approval by authorities having jurisdiction, and subsequent correction of those unacceptable items to satisfaction of such authorities.
- .2 Electrical;
  - .1 Thoroughly instruct Facilities Manager in safe operation of systems and equipment after installation of Work. Coordinate with Commissioning Authority and arrange commissioning programme and schedule for instruction times. Submit commissioning schedule to Commissioning Authority one week prior to commissioning of each system.
  - .2 Hire qualified service engineers and manufacturers' representatives to instruct Facilities Manager on specialized portions of installation, such as the following:
    - .1 Life Safety Systems.
    - .2 Security Systems.
    - .3 Fire Alarm Systems.
  - .3 Submit to Commissioning Authority complete record of instructions as part of maintenance instructions and data book given. For each instructional period, include:
    - .1 Date.
    - .2 System and equipment involved.
    - .3 Names of persons giving instructions.
    - .4 Names of persons being instructed.
    - .5 Other persons present.
  - .4 Carry out training of staff and instruction of Facilities Manager within a period of 30 days unless otherwise agreed with Commissioning Authority.
  - .5 Permit Commissioning Authority and Facilities Manager usage of systems prior to Substantial Performance for testing and learning operational procedures.
  - .6 At end of training, obtain and submit to Commissioning Authority, signed statement of Facilities Manager stating they understand system and equipment installation, operation and maintenance requirements.
  - .7 Arrange necessary inspections and obtain written approval and acceptance of equipment and systems requiring approval by authorities having jurisdiction, and subsequent correction of those unacceptable items to satisfaction of such authorities.

## **1.9 VIDEO-BASED TRAINING**

- .1 Manufacturer's videos to be used as training tool with Departmental Representative's review and written approval 2 months prior to commencement of scheduled training.
- .2 On-Site training videos:
  - .1 Provide Video recording of training sessions for use during future training.
  - .2 To be performed after systems are fully commissioned.
  - .3 Organize into several short modules to permit incorporation of changes.

- .3 Production methods to be professional and high quality.

**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            GENERAL REQUIREMENTS**

- .1    Standard letter size paper 216 mm x 279 mm.
- .2    Methodology used to facilitate updating.
- .3    Drawings, diagrams and schematics to be professionally developed.
- .4    Electronic copy of data to be in a format accepted and approved by Departmental Representative.

**1.2            APPROVALS**

- .1    Prior to commencement, co-ordinate requirements for preparation, submission and approval with Departmental Representative.

**1.3            GENERAL INFORMATION**

- .1    Acronyms:
  - .1    BMM - Building Management Manual.
  - .2    Cx - Commissioning.
  - .3    HVAC - Heating, Ventilation and Air Conditioning.
  - .4    PI - Product Information.
  - .5    PV - Performance Verification.
  - .6    TAB - Testing, Adjusting and Balancing.
  - .7    WHMIS - Workplace Hazardous Materials Information System.
- .2    Provide Departmental Representative the following for insertion into appropriate Part and Section of BMM:
  - .1    Complete list of names, addresses, telephone and fax numbers of contractor, sub-contractors that participated in delivery of project - as indicated in Section 1.2 of BMM.
  - .2    Summary of architectural, structural, fire protection, mechanical and electrical systems installed and commissioned - as indicated in Section 1.4 of BMM.
    - .1    Including sequence of operation as finalized after commissioning is complete as indicated in Section 2.0 of BMM.
  - .3    Description of building operation under conditions of heightened security and emergencies as indicated in Section 2.0 of BMM.
  - .4    System, equipment and components Maintenance Management System (MMS) identification - Section 2.1 of BMM.
  - .5    Information on operation and maintenance of architectural systems and equipment installed and commissioned - Section 2.0 of BMM.
  - .6    Information on operation and maintenance of fire protection and life safety systems and equipment installed and commissioned - Section 2.0 of BMM.
  - .7    Information on operation and maintenance of mechanical systems and equipment installed and commissioned - Section 2.0 of BMM.

- .8 Operating and maintenance manual - Section 3.2 of BMM.
- .9 Final commissioning plan as actually implemented.
- .10 Completed commissioning checklists.
- .11 Commissioning test procedures employed.
- .12 Completed Product Information (PI) and Performance Verification (PV) report forms, approved and accepted by Departmental Representative.
- .13 Commissioning reports.

#### **1.4 CONTENTS OF OPERATING AND MAINTENANCE MANUAL**

- .1 For detailed requirements refer to Section 01 78 00 - Closeout Submittals.
- .2 Departmental Representative to review and approve format and organization within 12 weeks of mobilization.
- .3 Include original manufactures brochures and written information on products and equipment installed on this project.
- .4 Record and organize for easy access and retrieval of information contained in BMM.
- .5 Include completed PI report forms, data and information from other sources as required.
- .6 Inventory directory relating to information on installed systems, equipment and components.
- .7 Approved project shop-drawings, product and maintenance data.
- .8 Manufacturer's data and recommendations relating: manufacturing process, installation, commissioning, start-up, O&M, shutdown and training materials.
- .9 Inventory and location of spare parts, special tools and maintenance materials.
- .10 Warranty information.
- .11 Inspection certificates with expiration dates, which require on-going re-certification inspections.
- .12 Maintenance program supporting information including:
  - .1 Recommended maintenance procedures and schedule.
  - .2 Information to removal and replacement of equipment including, required equipment, points of lift and means of entry and egress.

#### **1.5 LIFE SAFETY COMPLIANCE (LSC) MANUAL**

- .1 Samples of LSC Manual will be available from Departmental Representative.
- .2 Content of Manual:
  - .1 All possible Emergency situations modes including: presence of fire and smoke, power failure, lose of water or pressure, chemical spills and refrigerant release.
  - .2 Failure of elevators and escalators.
  - .3 HVAC emergencies and fuel supply failures.
  - .4 Intrusion and security breach.
  - .5 Emergency provisions for natural disasters, bomb threats and other disruptive situations.



- .6 Dedicated emergency generators for high security projects, medical facilities and computer systems.
- .7 Emergency control procedures for fire, power and major equipment failure.
- .8 Emergency contacts and numbers.
- .9 Manual to be readily available and comprehensible to non- technical readers.

## **1.6 SUPPORTING DOCUMENTATION FOR INSERTION INTO SUPPORTING APPENDICES**

- .1 Provide Departmental Representative supporting documentation relating to installed equipment and system, including:
  - .1 General:
    - .1 Finalized commissioning plan.
    - .2 WHMIS information manual.
    - .3 Approved "as-built" drawings and specifications.
    - .4 Procedures used during commissioning.
    - .5 Cross-Reference to specification sections.
  - .2 Architectural and structural:
    - .1 Inspection certificates, construction permits.
    - .2 Roof anchor log books.
    - .3 PV reports.
  - .3 Fire prevention, suppression and protection:
    - .1 Test reports.
    - .2 Smoke test reports.
    - .3 PV reports.
  - .4 Mechanical:
    - .1 Installation permits, inspection certificates.
    - .2 Piping pressure test certificates.
    - .3 Ducting leakage test reports.
    - .4 TAB and PV reports.
    - .5 Charts of valves and steam traps.
    - .6 Copies of posted instructions.
  - .5 Electrical:
    - .1 Installation permits, inspection certificates.
    - .2 Electrical work log book.
    - .3 Charts and schedules.
    - .4 Locations of cables and components.
    - .5 Copies of posted instructions.
- .2 Assist Departmental Representative with preparation of BMM.

## **1.7 LANGUAGE**

- .1 English and French Language to be in separate binders.

**1.8 USE OF CURRENT TECHNOLOGY**

- .1 Use current technology for production of documentation. Emphasis on ease of accessibility at all times, maintain in up-to-date state, compatibility with user's requirements.
- .2 Obtain Departmental Representative approval before starting Work.

**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            ALTERATION PROJECT PROCEDURES**

- .1      Materials: As specified in Product sections; match existing Products and work for patching and extending work.
- .2      Employ skilled and experienced installer to perform alteration work.
- .3      Close openings in exterior surfaces to protect existing work from weather and extremes of temperature and humidity.
- .4      Remove, cut and patch Work in a manner to minimize damage and to provide means of restoring Products and finishes to original condition.
- .5      Refinish existing visible surfaces to remain in renovated rooms and spaces, to renewed condition for each material, with a neat transition to adjacent finishes.
- .6      Where new Work abuts or aligns with existing provide a smooth and even transition. Patch Work to match existing adjacent Work in texture and appearance.
- .7      When finished surfaces are cut so that a smooth transition with new Work is not possible, terminate exiting surface along a straight line at a natural line of division and submit recommendation to Departmental Representative for review.
- .8      Where a change of plane of 6 mm or more occurs, request instructions from Departmental Representative.
- .9      Patch or replace portions of existing surfaces which are damaged, lifted, discoloured, or showing other imperfections.
- .10     Finish surfaces as specified in individual Product sections.

**1.2            SUBMITTALS FOR REVIEW**

- .1      Section 01 33 00 - Submittal Procedures.
- .2      Shop Drawings:
  - .1      Indicate demolition and removal sequence and location of salvageable items; location and construction of temporary work.
  - .2      Indicate temporary shoring details. Shoring drawings to be stamped by a Registered Professional Structural Engineer licensed at the Place of Work.

**1.3            SUBMITTALS FOR CLOSEOUT**

- .1      Section 01 78 00 - Submittal Closeout.
- .2      Project Record Documents: Accurately record actual locations of capped utilities and subsurface obstructions.

**1.4            REGULATORY REQUIREMENTS**

- .1      Conform to applicable code for demolition work, dust control, products requiring mechanical and electrical disconnection and re-connection.
- .2      Obtain required permits from authorities.

- .3 Do not close or obstruct egress width to any building or site exit.
- .4 Do not disable or disrupt building fire or life safety systems without 3 days prior written notice to Department Representative.
- .5 Conform to procedures applicable when hazardous or contaminated materials are discovered.
- .6 There may be locations where existing walls or slabs may have reinforcement. Allow for X-ray scan of the suspected existing construction.

## **1.5 SCHEDULING**

- .1 Schedule work to coincide with new construction.
- .2 Cease operation immediately if structure appears to be danger and notify Departmental Representative. Do not resume operations until directed.
- .3 Hazardous Materials:
  - .1 The Department Representative has retained an independent inspection agency to review the site for hazardous materials.
  - .2 Refer to the specifications sections provided under this contract.

## **Part 2 Products**

- .1 Not used.

## **Part 3 Execution**

### **3.1 PREPARATION**

- .1 Provide, erect, and maintain temporary barriers and insulated partitions as required to protect occupants and maintain environmental conditions conducive to Work being performed.
- .2 Erect and maintain weatherproof closures for exterior openings.
- .3 Erect and maintain temporary partitions to prevent spread of dust, odours, and noise to permit continued occupancy.
- .4 Protect existing materials and assemblies which are not to be demolished.
- .5 Prevent movement of structure; provide bracing and shoring and temporary structural members required to support wall, floor and roof assemblies scheduled to remain.
- .6 Temporary structural installations to be removed when new structural members have been installed and reviewed by Departmental Representative.
- .7 Notify affected utility companies before starting work and comply with their requirements.
- .8 Mark location and termination of utilities.
- .9 Provide appropriate temporary signage including signage for exit or building egress.

### **3.2 DEMOLITION**

- .1 Disconnect remove, cap and identify designated utilities within demolition areas.
- .2 Demolish in an orderly and careful manner. Protect existing supporting structural members and non-loadbearing assemblies.
- .3 Demolition of Masonry units – Insert structural angle door lintel prior to demolition of exterior wall to accommodate new rough opening for double door.  
  
Also refer to architectural drawings for brick masonry demolition requirements. Retain brick masonry for reuse.
- .4 Remove demolished materials from site except where specifically noted otherwise. Do not burn or bury materials on site. Retain existing brick veneer for reuse.
- .5 Remove materials as Work progresses. Upon completion of Work, leave areas in clean condition.
- .6 Remove temporary Work.

### **3.3 SALVAGED**

- .1 Contact Departmental Representative for direction.
- .2 Store and protect salvaged items until re-installation at location designated by Departmental Representative.
- .3 Turn over salvaged items to applicable specification sections for re-installation.
- .4 Contractor must protect existing equipment in operation from dust/debris or other incidental damage resulting from construction activities, including newly commissioned units in operation and equipment/material on site but not yet installed.

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

- .1 This specification covers the removal and disposal of asbestos-containing and asbestos-contaminated materials indicated in the Pinchin report "Hazardous Building Materials Assessment, Edmonton Institution, 21611 Meridian Street, Edmonton AB," dated June 23, 2017, and the Associated Engineering Preliminary Mechanical Drawings, Revision No. A. Work will include the removal of all settled dust, over spray and debris materials.
- .2 Furnish all labour, materials, services, insurance and equipment, in accordance with requirements of Workplace Health & Safety, Alberta Environment and other regulatory agencies to complete the work of this section.
- .3 Work will be subject to frequent inspection and air monitoring by the Department Representative.
- .4 Refer to the attached hazardous building materials assessment report for locations of asbestos materials in the renovation area.
- .5 Quantities and site conditions to be confirmed by the Contractor and any discrepancies are to be reported to the Department Representative.

**1.2 SCOPE OF WORK**

- .1 Removal of pipe fittings with asbestos-containing parging cements: Following Moderate Risk (glove-bag) procedures, remove and dispose of all asbestos-containing pipe insulation including but not limited to all insulating cements, finishing cements, paper product insulation, pre-formed thermal insulation, textile lagging materials and associated asbestos-contaminated materials. Control measures to include: Designated work area, glove-bags, and poly drop sheets. PPE to include half-face respirators with P100 filters and full-body Tyvek coveralls. Scope of work to include water piping elbows in the Cell Block Tunnels, Main Floor Ceiling Spaces, West Mechanical Rooms, Gym, Executive Services, and Engineering and Maintenance Area.
- .2 Removal of drywall with asbestos-containing drywall taping compound of less than one square foot of combined material: Following Low Risk procedures, remove and dispose of all asbestos-containing drywall taping compounds, and associated materials including gypsum board, metal bead, fasteners, millwork, mouldings, baseboards, electrical fixtures from wall and ceiling areas. Clean and store de-mounted objects in areas designated by the Department Representative or others and protect from re-contamination. Control measures to include: Designated work area (banner tape). PPE to include half-face respirators with P100 filters and full-body Tyvek coveralls. Scope of work to include the Engineering and Maintenance Areas, and the Medication Room.
- .3 Removal of drywall with asbestos-containing drywall taping compound in excess of one square foot of combined material: Following Moderate Risk procedures, remove and dispose of all asbestos-containing drywall taping compounds, and associated materials including gypsum board, metal bead, fasteners, millwork, mouldings, baseboards, electrical fixtures from wall and ceiling areas. Clean and store de-mounted objects in areas designated by the Department Representative or others and protect from re-contamination. Control measures to include: Partial containment enclosure, with above ceiling seals, 2-stage decontamination facility and negative air. PPE to include full-face, PAPR with P100 and full-body Tyvek coveralls. Scope of work to include the Engineering and Maintenance Areas, and the Medication Room.

- .4 Removal of concrete block wall with asbestos-containing loose-fill vermiculite insulation: Following High Risk procedures, remove and dispose of all asbestos-containing loose-fill vermiculite insulation, and associated materials including concrete block, millwork, mouldings, baseboards, electrical fixtures from wall and ceiling areas. Clean and store de-mounted objects in areas designated by the Department Representative or others and protect from re-contamination. Control measures to include: Full containment enclosure, with above ceiling seals, 3-stage decontamination facility and negative air. PPE to include full-face, PAPR with P100 and full-body Tyvek coveralls. Scope of work to include the Upper West Mechanical Room.

### **1.3 RELATED WORK**

- .1 Section 02 83 00 Lead Paint Removal
- .2 Section 02 83 01 Removal and Disposal of Lead Products
- .3 Section 02 84 00 PCB Ballast Removal
- .4 Section 02 87 00 Mercury Products Removal

### **1.4 REGULATIONS, CODES AND STANDARDS**

- .1 The current issue of the following regulations and guidelines shall govern. Where conflict among these requirements or with these specifications exist, the more stringent requirements shall apply.
  - .1 Occupational Health and Safety Act, Regulation and Code.
  - .2 Guidelines for the Disposal of Asbestos Waste.
  - .3 Transportation of Dangerous Goods Regulations.
  - .4 Alberta Asbestos Abatement Manual.
- .2 The current issue of the following codes and standards shall govern. Where conflict among these requirements or with these specifications exist, the more stringent requirements shall apply.
  - .1 ANSI/ASME N510-1980 Testing of Nuclear Air-Cleaning Systems and/or NSF Standard Number 49.
  - .2 CGSB 1-GP-205M Standard for: Sealer for Application to Asbestos-Fibre Releasing Materials.
  - .3 CSA Standard Z94.4-M2003, Selection, Care, and Use of Respirators
  - .4 CSA Standard CAN3Z180.1-M85, Compressed Breathing Air and Systems
  - .5 CSA Standard S269.2-M1980, Scaffolding Construction

### **1.5 QUALITY ASSURANCE**

- .1 The removal and handling of asbestos-containing or contaminated materials shall be performed by persons experienced in the methods, procedures, and industry practices of asbestos abatement.
- .2 The Contractor is responsible to ensure that work proceeds to schedule, meeting all requirements of this section. The Contractor shall complete this work so that at no time shall airborne asbestos, waste or asbestos waste-water runoff contaminate areas adjacent to work areas.

- .3 The Department Representative is empowered inspect adherence to specified work procedures and materials and inspect for final cleanliness and completion. Additional labour or materials expended by the Contractor to provide satisfactory performance to the level specified shall be at no additional cost.
- .4 The Department Representative is empowered to order a shutdown of work when a leakage of asbestos-containing or contaminated materials has occurred or is likely to occur. These conditions include, but are not limited to, failure of negative pressure systems, inadequate wetting, failure of critical barriers or decontamination enclosure systems, water leaks, excessive airborne fibre levels in areas adjacent to the work area or in clean room or holding room areas and the contamination of clean room or holding room areas by asbestos-containing or asbestos-contaminated materials. Additional labour or materials to rectify these or other unsatisfactory conditions shall be at no cost to the Department Representative.
- .5 Inspection and air monitoring services performed as a result of the Contractor's failure to conform to specified procedures or level of cleanliness, as determined by the Department Representative at the time of a milestone inspection, may be charged to the Contractor at the Department Representative's discretion.
- .6 All work of this section involving electrical, mechanical, plumbing, glazing, and other trade work, where applicable, shall be performed by skilled tradesmen regularly engaged in the work in question and under the direct supervision of a currently qualified journeyman.
- .7 Provide on-site a project supervisor, who has authority to oversee all aspects of the work of this section including the submission requirements, scheduling, manpower requirements, equipment requirements and production.
- .8 Provide on-site, for each shift, a shift supervisor who is outside of the containment, who has authority to oversee all aspects of the work of this section related to manpower requirements, equipment requirements and production.
- .9 Replacement of supervisory personnel cannot be undertaken without the written approval of the Department Representative.

## **1.6 SUBMITTALS**

- .1 Before commencing work Contractor shall:
  - .1 Submit proof satisfactory to the Department Representative that the site location, required permits and arrangements for transport and disposal of asbestos-containing or contaminated materials have been obtained. Ensure required manifest documentation regarding disposal is submitted in accordance with these specifications.
  - .2 Submit letter(s) of electrical and mechanical system lock-out as specified.
  - .3 Submit documentation verifying Workplace Health & Safety asbestos worker training certification. Submit to the Department Representative, documentation of respirator fit tests conducted for all personnel entering the removal site.
  - .4 Submit written "Asbestos Project Notification" to Workplace, Health & Safety 72 hours prior to the start of the work of this section. Provide verbal notification 24 hours prior to the start of the work of this section. Provide the Department Representative with a copy of the Notification. Submit site specific work procedures to Department Representative.



- .5 Submit to the Department Representative, manufacturer's information, including test results, material safety data sheets and product specifications, of all materials and equipment proposed for use on this project.
- .6 Submit certification or other documentation, acceptable to the Department Representative, certifying all air movement and vacuum equipment, intended for use on this project have had a filter integrity test. Negative air units used for High Risk work must have the filter integrity test conducted on a per project basis and tested every month. Vacuums must be tested with the last 12 months.
- .7 Prepare and submit work procedures and asbestos control plan.

## **1.7 SITE SUPERVISION**

- .1 During time of hazardous material handling (work at risk of dislodging asbestos-containing material) supervisory personnel shall co-ordinate work and take full responsibility for the health and safety of all personnel working within contaminated areas.
- .2 The Contractor shall employ at least one supervisory person within the enclosure and one outside at all times.
- .3 Submit, for all supervisory personnel, Workplace Health & Safety asbestos worker training certification and documentation substantiating supervisory function on at least two comparable projects in occupied buildings.

## **1.8 SCHEDULING OF WORK**

- .1 The Contractor shall prepare and submit the construction schedule for review by the Department Representative three days prior to the start of work. The schedule shall include milestone inspections and all other critical events relating to the work of this section and the work of others. The construction schedule shall incorporate Substantial Performance dates, turnover dates respecting related work elsewhere and time constraints as outlined by the building Department Representative.
- .2 The work of this section shall be conducted in the most efficient manner, and may include phasing the work to meet the Department Representative's schedule.
- .3 The work of this section must comply with the General Contract and Department Representative's requirements with regard to working hours, phasing, access restrictions and operational requirements.
- .4 The Contractor shall allow sufficient time for fibre settling and final air monitoring (minimum of 8-12 hours) following removal.
- .5 The Contractor shall ensure Department Representatives approval of work area preparation and clean-up is obtained as specified.
- .6 The Contractor shall allow sufficient time for inspection of site by Department Representative following site preparations and prior to the execution of the work of this section.

## **1.9 DEFINITIONS**

- .1 Abatement: procedures to control fibre release from asbestos-containing materials. Includes encapsulation, repair, removal.
- .2 Removal: all herein specified procedures necessary to strip all asbestos-containing materials from the designated areas and to dispose of these materials at an acceptable site.

- .3 Encapsulation: all herein specified procedures necessary to coat all asbestos-containing materials with an encapsulant to control the possible release of asbestos fibres into the ambient air.
- .4 Enclosure: all herein specified procedures necessary to complete the enclosure of all asbestos-containing materials within airtight, impermeable barriers.
- .5 Repair: all herein specified procedures necessary to complete containment of all asbestos-containing material using materials impermeable to the release of asbestos fibre.
- .6 Authorised Visitor: Department Representative and/or his appointed representative, and persons representing regulatory agencies.
- .7 Work Area: Areas where work at risk of increasing airborne fibre is to take place.
- .8 Negative Pressure: Air pressure within the work area resulting from air movement equipment established in the area to maintain a minimum pressure differential of 0.50 mm (0.02 inches) of water column relative to adjacent unsealed areas.
- .9 Airlock: System for permitting ingress and egress without permitting air movement between contaminated area and uncontaminated area, typically consisting of two curtain doorways at least 1800 mm (6 feet) apart.
- .10 Curtain Doorway: Device to allow ingress and egress from one room to another while permitting minimal air movement between rooms, typically constructed by placing two overlapping sheets of plastic over existing or temporarily framed doorway, securing each along top of doorway, securing vertical edge of one sheet along one vertical side of doorway, and securing vertical edge of other sheet along opposite vertical side of doorway. Free edges of polyethylene shall be reinforced with duct tape and bottom edge shall be weighted to ensure automatic closing.
- .11 Filter Integrity Test: leak testing using liquid polyalphaolefin (PAO) generated into an aerosol used for challenging HEPA filter assemblies.
- .12 Critical Barrier: A barrier constructed of a 38 mm by 89 mm timber framework, covered on both sides with 6 mil plastic sheeting, taped along all free edges and interfaces to prevent the movement of airborne asbestos fibre from the contaminated work area to adjacent uncontaminated areas. Exposed surfaces in public service areas shall be sheathed with plywood. Plywood to be finished with white, eggshell latex paint.
- .13 Contaminated: defines the state of materials, surfaces or areas which by virtue of physical contact with asbestos-containing materials or with airborne asbestos fibre shall require cleaning, removal and/or disposal, as specified in this section.
- .14 Air Monitoring: the process of measuring the fibre content of a specific volume of air in a stated period of time.
- .15 Surfactant: a chemical wetting agent added to water to improve penetration, thus reducing the quantity of water required for a given operation or area.
- .16 Amended Water: a water to which a surfactant has been added.
- .17 Decontamination Enclosure: a series of connected rooms, with curtained doorways between any two adjacent rooms, for the decontamination of workers or of materials and equipment. A decontamination enclosure system always contains at least one airlock.
- .18 Worker Decontamination Area: a decontamination area for workers, typically consisting of a clean area, bucket of clean tepid water, soap and towels.

- .19 Equipment Decontamination Area: a decontamination area for materials and equipment, typically consisting of a designated area of the work area, a wash area, a holding area, and an uncontaminated area.
- .20 Clean Area: an uncontaminated area or room which is part of the worker decontaminated area, with provisions for storage of workers' street clothes and protective equipment.
- .21 Equipment Room: a contaminated area or room which is part of the worker decontamination area, with provisions for storage of contaminated clothing and equipment.
- .22 Wash Area: an area between the work area and the holding area in the equipment decontamination area. The wash area may comprise an airlock.
- .23 Holding Area: a chamber between the wash area and an uncontaminated area in the equipment decontamination area. The holding area may comprise an airlock.
- .24 Fixed Object: a unit of equipment or furniture in the work area which cannot be removed from the work area.
- .25 Moveable Object: a unit of equipment or furniture in the work area which can be removed from the work area.
- .26 HEPA Filter: a throwaway extended-pleated-medium dry-type filter with (1) a rigid casing enclosing the full depth of the pleats, (2) a minimum removal efficiency of 99.97% for thermally generated monodisperse DOP smoke particles with a diameter of 0.3 micrometers and (3) a maximum pressure drop of 1.0 in w.g. when clean and operating at its rated airflow capacity.
- .27 Encapsulant (Sealant): a liquid material which can be applied to asbestos-containing material and which controls the possible release of asbestos fibres from the material either by creating a membrane over the surface (bridging encapsulant) or by penetrating into the material and binding its components together (penetrating encapsulant).
- .28 Wet Cleaning: the process of eliminating asbestos contamination from building surfaces and objects by using cloths, mops, or other cleaning tools which have been dampened with water, and by afterwards disposing of these cleaning tools as asbestos-contaminated waste.
- .29 Crated: solid self-supporting structure built over equipment or materials of sufficient strength to protect same from damage or contamination for the duration of the work of this section. A 38 mm x 89 mm (2"x 4") timber frame covered with plastic sheeting and hoarded with 10 mm (3/8") plywood shall be standard of acceptance.
- .30 Milestone Inspection: inspection of the work area by the Department Representative at a defined point in the abatement procedure.
- .31 Immediate Vicinity: a four (4) foot area surrounding an asbestos application or either side of a line application or such an area as defined by the Department Representative.
- .32 Occupational Exposure Limit (OEL): the airborne fibre level in fibres per cubic centimetre of air (f/cc) to which workers may be repeatedly exposed day after day without adverse effect as specified by Workplace Health & Safety.
- .33 Maximum Use Concentration: the airborne fibre level in fibres per cubic centimetre of air (f/cc) which limits respiratory use in asbestos work environments as outlined in the "Alberta Asbestos Abatement Manual".
- .34 Investigative Criteria: the airborne fibre level in fibres per cubic centimetre of air (f/cc) which corresponds with one half of the Occupational Exposure Limit.

#### **1.10 PERSONAL PROTECTION**

- .1 For low risk work or moderate risk glove bag work, half-face piece, negative pressure, dual-cartridge, P100 filter respirators shall be used by all workers.
- .2 For high risk work, Full-Face piece, Powered Air Purifying Respirators with P100 filters shall be used by all workers.
- .3 Respirators shall be personally issued and approved by the National Institute of Occupational Health and Safety (NIOSH). A review of respiratory protection requirements may be necessary, as dictated by air monitoring results obtained by the Department Representative.
- .4 Provide workers, including other sub-trades, with full-body disposable coveralls. Once coveralls are worn in work area, they shall be treated as asbestos contaminated waste and disposed of accordingly. Provide other body protection, including CSA approved safety footwear, required under applicable safety regulations.
- .5 Provide two complete sets of protective clothing and respirators must be present at all times outside the entrance to the work area for use by Department Representative and/or his appointed representative, and persons representing regulatory agencies who have authority over the project.
- .6 Workers shall be clean-shaven to ensure an adequate respirator face piece seal. Unshaven workers shall not be allowed in the work area.
- .7 Workers shall be fully protected with respirators and protective clothing at all times when the possibility of disturbance of asbestos exists, and when handling bags of asbestos waste.

#### **1.11 BUILDING PROTECTION**

- .1 Provide lockable doors sufficient to ensure work area security in the Clean Room and in the Holding Area of Decontamination Enclosure Systems. Ensure building security at all other points of entry to the building including windows and doors demounted to accommodate the installation and exhaust of air movement equipment used through the work of this section.
- .2 Ensure building security, prior to leaving the facilities, by reactivating alarm systems and contacting appropriate security agencies.
- .3 The Contractor shall be responsible to make good all building systems damaged through the work of this section.

#### **1.12 AIR MONITORING**

- .1 Air monitoring shall be performed by the Department Representative in accordance with NIOSH 7400.
- .2 The Contractor shall assist the Department Representative in the collection of air samples including the provision of workers to wear sampling pumps for up to a full work shift period and the provision of adequate, uninterrupted power for low amperage vacuum/pressure type pumps.
- .3 Allow sufficient time for fibre settling and final air monitoring (minimum 8-12 hours) following each phase of removal.
- .4 Airborne fibre levels found, in excess of “investigative criteria”, in areas adjacent to the work area or in clean room or holding room areas, shall initiate an investigation by the

Contractor and the Department Representative into the source of excess airborne fibre levels.

- .5 Where airborne fibre levels in the work area exceed the Maximum Use Concentration for the respiratory protective equipment observed in use, the Department Representative shall take measures outlined in Quality Assurance.
- .6 Air monitoring within the work area to establish acceptable clearance and tear down conditions shall be conducted following Milestone Inspection B (Visual Clearance Inspection), approval of work area clean-up procedures and the application of a lock-down encapsulant to all surfaces within the work area. Acceptable air clearance criteria have been established by Workplace Health & Safety at less than <0.01 f/cc using aggressive sampling methods.

### **1.13 INSPECTION**

- .1 The Department Representative will periodically inspect site conditions and work procedures inside and outside of the work area.
- .2 The Department Representative will perform the following milestone inspections:
  - .1 Milestone Inspection A - Pre-contamination inspection of work area preparation and set-up prior to disturbance and removal of asbestos-containing or asbestos-contaminated materials.
  - .2 Milestone Inspection B - Visual clearance inspection of work area following clean-up work procedures but prior to final tear-down procedures.
  - .3 Milestone Inspection C - Air clearance inspection and air monitoring of work area following Milestone Inspection B and the application of a slow drying sealer in the work area but prior to final tear-down procedures.
  - .4 Milestone Inspection D - Dismantling inspection following final tear-down procedures.

## **Part 2 Products and Facilities**

### **2.1 MATERIALS**

- .1 Deliver all materials and disposable equipment in the original packages, containers, or bundles bearing the name of the manufacturer and the brand name. Material that becomes contaminated with asbestos shall be disposed of in accordance with the applicable regulations.
- .2 Plastic sheet: of 0.25 mm (10 mil) and 0.15 mm (6 mil) thick polyethylene, unless otherwise specified, sized to minimise the frequency of joints.
- .3 Reinforced polyethylene: polyethylene or polyolefin materials, coated on each side, with a unit weight equivalent to or exceeding 107 g/sq. m (4.6 oz/sq. yd) and 12 mil thick.
- .4 Duct Tape: Suitable for sealing polyethylene to surfaces encountered and to itself under both wet and dry conditions including use of amended water.
- .5 Wetting agent: 50% polyoxyethylene ester and 50% polyoxyethylene ether or other product approved by Department Representative mixed with water in concentration to provide total penetration and wetting of asbestos fibre.

- .6 Amended water: Water with non-ionic water surfactant added for purpose of reducing surface tension to allow thorough wetting of asbestos fibre.
- .7 Asbestos waste receptors: 0.25 mm minimum thickness labelled polyethylene. Container must be acceptable to disposal site selected and provincial Ministry of Environment.
- .8 Disposable coveralls: Standard of acceptance - Full body coveralls with attached hood, manufactured by Dupont Tyvek, Kimberley Clarke or approved equal.
- .9 Warning labels and signs: delineating entry and protective equipment requirements and providing warning of the potential health effects of exposure to airborne asbestos fibre.
- .10 Encapsulant: a lock down encapsulant used to seal surfaces post removal meeting the requirements of CAN/CGSB 1.205-94. Standard of acceptance is Foster Chil-Lock CP240.
- .11 Plywood sheeting: good one side 10 mm (3/8") plywood.
- .12 Glove Bag: a clear, prefabricated, purpose-made, co-extruded poly-vinyl-chloride or polyethylene bag with integral gloves of suitable material. Continuous use bags shall be equipped with reversible double-pull, double-throw zippers with protective flaps to facilitate installation and progressive movement along pipe. Collars should be well defined to facilitate sealing the bag around the pipe. Bags with bottom seam or heat seam construction may be rejected at the discretion of the Department Representative.
- .13 Mastic Remover: Blue Bear, BEAN-e-doo mastic remover, Franmar Chemical.
- .14 Degreaser: Blue Bear Cleaner and Degreaser, or equivalent, Franmar Chemical.

## **2.2 TOOLS AND EQUIPMENT**

- .1 Spray equipment for application of amended water or slow drying sealer: Standard of Acceptance-Grayco Hydraspray Airless spray unit.
- .2 HEPA vacuum equipment: appropriate vacuum equipment equipped with High Efficiency Particulate Absolute air filters capable of capturing and retaining 99.97% of all fibrous material 0.3 microns or larger.
- .3 Removal tools: suitable tools for asbestos removal including pliable nylon brushes for the removal of base and finish application.
- .4 Air Movement Equipment: low velocity, high volume centrifugal fan units enclosed in a sealed cabinet incorporating HEPA filter assemblies in their design and manufacture and conforming to specified testing and certification requirements. No air movement equipment shall discharge asbestos fibres outside the work area.
- .5 Temporary Lighting: Grounded halogen light fixtures.
- .6 Temporary Power: 4#8 TECK Feeder Cable and 40 A three (3) pole breaker where required.
- .7 Ground fault electrical panel: temporary service panel NBLP type 100 amp, 120/208 volt, 3 phase wire equipped exclusively with ground fault interrupter circuit.

## **Part 3 Execution**

### **3.1 PREPARATION OF WORK AREA**

- .1 In Low Risk and Moderate Risk Glove Bag work areas:

- .1 Isolate the work area from adjacent building areas, using barricades, hazard warning tape or other means as appropriate.
- .2 Provide a polyethylene drop sheet immediately below the work area.
- .3 Turn-off all HVAC (supply, return, exhaust) serving the work area and seal with poly and tape.
- .4 Provide a worker decontamination area at the entrance to the work area consisting of a bucket of clean tepid water, soap and towels.
- .2 In Moderate Risk work areas:
  - .1 Establish critical barriers at all points of entry to the work area.
  - .2 Cover all openings (windows, doors, ducts, diffusers, etc.) with polyethylene and seal with duct tape. Line finished walls and critical barriers with 0.15 mm (6 mil) plastic sheet and seal with duct tape. Overlap floor linings with wall linings and seal in place along all free edges.
  - .3 Provide a two-stage worker decontamination unit connected to the enclosure complete with a bucket of clean tepid water, soap and towels.
  - .4 Establish negative pressure in the work area with HEPA filtered negative air units. Direct exhaust flow of negative air units to the outside, where possible, and maintain building security.
- .3 In High Risk work areas:
  - .1 Establish critical barriers at all points of entry to the work area.
  - .2 Provide a layer of reinforced polyethylene on the floor of the containment covered by a second layer of at least 6 mil polyethylene sheeting. Lay the floor linings in continuous sheets extending 300 mm (12 inches) up the walls and seal in place along all free edges. Bond floor linings with two-sided adhesive tape to prevent lifting.
  - .3 Line finished walls and critical barriers with 0.15 mm (6 mil) plastic sheet and seal with duct tape. Overlap floor linings with wall linings and seal in place along all free edges.
  - .4 Ensure that the plastic linings provide a continuous barrier and that a seal is maintained around penetrating objects, tears and elsewhere as required by the Department Representative.
  - .5 Remove perimeter ceiling tiles outside of the work area perimeter and install above ceiling critical barriers.
  - .6 Crate over and protect from damage all fixed objects in the removal area.
  - .7 Using HEPA filtered negative air cabinets, establish and maintain 0.02 inches negative pressure. One air change every 15 minutes shall be required. Ensure negative pressure requirements are maintained relative to pressures maintained in existing mechanical systems. Exhaust ducting from all air movement equipment installed in the work area shall extend outside of the building to areas meeting the approval of the Departmental Representative. Air movement equipment shall operate continuously from the time of initial asbestos disturbance until approval of clean-up procedures by the Department Representative or as directed by the Department Representative.

- .8 Remove windows, using qualified trades, to allow exhaust of air movement equipment. Install plywood panels to maintain building security.
- .4 General Preparation Requirements:
  - .1 Low risk personnel protection procedures shall apply during work area preparation if risk of dislodging asbestos exists.
  - .2 De-energize building electrical systems in the work area. Establish a lockout or tag-out procedure, as required by the Department Representative, for de-energization and re-energization of such systems and provide Department Representative with specified submittal requirements. Identify live electrical lines remaining in the work area. Electrical trades to follow low risk work procedures.
  - .3 Isolate building mechanical systems. Shut off all exhaust, supply and return fan units serving work area and implement required lock-out procedures. Install plastic seals reinforced with tape over all duct openings.
  - .4 Discharge, drain and cap fire suppression systems where approved by the Department Representative and authorities having jurisdiction. Where sprinkler systems cannot be drained, cage all sprinkler heads to protect from inadvertent damage. Obtain and follow Department Representative's instructions with regard to foam, carbon dioxide, halogen agent or dry chemical extinguishing systems.
  - .5 Provide and install temporary lighting to provide one (1) lamp for every 20 square metres of work area.
  - .6 Ensure that all holes or openings in existing wall, ceiling and floor structures are adequately sealed.
  - .7 Remove ceiling, floor and wall mounted objects and other moveable objects which interfere with asbestos abatement. Clean and store movable objects in areas designated by the Department Representative or others and protect from re-contamination.
  - .8 Maintain emergency and fire exits from the work areas, or establish alternative exits satisfactory to fire officials.
  - .9 Where boilers or hot water tanks or other gas fired appliances must remain in operation, provide a ducted source of combustion air to each unit. Ensure that the exhaust is effectively sealed in order to prevent back drafting.
  - .10 Seal all elevator and other shafts to prevent air leakage from or into these spaces.

### **3.2 DECONTAMINATION ENCLOSURES**

- .1 Worker Decontamination Unit (Moderate Risk)
  - .1 Worker Decontamination Enclosures shall be constructed in locations approved by the Department Representative.
  - .2 Locate switch for temporary lighting inside the clean room.
  - .3 Locate work area water supply shutoff inside the clean room.
  - .4 Build equipment and access room contiguous with the work area, with two curtain doorways, one to clean room and to work area.
  - .5 Build clean room between equipment and access room and clean areas outside of enclosures, with one curtain doorway leading to equipment and access room.



Provide lockers or hangers for workers' street clothes and personal belongings. Provide storage for clean protective clothing and respiratory equipment. Install mirror to permit workers to fit respiratory equipment properly. Provide one clean towel per worker per decontamination for all workers on site.

- .2 Worker Decontamination Unit (High Risk)
  - .1 Worker Decontamination Enclosures shall be constructed in locations approved by the Departmental Representative.
  - .2 Locate switch for temporary lighting inside the clean room.
  - .3 Locate work area water supply shutoff inside the clean room.
  - .4 Build equipment and access room between shower room and contiguous with the work area, with two curtain doorways, one to shower room and to work area.
  - .5 Build shower room between clean room and equipment and access room, with two curtain doorways, one to clean room and one to equipment and access room. Shower rooms shall be walk through type, ensure entry and exit through actual showers by opposing doors, such that access to clean room from shower room must be through actual showers. Contractor shall provide hot and cold water supply in each work area and must provide a minimum of two shower heads, self-activating pump for disposal of waste water and leak proof connections to water supply.
  - .6 Build clean room between shower room and clean areas outside of enclosures, with one curtain doorway leading to shower room and second lockable door to outside of enclosures. Provide lockers or hangers for workers' street clothes and personal belongings. Provide storage for clean protective clothing and respiratory equipment. Install mirror to permit workers to fit respiratory equipment properly. Provide one clean towel per worker per decontamination for all workers on site.
- .3 Waste Transfer Enclosure (Moderate Risk)
  - .1 Build staging area between contaminated area and holding room with two doorways, one to the contaminated area and one to holding room. Room shall be built of sufficient size to allow proper washing of equipment and drums and/or double bagging of asbestos waste. Wash water shall be treated as asbestos contaminated waste.
  - .2 Build holding room between staging area and un-contaminated area, with two curtain doorways, one to staging area and one to un-contaminated area. Holding room shall be of sufficient size to accommodate largest item of equipment used and all waste containers.
- .4 Waste Transfer Enclosure (High Risk)
  - .1 Build container cleaning room between staging area and holding room with two doorways, one to staging area and one to holding room. Room shall be built of sufficient size to allow proper washing of equipment and drums and/or double bagging of asbestos waste. Wash water shall be treated as asbestos contaminated waste.
  - .2 Build holding room between washroom and un-contaminated area, with two curtain doorways, one to washroom and one to un-contaminated area, and a lockable door to outside of enclosures. Holding room shall be of sufficient size to accommodate largest item of equipment used and all waste containers.

- .5 General Requirements for Decontamination Enclosures
  - .6 Construction shall be of quality and design to assure against leakage of asbestos fibres and/or water to areas outside scope of work.
  - .7 Build curtain doorways designed so when workers or drums and equipment move through doorway, one of two barriers comprising doorways always remains closed.
  - .8 Provide lockable doors at entrances to clean room and holding room of the decontamination enclosure systems.
  - .9 Enclosures shall be maintained in clean and tidy condition.
  - .10 Visually inspect enclosures regularly and at the beginning of each working period. Repair damaged barriers and remedy defects immediately upon discovery.

### 3.3 ASBESTOS DISTURBANCE AND REMOVAL

- .1 Wetting and removal of asbestos materials shall not proceed until Milestone Inspection A (pre-contamination inspection) is undertaken by the Department Representative.
- .2 Pipe Insulation (Glove Bag Method)
  - .1 Glove Bag removal is not recommended for use on active systems in hot service at surface temperatures above 160 degrees Fahrenheit or 70 degrees Celsius. Alternative work procedures and materials shall be necessary for hot service removal. Obtain Department Representative's instruction and approval where appropriate.
  - .2 HEPA vacuum pipe insulation to remove accumulated dust.
  - .3 Place removal tools in bag (tool pouch) and seal bag to pipe using tape to seal bag collars to taped areas on the pipe insulation. Cut entry sleeves and insert HEPA vacuum attachments and spray wands into the bag.
  - .4 Place hands in arm entries and spray asbestos insulation with amended water using approved spray equipment. Cut and remove exposed pipe lagging and thoroughly saturate asbestos insulation prior to and during any removal work. Remove asbestos insulation materials in small sections and place directly into bottom of glove bag. Remove 100 mm (4") of adjacent non-asbestos materials at all pipe fittings.
  - .5 Wash down exposed portion of pipe and top section of bag and thoroughly saturate waste materials in the bottom section of the bag. Use sponges, abrasive pads and other tools to aid in cleaning.
  - .6 Apply sealer encapsulant to exposed pipe. Evacuate the air from the glovebag by switching on the HEPA vacuum prior to removal of the glovebag.
  - .7 Seal glovebag and place in asbestos waste receptor and seal with duct tape. Double bag poly drop sheets and seal.
  - .8 Notify Department Representative of Visual Inspection B.
- .3 Drywall
  - .1 Mist drywall with water to reduce fibre levels.
  - .2 Remove drywall panels and place directly into disposal bags. Remove all debris materials in the work area and dispose as asbestos-contaminated waste.

- .4 Vermiculite
  - .1 Vacuum using HEPA filtered equipment or scoop loose fill insulation and package in asbestos disposal bags. Provide a continual mist of amended water, using approved spray equipment, to reduce airborne fibre levels. Remove drywall panels and place directly into disposal bags. Remove all debris materials in the work area and dispose as asbestos-contaminated waste.
  - .2 Where vermiculite is in hollow masonry walls, open the front face of the blocks to allow complete removal and cleaning of the cavities. Do not allow vermiculite to accumulate and scoop into bags on an on-going basis.
  - .3 The structural integrity of the wall shall be maintained by providing bracing or limiting the number of holes made in the blocks.
  - .4 Using low pressure compressed air blow vermiculite down through the cavities and collect at bottom with HEPA vacuum. NOTE: Should this procedure effect the structural integrity of the wall an alternate method will be required. This method must be approved by the Department Representative.

### **3.4 CLEAN-UP**

- .1 Place asbestos waste and associated debris in sealed asbestos waste receptors. Inner bag shall be cleaned of gross contamination and placed in clean 0.25 mm suitably labelled plastic bag or drum in washroom area of the decontamination enclosure system.
- .2 Wet clean or HEPA vacuum, as appropriate, all surfaces including but not limited to ceiling suspension systems, wooded ceiling joists, mechanical ducting and vents, domestic piping, electrical conduit and wiring and all horizontal and vertical surfaces within the work area.
- .3 Prior to the Department Representatives visual inspection supervisory personnel must perform a visual inspection to ensure the work has been performed as specified.
- .4 Notify Department Representative at suitable stage of final clean-up of requirement for Milestone Inspection B (Visual Clearance Inspection) of work area. Following inspection and acceptance by the Department Representative apply a coat of slow drying sealer to all surfaces in work site including plastic sheeting.
- .5 All HEPA filtered negative air pressure systems, air filtration, and decontamination enclosure systems shall remain in service at this time.
- .6 Allow a minimum of 8-12 hours for fibre settling after moderate risk work with no disturbance of work site before air clearance monitoring. Notify Department Representative of requirement for Milestone Inspection C (Air Clearance Inspection).

### **3.5 TEAR-DOWN**

- .1 Proceed with final tear-down operations when airborne fibre levels in the work area do not exceed acceptable air clearance levels.
- .2 Wet clean or HEPA vacuum entire work area including floor, wall and curtain doorway surfaces to a high standard of cleanliness.
- .3 Tear-down critical barriers, plastic linings, curtain doorways and air-locks and dispose of as contaminated waste. Remove and dispose all asbestos-contaminated materials.
- .4 Dispose of all cloths, mops, sponges, rags, nylon brushes, brooms and any bristled tools as asbestos waste.

- .5 Wet clean and bag all boots, tools before removal from site.
- .6 Clean and seal wood planks and ladders prior to removal from site.
- .7 Final clean-up and dismantling procedures shall be undertaken by workers suitably protected with half face respirators equipped with HEPA filters and disposable coveralls.
- .8 Notify Department Representative at suitable stage of final tear-down requirement for 'Milestone Inspection D' (Final Tear-Down Inspection) of work area.

### **3.6 REPLACEMENT AND RE-ESTABLISHMENT OF OBJECTS AND SYSTEMS**

- .1 When clean-up is complete, ensure that all objects and systems are re-established by qualified trades, including isolated or disconnected electrical and mechanical systems, HVAC systems, fire detection, building security and sprinkler systems. Reinstall, using qualified trades, windows removed to accommodate the work of this section.

### **3.7 DISPOSAL**

- .1 As work progresses, and to prevent exceeding available storage capacity on site, remove sealed and labelled asbestos waste and dispose of in an authorised disposal area in accordance with the requirements of the disposal authority.
- .2 Comply with Federal, Provincial and Municipal authorities regarding the transport and disposal of asbestos waste materials.
- .3 Dumpsters, lockable bins or covered vans only shall be used for the disposal of asbestos. Bins or dumpsters shall be firmly and securely covered with tarpaulins and provided with hazardous waste identification placards at all times and prior to transportation.
- .4 Ensure each shipment of containers to landfill is accompanied by Contractor's representative who shall supervise dumping of containers, supply equipment operators with appropriate personal protective equipment and ensure guidelines and regulations are followed. Each load shall require completion and signing of shipping documents.
- .5 Ensure landfill operator is fully aware of hazardous material being disposed of and equipment operators have been fully briefed in management of asbestos containers after delivery to the landfill.

**END OF SECTION**



# **FINAL Hazardous Building Materials Assessment**

Edmonton Institution  
21611 Meridian Street,  
Edmonton AB

Prepared for:

## **Associated Engineering Alberta Ltd.**

Suite 500, 9888 Jasper Avenue  
Edmonton, AB, T5J 5C6

Attention: Judd Mah, P.Eng. LEED AP  
Mechanical, Buildings Engineer

June 23, 2017

Pinchin File: 179150.000



**Issued to:** Associated Engineering Alberta  
**Contact:** Ltd.  
**Issued on:** Judd Mah, P.Eng. LEED AP  
**Pinchin File:** Mechanical, Buildings Engineer  
**Issuing Office:** June 23, 2017  
179150.000  
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## EXECUTIVE SUMMARY

Associated Engineering Alberta Ltd. (Client) retained Pinchin Ltd. (Pinchin) to conduct a hazardous building materials assessment of the Edmonton Institution located at 21611 Meridian Street, Edmonton AB. Pinchin performed the assessment between May 30, 2017 to June 2, 2017.

The objective of the assessment was to identify specified hazardous building materials in preparation for building renovation in relation to a planned HVAC upgrade. The results of this assessment are intended for use with a properly developed scope of work and performance specification.

The assessed areas were limited to the parts of the building determined to be subject to changes in relation to the planned HVAC upgrade. The assessed areas were limited to the parts of the building affected by the planned HVAC upgrade, delineated by mechanical renovation drawings provided by the Client.

## SUMMARY OF FINDINGS

Asbestos: Asbestos-containing materials (ACM) were confirmed to be present as follows:

- Parging cement insulation on water piping elbows in the Cell Block Tunnels, West Mechanical Rooms, Gym, Executive Services, and Engineering and Maintenance area;
- Drywall joint compound in the Medication Room and Engineering and Maintenance area.

Lead: Lead was confirmed present in select paints/surface.

Silica: Crystalline silica is present in concrete, mortar, brick, masonry, ceramics, granite, slate, stone, asphalt, etc.

Mercury: Mercury vapour is present in fluorescent lamps.

Polychlorinated Biphenyls (PCBs): PCBs are present in light ballasts.

## SUMMARY OF RECOMMENDATIONS

The following is a summary of significant recommendations; refer to the body of the report for detailed recommendations.

1. Remove and properly dispose of asbestos-containing materials prior to demolition or if disturbed by the planned renovation work.
2. Remove and properly dispose of PCB ballasts and mercury-containing items prior to demolition or if disturbed by the planned renovation work.



3. Follow appropriate safe work procedures when handling or disturbing lead and silica.

Please refer to Section 4.0 of this report for detailed recommendations regarding administrative, renovation or demolition activities.

*This Executive Summary is subject to the same standard limitations as contained in the report and must be read in conjunction with the entire report.*





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## APPENDICES

APPENDIX I	Drawings
APPENDIX II-A	Asbestos Analytical Certificates
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## **1.0 INTRODUCTION AND SCOPE**

Associated Engineering Alberta Ltd. (Client) retained Pinchin Ltd. (Pinchin) to conduct a hazardous building materials assessment of the Edmonton Institution, located at 21611 Meridian Street, Edmonton AB.

Ben Frederick, B.Sc., Technologist, performed the assessment between May 30, 2017 to June 2, 2017. The surveyor was accompanied by Keith Harrison, Lead Commissionaire, during the assessment. The building was occupied at the time of the assessment.

The objective of the assessment was to identify specified hazardous building materials in preparation for building renovation in relation to a planned HVAC upgrade. This assessment is intended to be used for pre-construction purposes only, and may not provide sufficient detail for long term management of hazardous materials as required by Health and Safety regulations. The results of this assessment are intended for use with a properly developed scope of work and performance specification.

### **1.1 Scope of Assessment**

The assessment was performed to establish the location and type of specified hazardous building materials incorporated in the structures and its finishes. The assessed areas were limited to the parts of the building affected by the planned HVAC upgrade, delineated by mechanical renovation drawings provided by the Client. The assessment only included items within each area that would be potentially disturbed or removed as part of the renovation.

For the purpose of the assessment and this report, hazardous building materials are defined as follows:

- Asbestos
- Lead
- Silica
- Mercury
- Polychlorinated Biphenyls (PCBs)



## 2.0 BACKGROUND INFORMATION

### 2.1 Building Description

Item	Details
Building Use	Multi-building Maximum Security Prison Complex
Number of Floors/Levels	Two stories, plus one below grade
Year of Construction	1978, with various renovations and additions
Structure	Structural steel, concrete, masonry
Exterior Cladding	Pre-cast concrete, metal siding, brick
HVAC	Rooftop AC, Boiler and hot water heating to radiators
Roof	Built-up roofing
Flooring	Concrete, vinyl tile, vinyl sheet flooring, carpet
Interior Walls	Concrete, drywall, concrete block
Ceilings	Concrete, drywall, acoustic ceiling tiles

### 2.2 Existing Reports

Pinchin was provided, and instructed to rely upon, the following existing reports:

- Asbestos-Containing Building Material Survey Report – Final Edmonton Maximum Security Penitentiary 21611 Meridian Street, Edmonton, Alberta, March 2009. Prepared by PHH ARC Environmental, File No. 6037AX.

## 3.0 FINDINGS

### 3.1 Asbestos

The following section summarizes the findings of the assessment and provides a general description of the asbestos materials identified and their locations. Appendix II-A presents the asbestos bulk sample analytical results. For details on quantities, assessment and locations of asbestos materials; refer to the Hazardous Material Summary Report and All Data Report in Appendix V and VI.

### 3.1.1 *Suspect Materials Not Found*

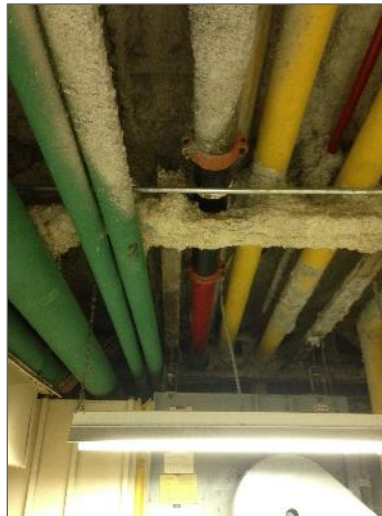
The following types of building materials may historically contain asbestos but were not observed in the assessed area, or deemed to be impacted by the renovation, and are not discussed in the report findings:

- Plaster
- Asbestos cement products
- Vinyl sheet flooring
- Vinyl floor tiles and mastic

### 3.1.2 *Spray-Applied Fireproofing and Thermal Insulation*

Spray-applied fireproofing is present in the East Mechanical Room, West Mechanical Room, Southwest Mechanical Room, Segregation Block Mechanical Room, and the Segregation Mechanical Room.

Asbestos was not detected in the fireproofing samples.



Non-asbestos fireproofing present within various mechanical rooms.

### 3.1.3 *Texture Finishes (Acoustic/Decorative)*

Texture finish is present on drywall ceilings in the Chapel. No asbestos was detected in the texture coat samples.



Non-asbestos texture coat present in the Chapel.

### 3.1.4 Thermal Systems Insulation (TSI)

#### 3.1.4.1 Pipe Insulation

Parging cement, containing asbestos, is present on pipe elbows related to the HVAC systems.

Non-asbestos fibreglass insulation is present on straight sections of pipe in all observed areas. There was no asbestos parging cement noted on the seams of the insulation at the locations inspected.



Asbestos pipe elbow in Cell Block Tunnels



Asbestos pipe elbows in Executive Services

#### 3.1.4.2 Duct Insulation

Ducts are either uninsulated or insulated with non-asbestos fibreglass and jacketed with either canvas or foil.



Example of non-asbestos ducting present.

### 3.1.4.3 *Mechanical Equipment Insulation*

Mechanical equipment is either uninsulated or insulated with non-asbestos fibreglass.



Example of mechanical equipment present.



Example of uninsulated mechanical equipment present.

### 3.1.4.4 *Vermiculite*

Loose fill vermiculite is not present in the assessed areas. Demolition of exterior masonry block walls was not performed as they are outside of this assessments scope, therefore vermiculite may be present within these cavities.

### 3.1.5 *Mortar*

Block wall mortar was samples within the Segregation Block Mechanical Room / Segregation Mechanical Room. The mortar returned as non-asbestos.



### 3.1.6 Acoustic Ceiling Tiles

A total of three distinct types of lay-in ceiling tile are present within the assessed area. Most ceiling tiles are presumed to be non-asbestos based on the date of manufacture determined from the date stamp applied to the top of the tiles or the age of the materials determined from the age of the building or the renovation. The tiles were manufactured after asbestos stopped being used in acoustic ceiling tiles. All other tiles in the assessed areas that did not display a date stamp were sampled and were determined not contain asbestos.



Non-asbestos lay-in ceiling tiles, Sample S0012, Contact Visiting Room.



Non-asbestos lay-in ceiling tiles, Sample S0023, Engineering And Maintenance.

### 3.1.7 Drywall Joint Compound

Drywall (gypsum board) and drywall joint compound is present as a wall and ceiling finish in many of the assessed areas. Based on the results of the testing, the drywall joint compound in the Medication Room and Engineering and Maintenance areas contains chrysotile asbestos.



Asbestos containing Drywall Joint Compound in Medication Room



Asbestos containing Drywall Joint Compound in room S22, Engineering and Maintenance



### 3.1.8 Sealants, Caulking, and Putty

Caulking at exterior windows and doors was outside of this assessments scope so were not sampled.

Four distinct colours of duct joint mastic were present in the assessed areas. All mastics were analysed for asbestos content and were not asbestos containing.



Non-asbestos "silver" mastic, Sample S0006, Southwest Mechanical Room.



Non-asbestos "red" mastic, Sample S0007, Southwest Mechanical Room.



Non-asbestos "brown" mastic, Sample S0008, Southwest Mechanical Room.



Non-asbestos "grey" mastic, Sample S0016, Segregation Block Mechanical Room.

### 3.1.9 Roofing Products

Built-up roofing is present on the roof over the entire assessment areas. The built up roofing materials do not contain asbestos (sample S0020A-H).



Non-asbestos roofing materials.

### 3.1.10 Presumed Asbestos Materials

A number of materials which might contain asbestos were not sampled during our assessment due to limitations in scope and methodology. Where present, these materials must be presumed to be an asbestos material and are best sampled during project planning and preparation of contract documents for their removal. Materials presumed to contain asbestos include:

- concrete floor levelling compound
- electrical components or wiring within control centers, breakers, motors or lights, insulation on wiring
- moulded plastic components (laboratory bench tops)
- vermiculite in concrete block wall cavities
- caulking
- fibre reinforced paints coatings
- paper products under wood flooring or metal or slate roofing
- mechanical packing, ropes and gaskets
- fire resistant doors or metal clad finishes
- exterior cladding

## 3.2 Lead

### 3.2.1 Paints and Surface Coatings

A total of nine paint samples were collected from interior painted finishes. All paints containing elevated levels of lead were found to be in good condition and not flaking, peeling or delaminating. For details on the types, location, results of paints sampled, refer to Appendix VI.



Lead-based "yellow" paint, Sample L0001.



Lead-based "beige" paint, Sample L0002.



Lead-based "brown" paint, Sample L0003.



Lead-based "white" paint, Sample L0004.



Lead-based "beige" wall paint, Sample L0005.



Lead-based "beige" paint, Sample L0006.



Lead-based "pinkish-brown over beige" paint, Sample L0007.



Lead-based "grey" paint, Sample L0008.

Grey wall and ceiling paint that did not have elevated levels of lead was flaking/peeling in the A and B Cell Blocks, central area:



Peeling non-lead based paint in Cell Block A and B office

Appendix II-B presents the lead testing results.

### 3.2.2 Lead Products and Applications

Lead products were not found within the scope of this survey.

### 3.2.3 Presumed Lead Materials

Lead may be present in a number of materials which were not assessed and/or sampled. The following materials, where found, should be considered to contain lead.

- electrical components, including wiring connectors
- grounding conductors, and solder
- glazing on ceramic tiles

### **3.3 Silica**

Crystalline silica is a presumed component of the following materials where present in the building:

- poured or pre-cast concrete
- masonry and mortar
- stone (granite, slate)
- refractory or ceramic materials in high temperature mechanical or production equipment
- ceramic tiles, grout
- plaster

### **3.4 Mercury**

#### *3.4.1 Lamps*

Mercury vapour is present in fluorescent light tubes.

#### *3.4.2 Mercury-Containing Devices*

Thermostats inspected did not contain liquid mercury ampules.

### **3.5 Polychlorinated Biphenyls**

#### *3.5.1 Caulking*

Caulking was not present in the scope of this survey, so it was not sampled.

#### *3.5.2 Lighting Ballasts*

The building has not been comprehensively re-lamped with new energy efficient light ballasts and lamps, and as such, a percentage of light ballasts will be pre-1980 and contain PCBs.

#### *3.5.3 Transformers*

Transformers were not found during the assessment.

#### *3.5.4 Presumed PCB Materials*

- oil impregnated cables and potheads
- voltage regulators
- hydraulic fluids
- paints

### **3.6 Mould**

Visible mould growth was not found on materials during the assessment.

## **4.0 RECOMMENDATIONS**

### **4.1 General**

1. Prepare plans and performance specifications for hazardous material removal for the planned work. The specifications should include the scope of work, safe work practices, and risk assessments
2. Provide this report and the detailed plans and specifications to the contractor prior to bidding or commencing work.
3. Retain a qualified consultant to specify, inspect and verify the successful removal of hazardous materials.
4. Update the asbestos inventory upon completion of the abatement and removal of asbestos-containing materials.

### **4.2 Building Demolition or Renovation Work**

The following recommendations are made regarding demolition or renovation involving the hazardous materials identified.

#### **4.2.1 Asbestos**

Remove all asbestos-containing materials (ACM) prior to renovation, alteration, maintenance or demolition work or if ACM may be disturbed by the work.

If the identified ACM will not be removed prior to commencement of the work, disturbance of ACM must follow the appropriate asbestos precautions for the classification of work being performed.

Asbestos-containing materials must be disposed of at a landfill approved to accept asbestos waste.

#### **4.2.2 Lead**

Construction disturbance of lead in paint and coatings (or other materials) may result in over-exposure to lead dust or fumes. The need for work procedures, engineering controls and personal protective equipment will need to be assessed on a project-by-project basis and must comply with provincial standards or guidelines. Performing an exposure assessment during work that disturbs lead in paints and coatings may be able to alleviate the use of some of the precautions specified by these standards or guidelines.





Items painted with paints containing elevated levels of lead may be a hazardous waste. Test lead-painted materials for leachable lead and other metals prior to disposal.

#### *4.2.3 Silica*

Construction disturbance of silica-containing products may result in excessive exposures to airborne silica, especially if performed indoors and dry. Cutting, grinding, drilling or demolition of materials containing silica should be completed only with proper respiratory protection and other worker safety precautions that comply with provincial standards or guidelines.

#### *4.2.4 Mercury*

Do not break lamps or separate liquid mercury from components. Recycle and reclaim mercury from fluorescent lamps when taken out of service. Liquid mercury is classified as a hazardous waste and must be disposed of in accordance with local regulations.

#### *4.2.5 PCBs*

When light fixtures are removed, examine light ballasts for PCB content. If ballasts are not clearly labelled as "non-PCB", or are suspected to contain PCBs; package and ship ballasts for destruction at a federally permitted facility.

#### *4.2.6 Mould*

No mould was observed. If mould is uncovered inside wall cavities during hand demolition, use appropriate precautions and protect workers using methods that comply with provincial guidelines.



## **5.0 TERMS AND LIMITATIONS**

This work was performed subject to the Terms and Limitations presented or referenced in the proposal for this project.

Information provided by Pinchin is intended for Client use only. Pinchin will not provide results or information to any party unless disclosure by Pinchin is required by law. Any use by a third party of reports or documents authored by Pinchin or any reliance by a third party on or decisions made by a third party based on the findings described in said documents, is the sole responsibility of such third parties. Pinchin accepts no responsibility for damages suffered by any third party as a result of decisions made or actions conducted. No other warranties are implied or expressed.





## 6.0 REFERENCES

The following legislation and documents were referenced in completing the assessment and this report:

1. Alberta Asbestos Abatement Manual, Government of Alberta Human Services, October 2012.
2. Occupational Health and Safety Act, Regulations and Code, Province of Alberta, 2009.
3. Environmental Protection and Enhancement Act, Waste Control Regulation, Alberta Regulation 192/96.
4. Alberta User Guide for Waste Managers, Alberta Environment and Sustainable Resource Development, 1989.
5. Guidelines for the Disposal of Asbestos Waste, Alberta Environment and Sustainable Resource Development, 1996.
6. Ozone-depleting Substances and Halocarbons Regulation, 181/2000, Alberta Environment.
7. PCB Regulations, SOR/2008-273, Canadian Environmental Protection Act.
8. Transportation of Dangerous Goods Regulations SOR/2008-34, Transportation of Dangerous Goods Act.
9. Workplace Health and Safety Bulletin, Lead at the Work Site, Government of Alberta, Employment and Immigration, November 2013.
10. Best Practices Mould at the Work Site, Government of Alberta, Employment and Immigration, July 2009.

Template: Master Report for Hazardous Materials Assessment Report (Tablet Pre-Construction), HAZ, January 16, 2017

**APPENDIX I**  
**Drawings**



- LEGEND:
- (X) LOCATION NUMBER
  - ⊙ NEGATIVE ASBESTOS SAMPLE LOCATION
  - ⊙ POSITIVE ASBESTOS SAMPLE LOCATION
  - ⚠ NEGATIVE LEAD PAINT SAMPLE LOCATION
  - ⚠ POSITIVE LEAD PAINT SAMPLE LOCATION

CLIENT:  
ASSOCIATED ENGINEERING  
ALBERTA LTD.  
SUITE 500, 9888 JASPER AVENUE  
EDMONTON, ALBERTA T5J 5C6

LOCATION:  
21611 MERIDIAN STREET  
EDMONTON, ALBERTA T5Y 6E7

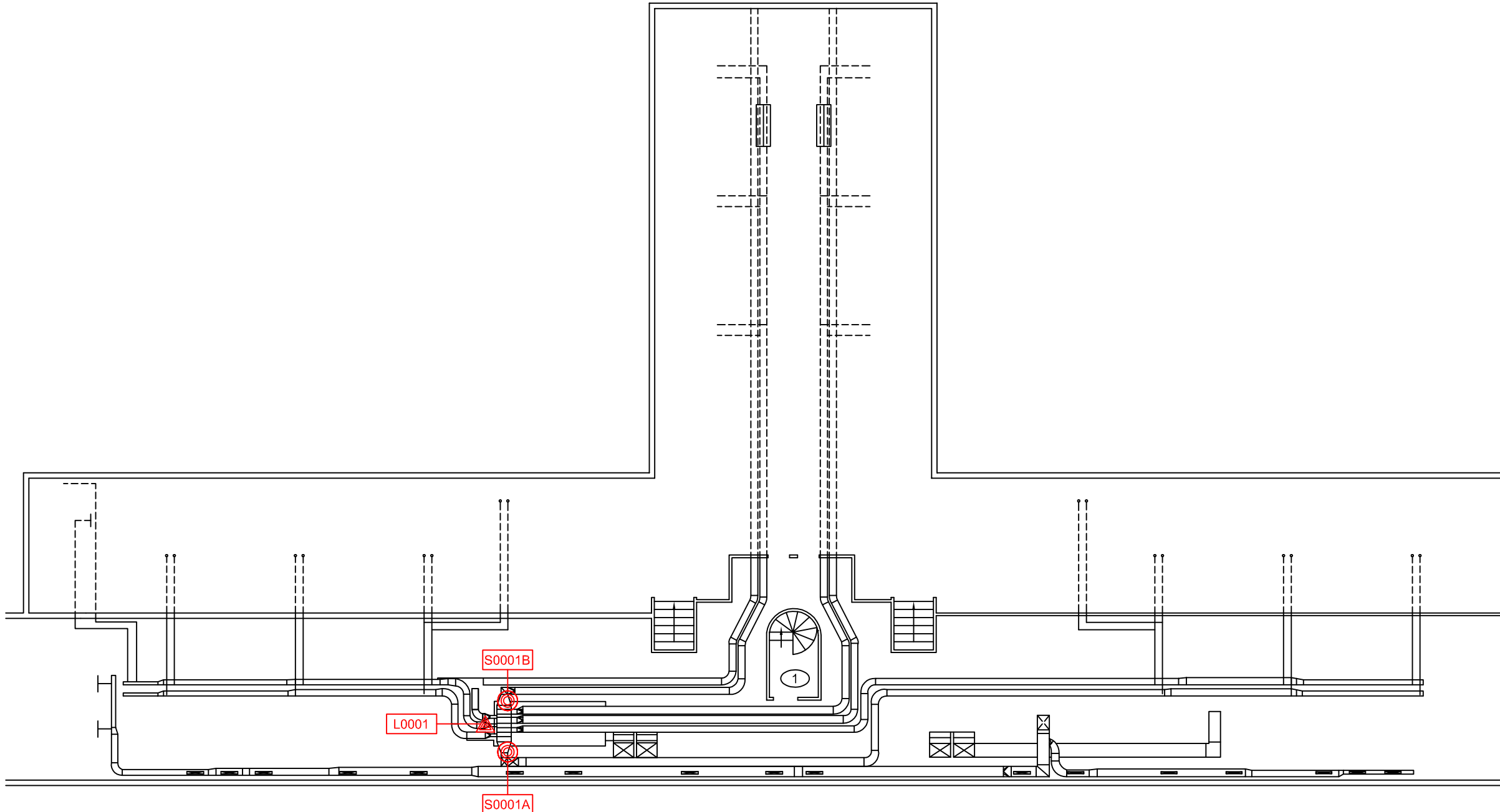
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HVAC UPGRADE HAZARDOUS  
MATERIALS ASSESSMENT  
EDMONTON INSTITUTION

DATE: 2017/06/20	PROJECT # : 179150
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DRAWN BY: CS	DRAWING:  1 OF 19
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CHECKED BY: SM
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SCALE: NTS
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- NOTES:
- ALL DRAWINGS TO BE REFERENCED WITH THE HAZARDOUS MATERIALS ASSESSMENT REPORT. NOT ALL KNOWN OR SUSPECT HAZARDOUS MATERIALS ARE DEPICTED ON THIS DRAWING. REFER TO THE HAZARDOUS MATERIALS ASSESSMENT REPORT FOR A COMPLETE LIST OF IDENTIFIED HAZARDOUS MATERIALS.
  - BASEPLAN PROVIDED BY THE CLIENT.
  - LEGEND IS COLOUR DEPENDENT, PHOTOCOPIES MAY ALTER INTERPRETATION OF FIGURE.



LEGEND:

- (X) LOCATION NUMBER  
⊙ NEGATIVE ASBESTOS SAMPLE LOCATION  
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▲ NEGATIVE LEAD PAINT SAMPLE LOCATION  
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MATERIALS ASSESSMENT  
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2017/06/20

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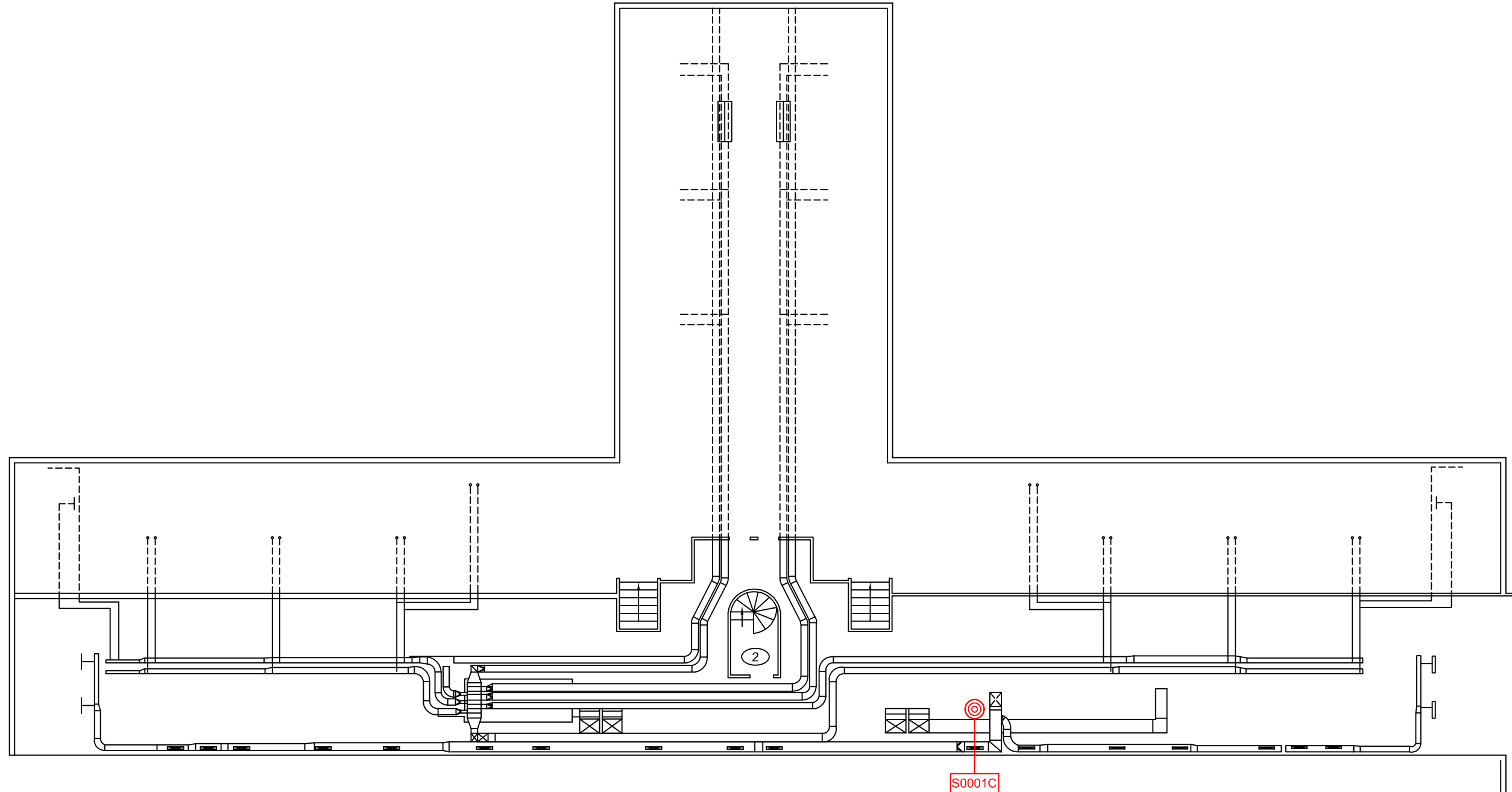
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  - ⊗ POSITIVE ASBESTOS SAMPLE LOCATION
  - ▲ NEGATIVE LEAD PAINT SAMPLE LOCATION
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EDMONTON, ALBERTA T5J 5C6

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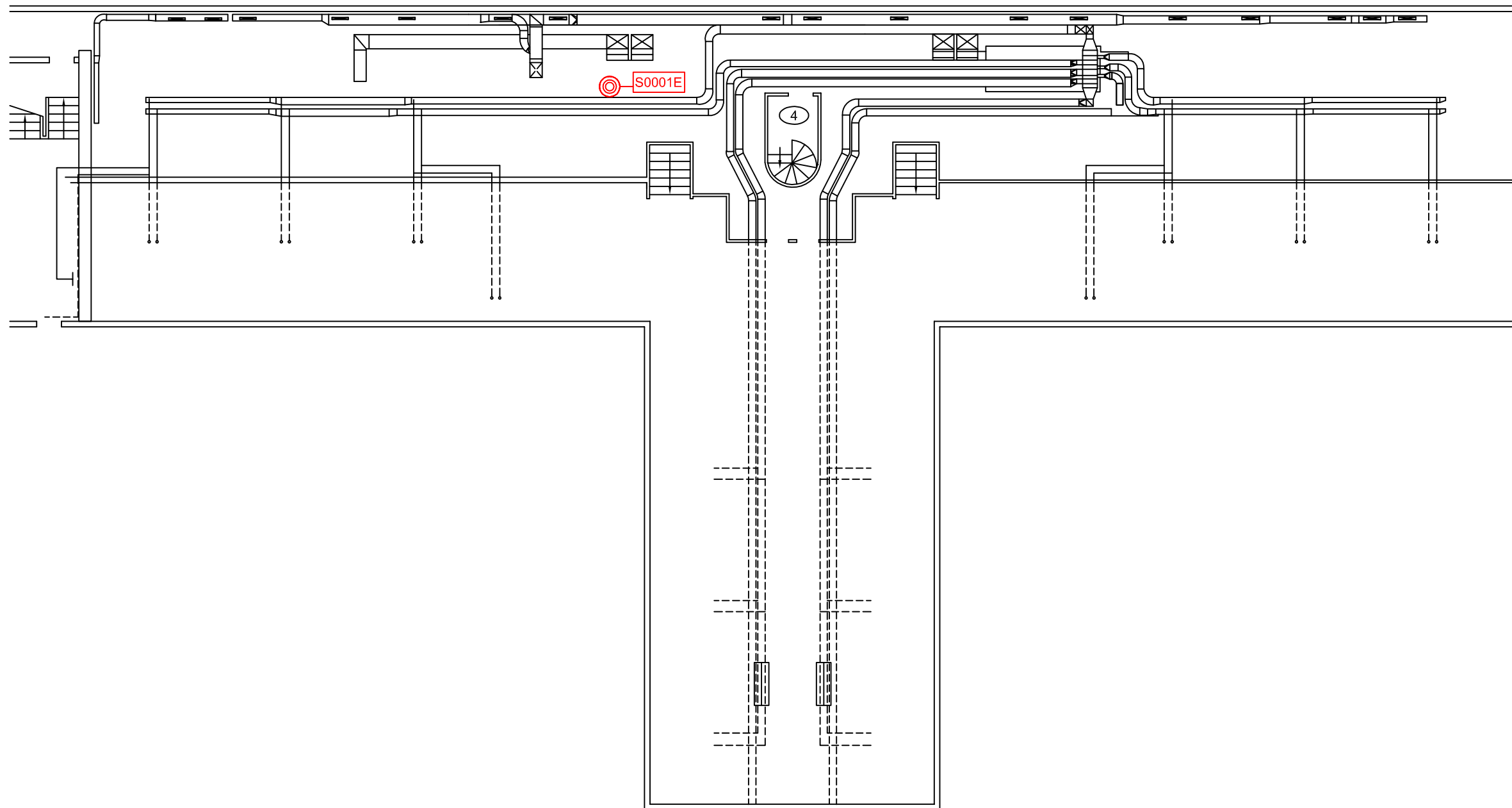
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DATE: 2017/06/20	PROJECT # : 179150
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CHECKED BY: SM
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SCALE: NTS
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LOCATION:

21611 MERIDIAN STREET  
EDMONTON, ALBERTA T5Y 6E7

TITLE:

HVAC UPGRADE HAZARDOUS  
MATERIALS ASSESSMENT  
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DATE:

2017/06/20

PROJECT # :

179150

DRAWN BY:

CS

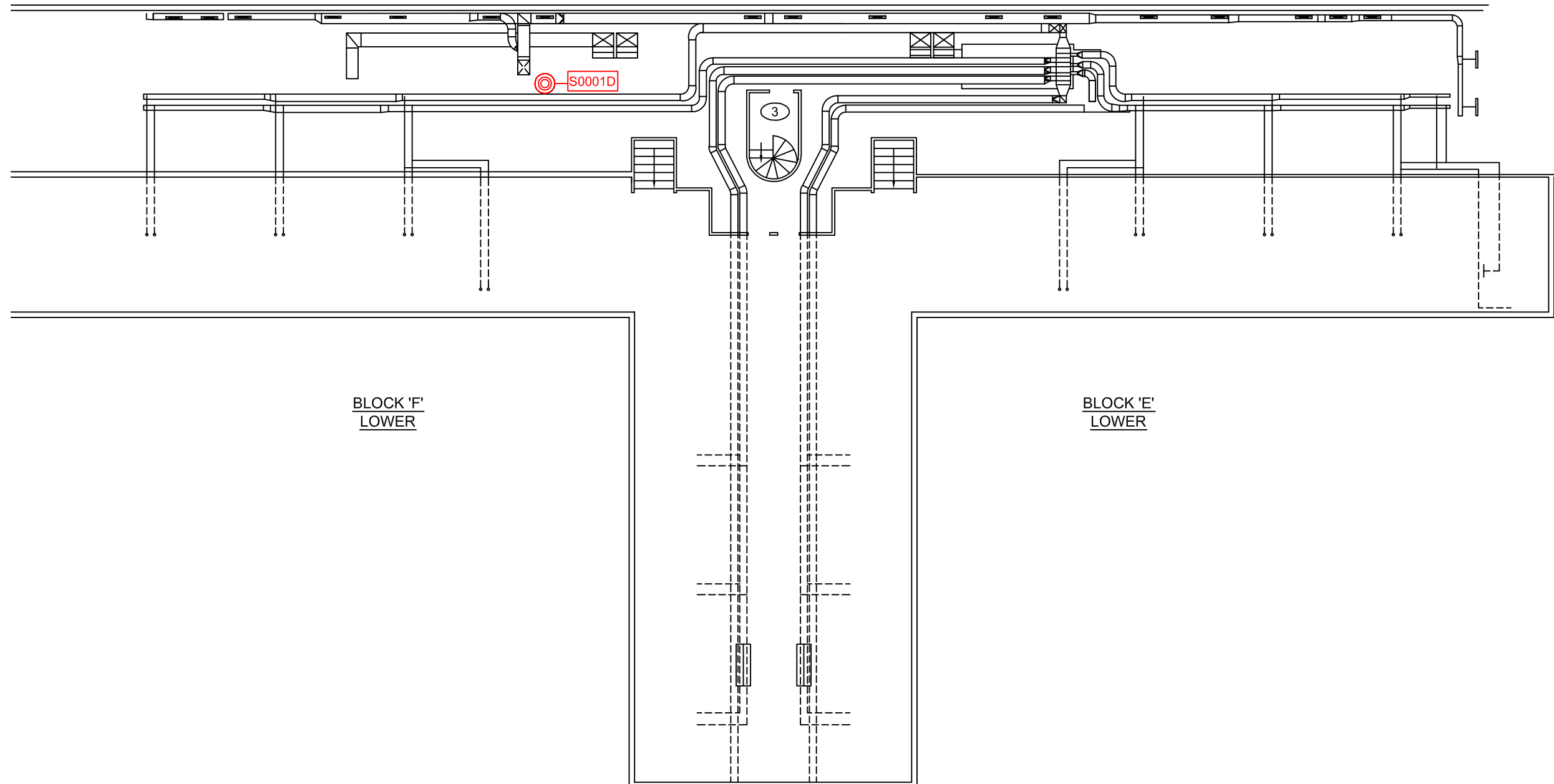
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4 OF 19



NOTES:

- ALL DRAWINGS TO BE REFERENCED WITH THE HAZARDOUS MATERIALS ASSESSMENT REPORT. NOT ALL KNOWN OR SUSPECT HAZARDOUS MATERIALS ARE DEPICTED ON THIS DRAWING. REFER TO THE HAZARDOUS MATERIALS ASSESSMENT REPORT FOR A COMPLETE LIST OF IDENTIFIED HAZARDOUS MATERIALS.
- BASEPLAN PROVIDED BY THE CLIENT.
- LEGEND IS COLOUR DEPENDENT, PHOTOCOPIES MAY ALTER INTERPRETATION OF FIGURE.



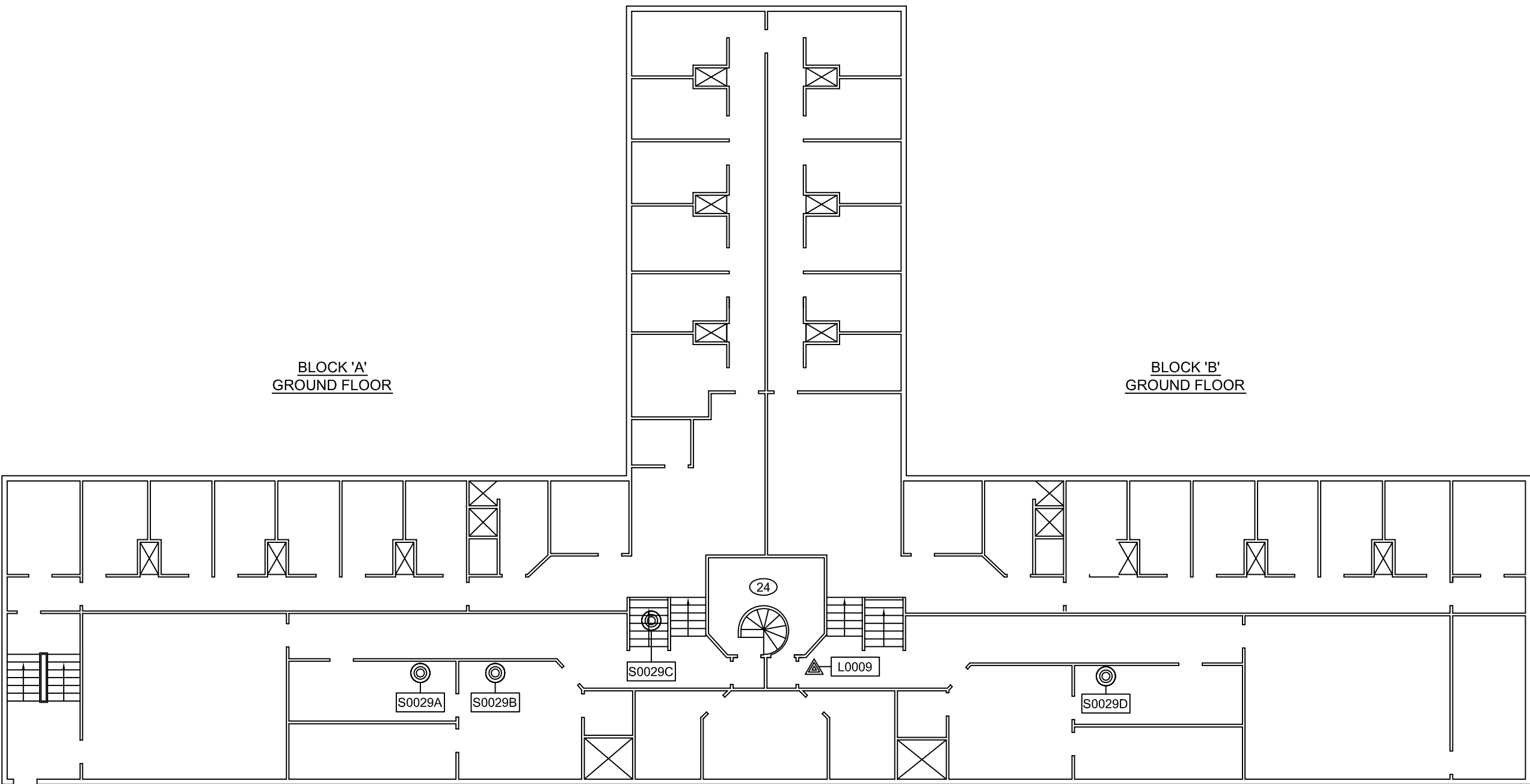
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  - ⊙ POSITIVE ASBESTOS SAMPLE LOCATION
  - ▲ NEGATIVE LEAD PAINT SAMPLE LOCATION
  - ▲ POSITIVE LEAD PAINT SAMPLE LOCATION

CLIENT:  
ASSOCIATED ENGINEERING  
ALBERTA LTD.  
SUITE 500, 9888 JASPER AVENUE  
EDMONTON, ALBERTA T5J 5C6

LOCATION:  
21611 MERIDIAN STREET  
EDMONTON, ALBERTA T5Y 6E7

TITLE:  
HVAC UPGRADE HAZARDOUS  
MATERIALS ASSESSMENT  
EDMONTON INSTITUTION

DATE: 2017/06/20	PROJECT # : 179150
DRAWN BY: CS	DRAWING:  5 OF 19
CHECKED BY: SM	
SCALE: NTS	



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- LEGEND:
- (X) LOCATION NUMBER
  - ⊙ NEGATIVE ASBESTOS SAMPLE LOCATION
  - ⊙ POSITIVE ASBESTOS SAMPLE LOCATION
  - ▲ NEGATIVE LEAD PAINT SAMPLE LOCATION
  - ▲ POSITIVE LEAD PAINT SAMPLE LOCATION

CLIENT:  
ASSOCIATED ENGINEERING  
ALBERTA LTD.  
SUITE 500, 9888 JASPER AVENUE  
EDMONTON, ALBERTA T5J 5C6

LOCATION:  
21611 MERIDIAN STREET  
EDMONTON, ALBERTA T5Y 6E7

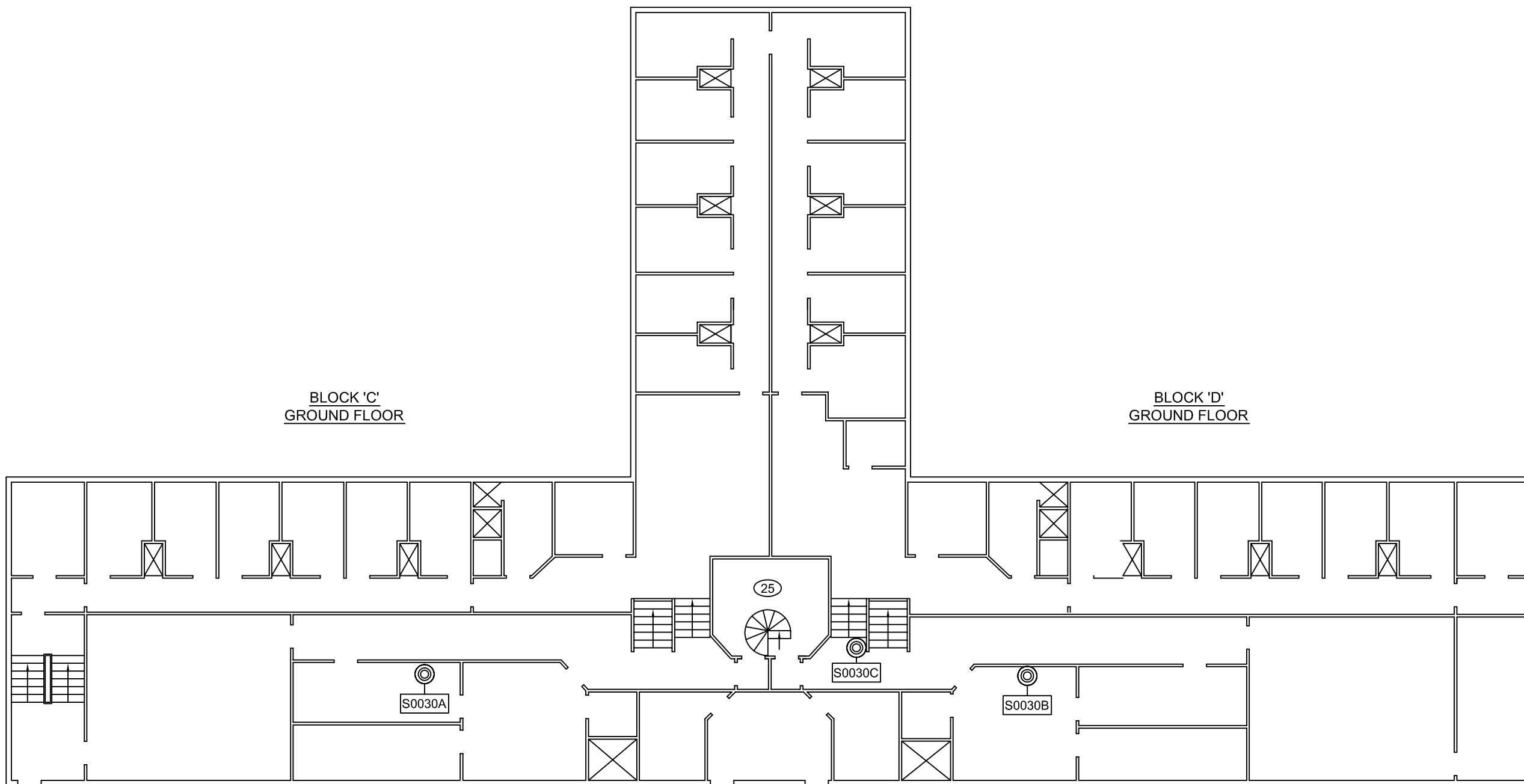
TITLE:  
HVAC UPGRADE HAZARDOUS  
MATERIALS ASSESSMENT  
EDMONTON INSTITUTION  
GROUND FLOOR

DATE: 2017/06/20	PROJECT # : 179150
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DRAWN BY: CS	DRAWING:  <b>6 OF 19</b>
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CHECKED BY: SM
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SCALE: NTS
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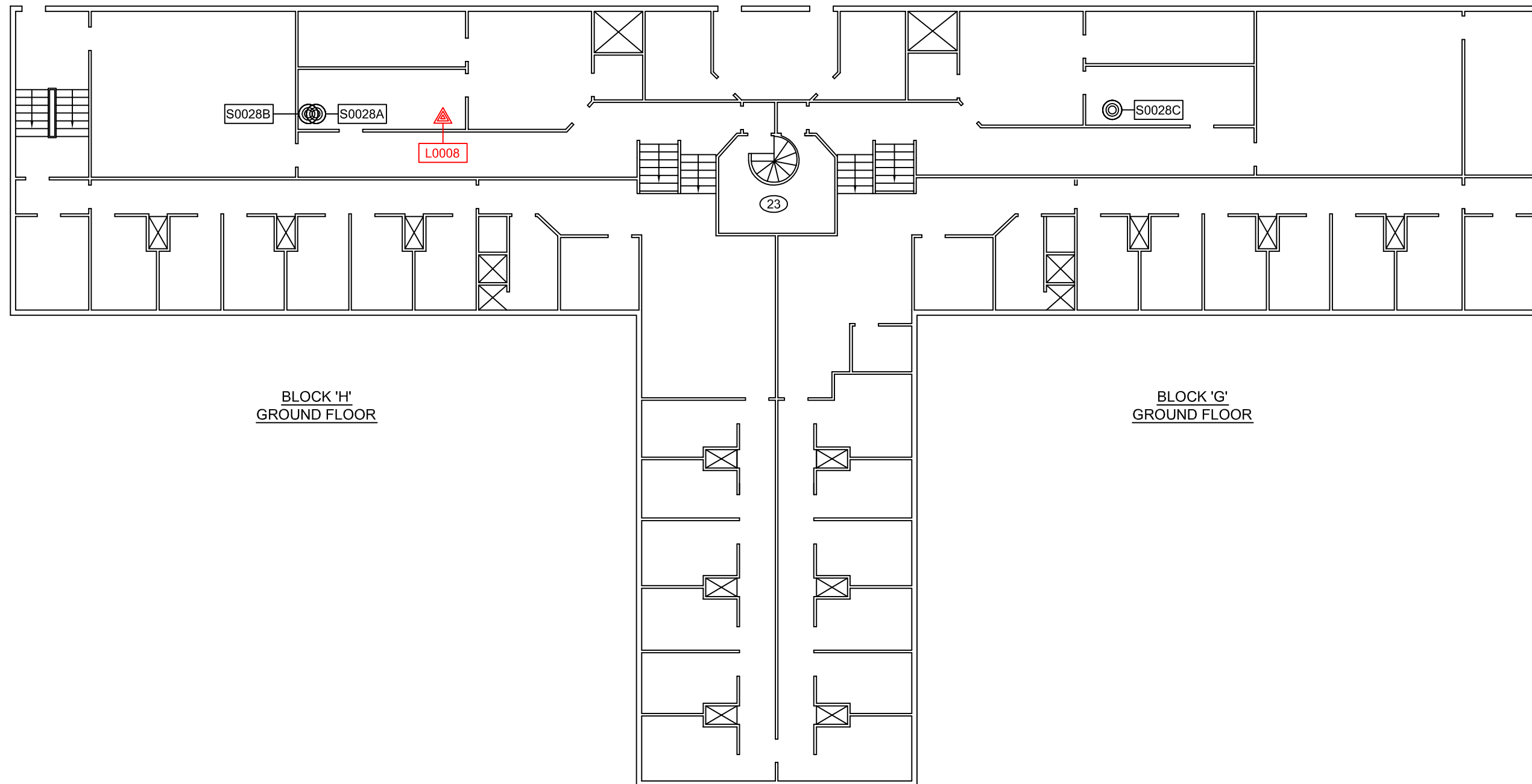
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LEGEND:

- (X) LOCATION NUMBER
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- ⊙ POSITIVE ASBESTOS SAMPLE LOCATION
- ▲ NEGATIVE LEAD PAINT SAMPLE LOCATION
- ▲ POSITIVE LEAD PAINT SAMPLE LOCATION



BLOCK 'H'  
GROUND FLOOR

BLOCK 'G'  
GROUND FLOOR

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CLIENT: ASSOCIATED ENGINEERING ALBERTA LTD. SUITE 500, 9888 JASPER AVENUE EDMONTON, ALBERTA T5J 5C6	
LOCATION: 21611 MERIDIAN STREET EDMONTON, ALBERTA T5Y 6E7	
TITLE: HVAC UPGRADE HAZARDOUS MATERIALS ASSESSMENT EDMONTON INSTITUTION	
DATE: 2017/06/20	PROJECT # : 179150
DRAWN BY: CS	DRAWING:  7 OF 19
CHECKED BY: SM	
SCALE: NTS	



LEGEND:

- (X) LOCATION NUMBER
- ⊙ NEGATIVE ASBESTOS SAMPLE LOCATION
- ⊗ POSITIVE ASBESTOS SAMPLE LOCATION
- ▲ NEGATIVE LEAD PAINT SAMPLE LOCATION
- ▲ POSITIVE LEAD PAINT SAMPLE LOCATION

CLIENT:

ASSOCIATED ENGINEERING  
ALBERTA LTD.  
SUITE 500, 9888 JASPER AVENUE  
EDMONTON, ALBERTA T5J 5C6

LOCATION:

21611 MERIDIAN STREET  
EDMONTON, ALBERTA T5Y 6E7

TITLE:

HVAC UPGRADE HAZARDOUS  
MATERIALS ASSESSMENT  
EDMONTON INSTITUTION

DATE:

2017/06/20

PROJECT # :

179150

DRAWN BY:

CS

CHECKED BY:

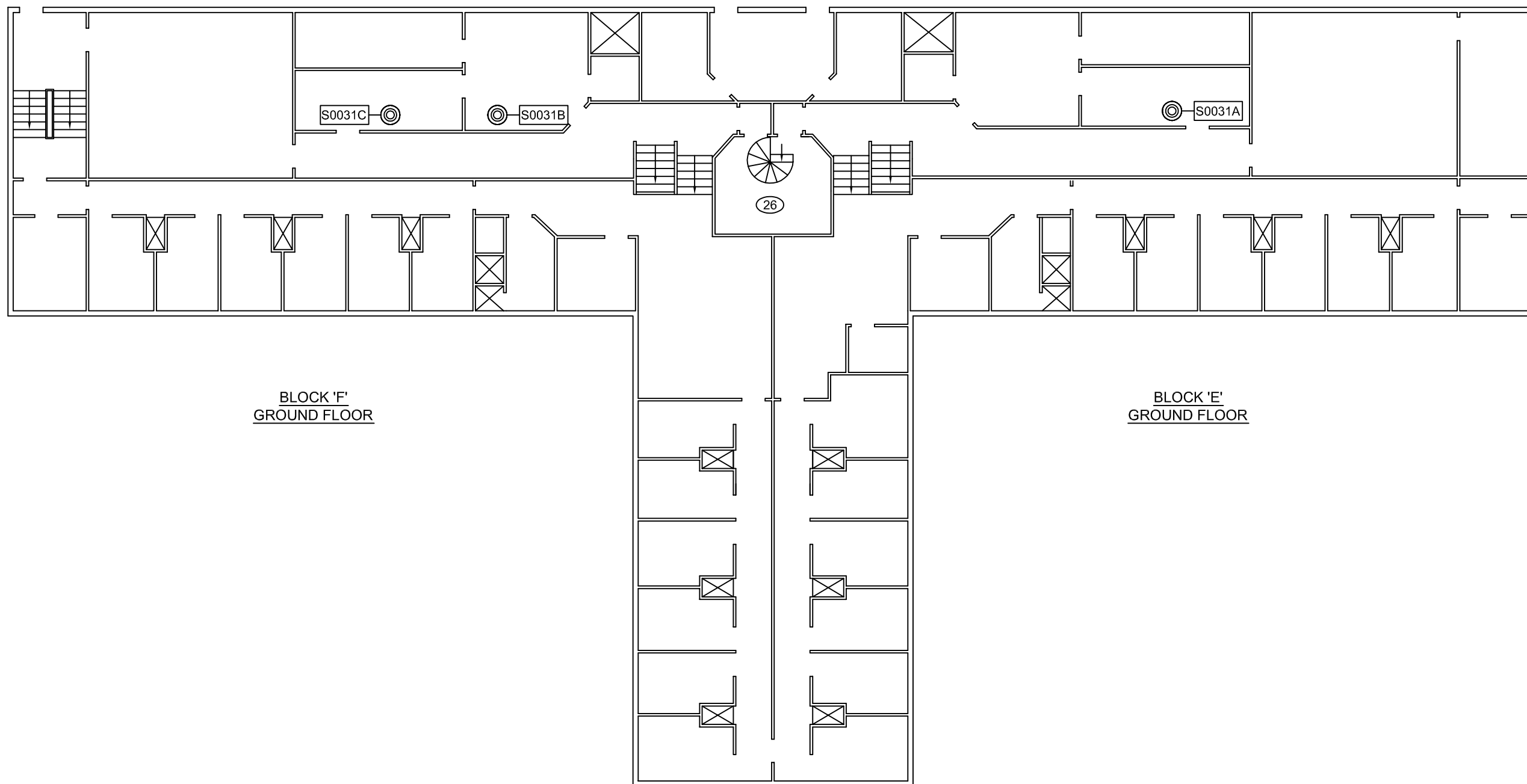
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SCALE:

NTS

8 OF 19

PA2017060293

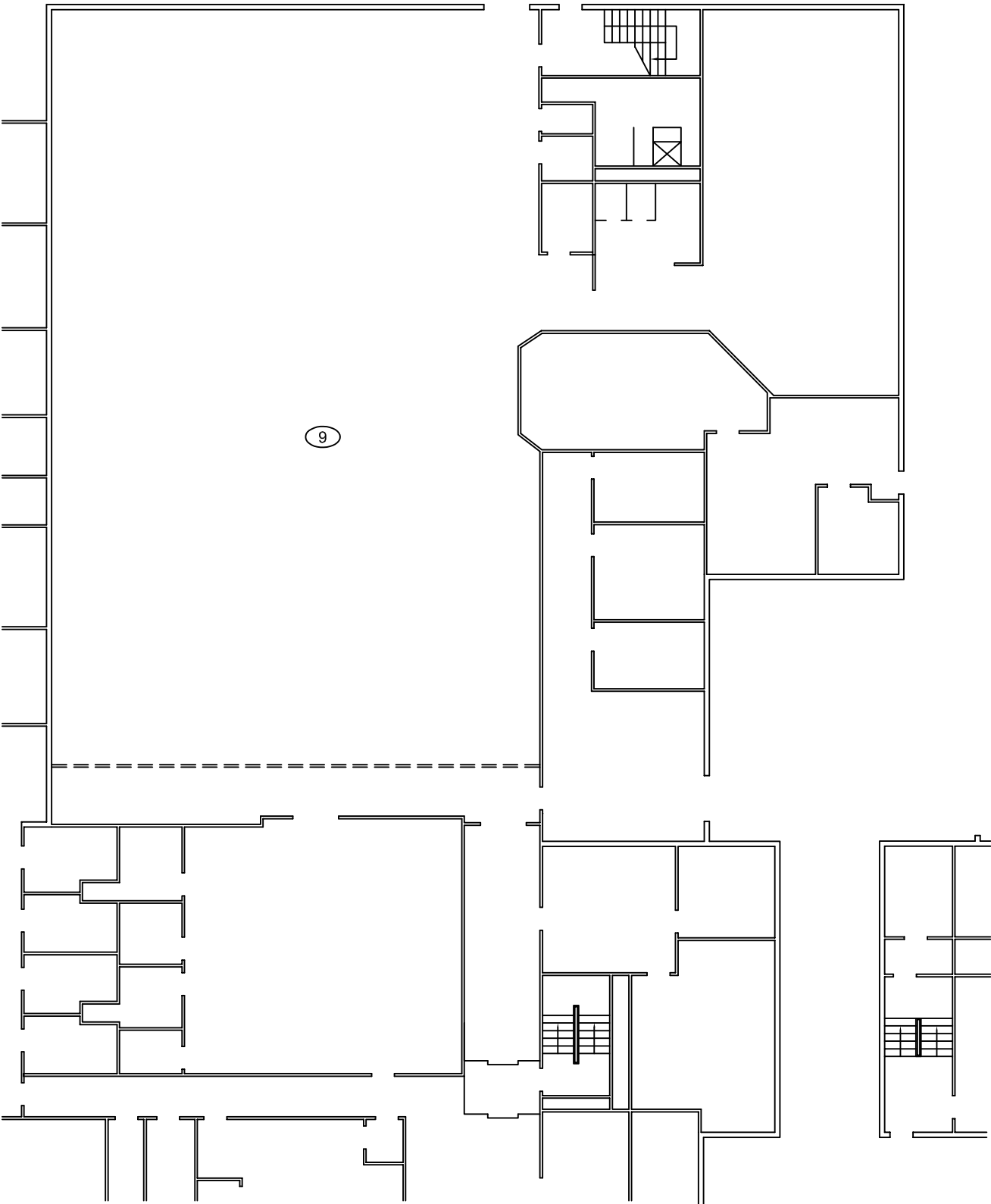


BLOCK 'F'  
GROUND FLOOR

BLOCK 'E'  
GROUND FLOOR

NOTES:

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  - ▲ NEGATIVE LEAD PAINT SAMPLE LOCATION
  - ▲ POSITIVE LEAD PAINT SAMPLE LOCATION

CLIENT:  
ASSOCIATED ENGINEERING  
ALBERTA LTD.  
SUITE 500, 9888 JASPER AVENUE  
EDMONTON, ALBERTA T5J 5C6

LOCATION:  
21611 MERIDIAN STREET  
EDMONTON, ALBERTA T5Y 6E7

TITLE:  
HVAC UPGRADE HAZARDOUS  
MATERIALS ASSESSMENT  
EDMONTON INSTITUTION

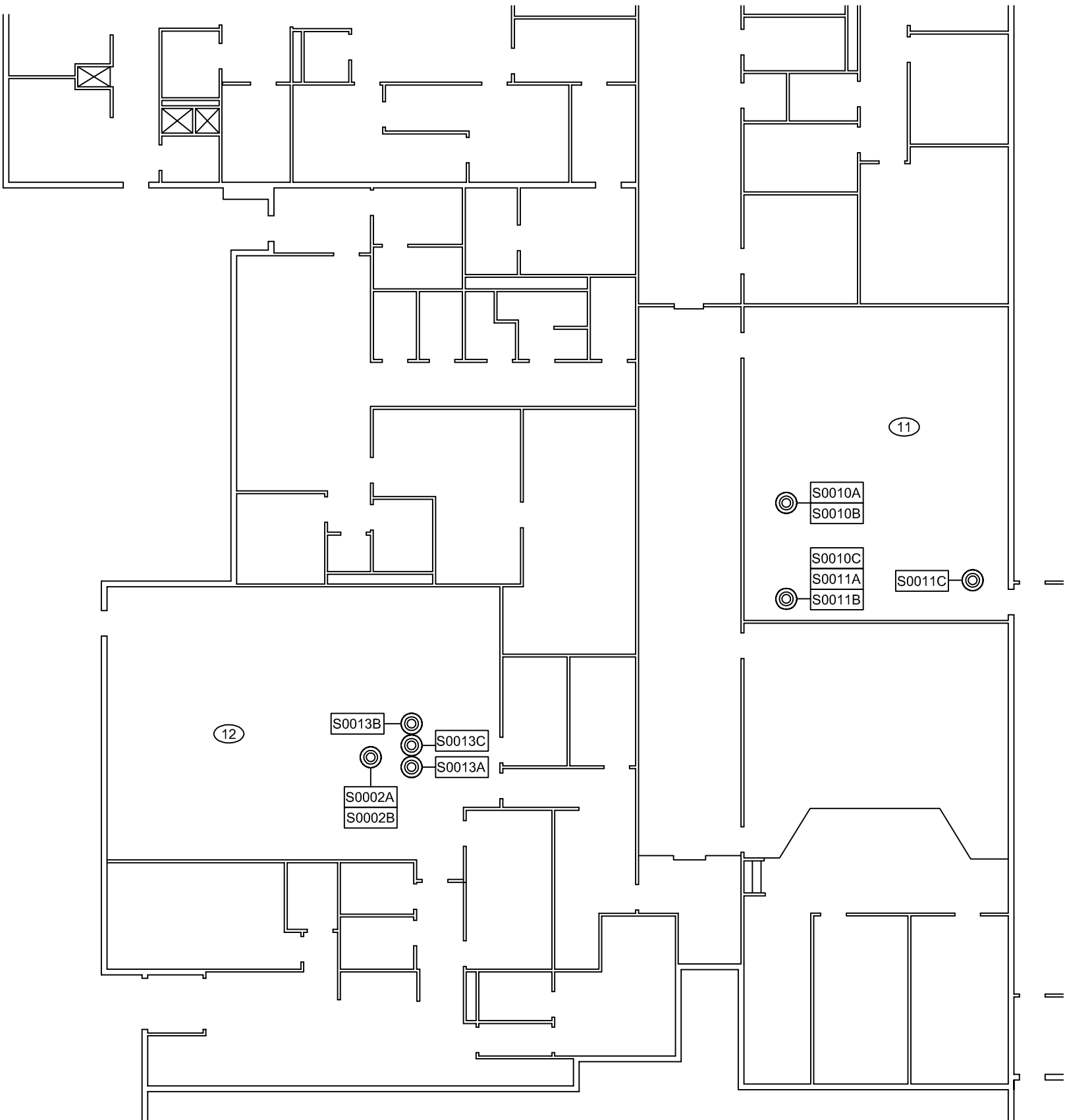
DATE: 2017/06/20	PROJECT # : 179150
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DRAWN BY: CS	DRAWING:  <b>9 OF 19</b>
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CHECKED BY: SM
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SCALE: NTS
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- NOTES:
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  - ⊙ POSITIVE ASBESTOS SAMPLE LOCATION
  - ▲ NEGATIVE LEAD PAINT SAMPLE LOCATION
  - ▲ POSITIVE LEAD PAINT SAMPLE LOCATION

CLIENT: ASSOCIATED ENGINEERING ALBERTA LTD. SUITE 500, 9888 JASPER AVENUE EDMONTON, ALBERTA T5J 5C6	
LOCATION: 21611 MERIDIAN STREET EDMONTON, ALBERTA T5Y 6E7	
TITLE: HVAC UPGRADE HAZARDOUS MATERIALS ASSESSMENT EDMONTON INSTITUTION	
DATE: 2017/06/20	PROJECT # : 179150
DRAWN BY: CS	DRAWING:  10 OF 19
CHECKED BY: SM	
SCALE: NTS	



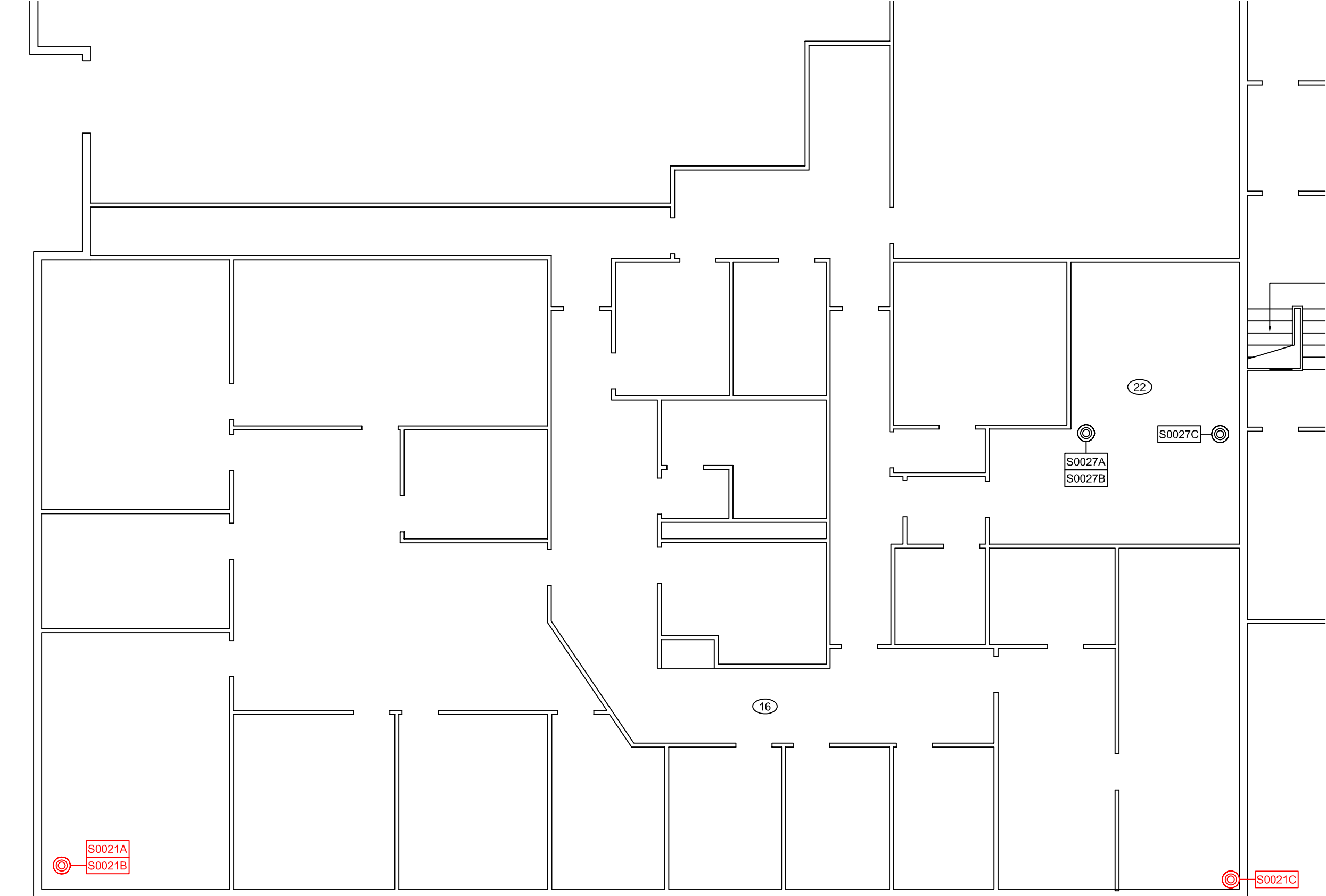
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  - ▲ POSITIVE LEAD PAINT SAMPLE LOCATION

CLIENT:  
ASSOCIATED ENGINEERING  
ALBERTA LTD.  
SUITE 500, 9888 JASPER AVENUE  
EDMONTON, ALBERTA T5J 5C6

LOCATION:  
21611 MERIDIAN STREET  
EDMONTON, ALBERTA T5Y 6E7

TITLE:  
HVAC UPGRADE HAZARDOUS  
MATERIALS ASSESSMENT  
EDMONTON INSTITUTION

DATE: 2017/06/20	PROJECT # : 179150
DRAWN BY: CS	11 OF 19
CHECKED BY: SM	
SCALE: NTS	



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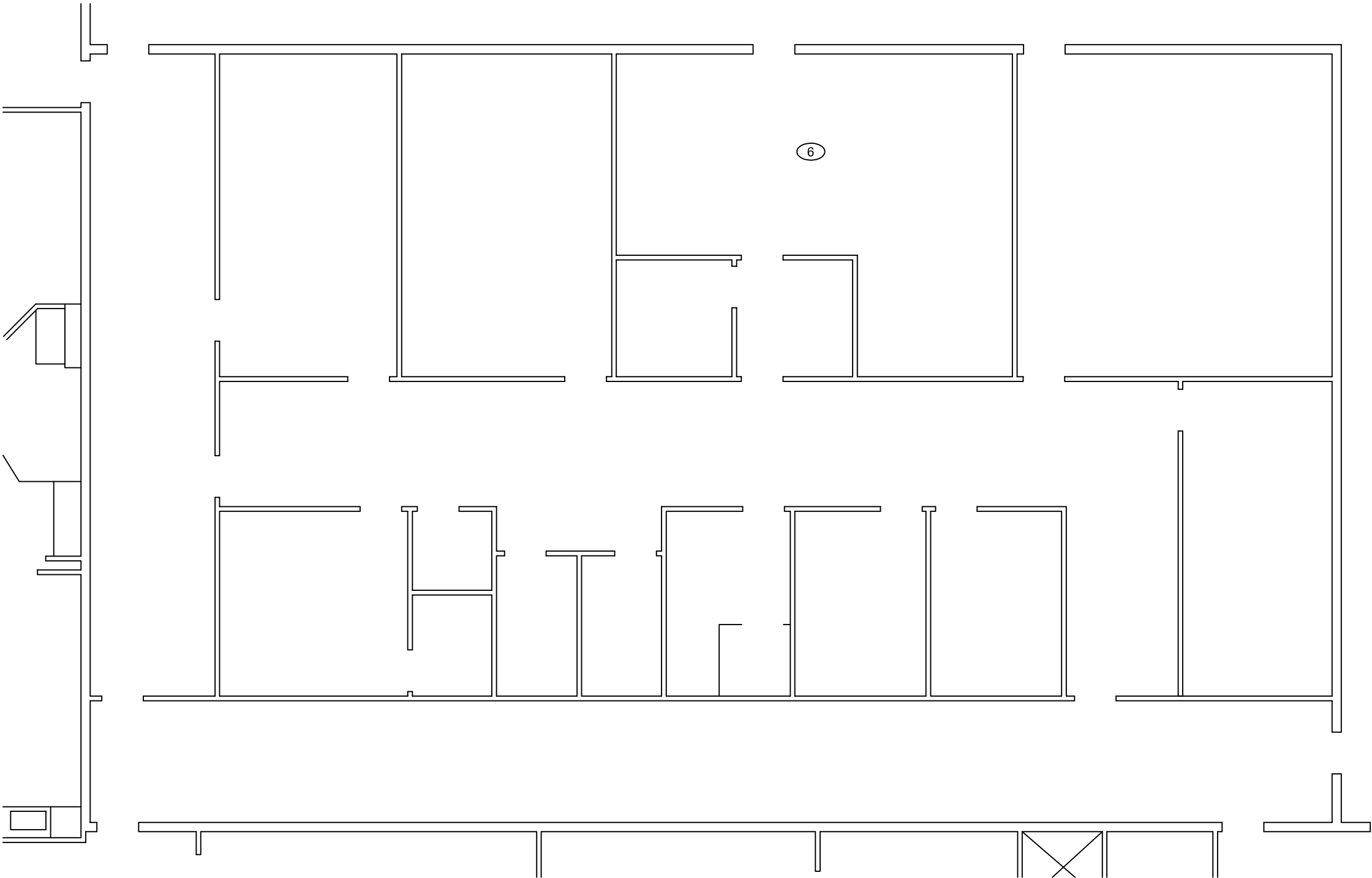
CLIENT:  
ASSOCIATED ENGINEERING  
ALBERTA LTD.  
SUITE 500, 9888 JASPER AVENUE  
EDMONTON, ALBERTA T5J 5C6

LOCATION:  
21611 MERIDIAN STREET  
EDMONTON, ALBERTA T5Y 6E7

TITLE:  
HVAC UPGRADE HAZARDOUS  
MATERIALS ASSESSMENT  
EDMONTON INSTITUTION

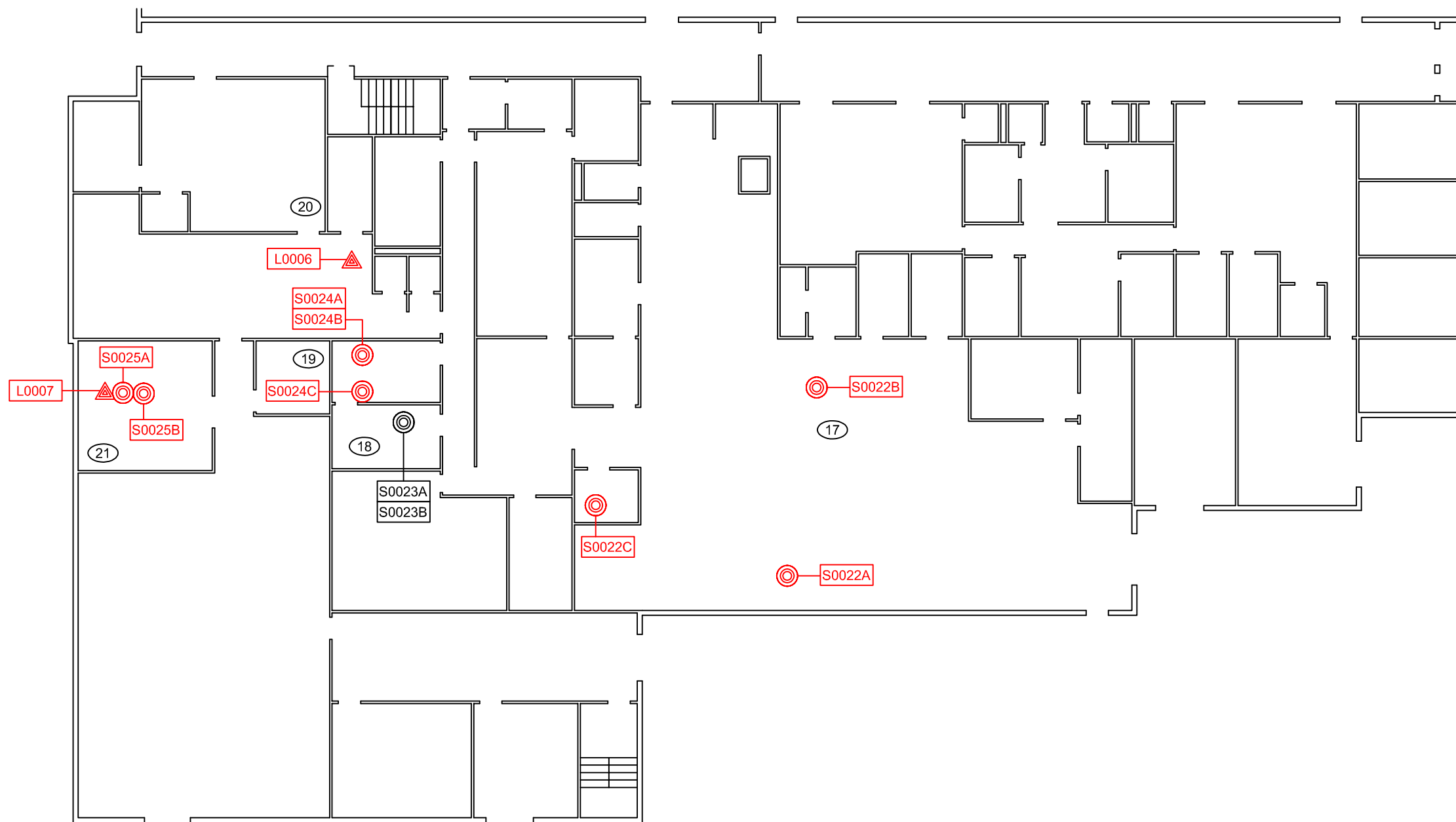
DATE: 2017/06/20	PROJECT # : 179150
DRAWN BY: CS	DRAWING:  12 OF 19
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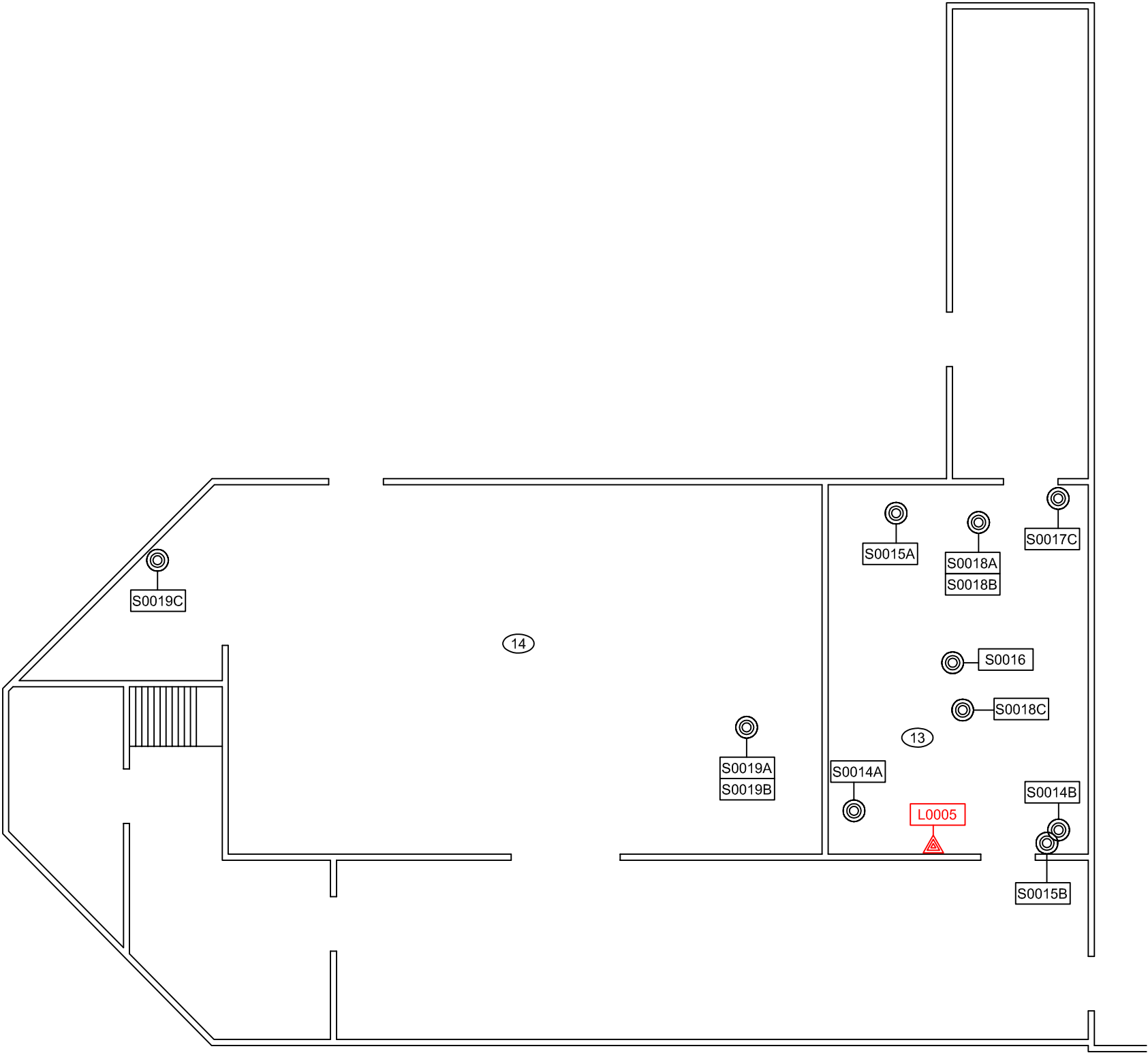


- LEGEND:
- (X) LOCATION NUMBER
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  - ⊗ POSITIVE ASBESTOS SAMPLE LOCATION
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CLIENT: ASSOCIATED ENGINEERING ALBERTA LTD. SUITE 500, 9888 JASPER AVENUE EDMONTON, ALBERTA T5J 5C6	
LOCATION: 21611 MERIDIAN STREET EDMONTON, ALBERTA T5Y 6E7	
TITLE: HVAC UPGRADE HAZARDOUS MATERIALS ASSESSMENT EDMONTON INSTITUTION MECHANICAL ROOM	
DATE: 2017/06/20	PROJECT # : 179150
DRAWN BY: VM	DRAWING:  13 OF 19
CHECKED BY: SM	
SCALE: NTS	



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  - ▲ NEGATIVE LEAD PAINT SAMPLE LOCATION
  - ▲ POSITIVE LEAD PAINT SAMPLE LOCATION

CLIENT: ASSOCIATED ENGINEERING ALBERTA LTD. SUITE 500, 9888 JASPER AVENUE EDMONTON, ALBERTA T5J 5C6	
LOCATION: 21611 MERIDIAN STREET EDMONTON, ALBERTA T5Y 6E7	
TITLE: HVAC UPGRADE HAZARDOUS MATERIALS ASSESSMENT EDMONTON INSTITUTION MECHANICAL ROOM	
DATE: 2017/06/20	PROJECT # : 179150
DRAWN BY: VM	DRAWING:  14 OF 19
CHECKED BY: SM	
SCALE: NTS	





- LEGEND:
- (X) LOCATION NUMBER
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  - ⊙ POSITIVE ASBESTOS SAMPLE LOCATION
  - ▲ NEGATIVE LEAD PAINT SAMPLE LOCATION
  - ▲ POSITIVE LEAD PAINT SAMPLE LOCATION

CLIENT:  
ASSOCIATED ENGINEERING  
ALBERTA LTD.  
SUITE 500, 9888 JASPER AVENUE  
EDMONTON, ALBERTA T5J 5C6

LOCATION:  
21611 MERIDIAN STREET  
EDMONTON, ALBERTA T5Y 6E7

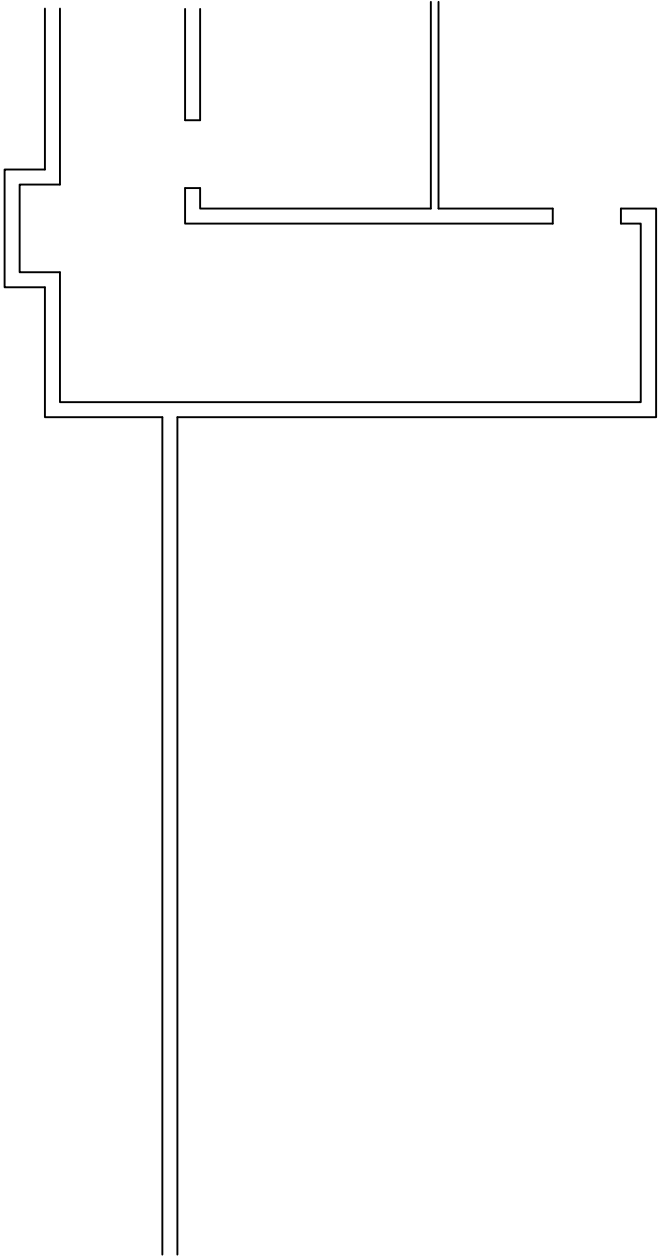
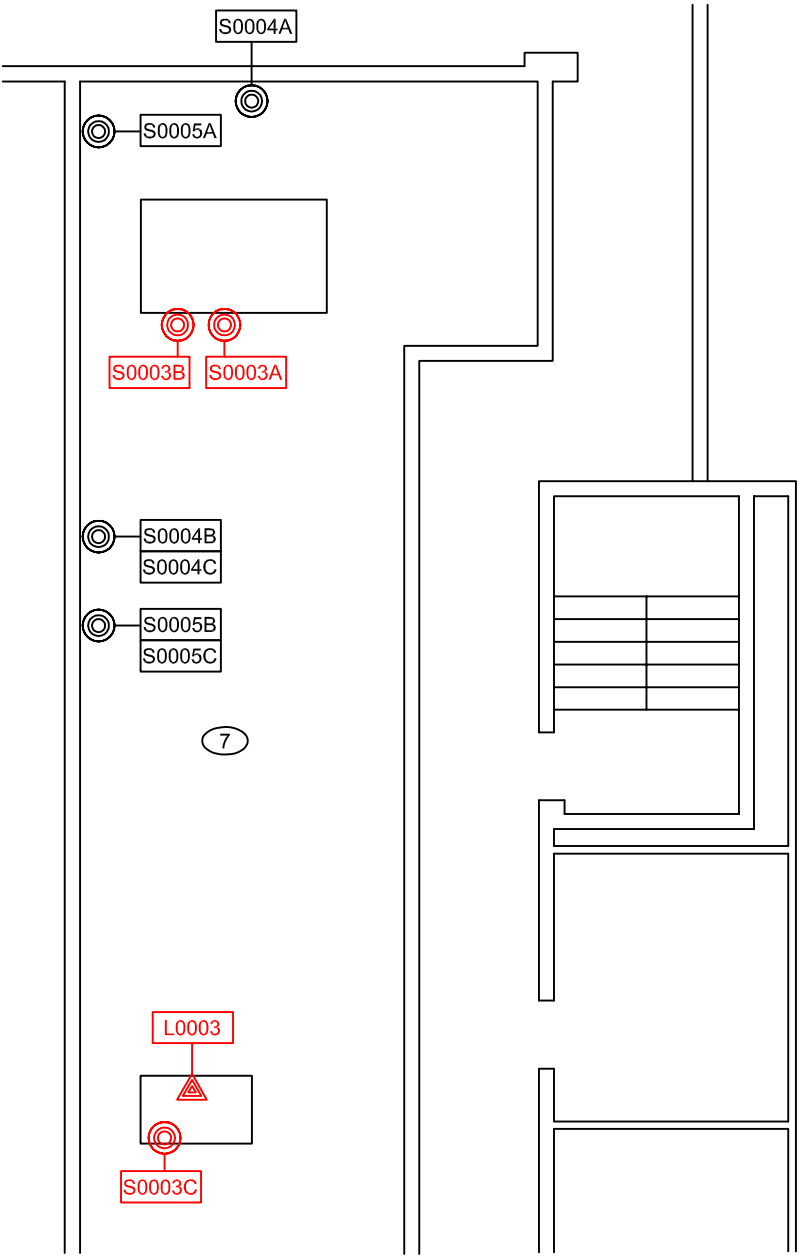
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MATERIALS ASSESSMENT  
EDMONTON INSTITUTION  
WEST MECHANICAL ROOM NORTH

DATE: 2017/06/20	PROJECT # : 179150
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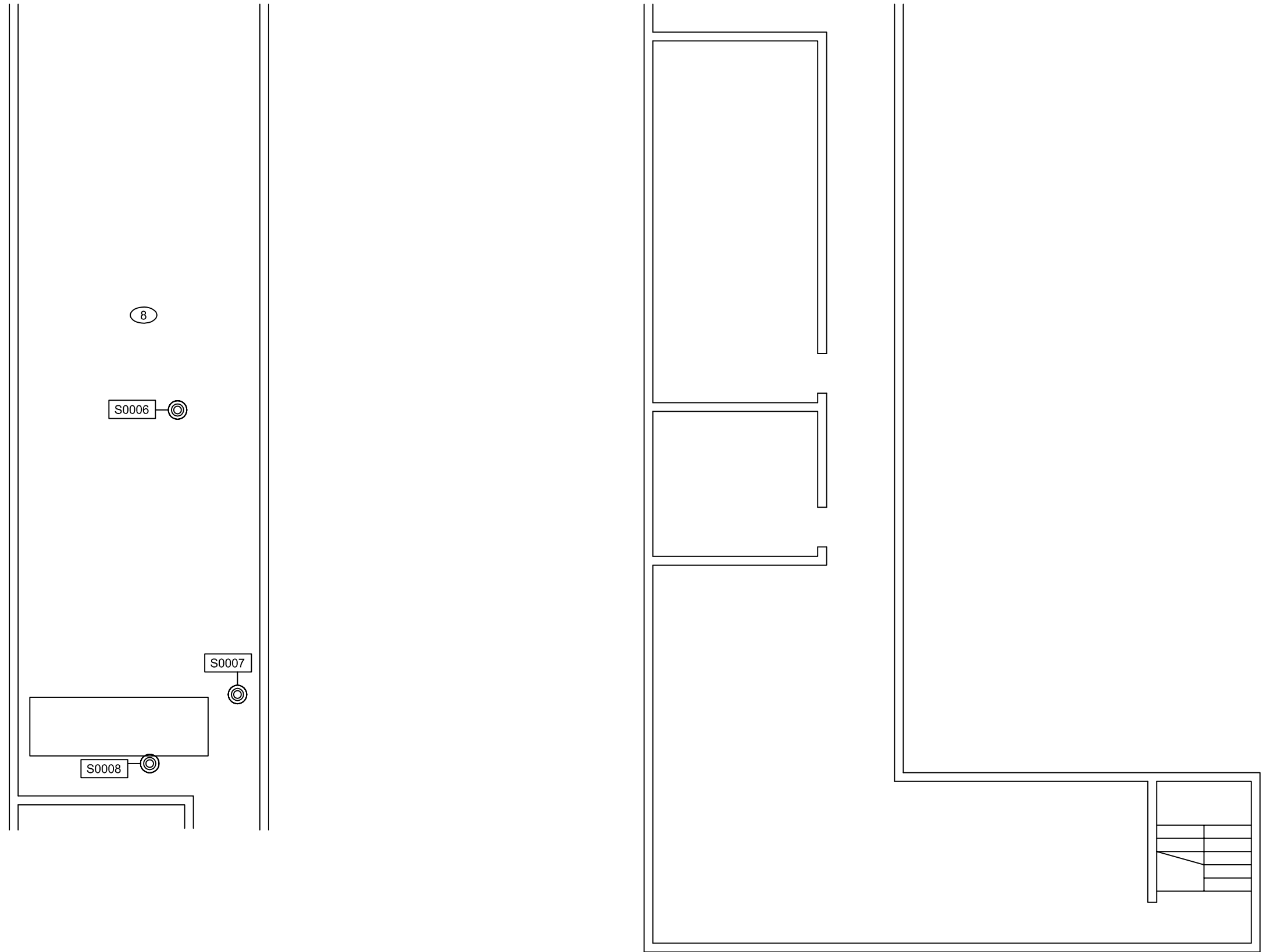
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CHECKED BY: SM
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SCALE: NTS
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  - ⚠ POSITIVE LEAD PAINT SAMPLE LOCATION

CLIENT: ASSOCIATED ENGINEERING ALBERTA LTD. SUITE 500, 9888 JASPER AVENUE EDMONTON, ALBERTA T5J 5C6	
LOCATION: 21611 MERIDIAN STREET EDMONTON, ALBERTA T5Y 6E7	
TITLE: HVAC UPGRADE HAZARDOUS MATERIALS ASSESSMENT EDMONTON INSTITUTION EAST MECHANICAL ROOM	
DATE: 2017/06/20	PROJECT # : 179150
DRAWN BY: VM	DRAWING:  16 OF 19
CHECKED BY: SM	
SCALE: NTS	



- LEGEND:
- (X) LOCATION NUMBER
  - ⊙ NEGATIVE ASBESTOS SAMPLE LOCATION
  - ⊙ POSITIVE ASBESTOS SAMPLE LOCATION
  - ▲ NEGATIVE LEAD PAINT SAMPLE LOCATION
  - ▲ POSITIVE LEAD PAINT SAMPLE LOCATION

CLIENT:  
ASSOCIATED ENGINEERING  
ALBERTA LTD.  
SUITE 500, 9888 JASPER AVENUE  
EDMONTON, ALBERTA T5J 5C6

LOCATION:  
21611 MERIDIAN STREET  
EDMONTON, ALBERTA T5Y 6E7

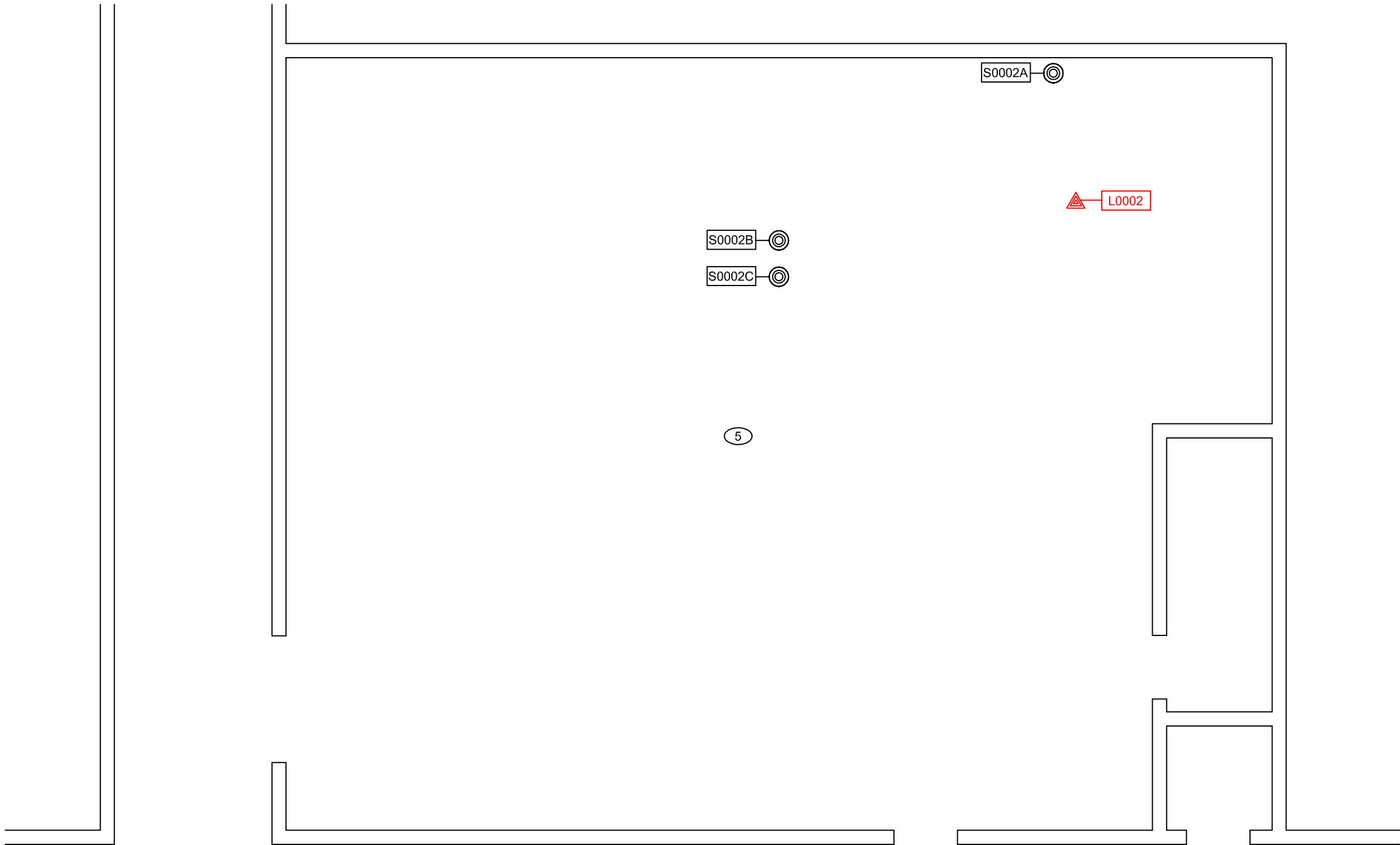
TITLE: HVAC UPGRADE HAZARDOUS  
MATERIALS ASSESSMENT  
EDMONTON INSTITUTION  
EAST MECHANICAL ROOM

DATE: 2017/06/20	PROJECT # : 179150
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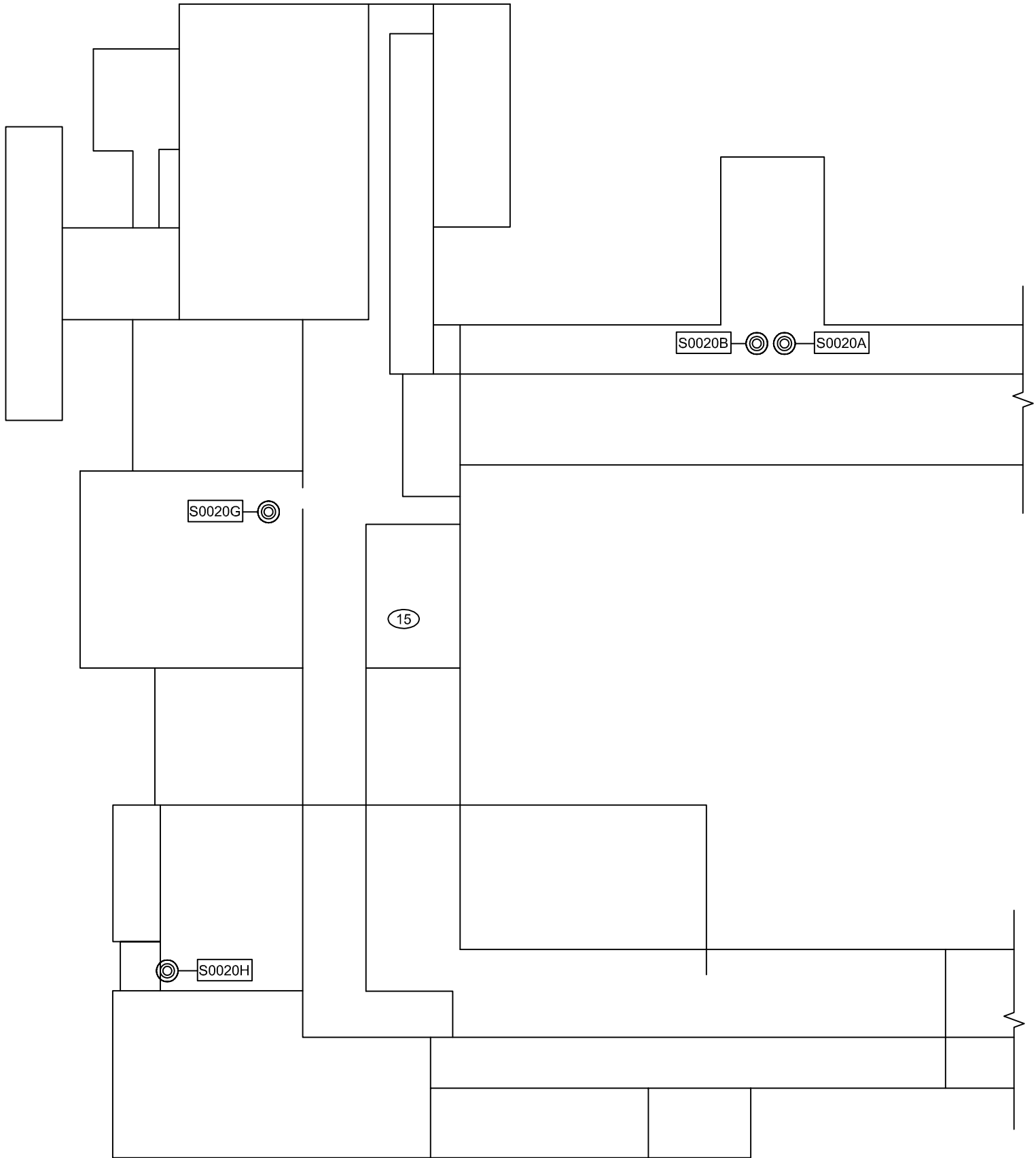
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CHECKED BY: SM
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SCALE: NTS
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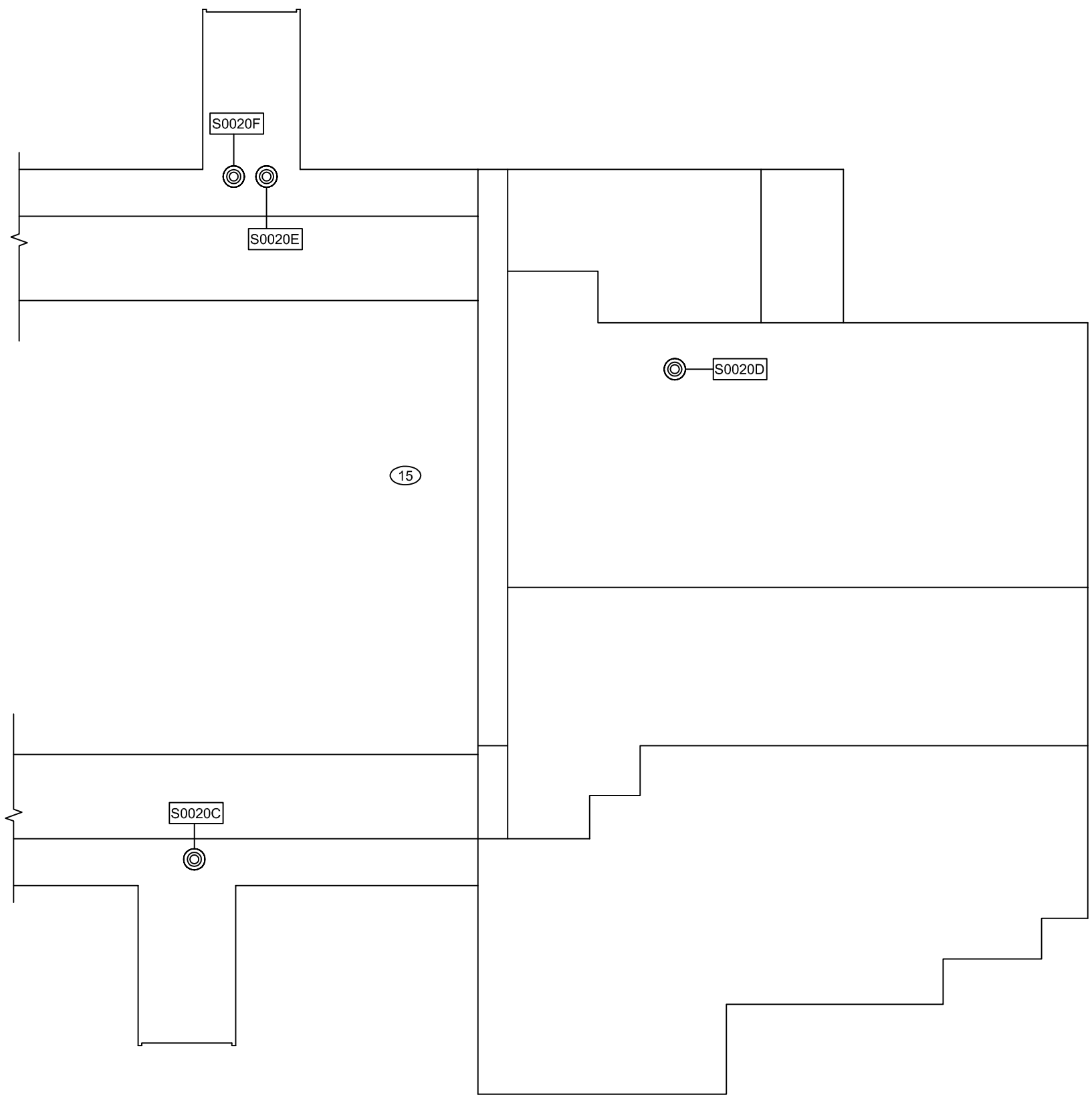


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  - ▲ POSITIVE LEAD PAINT SAMPLE LOCATION

CLIENT: ASSOCIATED ENGINEERING ALBERTA LTD. SUITE 500, 9888 JASPER AVENUE EDMONTON, ALBERTA T5J 5C6	
LOCATION: 21611 MERIDIAN STREET EDMONTON, ALBERTA T5Y 6E7	
TITLE: HVAC UPGRADE HAZARDOUS MATERIALS ASSESSMENT EDMONTON INSTITUTION	
DATE: 2017/06/20	PROJECT # : 179150
DRAWN BY: VM	DRAWING:  18 OF 19
CHECKED BY: SM	
SCALE: NTS	



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  - ▲ POSITIVE LEAD PAINT SAMPLE LOCATION

CLIENT: ASSOCIATED ENGINEERING ALBERTA LTD. SUITE 500, 9888 JASPER AVENUE EDMONTON, ALBERTA T5J 5C6	
LOCATION: 21611 MERIDIAN STREET EDMONTON, ALBERTA T5Y 6E7	
TITLE: HVAC UPGRADE HAZARDOUS MATERIALS ASSESSMENT EDMONTON INSTITUTION	
DATE: 2017/06/20	PROJECT # : 179150
DRAWN BY: VM	DRAWING:  19 OF 19
CHECKED BY: SM	
SCALE: NTS	

**APPENDIX II-A**  
**Asbestos Analytical Certificates**



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** Pinchin West Ltd.  
#200 9707 110 Street  
Edmonton, AB T5K 2L9

**Attn:** Ben Frederick  
Stephinie Mallon  
Sarah Loewen

**Lab Order ID:** 1712079  
**Analysis ID:** 1712079\_PLM  
**Date Received:** 6/8/2017  
**Date Reported:** 6/12/2017

**Project:** Edmonton Institution

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
S0001A	Parging Cement Insulation,Pipe Elbows ,Loc:1,AB Block Tunnel	40% Chrysotile		60% Other	Gray Fibrous Homogeneous
1712079PLM_1					Teased
S0001B	Parging Cement Insulation,Pipe Elbows ,Loc:1,AB Block Tunnel	40% Chrysotile		60% Other	Gray Fibrous Homogeneous
1712079PLM_2					Teased
S0001C	Parging Cement Insulation,Dark Yellow Pipes ,Loc:2,CD Block Tunnel	40% Chrysotile		60% Other	Gray Fibrous Homogeneous
1712079PLM_3					Teased
S0001D	Parging Cement Insulation,Dark Yellow Pipes ,Loc:3,EF Block	40% Chrysotile		60% Other	Gray Fibrous Homogeneous
1712079PLM_4					Teased
S0001E	Parging Cement Insulation,Pipe Fitting ,Loc:4,GH Block	30% Chrysotile	20% Cellulose	50% Other	Gray, White Fibrous Heterogeneous
1712079PLM_5	inseperable layers				Teased
S0002A	Fibrous Fireproofing,Grey Fibrous Fireproofing Spray ,Loc:5,East Mechanical Room	None Detected	95% Fiber Glass	5% Other	Gray Fibrous Homogeneous
1712079PLM_6					Teased
S0002B	Fibrous Fireproofing,Grey Fibrous Fireproofing Spray ,Loc:5,East Mechanical Room	None Detected	95% Fiber Glass	5% Other	Gray Fibrous Homogeneous
1712079PLM_7					Teased
S0002C	Fibrous Fireproofing,Grey Fibrous Fireproofing Spray ,Loc:5,East Mechanical Room	None Detected	95% Fiber Glass	5% Other	Gray Fibrous Homogeneous
1712079PLM_8					Teased

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Megan Javonovich (86)

Analyst

Approved Signatory



# Bulk Asbestos Analysis

By Polarized Light Microscopy  
EPA Method: 600/R-93/116 and 600/M4-82-020



**Customer:** Pinchin West Ltd.  
#200 9707 110 Street  
Edmonton, AB T5K 2L9

**Attn:** Ben Frederick  
Stephinie Mallon  
Sarah Loewen

**Lab Order ID:** 1712079  
**Analysis ID:** 1712079\_PLM  
**Date Received:** 6/8/2017  
**Date Reported:** 6/12/2017

**Project:** Edmonton Institution

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
S0003A	Parging Cement Insulation,Parging On Elbows,Loc:7,West Mechanic	30% Chrysotile	30% Fiber Glass	40% Other	Gray Fibrous Homogeneous
1712079PLM_9					Teased
S0003B	Parging Cement Insulation,Parging On Elbows,Loc:7,West Mechanic	30% Chrysotile	30% Fiber Glass	40% Other	Gray Fibrous Homogeneous
1712079PLM_10					Teased
S0003C	Parging Cement Insulation,Parging On Elbows,Loc:7,West Mechanic	30% Chrysotile	30% Fiber Glass	40% Other	Gray Fibrous Homogeneous
1712079PLM_11					Teased
S0004A	Fibrous Fireproofing,Grey Spray Applied Fireproofing ,Loc:7,West Mechanical Room	None Detected	95% Fiber Glass	5% Other	Gray Fibrous Homogeneous
1712079PLM_12					Teased
S0004B	Fibrous Fireproofing,Grey Spray Applied Fireproofing ,Loc:7,West Mechanical Room	None Detected	95% Fiber Glass	5% Other	Gray Fibrous Homogeneous
1712079PLM_13					Teased
S0004C	Fibrous Fireproofing,Grey Spray Applied Fireproofing ,Loc:7,West Mechanical Room	None Detected	95% Fiber Glass	5% Other	Gray Fibrous Homogeneous
1712079PLM_14					Teased
S0005A	Masonry,Mortar Estimate 50 For Possible Disturbance ,Loc:7,West Mechanical Room	None Detected		70% Other 30% Quartz	Gray Non Fibrous Heterogeneous
1712079PLM_15					Crushed
S0005B	Masonry,Mortar Estimate 50 For Possible Disturbance ,Loc:7,West Mechanical Room	None Detected		70% Other 30% Quartz	Gray Non Fibrous Heterogeneous
1712079PLM_16					Crushed

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Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
S0005C	Masonry, Mortar Estimate 50 For Possible Disturbance, Loc: 7, West Mechanical Room	None Detected		70% Other 30% Quartz	Gray Non Fibrous Heterogeneous
1712079PLM_17					Crushed
S0006	Mastic, Silver Colour, Loc: 8, South, West Mechanical Room	None Detected		100% Other	Silver Non Fibrous Homogeneous
1712079PLM_18					Ashed
S0007	Mastic, Red Colour, Loc: 8, South, West Mechanical Room	None Detected	10% Wollastonite	90% Other	Red Non Fibrous Homogeneous
1712079PLM_19					Ashed
S0008	Mastic, Brown Colour, Loc: 8, South, West Mechanical Room	None Detected		100% Other	Brown Non Fibrous Homogeneous
1712079PLM_20					Ashed
S0009A	Drywall And Joint Compound, Dwjc White, Loc: 10, Medication Roo	3% Chrysotile		97% Other	Gray Non Fibrous Homogeneous
1712079PLM_21					Crushed
S0009B	Drywall And Joint Compound, Dwjc White, Loc: 10, Medication Roo	3% Chrysotile		97% Other	Gray Non Fibrous Homogeneous
1712079PLM_22					Crushed
S0009C	Drywall And Joint Compound, Dwjc White, Loc: 10, Medication Roo	3% Chrysotile		97% Other	Gray Non Fibrous Homogeneous
1712079PLM_23					Crushed
S0010A	Texture Finish (Texture Coat), White Stipple, Loc: 11, Team Room Or Program Room And	None Detected		100% Other	White Non Fibrous Homogeneous
1712079PLM_24					Crushed

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Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
S0010B	Texture Finish ( Texture Coat ) White Stipple, Loc: 11, Team Room Or Program Room And	None Detected		100% Other	White Non Fibrous Homogeneous
1712079PLM_25					Crushed
S0010C	Texture Finish ( Texture Coat ) White Stipple, Loc: 11, Team Room Or Program Room And	None Detected		100% Other	White Non Fibrous Homogeneous
1712079PLM_26					Crushed
S0011A	Drywall And Joint Compound, Dwjc, Loc: 11, Team Room Or Program Room And	None Detected		100% Other	White Non Fibrous Homogeneous
1712079PLM_27					Crushed
S0011B	Drywall And Joint Compound, Dwjc, Loc: 11, Team Room Or Program Room And	None Detected		100% Other	White Non Fibrous Homogeneous
1712079PLM_28					Crushed
S0011C	Drywall And Joint Compound, Dwjc, Loc: 11, Team Room Or Program Room And	None Detected		100% Other	White Non Fibrous Homogeneous
1712079PLM_29					Crushed
S0012A	Lay-in Ceiling Tiles, Pin And Wormy Holes, Loc: 12, Contact Visiting Room	None Detected	40% Cellulose 30% Fiber Glass	20% Perlite 10% Other	Gray Fibrous Homogeneous
1712079PLM_30					Ashed
S0012B	Lay-in Ceiling Tiles, Pin And Wormy Holes, Loc: 12, Contact Visiting Room	None Detected	40% Cellulose 30% Fiber Glass	20% Perlite 10% Other	Gray Fibrous Homogeneous
1712079PLM_31					Ashed
S0013A	Drywall And Joint Compound, Dwjc, Loc: 12, Contact Visiting Room	None Detected		100% Other	White Non Fibrous Homogeneous
1712079PLM_32					Crushed

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Lab Sample ID	Lab Notes				Treatment
S0013B	Drywall And Joint Compound,Dwjc,Loc:12,Cont act Visiting Room	None Detected		100% Other	White Non Fibrous Homogeneous
1712079PLM_33					Crushed
S0013C	Drywall And Joint Compound,Dwjc,Loc:12,Cont act Visiting Room	None Detected		100% Other	White Non Fibrous Homogeneous
1712079PLM_34					Crushed
S0014A	Parging Cement Insulation,Elbow Cement Sw Corner ,Loc:13,Segregation Bl	None Detected	40% Fiber Glass	60% Other	Gray Fibrous Homogeneous
1712079PLM_35					Teased
S0014B	Parging Cement Insulation,Elbow Cement Se Corner ,Loc:13,Segregation Bl	None Detected	40% Fiber Glass	60% Other	Gray Fibrous Homogeneous
1712079PLM_36					Teased
S0015A	Parging Cement Insulation,Elbow Cement Nw Corner ,Loc:13,Segregation Bl	None Detected	40% Fiber Glass	60% Other	Gray Fibrous Homogeneous
1712079PLM_37					Teased
S0015B	Parging Cement Insulation,Elbow Cement Se Corner ,Loc:13,Segregation Bl	None Detected	40% Fiber Glass	60% Other	Gray Fibrous Homogeneous
1712079PLM_38					Teased
S0016	Mastic,Grey Mastic ,Loc:13,Segregation Block Mechanical Room	None Detected		100% Other	Gray Non Fibrous Homogeneous
1712079PLM_39					Ashed
S0017A	Masonry,Mortar ,Loc:13,Segregation Block Mechanical Room	None Detected		70% Other 30% Quartz	Gray Non Fibrous Heterogeneous
1712079PLM_40					Crushed

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Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
S0017B	Masonry, Mortar , Loc: 13, Segregation Block Mechanical Room	None Detected		70% Other 30% Quartz	Gray Non Fibrous Heterogeneous
1712079PLM_41					Crushed
S0017C	Masonry, Mortar , Loc: 13, Segregation Block Mechanical Room	None Detected		70% Other 30% Quartz	Gray Non Fibrous Heterogeneous
1712079PLM_42					Crushed
S0018A	Fibrous Fireproofing, Spray Fireproofing , Loc: 13, Segregation Block Me	None Detected	95% Fiber Glass	5% Other	Gray Fibrous Homogeneous
1712079PLM_43					Teased
S0018B	Fibrous Fireproofing, Spray Fireproofing , Loc: 13, Segregation Block Me	None Detected	95% Fiber Glass	5% Other	Gray Fibrous Homogeneous
1712079PLM_44					Teased
S0018C	Fibrous Fireproofing, Spray Fireproofing , Loc: 13, Segregation Block Me	None Detected	95% Fiber Glass	5% Other	Gray Fibrous Homogeneous
1712079PLM_45					Teased
S0019A	Parging Cement Insulation, Parging On Duct Elbows, Loc: 14, Segregation	None Detected	40% Fiber Glass	60% Other	Gray Fibrous Homogeneous
1712079PLM_46					Teased
S0019B	Parging Cement Insulation, Parging On Duct Elbows, Loc: 14, Segregation	None Detected	40% Fiber Glass	60% Other	Gray Fibrous Homogeneous
1712079PLM_47					Teased
S0019C	Parging Cement Insulation, Parging On Duct Elbows In Nw Corner, Loc: 14,	None Detected	40% Fiber Glass	60% Other	Gray Fibrous Homogeneous
1712079PLM_48					Teased

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Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
S0020A	Asphalt Shingles, Roofing Asphalt And Tar, Loc: 15, East And West Roof	None Detected	30% Fiber Glass	50% Other 20% Quartz	Black, Gray Fibrous Heterogeneous
1712079PLM_49					Dissolved
S0020B	Asphalt Shingles, Roofing Asphalt And Tar, Loc: 15, East And West Roof	None Detected	30% Fiber Glass	50% Other 20% Quartz	Gray, Black Fibrous Heterogeneous
1712079PLM_50					Dissolved
S0020C	Asphalt Shingles, Roofing Asphalt And Tar, Loc: 15, East And West Roof	None Detected	30% Fiber Glass	50% Other 20% Quartz	Black, Gray Fibrous Heterogeneous
1712079PLM_51					Dissolved
S0020D	Asphalt Shingles, Roofing Asphalt And Tar, Loc: 15, East And West Roof	None Detected	30% Fiber Glass	50% Other 20% Quartz	Black, Gray Fibrous Heterogeneous
1712079PLM_52					Dissolved
S0020E	Asphalt Shingles, Roofing Asphalt And Tar, Loc: 15, East And West Roof	None Detected	30% Fiber Glass	50% Other 20% Quartz	Black, Gray Fibrous Heterogeneous
1712079PLM_53					Teased
S0020F	Asphalt Shingles, Roofing Asphalt And Tar, Loc: 15, East And West Roof	None Detected	10% Fiber Glass	70% Other 20% Quartz	Black, Gray Non Fibrous Heterogeneous
1712079PLM_54					Dissolved
S0020G	Asphalt Shingles, Roofing Asphalt And Tar, Loc: 15, East And West Roof	None Detected	10% Fiber Glass	70% Other 20% Quartz	Black, Gray Non Fibrous Heterogeneous
1712079PLM_55					Dissolved
S0020H	Asphalt Shingles, Roofing Asphalt And Tar, Loc: 15, East And West Roof	None Detected	10% Fiber Glass	70% Other 20% Quartz	Black, Gray Non Fibrous Heterogeneous
1712079PLM_56					Dissolved

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Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
S0021A	Parging Cement Insulation,Grey Elbow Cement,Loc:16,Executive Ser	20% Chrysotile		60% Other 20% Vermiculite	Tan Non Fibrous Heterogeneous
1712079PLM_57					Teased
S0021B	Parging Cement Insulation,Grey Elbow Cement,Loc:16,Executive Ser	20% Chrysotile		60% Other 20% Vermiculite	Tan Non Fibrous Heterogeneous
1712079PLM_58					Teased
S0021C	Parging Cement Insulation,Grey Elbow Cement,Loc:16,Executive Ser	20% Chrysotile		60% Other 20% Vermiculite	Tan Non Fibrous Heterogeneous
1712079PLM_59					Teased
S0022A	Parging Cement Insulation,Pipe Elbows,Loc:17,Engineering A	40% Chrysotile		60% Other	Gray Fibrous Homogeneous
1712079PLM_60					Teased
S0022B	Parging Cement Insulation,Pipe Elbows,Loc:17,Engineering A	40% Chrysotile		60% Other	Gray Fibrous Homogeneous
1712079PLM_61					Teased
S0022C	Parging Cement Insulation,Pipe Elbows,Loc:17,Engineering A	40% Chrysotile		60% Other	Gray Fibrous Homogeneous
1712079PLM_62					Teased
S0023A	Lay-in Ceiling Tiles,Medium Holes With Worms,Loc:18,Engineering A	None Detected	40% Cellulose 40% Fiber Glass	10% Perlite 10% Other	Gray Fibrous Homogeneous
1712079PLM_63					Ashed
S0023B	Lay-in Ceiling Tiles,Medium Holes With Worms,Loc:18,Engineering A	None Detected	40% Cellulose 40% Fiber Glass	10% Perlite 10% Other	Gray Fibrous Homogeneous
1712079PLM_64					Ashed

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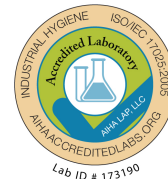
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Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
S0024A	Drywall And Joint Compound,Dwjc,Loc:19,Engineering And Maintenance	3% Chrysotile		97% Other	Gray Non Fibrous Homogeneous
1712079PLM_65					Crushed
S0024B	Drywall And Joint Compound,Dwjc,Loc:19,Engineering And Maintenance	3% Chrysotile		97% Other	Gray Non Fibrous Homogeneous
1712079PLM_66					Crushed
S0024C	Drywall And Joint Compound,Dwjc,Loc:19,Engineering And Maintenance	3% Chrysotile		97% Other	Gray Non Fibrous Homogeneous
1712079PLM_67					Crushed
S0025A	Parging Cement Insulation,Pipe Elbows ,Loc:21,Engineering And Mai	30% Chrysotile	30% Fiber Glass	40% Other	Gray Fibrous Heterogeneous
1712079PLM_68					Teased
S0025B	Parging Cement Insulation,Pipe Elbows ,Loc:21,Engineering And Mai	30% Chrysotile	30% Fiber Glass	40% Other	Gray Fibrous Heterogeneous
1712079PLM_69					Teased
S0026	Parging Cement Over Fibreglass,Grey Parging ,Loc:21,Engineering And Mai	50% Chrysotile	20% Cellulose	30% Other	Gray Fibrous Homogeneous
1712079PLM_70					Teased
S0027A	Drywall And Joint Compound,Dwjc,Loc:22,Executive Services	None Detected		100% Other	White Non Fibrous Homogeneous
1712079PLM_71					Crushed
S0027B	Drywall And Joint Compound,Dwjc,Loc:22,Executive Services	None Detected		100% Other	White Non Fibrous Homogeneous
1712079PLM_72					Crushed

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Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
S0027C	Drywall And Joint Compound,Dwjc,Loc:22,Executive Services	None Detected		100% Other	Beige Non Fibrous Homogeneous
1712079PLM_73					Crushed
S0028A	Drywall And Joint Compound,Dwjc,Loc:23,Cell Block G And H	None Detected		100% Other	White Non Fibrous Homogeneous
1712079PLM_74					Crushed
S0028B	Drywall And Joint Compound,Dwjc,Loc:23,Cell Block G And H	None Detected		100% Other	White Non Fibrous Homogeneous
1712079PLM_75					Crushed
S0028C	Drywall And Joint Compound,Dwjc,Loc:23,Cell Block G And H	None Detected		100% Other	White Non Fibrous Homogeneous
1712079PLM_76					Crushed
S0029A	Drywall And Joint Compound,Dwjc,Loc:24,Cell Block A And B	None Detected		100% Other	White Non Fibrous Homogeneous
1712079PLM_77					Crushed
S0029B	Drywall And Joint Compound,Dwjc,Loc:24,Cell Block A And B	None Detected		100% Other	White Non Fibrous Homogeneous
1712079PLM_78					Crushed
S0029C	Drywall And Joint Compound,Dwjc,Loc:24,Cell Block A And B	None Detected		100% Other	Beige Non Fibrous Homogeneous
1712079PLM_79					Crushed
S0029D	Drywall And Joint Compound,Dwjc,Loc:24,Cell Block A And B	None Detected		100% Other	White Non Fibrous Homogeneous
1712079PLM_80					Crushed

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Sarah Loewen

**Lab Order ID:** 1712079  
**Analysis ID:** 1712079\_PLM  
**Date Received:** 6/8/2017  
**Date Reported:** 6/12/2017

**Project:** Edmonton Institution

Sample ID	Description	Asbestos	Fibrous Components	Non-Fibrous Components	Attributes
Lab Sample ID	Lab Notes				Treatment
S0030A	Drywall And Joint Compound,Dwjc,Loc:25,Cell Block C And D	None Detected		100% Other	White Non Fibrous Homogeneous
1712079PLM_81					Crushed
S0030B	Drywall And Joint Compound,Dwjc,Loc:25,Cell Block C And D	None Detected		100% Other	White Non Fibrous Homogeneous
1712079PLM_82					Crushed
S0030C	Drywall And Joint Compound,Dwjc,Loc:25,Cell Block C And D	None Detected		100% Other	White Non Fibrous Homogeneous
1712079PLM_83					Crushed
S0031A	Drywall And Joint Compound,Dwjc,Loc:26,Cell Block E And F	None Detected		100% Other	White Non Fibrous Homogeneous
1712079PLM_84					Crushed
S0031B	Drywall And Joint Compound,Dwjc,Loc:26,Cell Block E And F	None Detected		100% Other	White Non Fibrous Homogeneous
1712079PLM_85					Crushed
S0031C	Drywall And Joint Compound,Dwjc,Loc:26,Cell Block E And F	None Detected		100% Other	White Non Fibrous Homogeneous
1712079PLM_86					Crushed

**Disclaimer:** Due to the nature of the EPA 600 method, asbestos may not be detected in samples containing low levels of asbestos. We strongly recommend that analysis of floor tiles, vermiculite, and/or heterogeneous soil samples be conducted by TEM for confirmation of "None Detected" by PLM. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. government. Analytical uncertainty available upon request. Scientific Analytical Institute participates in the NVLAP Proficiency Testing program. Unless otherwise noted blank sample correction was not performed. Estimated MDL is 0.1%.

Megan Javonovich (86)

Analyst

Approved Signatory

**APPENDIX II-B**  
**Lead Analytical Certificates**



# Analysis for Lead Concentration in Paint Chips

by Flame Atomic Absorption Spectroscopy  
EPA SW-846 3050B/6010C/7000B



**Customer:** Pinchin Ltd.  
#200 9707 110 Street  
Edmonton, AB T5K 2L9

**Attn:** Ben Frederick  
Stephinie Mallon  
Sarah Loewen

**Lab Order ID:** 1712072  
**Analysis ID:** 1712072\_PBP  
**Date Received:** 6/8/2017  
**Date Reported:** 6/13/2017

**Project:** Edmonton Institution

Sample ID	Description	Mass	Concentration	Concentration
Lab Sample ID	Lab Notes	(g)	(ppm)	(% by weight)
L0001	Mechanical, Metal, Yellow Paint, Loc:1, AB Block Tunnel	0.0648	1700	0.17%
1712072PBP_1				
L0002	Duct, Metal, Beige, Loc:5, East Mechanical Room	0.0614	160000	16%
1712072PBP_2				
L0003	Mechanical, Metal, Brown, Loc:7, West Mechanical Room	0.0640	12000	1.2%
1712072PBP_3				
L0004	Ceiling, Drywall And Joint Compound, White Colour, Loc:10, Medication Room	0.0661	780	0.078%
1712072PBP_4				
L0005	Wall, Masonry, Beige Wall Paint, Loc:13, Segregation Block Mechanical Room	0.0623	600	0.060%
1712072PBP_5				
L0006	Duct, Metal, Beige Paint, Loc:20, Engineering And Maintenance	0.0639	2200	0.22%
1712072PBP_6				
L0007	Mechanical, Metal, Pinkish Brown Over Beige, Loc:21, Engineering And Maintenance	0.0586	5800	0.58%
1712072PBP_7				
L0008	Ceiling, Drywall And Joint Compound, Grey Colour, Loc:23, Cell Block G And H	0.0820	100	0.010%
1712072PBP_8				
L0009	Ceiling, Drywall And Joint Compound, Grey Colour, Loc:24, Cell Block A And B	0.0585	< 68	< 0.007%
1712072PBP_9				

Unless otherwise noted blank sample correction was not performed on analytical results. Scientific Analytical Institute participates in the AIHA ELPAT program. ELPAT Laboratory ID: 173190. This report relates only to the samples tested and may not be reproduced, except in full, without the written approval of SAI. Analytical uncertainty available upon request. The quality control samples run with the samples in this report have passed all EPA required specifications unless otherwise noted. RL: (Report Limit for an undiluted 50ml sample is 4µg Total Pb).

Taylor Davis (9)

Analyst

Scientific Analytical Institute, Inc. 4604 Dundas Dr. Greensboro, NC 27407 (336) 292-3888

Laboratory Director

**APPENDIX III**  
**Methodology**

## 1.0 GENERAL

PWL conducts a room-by-room survey (rooms, corridors, service areas, exterior, etc.) to identify the hazardous building materials as defined by the scope of work. All work is conducted in accordance with our own internal Standard Operating Procedures.

Information regarding the location and condition of hazardous building materials encountered and visually estimated quantities are recorded. The locations of any samples collected are recorded on small-scale plans.

As-built drawings and previous reports are referenced where provided.

### 1.1 Scope Limitations

The assessment excludes the following:

- Articles belonging to the owner, tenant or occupant (e.g. stored items, furniture, appliances, etc.);
- Underground materials or equipment (e.g. vessels, drums, underground storage tanks, pipes, etc.);
- Building envelope, structural components, inaccessible or concealed materials or other items where sampling may cause consequential damage to the property.
- Energized systems (e.g. internal boiler components, elevators, mechanical or electrical components);
- Controlled products (e.g. stored chemicals, operational or process-related substances); and
- Materials not typically associated with construction (e.g. settled dust, spills, residual contamination from prior spills, etc.).

The assessment includes limited demolition of wall and ceiling finishes (drywall or plaster) to view concealed conditions at representative areas as permitted by the current building use. Limited destructive testing of flooring is conducted where possible (under carpets or multiple layers of flooring). Demolition of masonry walls (chases, shafts etc.), structural items or exterior building finishes is not conducted.

In occupied facilities, PWL only undertakes non-intrusive testing. Concealed spaces such as those above solid ceilings and within shafts and pipe chases are accessed via existing access panels only. PWL does not conduct demolition of walls, solid ceilings, structural items, interior finishes or exterior building finishes, to determine the presence of concealed materials.

## 1.2 Asbestos

PWL conducts an inspection for the presence of friable and non-friable asbestos-containing materials (ACM). A friable material is a material that when dry can be crumbled, pulverized or powdered by hand pressure.

A separate set of samples is collected of each type of homogenous material suspected to contain asbestos. A homogenous material is defined by the US EPA as material that is uniform in texture and appearance, was installed at one time, and is unlikely to consist of more than one type or formulation of material. The homogeneous materials are determined by visual examination and available information on the phases of construction and prior renovations.

PWL collects samples at a rate that is in compliance with the requirements of local regulations and guidelines.

The sampling strategy is also based on known ban dates and phase out dates of the use of asbestos; sampling of certain building materials is not conducted after specific construction dates. In addition, to be conservative, several years past these dates are added to account for some uncertainty in the exact start/finish date of construction and associated usage of ACM.

In some cases, manufactured products such as asbestos cement pipe are visually identified without sample confirmation.

PWL conducts limited demolition of masonry block walls (core holes) to investigate for loose fill insulation. The core holes are temporarily patched with expanding foam.

Flooring mastic/adhesive and leveling compounds are only sampled and analyzed if present on the underside of flooring samples (vinyl floor tile and vinyl sheet flooring).

If present, the following materials are presumed to be asbestos-containing and are best sampled immediately prior to commencing renovation/disturbance:

- roofing, felts and tar
- concrete floor levelling compound
- elevator and lift brakes
- electrical components or wiring within control centers, breakers, motors or lights, insulation on wiring
- refractory materials and insulations in boilers, incinerators and stacks
- insulation under metal clad boilers and vessels
- caulking

- paper products under wood flooring or metal or slate roofing
- soffit and fascia boards at elevated heights
- mechanical packing, ropes and gaskets
- fire resistant doors or metal clad finishes
- exterior cladding

PWL submits the bulk samples to a NVLAP accredited laboratory for analysis. The analysis is performed in accordance with Test Method EPA/600/R-93/116: Method for the Determination of Asbestos in Bulk Building Materials, July 1993.

In Alberta an ACM is not defined as a percentage. The generally accepted threshold is 1%, however materials that contain less than 1% asbestos need to be assessed on a case-by-case basis to determine whether there is a potential for asbestos release when the material is disturbed.

### 1.3 Lead

PWL collects samples of distinctive paint finishes and surface coatings present in more than a limited application, where removal of the paint is possible. PWL collects samples by scraping the painted finish to include base and covering applications. Drawings included show sample locations.

Analysis for lead in paints or surface coatings is performed at an accredited laboratory in accordance with EPA Method No. 3050B/Method No. 7420; flame atomic absorption.

For this report, all paints containing lead at a concentration of 0.009% or greater are discussed. Paint and surface coatings are evaluated for condition such as flaking, chipping or chalking.

Other lead building products (e.g. batteries, lead sheeting, flashing) are identified by visual observation only.

### 1.4 Silica

PWL identifies building materials suspected of containing crystalline silica (e.g. concrete, cement, tile, brick, masonry, mortar) by knowledge of current and historic applications and visual inspection only. PWL does not perform sampling of these materials for laboratory analysis of crystalline silica content.

### 1.5 Mercury

Building materials/products/equipment (e.g. thermostats, barometers, pressure gauges, light tubes), suspected to contain mercury are identified by visual inspection only. Dismantling of equipment suspected of containing mercury is not performed. Sampling of these materials for laboratory analysis of mercury content is not performed.

Mercury spills or damaged mercury-containing equipment are recorded where observed.

### 1.6 Polychlorinated Biphenyls

PWL determines the potential for light ballasts to contain PCBs based on the age of the building, a review of maintenance records and examination of labels or nameplates on equipment, where present and accessible. The information is compared to known ban dates of PCBs and Environment Canada publications. Other than light ballasts and pole mounted transformers, all other liquid uses of PCBs should have been discontinued.

PWL records spills or leakage of suspect PCB-containing fluids where observed or identified in historical documents.

PWL samples exterior caulking or sealants for PCBs based on the date of construction or installation. Caulking installed after 1985 is presumed to be free of PCBs and hence not sampled. If sampled, analysis for PCBs is performed using an ASTM test method appropriate to the sample matrix at an accredited laboratory.

### 1.7 Ozone Depleting Substances (ODS)

PWL determines the potential presence of ODS (chlorofluorocarbon, hydrochlorofluorocarbon, hydrofluorocarbon, halon, etc.) in air conditioning units, chillers, commercial coolers and fire suppression systems by visual inspection of manufactures' labels or plates, maintenance records, or log books, etc.

Domestic type equipment such as window mounted and small central air conditioners, refrigerators, and freezers are not evaluated for the presence of ODS.

### 1.8 Visible Mould

PWL identifies the presence of mould if visibly present in a significant quantity on exposed building surfaces. If any mould growth is concealed within wall cavities it is not addressed in this assessment.



**APPENDIX IV**  
**Location Summary Report**



## LOCATIONS LIST

Project #: 179150

Site: 21611 Meridian Street,  
Edmonton, AB

Building Name: Edmonton Institution

Surveyor: Ben Frederick

Survey Date:  
2017-05-30

Location No.	Name or Description	ft <sup>2</sup>	Floor No.	Notes
1	AB Block Tunnel		B	Concrete tunnel. No finishes
2	CD Block Tunnel		B	
3	EF Block		B	
4	GH Block		B	
5	East Mechanical Room		2	
6	Program Offices, room no. RC13		1	Thought to be built mid nineties
7	West Mechanical Room		2	
8	South, West Mechanical Room		2	
9	Gym		1	
10	Medication Room		1	
11	Team Room Or Program Room And Chapel		1	
12	Contact Visiting Room		1	
13	Segregation Block Mechanical Room, room no. Y12		2	
14	Segregation Mechanical Room, room no. Y13		2	
15	East And West Roof			
16	Executive Services		1	
17	Engineering And Maintenance		1	
18	Engineering And Maintenance, room no. S20		1	
19	Engineering And Maintenance, room no. S22		1	
20	Engineering And Maintenance, room no. S24		1	
21	Engineering And Maintenance, room no. T10		1	
22	Executive Services, room no. N30		1	
23	Cell Block G And H		1	
24	Cell Block A And B		1	
25	Cell Block C And D		1	
26	Cell Block E And F		1	

**APPENDIX V**  
**Hazardous Material Summary Report**



## HAZARDOUS MATERIALS SUMMARY

Project #: 179150

Site: 21611 Meridian Street, Edmonton, AB

Building Name: Edmonton Institution

Surveyor: Ben Frederick

Survey Date: 2017-05-30

HAZARDOUS MATERIALS SUMMARY - ASBESTOS CONTAINING MATERIALS (ACM)								
Sample No.	System	Material/Notes	Friable	Location(s)	Substance	Amount	Unit	Positive
S0001	PIPE	PARGING CEMENT INSULATION, PIPE ELBOWS	Yes	1,2,3,4	Chrysotile	40	%	Yes
S0002	STRUCTURE	FIBROUS FIREPROOFING, GREY FIBROUS FIREPROOFING SPRAY	Yes	5	None Detected			No
S0003	PIPE	PARGING CEMENT INSULATION, PARGING ON ELBOWS	Yes	7,8	Chrysotile	30	%	Yes
S0004	STRUCTURE	FIBROUS FIREPROOFING, GREY SPRAY APPLIED FIREPROOFING	Yes	7,8	None Detected			No
S0005	WALL	MASONRY, MORTAR ESTIMATE 50 FOR POSSIBLE DISTURBANCE	No	7,8	None Detected			No
S0006	DUCT	MASTIC, SILVER COLOUR	No	8	None Detected			No
S0007	DUCT	MASTIC, RED COLOUR	No	8	None Detected			No
S0008	DUCT	MASTIC, BROWN COLOUR	No	8	None Detected			No
S0009	CEILING	DRYWALL AND JOINT COMPOUND, DWJC WHITE	No	10	Chrysotile	3	%	Yes
S0010	CEILING	TEXTURE FINISH ( TEXTURE COAT), WHITE STIPPLE	Yes	11	None Detected			No
S0011	CEILING	DRYWALL AND JOINT COMPOUND, DWJC	No	11	None Detected			No
S0012	CEILING	LAY-IN CEILING TILES, PIN AND WORMY HOLES	Yes	12	None Detected			No
S0013	CEILING	DRYWALL AND JOINT COMPOUND, DWJC	No	12	None Detected			No
S0014	PIPE	PARGING CEMENT INSULATION, ELBOW CEMENT SW CORNER	Yes	13,14	None Detected			No
S0015	PIPE	PARGING CEMENT INSULATION, ELBOW CEMENT NW CORNER	Yes	13,14	None Detected			No
S0016	DUCT	MASTIC, GREY MASTIC	No	13,14	None Detected			No
S0017	WALL	MASONRY, MORTAR	No	13,14	None Detected			No
S0018	STRUCTURE	FIBROUS FIREPROOFING, SPRAY FIREPROOFING	Yes	13,14	None Detected			No
S0019	DUCT	PARGING CEMENT INSULATION, PARGING ON DUCT ELBOWS	Yes	14	None Detected			No



## HAZARDOUS MATERIALS SUMMARY

S0020	OTHER	ASPHALT SHINGLES, ROOFING ASPHALT AND TAR	No	15	None Detected	No
S0021	PIPE	PARGING CEMENT INSULATION, GREY ELBOW CEMENT	Yes	16	Chrysotile	20 % Yes
S0022	PIPE	PARGING CEMENT INSULATION, PIPE ELBOWS	Yes	17	Chrysotile	40 % Yes
S0023	CEILING	LAY-IN CEILING TILES, MEDIUM HOLES WITH WORMS	Yes	18	None Detected	No
S0024	CEILING	DRYWALL AND JOINT COMPOUND, DWJC	No	19	Chrysotile	3 % Yes
S0025	PIPE	PARGING CEMENT INSULATION, PIPE ELBOWS	Yes	21	Chrysotile	30 % Yes
S0026	PIPE	PARGING CEMENT INSULATION, GREY PARGING	Yes	21	Chrysotile	50 % Yes
S0027	CEILING	DRYWALL AND JOINT COMPOUND, DWJC	No	22	None Detected	No
S0028	CEILING	DRYWALL AND JOINT COMPOUND, DWJC	No	23	None Detected	No
S0029	CEILING	DRYWALL AND JOINT COMPOUND, DWJC	No	24	None Detected	No
S0030	CEILING	DRYWALL AND JOINT COMPOUND, DWJC	No	25	None Detected	No
S0031	CEILING	DRYWALL AND JOINT COMPOUND, DWJC	No	26	None Detected	No
V9500	PIPE	PARGING CEMENT INSULATION	Yes	9	Presumed Asbestos	Yes

Project #: 179150

Site: 21611 Meridian Street, Edmonton, AB

Building Name: Edmonton Institution

Surveyor: Ben Frederick

Survey Date: 2017-05-30

HAZARDOUS MATERIALS SUMMARY - LEAD BASED PAINT (LBP)							
Sample No.	System	Description	Location(s)	Substance	Amount	Unit	Positive
L0001	MECHANICAL	YELLOW PAINT	1,2,3,4,7,8	Lead	0.17	%	Yes
L0002	DUCT	BEIGE	5	Lead	16	%	Yes
L0003	MECHANICAL	BROWN	7,8	Lead	1.2	%	Yes
L0004	CEILING	WHITE COLOUR	10	Lead	0.078	%	Yes
L0005	WALL	BEIGE WALL PAINT	13,14	Lead	0.06	%	Yes
L0006	DUCT	BEIGE PAINT	20	Lead	0.22	%	Yes
L0007	MECHANICAL	PINKISH BROWN OVER BEIGE	21	Lead	0.58	%	Yes
L0008	CEILING	GREY COLOUR	23	Lead	0.01	%	Yes
L0009	CEILING	GREY COLOUR	24,25,26	Lead	<0.007	%	No

**APPENDIX VI**  
**All Data**



## ALL DATA REPORT

1-877-322-4744  
www.pinchin.comProject #: 179150  
Location #: 1Site: 21611 Meridian Street, Edmonton, AB  
Location Name: AB Block TunnelBuilding Name: Edmonton Institution  
Floor: BSurveyor: Ben Frederick  
Room #:Survey Date: 2017-05-30  
Square ft:

ASBESTOS															
System	Component	Material	Friable	Item	Covering	Access	Visible	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Asbestos
DUCT <sup>1</sup>	ALL	FIBREGLASS	No	ALL	FOIL FACE	B	Y						~		No
PIPE <sup>2</sup>	ALL	PARGING CEMENT INSULATION, PIPE ELBOWS	Yes	PIPE ELBOW	CANVAS	B	Y	11 (7)			EA	S0001A	CHRYSTILE	40%	Yes
PIPE <sup>3</sup>	ALL	PARGING CEMENT INSULATION, PIPE ELBOWS	Yes	PIPE ELBOW	CANVAS	B	Y				EA	S0001B	CHRYSTILE	40%	Yes
PIPE <sup>4</sup>	ALL	PARGING CEMENT INSULATION, DARK YELLOW PIPES	Yes	PIPE ELBOW	CANVAS	B	Y	10 (7)			EA	V0001	CHRYSTILE	40%	Yes
MECHANICAL <sup>5</sup>	AIR HANDLING UNIT	FIBREGLASS	No	INSULATION	CANVAS	B	Y						~		No

Note: Concrete tunnel. No finishes

1 - Comment 1 fibreglass on two ducts

2 - Dark yellow hot water pipes

3 - Dark yellow hot water pipes

4 - Piping near air handler 14

5 - Foil backed insulation on air handlers 13, 14 15

Project #: 179150  
Location #: 2Site: 21611 Meridian Street, Edmonton, AB  
Location Name: CD Block TunnelBuilding Name: Edmonton Institution  
Floor: BSurveyor: Ben Frederick  
Room #:Survey Date: 2017-05-30  
Square ft:

ASBESTOS															
System	Component	Material	Friable	Item	Covering	Access	Visible	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Asbestos
DUCT <sup>1</sup>	ALL	FIBREGLASS	No	ALL	FOIL FACE	B	Y						~		No
PIPE <sup>2</sup>	ALL	PARGING CEMENT INSULATION, PIPE ELBOWS	Yes	PIPE ELBOW	CANVAS	B	Y	11 (7)			EA	V0001	CHRYSTILE	40%	Yes
PIPE <sup>3</sup>	ALL	PARGING CEMENT INSULATION, PIPE ELBOWS	Yes	PIPE ELBOW	CANVAS	B	Y				EA	V0001	CHRYSTILE	40%	Yes
PIPE <sup>4</sup>	ALL	PARGING CEMENT INSULATION, DARK YELLOW PIPES	Yes	PIPE ELBOW	CANVAS	B	Y	10 (7)			EA	S0001C	CHRYSTILE	40%	Yes
MECHANICAL <sup>5</sup>	AIR HANDLING UNIT	FIBREGLASS	No	INSULATION	CANVAS	B	Y						~		No

1 - Comment 1 fibreglass on two ducts

2 - Dark yellow hot water pipes

3 - Dark yellow hot water pipes

4 - Piping near air handler 11

5 - Foil backed insulation on air handlers 10, 11, 12

Project #: 179150  
Location #: 3Site: 21611 Meridian Street, Edmonton, AB  
Location Name: EF BlockBuilding Name: Edmonton Institution  
Floor: BSurveyor: Ben Frederick  
Room #:Survey Date: 2017-05-30  
Square ft:

ASBESTOS															
System	Component	Material	Friable	Item	Covering	Access	Visible	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Asbestos
DUCT <sup>1</sup>	ALL	FIBREGLASS	No	ALL	FOIL FACE	B	Y						~		No



## ALL DATA REPORT

1-877-322-4744  
www.pinchin.com

PIPE <sup>2</sup>	ALL	PARGING CEMENT INSULATION, PIPE ELBOWS	Yes	PIPE ELBOW	CANVAS	B	Y	11 (7)			EA	V0001	CHRYSTILE	40%	Yes
PIPE <sup>3</sup>	ALL	PARGING CEMENT INSULATION, PIPE ELBOWS	Yes	PIPE ELBOW	CANVAS	B	Y				EA	V0001	CHRYSTILE	40%	Yes
PIPE <sup>4</sup>	ALL	PARGING CEMENT INSULATION, DARK YELLOW PIPES	Yes	PIPE ELBOW	CANVAS	B	Y	10 (7)			EA	S0001D	CHRYSTILE	40%	Yes
MECHANICAL <sup>5</sup>	AIR HANDLING UNIT	FIBREGLASS	No	INSULATION	CANVAS	B	Y						~		No

1 - Comment 1 fibreglass on two ducts

2 - Dark yellow hot water pipes

3 - Dark yellow hot water pipes

4 - Piping near air handler 4

5 - Foil backed insulation on air handlers 4, 5, 6





## ALL DATA REPORT

Project #: 179150 Site: 21611 Meridian Street, Edmonton, AB Building Name: Edmonton Institution Surveyor: Ben Frederick Survey Date: 2017-05-30  
Location #: 4 Location Name: GH Block Floor: B Room #: Square ft:

ASBESTOS															
System	Component	Material	Friable	Item	Covering	Access	Visible	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Asbestos
DUCT <sup>1</sup>	ALL	FIBREGLASS	No	ALL	FOIL FACE	B	Y						~		No
PIPE <sup>2</sup>	ALL	PARGING CEMENT INSULATION, PIPE FITTING	Yes	PIPE ELBOW	CANVAS	B	Y	11 (7)			EA	S0001E	CHRYSTOTILE	40%	Yes
PIPE <sup>3</sup>	ALL	PARGING CEMENT INSULATION, PIPE ELBOWS	Yes	PIPE ELBOW	CANVAS	B	Y				EA	V0001	CHRYSTOTILE	40%	Yes
PIPE <sup>4</sup>	ALL	PARGING CEMENT INSULATION, DARK YELLOW PIPES	Yes	PIPE ELBOW	CANVAS	B	Y	10 (7)			EA	V0001	CHRYSTOTILE	40%	Yes
MECHANICAL <sup>5</sup>	AIR HANDLING UNIT	FIBREGLASS	No	INSULATION	CANVAS	B	Y						~		No

- 1 - Comment 1 fibreglass on two ducts  
2 - Dark yellow hot water pipes  
3 - Dark yellow hot water pipes  
4 - Piping near air handler 4  
5 - Foil backed insulation on air handlers 7, 8, 9

Project #: 179150 Site: 21611 Meridian Street, Edmonton, AB Building Name: Edmonton Institution Surveyor: Ben Frederick Survey Date: 2017-05-30  
Location #: 5 Location Name: East Mechanical Room Floor: 2 Room #: Square ft:

ASBESTOS															
System	Component	Material	Friable	Item	Covering	Access	Visible	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Asbestos
STRUCTURE	BEAM, DECK, JOIST	FIBROUS FIREPROOFING, GREY FIBROUS FIREPROOFING SPRAY	Yes	INSULATION	N/A	B	Y	300			SF	S0002A	NON-ASBESTOS		No
STRUCTURE	BEAM, DECK, JOIST	FIBROUS FIREPROOFING, GREY FIBROUS FIREPROOFING SPRAY	Yes	INSULATION	N/A	B	Y	300			SF	S0002B	NON-ASBESTOS		No
STRUCTURE	BEAM, DECK, JOIST	FIBROUS FIREPROOFING, GREY FIBROUS FIREPROOFING SPRAY	Yes	INSULATION	N/A	B	Y	300			SF	S0002C	NON-ASBESTOS		No
DUCT	ALL	NOT INSULATED	No	ALL	PAINTED								~		No
PIPE <sup>1</sup>	ALL	FIBREGLASS	No	ALL	CANVAS								~		No
MECHANICAL <sup>2</sup>	AIR HANDLING UNIT	NOT INSULATED	No	ALL	N/A								~		No

- 1 - Whole room looks to be asbestos clean  
2 - Air handlers and associated ducting not insulated

Project #: 179150 Site: 21611 Meridian Street, Edmonton, AB Building Name: Edmonton Institution Surveyor: Ben Frederick Survey Date: 2017-05-30  
Location #: 6 Location Name: Program Offices Floor: 1 Room #: RC13 Square ft:

ASBESTOS															
System	Component	Material	Friable	Item	Covering	Access	Visible	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Asbestos
CEILING <sup>1</sup>	ACOUSTIC TILE	LAY-IN CEILING TILES	Yes	ALL		B	Y						~		No
DUCT	ALL	NOT INSULATED	No	ALL	METAL								~		No
MECHANICAL	AIR HANDLING UNIT	NOT INSULATED	No	ALL	PAINTED								~		No

Note: Thought to be built mid nineties



## ALL DATA REPORT

1-877-322-4744  
[www.pinchin.com](http://www.pinchin.com)

1 - Stamped 1993



## ALL DATA REPORT

Project #: 179150  
Location #: 7

Site: 21611 Meridian Street, Edmonton, AB  
Location Name: West Mechanical Room

Building Name: Edmonton Institution  
Floor: 2

Surveyor: Ben Frederick  
Room #:

Survey Date: 2017-05-30  
Square ft:

ASBESTOS															
System	Component	Material	Friable	Item	Covering	Access	Visible	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Asbestos
WALL <sup>1</sup>	ALL	MASONRY, MORTAR ESTIMATE 50 FOR POSSIBLE DISTURBANCE	No	ALL	N/A	B	Y	50			SF	S0005A	NON-ASBESTOS		No
WALL <sup>2</sup>	ALL	MASONRY, MORTAR ESTIMATE 50 FOR POSSIBLE DISTURBANCE	No	ALL	N/A	B	Y	50			SF	S0005B	NON-ASBESTOS		No
WALL <sup>3</sup>	ALL	MASONRY, MORTAR ESTIMATE 50 FOR POSSIBLE DISTURBANCE	No	ALL	N/A	B	Y	50			SF	S0005C	NON-ASBESTOS		No
STRUCTURE	ALL	FIBROUS FIREPROOFING, GREY SPRAY APPLIED FIREPROOFING	Yes	INSULATION		B	Y	400			SF	S0004A	NON-ASBESTOS		No
STRUCTURE	ALL	FIBROUS FIREPROOFING, GREY SPRAY APPLIED FIREPROOFING	Yes	INSULATION		B	Y	400			SF	S0004B	NON-ASBESTOS		No
STRUCTURE	ALL	FIBROUS FIREPROOFING, GREY SPRAY APPLIED FIREPROOFING	Yes	INSULATION		B	Y	400			SF	S0004C	NON-ASBESTOS		No
DUCT	ALL	NOT INSULATED	No										~		No
PIPE <sup>4</sup>	ALL	PARGING CEMENT INSULATION, PARGING ON ELBOWS	Yes	PIPE ELBOW	CANVAS	B	Y				EA	S0003A	CHRYSTILE	30%	Yes
PIPE <sup>5</sup>	ALL	PARGING CEMENT INSULATION, PARGING ON ELBOWS	Yes	PIPE ELBOW	CANVAS	B	Y				EA	S0003B	CHRYSTILE	30%	Yes
PIPE <sup>6</sup>	ALL	PARGING CEMENT INSULATION, PARGING ON ELBOWS	Yes	PIPE ELBOW	CANVAS	B	Y	20 (7)			EA	S0003C	CHRYSTILE	30%	Yes
MECHANICAL <sup>7</sup>	AIR HANDLING UNIT	NOT INSULATED	No										~		No

1 - Unpainted block wall

2 - Unpainted block wall

3 - Unpainted block wall

4 - Same dark yellow colour as in basement of the blocks

5 - Same dark yellow colour as in basement of the blocks

6 - Same dark yellow colour as in basement of the blocks

7 - Ahu 23 and 28 and 103



## ALL DATA REPORT

Project #: 179150  
Location #: 8

Site: 21611 Meridian Street, Edmonton, AB  
Location Name: South, West Mechanical Room

Building Name: Edmonton Institution  
Floor: 2

Surveyor: Ben Frederick  
Room #:

Survey Date: 2017-05-30  
Square ft:

ASBESTOS															
System	Component	Material	Friable	Item	Covering	Access	Visible	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Asbestos
WALL <sup>1</sup>	ALL	MASONRY, MORTAR ESTIMATE 50 FOR POSSIBLE DISTURBANCE	No	ALL	N/A	B	Y				SF	V0005	NON-ASBESTOS		No
WALL <sup>2</sup>	ALL	MASONRY, MORTAR ESTIMATE 50 FOR POSSIBLE DISTURBANCE	No	ALL	N/A	B	Y				SF	V0005	NON-ASBESTOS		No
WALL <sup>3</sup>	ALL	MASONRY, MORTAR ESTIMATE 150 FOR POSSIBLE DISTURBANCE	No	ALL	N/A	B	Y	150			SF	V0005	NON-ASBESTOS		No
STRUCTURE	ALL	FIBROUS FIREPROOFING, GREY SPRAY APPLIED FIREPROOFING	Yes	INSULATION		B	Y				SF	V0004	NON-ASBESTOS		No
STRUCTURE	ALL	FIBROUS FIREPROOFING, GREY SPRAY APPLIED FIREPROOFING	Yes	INSULATION		B	Y				SF	V0004	NON-ASBESTOS		No
STRUCTURE	ALL	FIBROUS FIREPROOFING, GREY SPRAY APPLIED FIREPROOFING	Yes	INSULATION		B	Y	2000			SF	V0004	NON-ASBESTOS		No
DUCT	ALL	NOT INSULATED	No										~		No
DUCT <sup>4</sup>	ALL	MASTIC, SILVER COLOUR	No			B	Y	10			LF	S0006	NON-ASBESTOS		No
DUCT <sup>5</sup>	ALL	MASTIC, RED COLOUR	No			B	Y	10			LF	S0007	NON-ASBESTOS		No
DUCT <sup>6</sup>	ALL	MASTIC, BROWN COLOUR	No			B	Y	20			LF	S0008	NON-ASBESTOS		No
PIPE <sup>7</sup>	ALL	PARGING CEMENT INSULATION, PARGING ON ELBOWS	Yes	PIPE ELBOW	CANVAS	B	Y				EA	V0003	CHRYSTILE	30%	Yes
PIPE <sup>8</sup>	ALL	PARGING CEMENT INSULATION, PARGING ON ELBOWS	Yes	PIPE ELBOW	CANVAS	B	Y				EA	V0003	CHRYSTILE	30%	Yes
PIPE <sup>9</sup>	ALL	PARGING CEMENT INSULATION, PARGING ON ELBOWS	Yes	PIPE ELBOW	CANVAS	B	Y	120 (7)			EA	V0003	CHRYSTILE	30%	Yes
MECHANICAL <sup>10</sup>	AIR HANDLING UNIT	NOT INSULATED	No										~		No

1 - Unpainted block wall

2 - Unpainted block wall

3 - Unpainted block wall

4 - On ahu 101 ducting

5 - On 2 duct columns near ahu 19

6 - On ahu 18

7 - Same dark yellow colour as in basement of the blocks

8 - Same dark yellow colour as in basement of the blocks

9 - Same dark yellow colour as in basement of the blocks

10 - All Ahu

Project #: 179150  
Location #: 9

Site: 21611 Meridian Street, Edmonton, AB  
Location Name: Gym

Building Name: Edmonton Institution  
Floor: 1

Surveyor: Ben Frederick  
Room #:

Survey Date: 2017-05-30  
Square ft:

ASBESTOS															
System	Component	Material	Friable	Item	Covering	Access	Visible	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Asbestos
DUCT	ALL	NOT INSULATED	No										~		No



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PIPE <sup>1</sup>	ALL	PARGING CEMENT INSULATION	Yes	PIPE ELBOW		D	Y	15 (7)			EA	V9500	PRESUMED		Yes
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1 - To High for 6 foot ladder

Project #: 179150

Site: 21611 Meridian Street, Edmonton, AB

Building Name: Edmonton Institution

Surveyor: Ben Frederick

Survey Date: 2017-05-30

Location #: 10

Location Name: Medication Room

Floor: 1

Room #:

Square ft:

ASBESTOS															
System	Component	Material	Friable	Item	Covering	Access	Visible	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Asbestos
CEILING	BULKHEAD	DRYWALL AND JOINT COMPOUND, DWJC WHITE	No		PAINTED	B	Y				SF	S0009A	CHRYSTILE	3%	Yes
CEILING	BULKHEAD	DRYWALL AND JOINT COMPOUND, DWJC WHITE	No		PAINTED	B	Y				SF	S0009B	CHRYSTILE	3%	Yes
CEILING	BULKHEAD	DRYWALL AND JOINT COMPOUND, DWJC WHITE	No		PAINTED	B	Y	200 (7)			SF	S0009C	CHRYSTILE	3%	Yes



## ALL DATA REPORT

Project #: 179150

Site: 21611 Meridian Street, Edmonton, AB

Building Name: Edmonton Institution

Surveyor: Ben Frederick

Survey Date: 2017-05-31

Location #: 11

Location Name: Team Room Or Program Room And Chapel

Floor: 1

Room #:

Square ft:

ASBESTOS															
System	Component	Material	Friable	Item	Covering	Access	Visible	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Asbestos
CEILING <sup>1</sup>	ALL	TEXTURE FINISH ( TEXTURE COAT), WHITE STIPPLE	Yes	SURFACE	N/A	B	Y	1200			SF	S0010A	NON-ASBESTOS		No
CEILING <sup>2</sup>	ALL	TEXTURE FINISH ( TEXTURE COAT), WHITE STIPPLE	Yes	SURFACE	N/A	B	Y	1200			SF	S0010B	NON-ASBESTOS		No
CEILING <sup>3</sup>	ALL	TEXTURE FINISH ( TEXTURE COAT), WHITE STIPPLE	Yes	SURFACE	N/A	B	Y	1200			SF	S0010C	NON-ASBESTOS		No
CEILING <sup>4</sup>	ALL	DRYWALL AND JOINT COMPOUND, DWJC	No	ALL		B	N	1200			SF	S0011A	NON-ASBESTOS		No
CEILING <sup>5</sup>	ALL	DRYWALL AND JOINT COMPOUND, DWJC	No	ALL		B	N	1200			SF	S0011B	NON-ASBESTOS		No
CEILING <sup>6</sup>	ALL	DRYWALL AND JOINT COMPOUND, DWJC	No	ALL		B	N	1200			SF	S0011C	NON-ASBESTOS		No

1 - White stipple

2 - White stipple

3 - White stipple

4 - Under ceiling stipple

5 - Under ceiling stipple

6 - Under ceiling stipple

Project #: 179150

Site: 21611 Meridian Street, Edmonton, AB

Building Name: Edmonton Institution

Surveyor: Ben Frederick

Survey Date: 2017-05-31

Location #: 12

Location Name: Contact Visiting Room

Floor: 1

Room #:

Square ft:

ASBESTOS															
System	Component	Material	Friable	Item	Covering	Access	Visible	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Asbestos
CEILING <sup>1</sup>	ACOUSTIC TILE	LAY-IN CEILING TILES, PIN AND WORMY HOLES	Yes			B	Y	1200			SF	S0012A	NON-ASBESTOS		No
CEILING <sup>2</sup>	ACOUSTIC TILE	LAY-IN CEILING TILES, PIN AND WORMY HOLES	Yes			B	Y	1200			SF	S0012B	NON-ASBESTOS		No
CEILING <sup>3</sup>	ALL	DRYWALL AND JOINT COMPOUND, DWJC	No			B	N	1200			SF	S0013A	NON-ASBESTOS		No
CEILING <sup>4</sup>	ALL	DRYWALL AND JOINT COMPOUND, DWJC	No			B	N	1200			SF	S0013B	NON-ASBESTOS		No
CEILING <sup>5</sup>	ALL	DRYWALL AND JOINT COMPOUND, DWJC	No			B	N	1200			SF	S0013C	NON-ASBESTOS		No

1 - Pin and wormy holes

2 - Pin and wormy holes

3 - Above drop ceiling

4 - Above drop ceiling

5 - Above drop ceiling



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Project #: 179150

Site: 21611 Meridian Street, Edmonton, AB  
Location Name: Segregation Block Mechanical Room

Building Name: Edmonton Institution  
Floor: 2

Surveyor: Ben Frederick  
Room #: Y12

Survey Date: 2017-05-31  
Square ft:

ASBESTOS															
System	Component	Material	Friable	Item	Covering	Access	Visible	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Asbestos
WALL <sup>1</sup>	ALL	MASONRY, MORTAR	No		PAINTED	B	Y				SF	S0017A	NON-ASBESTOS		No
WALL <sup>2</sup>	ALL	MASONRY, MORTAR	No		PAINTED	B	Y				SF	S0017B	NON-ASBESTOS		No
WALL <sup>3</sup>	ALL	MASONRY, MORTAR	No		PAINTED	B	Y	800			SF	S0017C	NON-ASBESTOS		No
STRUCTURE	ALL	FIBROUS FIREPROOFING, SPRAY FIREPROOFING	Yes		N/A	B	Y				SF	S0018A	NON-ASBESTOS		No
STRUCTURE	ALL	FIBROUS FIREPROOFING, SPRAY FIREPROOFING	Yes		N/A	B	Y				SF	S0018B	NON-ASBESTOS		No
STRUCTURE	ALL	FIBROUS FIREPROOFING, SPRAY FIREPROOFING	Yes		N/A	B	Y	400			SF	S0018C	NON-ASBESTOS		No
DUCT	ALL	MASTIC, GREY MASTIC	No			B	Y	40			LF	S0016	NON-ASBESTOS		No
PIPE <sup>4</sup>	ALL	PARGING CEMENT INSULATION, ELBOW CEMENT SW CORNER	Yes		CANVAS	B	Y				EA	S0014A	NON-ASBESTOS		No
PIPE <sup>5</sup>	ALL	PARGING CEMENT INSULATION, ELBOW CEMENT SE CORNER	Yes		CANVAS	B	Y	25			EA	S0014B	NON-ASBESTOS		No
PIPE <sup>6</sup>	ALL	PARGING CEMENT INSULATION, ELBOW CEMENT NW CORNER	Yes		CANVAS	B	Y				EA	S0015A	NON-ASBESTOS		No
PIPE <sup>7</sup>	ALL	PARGING CEMENT INSULATION, ELBOW CEMENT SE CORNER	Yes		CANVAS	B	Y	35			EA	S0015B	NON-ASBESTOS		No
MECHANICAL	HEATING WATER TANK	NOT INSULATED	No										~		No

- 1 - All 4 walls
- 2 - All 4 walls
- 3 - All 4 walls
- 4 - Green piping
- 5 - Green piping
- 6 - Yellow piping
- 7 - Yellow piping



## ALL DATA REPORT

Project #: 179150

Site: 21611 Meridian Street, Edmonton, AB

Building Name: Edmonton Institution

Surveyor: Ben Frederick

Survey Date: 2017-05-31

Location #: 14

Location Name: Segregation Mechanical Room

Floor: 2

Room #: Y13

Square ft:

ASBESTOS															
System	Component	Material	Friable	Item	Covering	Access	Visible	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Asbestos
WALL <sup>1</sup>	ALL	MASONRY, MORTAR	No		PAINTED	B	Y				SF	V0017	NON-ASBESTOS		No
WALL <sup>2</sup>	ALL	MASONRY, MORTAR	No		PAINTED	B	Y				SF	V0017	NON-ASBESTOS		No
WALL <sup>3</sup>	ALL	MASONRY, MORTAR	No		PAINTED	B	Y	1000			SF	V0017	NON-ASBESTOS		No
STRUCTURE	ALL	FIBROUS FIREPROOFING, SPRAY FIREPROOFING	Yes		N/A	B	Y				SF	V0018	NON-ASBESTOS		No
STRUCTURE	ALL	FIBROUS FIREPROOFING, SPRAY FIREPROOFING	Yes		N/A	B	Y				SF	V0018	NON-ASBESTOS		No
STRUCTURE	ALL	FIBROUS FIREPROOFING, SPRAY FIREPROOFING	Yes		N/A	B	Y	800			SF	V0018	NON-ASBESTOS		No
DUCT	ALL	MASTIC, GREY MASTIC	No			B	Y	20			LF	V0016	NON-ASBESTOS		No
DUCT	ALL	PARGING CEMENT INSULATION, PARGING ON DUCT ELBOWS	Yes		CANVAS	B	Y	10			EA	S0019A	NON-ASBESTOS		No
DUCT	ALL	PARGING CEMENT INSULATION, PARGING ON DUCT ELBOWS	Yes		CANVAS	B	Y				EA	S0019B	NON-ASBESTOS		No
DUCT	ALL	PARGING CEMENT INSULATION, PARGING ON DUCT ELBOWS IN NW CORNER	Yes		CANVAS	B	Y				EA	S0019C	NON-ASBESTOS		No
PIPE <sup>4</sup>	ALL	PARGING CEMENT INSULATION, ELBOW CEMENT SW CORNER	Yes		CANVAS	B	Y				EA	V0014	NON-ASBESTOS		No
PIPE <sup>5</sup>	ALL	PARGING CEMENT INSULATION, ELBOW CEMENT SE CORNER	Yes		CANVAS	B	Y	20			EA	V0014	NON-ASBESTOS		No
PIPE <sup>6</sup>	ALL	PARGING CEMENT INSULATION, ELBOW CEMENT NW CORNER	Yes		CANVAS	B	Y				EA	V0015	NON-ASBESTOS		No
PIPE <sup>7</sup>	ALL	PARGING CEMENT INSULATION, ELBOW CEMENT SE CORNER	Yes		CANVAS	B	Y	35			EA	V0015	NON-ASBESTOS		No
MECHANICAL	HEATING WATER TANK	NOT INSULATED	No										~		No

1 - All 4 walls

2 - All 4 walls

3 - All 4 walls

4 - Green piping

5 - Green piping

6 - Yellow piping

7 - Yellow piping





## ALL DATA REPORT

Project #: 179150  
Location #: 15

Site: 21611 Meridian Street, Edmonton, AB  
Location Name: East And West Roof

Building Name: Edmonton Institution  
Floor:

Surveyor: Ben Frederick  
Room #:

Survey Date: 2017-06-01  
Square ft:

ASBESTOS															
System	Component	Material	Friable	Item	Covering	Access	Visible	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Asbestos
OTHER <sup>1</sup>	ROOF	ASPHALT SHINGLES, ROOFING ASPHALT AND TAR	No	ALL		B	Y	>5000			SF	S0020A	NON-ASBESTOS		No
OTHER <sup>2</sup>	ROOF	ASPHALT SHINGLES, ROOFING ASPHALT AND TAR	No	ALL		B	Y				SF	S0020B	NON-ASBESTOS		No
OTHER <sup>3</sup>	ROOF	ASPHALT SHINGLES, ROOFING ASPHALT AND TAR	No	ALL		B	Y				SF	S0020C	NON-ASBESTOS		No
OTHER <sup>4</sup>	ROOF	ASPHALT SHINGLES, ROOFING ASPHALT AND TAR	No	ALL		B	Y				SF	S0020D	NON-ASBESTOS		No
OTHER <sup>5</sup>	ROOF	ASPHALT SHINGLES, ROOFING ASPHALT AND TAR	No	ALL		B	Y				SF	S0020E	NON-ASBESTOS		No
OTHER <sup>6</sup>	ROOF	ASPHALT SHINGLES, ROOFING ASPHALT AND TAR	No	ALL		B	Y				SF	S0020F	NON-ASBESTOS		No
OTHER <sup>7</sup>	ROOF	ASPHALT SHINGLES, ROOFING ASPHALT AND TAR	No	ALL		B	Y				SF	S0020G	NON-ASBESTOS		No
OTHER <sup>8</sup>	ROOF	ASPHALT SHINGLES, ROOFING ASPHALT AND TAR	No	ALL		B	Y				SF	S0020H	NON-ASBESTOS		No

- 1 - Asphalt roofing strips
- 2 - Asphalt roofing strips
- 3 - Asphalt roofing strips
- 4 - Asphalt roofing strips
- 5 - Asphalt roofing strips
- 6 - Asphalt roofing strips
- 7 - Asphalt roofing strips
- 8 - Asphalt roofing strips

Project #: 179150  
Location #: 16

Site: 21611 Meridian Street, Edmonton, AB  
Location Name: Executive Services

Building Name: Edmonton Institution  
Floor: 1

Surveyor: Ben Frederick  
Room #:

Survey Date: 2017-06-01  
Square ft:

ASBESTOS															
System	Component	Material	Friable	Item	Covering	Access	Visible	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Asbestos
PIPE <sup>1</sup>	ALL	PARGING CEMENT INSULATION, GREY ELBOW CEMENT	Yes	PIPE ELBOW	CANVAS	B	N				EA	S0021A	CHRYSTILE	20%	Yes
PIPE <sup>2</sup>	ALL	PARGING CEMENT INSULATION, GREY ELBOW CEMENT	Yes	PIPE ELBOW	CANVAS	B	N				EA	S0021B	CHRYSTILE	20%	Yes
PIPE <sup>3</sup>	ALL	PARGING CEMENT INSULATION, GREY ELBOW CEMENT	Yes	PIPE ELBOW	CANVAS	B	N				EA	S0021C	CHRYSTILE	20%	Yes

- 1 - Appears newish
- 2 - Appears newish
- 3 - Appears newish

Project #: 179150  
Location #: 17

Site: 21611 Meridian Street, Edmonton, AB  
Location Name: Engineering And Maintenance

Building Name: Edmonton Institution  
Floor: 1

Surveyor: Ben Frederick  
Room #:

Survey Date: 2017-06-01  
Square ft:

ASBESTOS															
System	Component	Material	Friable	Item	Covering	Access	Visible	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Asbestos
PIPE <sup>1</sup>	ALL	PARGING CEMENT INSULATION, PIPE ELBOWS	Yes	PIPE ELBOW	CANVAS	B	Y	30 (7)			EA	S0022A	CHRYSTILE	40%	Yes



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PIPE <sup>2</sup>	ALL	PARGING CEMENT INSULATION, PIPE ELBOWS	Yes	PIPE ELBOW	CANVAS	B	Y				EA	S0022B	CHRYSTILE	40%	Yes
PIPE <sup>3</sup>	ALL	PARGING CEMENT INSULATION, PIPE ELBOWS	Yes	PIPE ELBOW	CANVAS	B	Y				EA	S0022C	CHRYSTILE	40%	Yes

1 - Yellow piping

2 - Yellow piping

3 - Yellow piping

Project #: 179150

Site: 21611 Meridian Street, Edmonton, AB

Building Name: Edmonton Institution

Surveyor: Ben Frederick

Survey Date: 2017-06-01

Location #: 18

Location Name: Engineering And Maintenance

Floor: 1

Room #: S20

Square ft:

ASBESTOS															
System	Component	Material	Friable	Item	Covering	Access	Visible	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Asbestos
CEILING <sup>1</sup>	ACOUSTIC TILE	LAY-IN CEILING TILES, MEDIUM HOLES WITH WORMS	Yes	ALL		B	Y	160			SF	S0023A	NON-ASBESTOS		No
CEILING <sup>2</sup>	ACOUSTIC TILE	LAY-IN CEILING TILES, MEDIUM HOLES WITH WORMS	Yes	ALL		B	Y				SF	S0023B	NON-ASBESTOS		No

1 - Fire rated tiles

2 - Fire rated tiles



## ALL DATA REPORT

**Project #:** 179150 **Site:** 21611 Meridian Street, Edmonton, AB **Building Name:** Edmonton Institution **Surveyor:** Ben Frederick **Survey Date:** 2017-06-01  
**Location #:** 19 **Location Name:** Engineering And Maintenance **Floor:** 1 **Room #:** S22 **Square ft:**

ASBESTOS															
System	Component	Material	Friable	Item	Covering	Access	Visible	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Asbestos
CEILING <sup>1</sup>	ALL	DRYWALL AND JOINT COMPOUND, DWJC	No		PAINTED	B	Y	150 (7)			SF	S0024A	CHRYSTILE	3%	Yes
CEILING <sup>2</sup>	ALL	DRYWALL AND JOINT COMPOUND, DWJC	No		PAINTED	B	Y				SF	S0024B	CHRYSTILE	3%	Yes
CEILING <sup>3</sup>	ALL	DRYWALL AND JOINT COMPOUND, DWJC	No		PAINTED	B	Y				SF	S0024C	CHRYSTILE	3%	Yes

1 - Border of ceiling no dwjc

2 - Border of ceiling no dwjc

3 - Border of ceiling no dwjc

**Project #:** 179150 **Site:** 21611 Meridian Street, Edmonton, AB **Building Name:** Edmonton Institution **Surveyor:** Ben Frederick **Survey Date:** 2017-06-01  
**Location #:** 20 **Location Name:** Engineering And Maintenance **Floor:** 1 **Room #:** S24 **Square ft:**

ASBESTOS															
System	Component	Material	Friable	Item	Covering	Access	Visible	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Asbestos
DUCT	ALL	NOT INSULATED	No		PAINTED								~		No

**Project #:** 179150 **Site:** 21611 Meridian Street, Edmonton, AB **Building Name:** Edmonton Institution **Surveyor:** Ben Frederick **Survey Date:** 2017-06-02  
**Location #:** 21 **Location Name:** Engineering And Maintenance **Floor:** 1 **Room #:** T10 **Square ft:**

ASBESTOS															
System	Component	Material	Friable	Item	Covering	Access	Visible	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Asbestos
DUCT	ALL	NOT INSULATED	No										~		No
PIPE <sup>1</sup>	ALL	PARGING CEMENT INSULATION, PIPE ELBOWS	Yes	PIPE ELBOW	CANVAS	B	Y	20 (7)			EA	S0025A	CHRYSTILE	30%	Yes
PIPE <sup>2</sup>	ALL	PARGING CEMENT INSULATION, PIPE ELBOWS	Yes	PIPE ELBOW	CANVAS	B	Y				EA	S0025B	CHRYSTILE	30%	Yes
PIPE <sup>3</sup>	HOT WATER HEATING	PARGING CEMENT INSULATION, GREY PARGING	Yes	PIPE ELBOW	CANVAS	B	Y	1 (7)			EA	S0026	CHRYSTILE	50%	Yes
MECHANICAL	AIR HANDLING UNIT	NOT INSULATED	No										~		No

1 - Yellow piping

2 - Yellow piping

3 - On fibreglass insulation next to abated elbow

**Project #:** 179150 **Site:** 21611 Meridian Street, Edmonton, AB **Building Name:** Edmonton Institution **Surveyor:** Ben Frederick **Survey Date:** 2017-06-02  
**Location #:** 22 **Location Name:** Executive Services **Floor:** 1 **Room #:** N30 **Square ft:**

ASBESTOS															
System	Component	Material	Friable	Item	Covering	Access	Visible	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Asbestos
CEILING	ALL	DRYWALL AND JOINT COMPOUND, DWJC	No			B	Y	600			SF	S0027A	NON-ASBESTOS		No
CEILING	ALL	DRYWALL AND JOINT COMPOUND, DWJC	No			B	Y				SF	S0027B	NON-ASBESTOS		No
CEILING	ALL	DRYWALL AND JOINT COMPOUND, DWJC	No			B	Y				SF	S0027C	NON-ASBESTOS		No



## ALL DATA REPORT

Project #: 179150  
Location #: 23

Site: 21611 Meridian Street, Edmonton, AB  
Location Name: Cell Block G And H

Building Name: Edmonton Institution  
Floor: 1

Surveyor: Ben Frederick  
Room #:

Survey Date: 2017-06-02  
Square ft:

ASBESTOS															
System	Component	Material	Friable	Item	Covering	Access	Visible	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Asbestos
CEILING <sup>1</sup>	ALL	DRYWALL AND JOINT COMPOUND, DWJC	No		PAINTED	B	Y	2000			SF	S0028A	NON-ASBESTOS		No
CEILING <sup>2</sup>	ALL	DRYWALL AND JOINT COMPOUND, DWJC	No		PAINTED	B	Y				SF	S0028B	NON-ASBESTOS		No
CEILING	ALL	DRYWALL AND JOINT COMPOUND, DWJC	No		PAINTED	B	Y				SF	S0028C	NON-ASBESTOS		No

1 - Room H12

2 - Room H12



## ALL DATA REPORT

Project #: 179150  
Location #: 24

Site: 21611 Meridian Street, Edmonton, AB  
Location Name: Cell Block A And B

Building Name: Edmonton Institution  
Floor: 1

Surveyor: Ben Frederick  
Room #:

Survey Date: 2017-06-02  
Square ft:

ASBESTOS															
System	Component	Material	Friable	Item	Covering	Access	Visible	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Asbestos
CEILING <sup>1</sup>	ALL	DRYWALL AND JOINT COMPOUND, DWJC	No		PAINTED	B	Y	2000			SF	S0029A	NON-ASBESTOS		No
CEILING	ALL	DRYWALL AND JOINT COMPOUND, DWJC	No		PAINTED	B	Y				SF	S0029B	NON-ASBESTOS		No
CEILING	ALL	DRYWALL AND JOINT COMPOUND, DWJC	No		PAINTED	B	Y				SF	S0029C	NON-ASBESTOS		No
CEILING <sup>2</sup>	ALL	DRYWALL AND JOINT COMPOUND, DWJC	No		PAINTED	B	Y					S0029D	NON-ASBESTOS		No

1 - Room A11

2 - Room B11

Project #: 179150  
Location #: 25

Site: 21611 Meridian Street, Edmonton, AB  
Location Name: Cell Block C And D

Building Name: Edmonton Institution  
Floor: 1

Surveyor: Ben Frederick  
Room #:

Survey Date: 2017-06-02  
Square ft:

ASBESTOS															
System	Component	Material	Friable	Item	Covering	Access	Visible	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Asbestos
CEILING <sup>1</sup>	ALL	DRYWALL AND JOINT COMPOUND, DWJC	No		PAINTED	B	Y	2000			SF	S0030A	NON-ASBESTOS		No
CEILING	ALL	DRYWALL AND JOINT COMPOUND, DWJC	No		PAINTED	B	Y				SF	S0030B	NON-ASBESTOS		No
CEILING	ALL	DRYWALL AND JOINT COMPOUND, DWJC	No		PAINTED	B	Y				SF	S0030C	NON-ASBESTOS		No

1 - Room C11

Project #: 179150  
Location #: 26

Site: 21611 Meridian Street, Edmonton, AB  
Location Name: Cell Block E And F

Building Name: Edmonton Institution  
Floor: 1

Surveyor: Ben Frederick  
Room #:

Survey Date: 2017-06-02  
Square ft:

ASBESTOS															
System	Component	Material	Friable	Item	Covering	Access	Visible	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Asbestos
CEILING <sup>1</sup>	ALL	DRYWALL AND JOINT COMPOUND, DWJC	No		PAINTED	B	Y	2000			SF	S0031A	NON-ASBESTOS		No
CEILING	ALL	DRYWALL AND JOINT COMPOUND, DWJC	No		PAINTED	B	Y				SF	S0031B	NON-ASBESTOS		No
CEILING <sup>2</sup>	ALL	DRYWALL AND JOINT COMPOUND, DWJC	No		PAINTED	B	Y				SF	S0031C	NON-ASBESTOS		No

1 - Room E12

2 - Room F12



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Project #: 179150	Site: 21611 Meridian Street, Edmonton, AB	Building Name: Edmonton Institution	Surveyor: Ben Frederick	Survey Date: 2017-05-30					
Location #: 1	Location Name: AB Block Tunnel	Floor: B	Room #:	Square ft:					
LEAD PAINT									
System	Item	Good	Poor	Unit	Sample	Sample Description	Result Description	Amount	Lead
MECHANICAL <sup>1</sup>	METAL	150		SF	L0001	Yellow paint		0.17%	Yes

Note: Concrete tunnel. No finishes

1 - Yellow paint on air handlers

Project #: 179150		Site: 21611 Meridian Street, Edmonton, AB		Building Name: Edmonton Institution			Surveyor: Ben Frederick		Survey Date: 2017-05-30	
Location #: 2		Location Name: CD Block Tunnel		Floor: B			Room #:		Square ft:	
LEAD PAINT										
System	Item	Good	Poor	Unit	Sample	Sample Description	Result Description	Amount	Lead	
MECHANICAL <sup>1</sup>	METAL	150		SF	V0001	Yellow paint		0.17%	Yes	

1 - Yellow paint on air handlers

Project #: 179150		Site: 21611 Meridian Street, Edmonton, AB		Building Name: Edmonton Institution			Surveyor: Ben Frederick		Survey Date: 2017-05-30	
Location #: 3		Location Name: EF Block		Floor: B			Room #:		Square ft:	
LEAD PAINT										
System	Item	Good	Poor	Unit	Sample	Sample Description	Result Description	Amount	Lead	
MECHANICAL <sup>1</sup>	METAL	300		SF	V0001	Yellow paint		0.17%	Yes	

1 - Yellow paint on air handlers

Project #: 179150		Site: 21611 Meridian Street, Edmonton, AB		Building Name: Edmonton Institution			Surveyor: Ben Frederick		Survey Date: 2017-05-30	
Location #: 4		Location Name: GH Block		Floor: B			Room #:		Square ft:	
LEAD PAINT										
System	Item	Good	Poor	Unit	Sample	Sample Description	Result Description	Amount	Lead	
MECHANICAL <sup>1</sup>	METAL	300		SF	V0001	Yellow paint		0.17%	Yes	

1 - Yellow paint on air handlers

Project #: 179150		Site: 21611 Meridian Street, Edmonton, AB		Building Name: Edmonton Institution			Surveyor: Ben Frederick		Survey Date: 2017-05-30	
Location #: 5		Location Name: East Mechanical Room		Floor: 2			Room #:		Square ft:	
LEAD PAINT										
System	Item	Good	Poor	Unit	Sample	Sample Description	Result Description	Amount	Lead	
DUCT <sup>1</sup>	METAL	400		SF	L0002	Beige		16%	Yes	

1 - Beige colour



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Project #: 179150  
Location #: 7

Site: 21611 Meridian Street, Edmonton, AB  
Location Name: West Mechanical Room

Building Name: Edmonton Institution  
Floor: 2

Surveyor: Ben Frederick  
Room #:

Survey Date: 2017-05-30  
Square ft:

LEAD PAINT									
System	Item	Good	Poor	Unit	Sample	Sample Description	Result Description	Amount	Lead
DUCT	METAL	400		SF	V0001	Beige		0.17%	Yes
MECHANICAL <sup>1</sup>	METAL	150		SF	L0003	Brown		1.2%	Yes

1 - On ahu 28 and 23

Project #: 179150  
Location #: 8

Site: 21611 Meridian Street, Edmonton, AB  
Location Name: South, West Mechanical Room

Building Name: Edmonton Institution  
Floor: 2

Surveyor: Ben Frederick  
Room #:

Survey Date: 2017-05-30  
Square ft:

LEAD PAINT									
System	Item	Good	Poor	Unit	Sample	Sample Description	Result Description	Amount	Lead
DUCT	METAL	2000		SF	V0001	Beige		0.17%	Yes
MECHANICAL <sup>1</sup>	METAL	500		SF	V0003	Brown		1.2%	Yes

1 - On ahu 26, 27, 19, 16, 17, 47

Project #: 179150  
Location #: 10

Site: 21611 Meridian Street, Edmonton, AB  
Location Name: Medication Room

Building Name: Edmonton Institution  
Floor: 1

Surveyor: Ben Frederick  
Room #:

Survey Date: 2017-05-30  
Square ft:

LEAD PAINT									
System	Item	Good	Poor	Unit	Sample	Sample Description	Result Description	Amount	Lead
CEILING <sup>1</sup>	DRYWALL AND JOINT COMPOUND	200		SF	L0004	White colour		0.078%	Yes

1 - Flaking



## ALL DATA REPORT

**Project #:** 179150      **Site:** 21611 Meridian Street, Edmonton, AB      **Building Name:** Edmonton Institution      **Surveyor:** Ben Frederick      **Survey Date:** 2017-05-31  
**Location #:** 13      **Location Name:** Segregation Block Mechanical Room      **Floor:** 2      **Room #:** Y12      **Square ft:**

LEAD PAINT									
System	Item	Good	Poor	Unit	Sample	Sample Description	Result Description	Amount	Lead
WALL <sup>1</sup>	MASONRY	800		SF	L0005	Beige wall paint		0.06%	Yes

1 - Beige over white

**Project #:** 179150      **Site:** 21611 Meridian Street, Edmonton, AB      **Building Name:** Edmonton Institution      **Surveyor:** Ben Frederick      **Survey Date:** 2017-05-31  
**Location #:** 14      **Location Name:** Segregation Mechanical Room      **Floor:** 2      **Room #:** Y13      **Square ft:**

LEAD PAINT									
System	Item	Good	Poor	Unit	Sample	Sample Description	Result Description	Amount	Lead
WALL <sup>1</sup>	MASONRY	1000		SF	V0005	Beige wall paint		0.06%	Yes

1 - Beige over white

**Project #:** 179150      **Site:** 21611 Meridian Street, Edmonton, AB      **Building Name:** Edmonton Institution      **Surveyor:** Ben Frederick      **Survey Date:** 2017-06-01  
**Location #:** 20      **Location Name:** Engineering And Maintenance      **Floor:** 1      **Room #:** S24      **Square ft:**

LEAD PAINT									
System	Item	Good	Poor	Unit	Sample	Sample Description	Result Description	Amount	Lead
DUCT	METAL	80		LF	L0006	Beige paint		0.22%	Yes

**Project #:** 179150      **Site:** 21611 Meridian Street, Edmonton, AB      **Building Name:** Edmonton Institution      **Surveyor:** Ben Frederick      **Survey Date:** 2017-06-02  
**Location #:** 21      **Location Name:** Engineering And Maintenance      **Floor:** 1      **Room #:** T10      **Square ft:**

LEAD PAINT									
System	Item	Good	Poor	Unit	Sample	Sample Description	Result Description	Amount	Lead
MECHANICAL <sup>1</sup>	METAL	600		SF	L0007	Pinkish brown over beige		0.58%	Yes

1 - Pinkish brown paint over beige

**Project #:** 179150      **Site:** 21611 Meridian Street, Edmonton, AB      **Building Name:** Edmonton Institution      **Surveyor:** Ben Frederick      **Survey Date:** 2017-06-02  
**Location #:** 23      **Location Name:** Cell Block G And H      **Floor:** 1      **Room #:**      **Square ft:**

LEAD PAINT									
System	Item	Good	Poor	Unit	Sample	Sample Description	Result Description	Amount	Lead
CEILING	DRYWALL AND JOINT COMPOUND	2000		SF	L0008	Grey colour		0.01%	Yes

**Project #:** 179150      **Site:** 21611 Meridian Street, Edmonton, AB      **Building Name:** Edmonton Institution      **Surveyor:** Ben Frederick      **Survey Date:** 2017-06-02  
**Location #:** 24      **Location Name:** Cell Block A And B      **Floor:** 1      **Room #:**      **Square ft:**

LEAD PAINT									
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System	Item	Good	Poor	Unit	Sample	Sample Description	Result Description	Amount	Lead
CEILING	DRYWALL AND JOINT COMPOUND	2000		SF	L0009	Grey colour		<0.007%	No

Project #: 179150  
Location #: 25

Site: 21611 Meridian Street, Edmonton, AB  
Location Name: Cell Block C And D

Building Name: Edmonton Institution  
Floor: 1

Surveyor: Ben Frederick  
Room #:

Survey Date: 2017-06-02  
Square ft:

### LEAD PAINT

System	Item	Good	Poor	Unit	Sample	Sample Description	Result Description	Amount	Lead
CEILING	DRYWALL AND JOINT COMPOUND	2000		SF	V0009	Grey colour		<0.007%	No

Project #: 179150  
Location #: 26

Site: 21611 Meridian Street, Edmonton, AB  
Location Name: Cell Block E And F

Building Name: Edmonton Institution  
Floor: 1

Surveyor: Ben Frederick  
Room #:

Survey Date: 2017-06-02  
Square ft:

### LEAD PAINT

System	Item	Good	Poor	Unit	Sample	Sample Description	Result Description	Amount	Lead
CEILING	DRYWALL AND JOINT COMPOUND	2000		SF	V0009	Grey colour		<0.007%	No



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### Legend:

Sample number		Units		Other	
S####	Sample collected.	SF	Square feet	SVM	Suspect Visible Mould
V####	Material is visually identified to be identical to S####	LF	Linear feet		
V0000	Known non asbestos material.	EA	Each		
V9000	Material is visually identified to contain asbestos.	%	Percentage		
V9500	Material is presumed to contain asbestos.				
Access		Condition			
A	Accessible to all building occupants	Good	No visible damage or deterioration		
B	Accessible to maintenance and operations staff without a ladder	Fair	Minor, repairable damage, cracking or deterioration.		
C	Accessible to maintenance and operations staff with a ladder. Also rarely entered, locked areas.	Poor	Irreparable damage or deterioration with exposed and missing material.		
D	Not normally accessible or without demolition				
Action					
(1)	Clean up of ACM Debris	(2)	Precautions for Access Which may Disturb ACM Debris	(3)	ACM removal
(4)	Precautions for Work Which may Disturb ACM in Poor Condition	(5)	Proactive ACM removal (Minimum repair required for fair condition)	(6)	ACM repair
(7)	Management program and surveillance				



- LEGEND:
- (X) LOCATION NUMBER
  - ⊙ NEGATIVE ASBESTOS SAMPLE LOCATION
  - ⊗ POSITIVE ASBESTOS SAMPLE LOCATION
  - ▲ NEGATIVE LEAD PAINT SAMPLE LOCATION
  - ▲ POSITIVE LEAD PAINT SAMPLE LOCATION
  - BLOCK WALL REMOVAL REQUIRED FOR INSTALLATION OF NEW DOOR

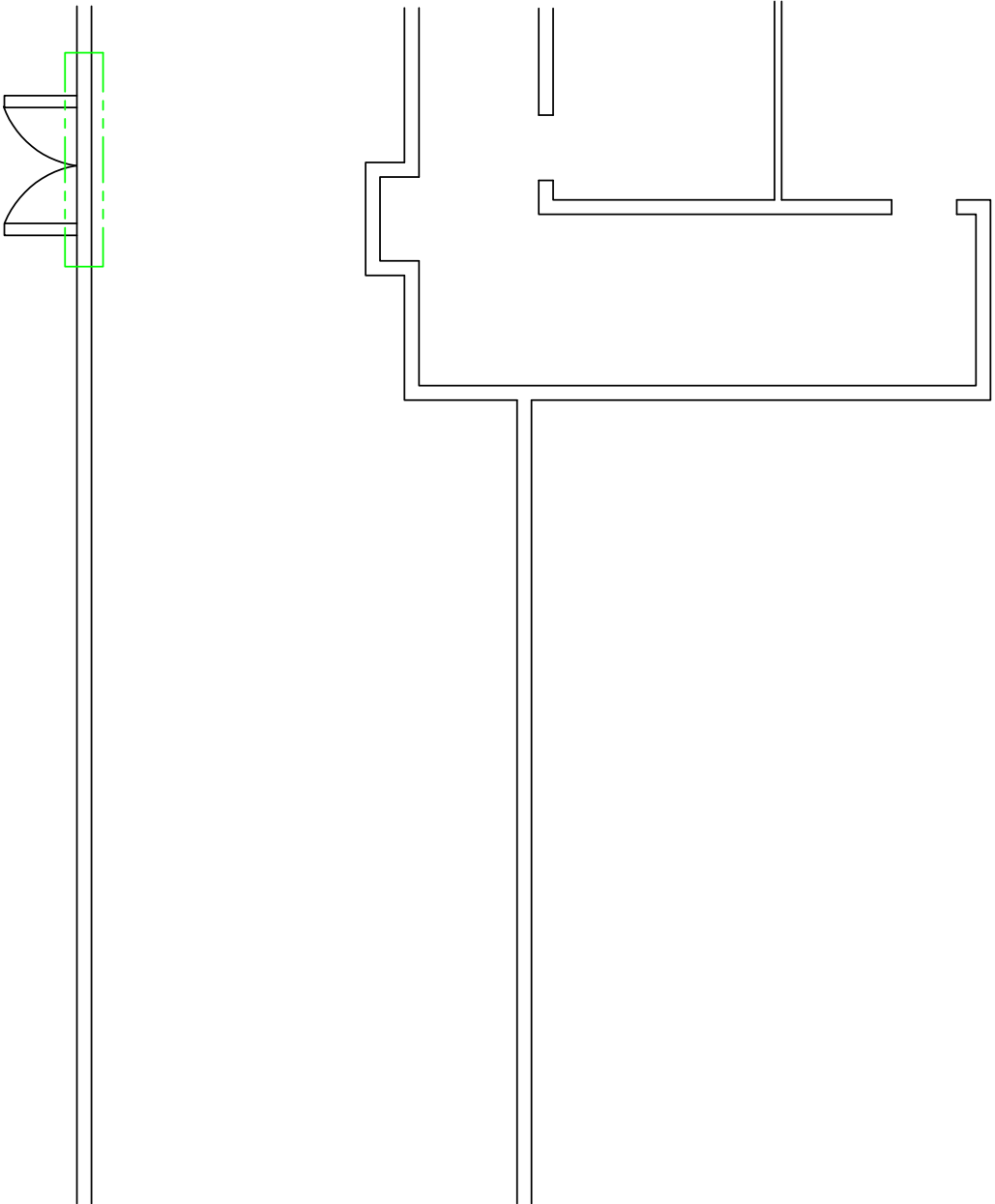
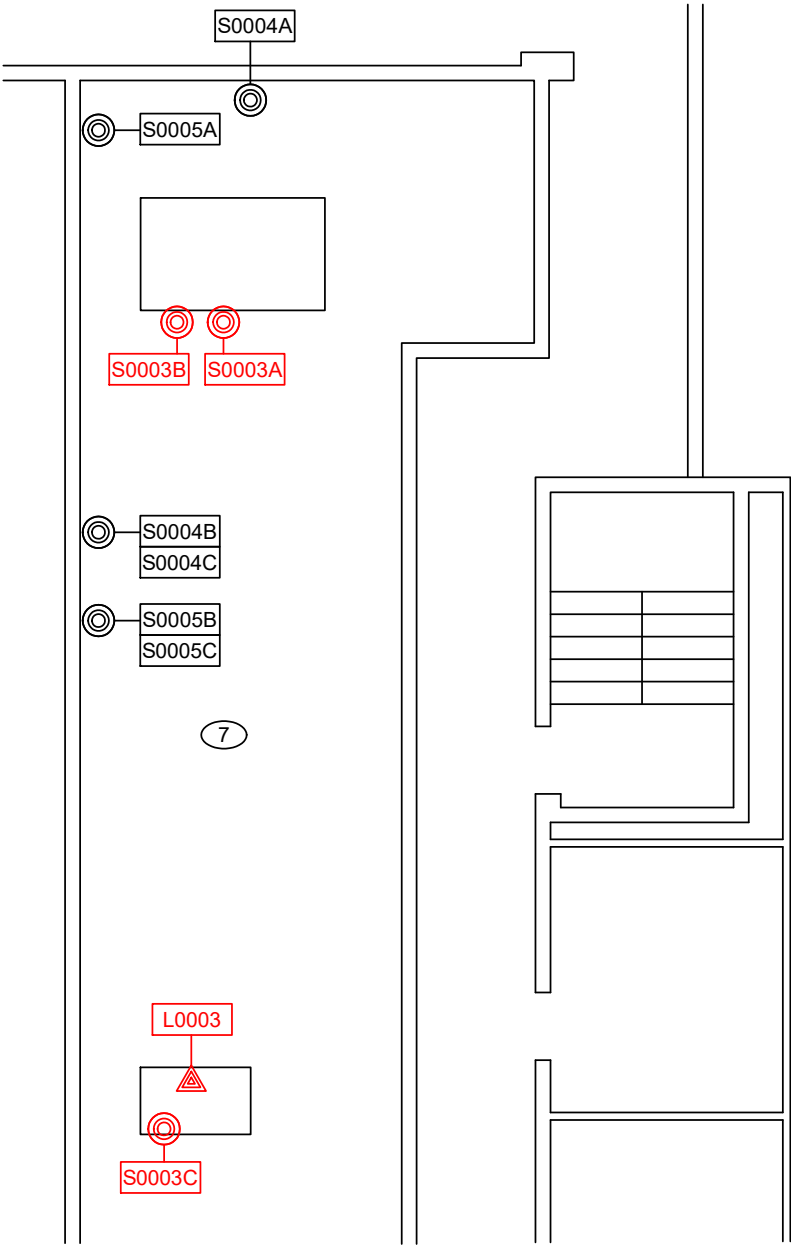
CLIENT:  
ASSOCIATED ENGINEERING  
ALBERTA LTD.  
SUITE 500, 9888 JASPER AVENUE  
EDMONTON, ALBERTA T5J 5C6

LOCATION:  
21611 MERIDIAN STREET  
EDMONTON, ALBERTA T5Y 6E7

TITLE: HVAC UPGRADE HAZARDOUS  
MATERIALS ASSESSMENT  
EDMONTON INSTITUTION  
WEST MECHANICAL ROOM NORTH

DATE: 2017/06/20	PROJECT # : 179150
---------------------	-----------------------

DRAWN BY: VM	15 OF 19
CHECKED BY: SM	
SCALE: NTS	



- NOTES:
- ALL DRAWINGS TO BE REFERENCED WITH THE HAZARDOUS MATERIALS ASSESSMENT REPORT. NOT ALL KNOWN OR SUSPECT HAZARDOUS MATERIALS ARE DEPICTED ON THIS DRAWING. REFER TO THE HAZARDOUS MATERIALS ASSESSMENT REPORT FOR A COMPLETE LIST OF IDENTIFIED HAZARDOUS MATERIALS.
  - BASEPLAN PROVIDED BY THE CLIENT.
  - LEGEND IS COLOUR DEPENDENT, PHOTOCOPIES MAY ALTER INTERPRETATION OF FIGURE.

**Part 1        General**

**1.1        SUMMARY**

- .1        Comply with requirements of this Section when performing lead-based paints from mechanical equipment, piping, ductwork, masonry, drywall or surfaces as indicated in the Pinchin report "Hazardous Building Materials Assessment, Edmonton Institution, 21611 Meridian Street, Edmonton AB," dated June 23, 2017, and the Associated Engineering Preliminary Mechanical Drawings, Revision No. A.:
  - .1        Removal of lead-containing coatings with a chemical gel or paste.
  - .2        Removal of lead-containing coatings or materials using a power tool with an effective dust collection system equipped with a HEPA filter.
  - .3        Removal of lead-containing coatings or materials with non-powered hand tool, other than manual scraping and sanding.
  - .4        Manual demolition of lead-painted concrete block walls, drywall ceilings or building components by striking the surface with sledgehammer or similar tool.

**1.2        RELATED WORK**

- .1        Section 02 83 01 Removal and Disposal of Lead Products
- .2        Section 02 82 00 Asbestos Removal
- .3        Section 02 84 00 PCB Ballast Removal
- .4        Section 02 87 00 Mercury Products Removal

**1.3        REFERENCES**

- .1        Department of Justice Canada
  - .1        Canadian Environmental Protection Act, 1999 (CEPA).
  - .2        Surface Coating Materials Regulations, SOR/2005-109, Hazardous Products Act.
- .2        Alberta Government
  - .1        Occupational Health and Safety Act, Regulation and Code, Province of Alberta, 2009.
  - .2        Workplace Health and Safety Bulletin, Lead at the Work Site (CH061), Government of Alberta, Employment and Immigration, July 2009.
- .3        Health Canada
  - .1        Workplace Hazardous Materials Information System (WHMIS), Material Safety Data Sheets (MSDS).
- .4        Canadian Standards Association (CSA)
  - .1        CSA Standard Z94.4-M2003, Selection, Care, and Use of Respirators.
- .5        Human Resources and Social Development Canada (HRSDC)

- .1 Canada Labour Code Part II, - SOR 86-304 - Occupational Health and Safety Regulations.
- .6 Transport Canada (TC)
  - .1 Transportation of Dangerous Goods Act, 1992 (TDGA).
- .7 U.S. Environmental Protection Agency (EPA)
  - .1 EPA 747-R-95-007-(1995), Sampling House Dust for Lead.
- .8 U.S. Department of Health and Human Services/Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health (NIOSH)
  - .1 NIOSH 94-113 - NIOSH Manual of Analytical Methods (NMAM), 4th Edition (1994).
- .9 U.S. Department of Labour - Occupational Safety and Health Administration (OSHA) - Toxic and Hazardous Substances
  - .1 Lead in Construction Regulation - 29 CFR 1926.62-(1993).
- .10 Underwriters' Laboratories of Canada (ULC)

#### **1.4 DEFINITIONS**

- .1 HEPA vacuum: High Efficiency Particulate Air filtered vacuum equipment with a filter system capable of collecting and retaining fibres greater than 0.3 microns in any direction at 99.97% efficiency.
- .2 Authorized Visitors: Departmental Representative.
- .3 Polyethylene: polyethylene sheeting or rip-proof polyethylene sheeting with tape along edges, around penetrating objects over cuts and tears, and elsewhere as required to provide protection and isolation. For protection of underlying surfaces from damage and to prevent lead dust entering in clean area.
- .4 Occupied Area: areas of building or work site that is outside Work Area.
- .5 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must be appropriate capacity for scope of work.
- .6 Action level: employee exposure, without regard to use of respirators, to airborne concentration of lead of 50 micrograms per cubic meter of air (50 µg/m<sup>3</sup>) calculated as 8-hour time-weighted average (TWA). Minimum precautions for lead abatement are based on airborne lead concentrations less than 0.05 milligrams per cubic meter of air for removal of lead based paint by methods noted in paragraph 1.1.
- .7 Competent person: individuals capable of identifying existing lead hazards in workplace taking corrective measures to eliminate them.
- .8 Lead dust: wipe sampling on vertical surfaces and/or horizontal surfaces, dust and debris is considered to be lead contaminated if it contains more than 40 micrograms of lead in dust per square foot.
- .9 Airlock: ingress or egress system, without permitting air movement between contaminated area and uncontaminated area. Consisting of two curtained doorways at least 2 m apart.

- .10 Curtained doorway: arrangement of closures to allow ingress and egress from one room to another. Typically constructed as follows:
  - .1 Place two overlapping polyethylene sheets over existing or temporarily framed doorway, securing each along top of doorway, securing vertical edge of one sheet along one vertical side of doorway, and secure other sheet along opposite vertical side of doorway.
  - .2 Reinforce free edges of polyethylene with duct tape and add weight to bottom edge to ensure proper closing.
  - .3 Overlap each polyethylene sheet at openings 1.5 m on each side.
- .11 Action level: employee exposure, without regard to usage of respirators, to an airborne concentration of lead of 50 micrograms per cubic meter of air calculated as 8-hour time-weighted average (TWA). Intermediate precautions for lead abatement are based on airborne lead concentrations greater than 0.05 milligrams per cubic meter of air within Work Area.
- .12 Competent person: individuals or Department Representative capable of identifying existing lead hazards in workplace and taking corrective measures to eliminate them.

## **1.5 SUBMITTALS**

- .1 Before commencing work, Contractor shall:
  - .1 Submit proof satisfactory to the Department Representative that the site location, required permits and suitable arrangements for transport and disposal of lead-based paint waste or contaminated materials have been obtained. Ensure required manifest documentation regarding disposal is submitted in accordance with these specifications.
  - .2 Provide proof satisfactory to the Department Representative that employees have had instruction on hazards of lead exposure, respirator use, dress, and aspects of work procedures and protective measures.

## **1.6 QUALITY ASSURANCE**

- .1 Regulatory Requirements: comply with Federal, Provincial/Territorial and local requirements pertaining to lead paint, provided that in case of conflict among those requirements or with these specifications more stringent requirement applies. Comply with regulations in effect at time work is performed.
- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance the Occupational Health and Safety Act (2002).
  - .2 Safety Requirements: worker and visitor protection.
    - .1 Protective equipment and clothing to be worn by workers and visitors in work Area include:
      - .1 Half mask respirator: half-mask particulate respirator with P-series filter, and 100% efficiency, suitable for type of lead and level of lead dust exposure. Provide sufficient amount of filters.

- .2 Protective clothing: Disposable full body coveralls complete with hoods and disposable gloves manufactured of a material which does not permit penetration of lead.
- .2 Eating, drinking, chewing, and smoking are not permitted in work area.
- .3 Ensure workers wash hands and face when leaving work area.
- .4 Visitor Protection:
  - .1 Provide approved respirators and protective clothing to Authorized Visitors to work areas.
  - .2 Instruct Authorized Visitors procedures to be followed in entering and exiting work area.
- .5 Provide and post in Clean Change Room and in Equipment and Access Room the procedures described in this Section, in both official languages.

## **1.7 PRODUCT DATA**

- .1 Product data:
  - .1 Provide documentation including test results, fire and flammability data, and Material Safety Data Sheets (MSDS) for chemicals or materials including:
    - .1 Encapsulants.
    - .2 Amended water.
    - .3 Slow-drying sealer.

## **1.8 WASTE MANAGEMENT AND DISPOSAL**

- .1 Dispose of all lead-painted materials as hazardous waste unless a Toxicity Characterization Leaching Procedure (TCLP) test proves otherwise.
- .2 Separate waste materials for reuse and recycling in accordance with the Department Representative's requirements while following applicable transport and waste disposal regulations.
- .3 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.
- .4 Disposal of lead waste generated by removal activities must comply with Federal, Provincial, Territorial and Municipal regulations. Dispose of lead waste in sealed double thickness 6 ml bags or leak proof drums. Label containers with appropriate warning labels.
- .5 Provide manifests describing and listing waste created. Transport containers by approved means to licensed landfill for burial.

## **1.9 EXISTING CONDITIONS**

- .1 Reports and information pertaining to lead based paint to be handled, removed, or otherwise disturbed and disposed of during this Project are attached to this specification.

- .2 Notify the Department Representative of lead based paint discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material until instructed by the Department Representative.

#### **1.10 SCHEDULING**

- .1 Not later than two days before beginning Work on this Project notify following in writing:
  - .1 Appropriate Regional or Zone Director of Medical Services Branch, Health Canada.
  - .2 Provincial Ministry of Labour.
  - .3 Disposal Authority.
- .2 Inform sub trades of presence of lead-containing materials identified in Existing Conditions.
- .3 Provide the Department Representative a copy of notifications prior to start of Work.

#### **1.11 DEPARTMENT REPRESENTATIVE'S INSTRUCTIONS**

- .1 Provide the Department Representative satisfactory proof that every worker has had instruction and training in hazards of lead exposure, in personal hygiene, in aspects of work procedures, and in use, cleaning, and disposal of respirators and protective clothing.
- .2 Instruction and training related to respirators includes, at minimum:
  - .1 Proper fitting of equipment.
  - .2 Inspection and maintenance of equipment.
  - .3 Disinfecting of equipment.
  - .4 Limitations of equipment.
- .3 Instruction and training must be provided by competent, qualified person.
- .4 Supervisory personnel to complete required training.

### **Part 2 Products**

#### **2.1 MATERIALS**

- .1 Polyethylene 6 mm thick unless otherwise specified; in sheet size to minimize joints.
- .2 Tape: fibreglass - reinforced duct tape suitable for sealing polyethylene under dry conditions and wet conditions using amended water.
- .3 Slow - drying sealer: non-staining, clear, water - dispersible type that remains tacky on surface for at least 8 hours and designed for purpose of trapping residual lead paint residue.
- .4 Polyethylene disposal bags, 6 mm thick.
- .5 Lead waste containers: type acceptable to dump operator with tightly fitting covers and 6 mm thickness sealable polyethylene liners.



- .1 Label containers with pre-printed bilingual cautionary Warning Lead clearly visible when ready for removal to disposal site.

### **Part 3 Execution**

#### **3.1 SUPERVISION**

- .1 One Supervisor for every ten workers is required.
- .2 Supervisor must remain within work area during disturbance, removal, or handling of lead based paints.

#### **3.2 PREPARATION**

- .1 Remove and store items to be salvaged or reused.
  - .1 Protect and wrap items and transport and store in area specified by the Departmental Representative.
- .2 Provide warning signs at the entrances to the lead control area which state:
  - .1 Lead hazard area.
  - .2 Access to the area is prohibited, except to authorized personnel.
  - .3 Personal protective equipment is required.
  - .4 Drinking, eating and smoking are prohibited in the area.
- .3 Work Area, General:
  - .1 Shut off and isolate HVAC system to prevent dust dispersal into other building areas.
  - .2 Pre-clean fixed casework and equipment within work area, using HEPA vacuum and cover and seal with polyethylene sheeting and tape.
  - .3 Clean work area using HEPA vacuum. If not practicable, use wet cleaning method. Do not raise dust.
  - .4 Seal off openings with polyethylene sheeting and seal with tape.
  - .5 Protect floor surfaces covered from wall to wall with polyethylene sheets.
  - .6 Maintain emergency fire exits or establish alternatives satisfactory to Authority having jurisdiction.
  - .7 Where water application is required for wetting lead containing materials, provide temporary water supply appropriately sized for application of water as required.
  - .8 Provide electrical power and shut off for operation of powered tools and equipment. Provide 24-volt safety lighting and ground fault interrupter circuits on power source for electrical tools, in accordance with applicable CSA Standard. Ensure safe installation of electrical cables and equipment.
- .4 Do not start work until:
  - .1 Arrangements have been made for disposal of waste.

- .2 Tools, equipment, and materials waste containers are on site.
- .3 Arrangements have been made for building security.
- .4 Notifications have been completed and preparatory steps have been taken.

### **3.3 LEAD ABATEMENT USING CHEMICAL GEL, PASTE, HEPA-EQUIPPED POWER TOOLS OR NON-POWERED HAND TOOLS**

- .1 Remove lead-containing coatings with a chemical gel or paste; or remove with power tools equipped with HEPA filters; or remove with non-powered hand tool, other than manual scraping and sanding.
- .2 Remove lead based paint in small sections and pack as it is being removed in sealable 6 mm plastic bags and place in labelled containers for transport.
- .3 Seal filled containers. Clean external surfaces thoroughly by wet sponging. Remove from immediate working area to staging area. Clean external surfaces thoroughly again by wet sponging. Wash containers thoroughly pending removal to outside. Ensure containers are removed by workers who have entered from uncontaminated areas dressed in clean coveralls.
- .4 After completion of stripping work, wire brush and wet sponge surface from which lead based paint has been removed to remove visible material. During this work keep surfaces wet.
- .5 After wire brushing and wet sponging to remove visible lead based paint, and after encapsulating lead containing material impossible to remove, wet clean entire work area, and equipment used in process. After inspection by the Department Representative, the work area can be turned over to unprotected workers.

### **3.4 LEAD ABATEMENT USING GENERAL DEMOLITION**

- .1 Build airlocks at entrances and exits from work areas to ensure work areas are always closed off by one curtained doorway when workers enter or exit.
- .2 Where water application is required for wetting lead containing materials, provide temporary water supply by use of appropriately sized hoses for application of water as required.
- .3 Provide electrical power and shut off for operation of powered tools and equipment. Provide 24-volt safety lighting and ground fault interrupter circuits on power source for electrical tools, in accordance with applicable CSA Standard. Ensure safe installation of electrical lines and equipment.
- .4 Construct a Worker Decontamination Enclosure System that includes Equipment and Access Room and Clean Room, as follows:
  - .1 Equipment and Access Room: construct between exit and work areas, with two curtained doorways, one to the rest of suite, and one to work area. Install waste receptor and storage facilities for workers' shoes and protective clothing to be re-worn in work areas. Build large enough to accommodate specified facilities, equipment needed, and at least one worker allowing sufficient space to change comfortably.

- .2 Clean Room: construct with curtained doorway to outside of enclosures. Provide lockers or hangers and hooks for workers' street clothes and personal belongings. Provide storage for clean protective clothing and respiratory equipment. Install mirror to permit workers to fit respiratory equipment properly.
- .5 Construct Decontamination Enclosures:
  - .1 Construct framing for enclosures or use existing rooms. Line enclosure with polyethylene sheeting and seal with tape, apply two layers of FR polyethylene on floor.
  - .2 Construct curtain doorways between enclosures so when people move through or waste containers and equipment are moved through doorway, one of two closures comprising doorway always remains closed.
- .6 Separation of Work Areas from Occupied Areas
  - .1 Construct barriers between work area and occupied areas. Barriers to be covered in poly and sealed with tape to prevent dust transfer.
- .7 Maintenance of Enclosures:
  - .1 Maintain enclosures in clean condition.
  - .2 Ensure barriers and polyethylene linings are effectively sealed and taped. Repair damaged barriers and remedy defects immediately.
  - .3 Visually inspect enclosures at beginning of each work day.
- .8 Manual demolition of lead-painted walls or building components by striking a wall with sledgehammer or similar tool.
- .9 Remove lead based paint and debris in small sections and pack as it is being removed in sealable 6 mil plastic bags and place in labelled containers for transport.
- .10 Seal filled containers. Clean external surfaces thoroughly by wet sponging. Remove from immediate working area to Staging Area. Clean external surfaces thoroughly again by wet sponging before moving containers to decontamination Washroom. Wash containers thoroughly in decontamination Washroom, and store in Holding Room pending removal to Unloading Room and outside. Ensure containers are removed from Holding Room by workers who have entered from uncontaminated areas dressed in clean coveralls.
- .11 After removal is completed, wet clean work area including equipment and access room, and equipment used in process. After inspection by the Department Representative, apply continuous coat of sealer to surfaces. Do not disturb work for drying period with no entry, activity, ventilation or disturbance during this period.

### **3.5 INSPECTION**

- .1 Perform inspection to confirm compliance with specification and governing authority requirements. Deviations from these requirements not approved in writing by the Department Representative will result in work stoppage, at no additional cost to the project.
- .2 The Department Representative will inspect work for:
  - .1 Adherence to specific procedures and materials.

- .2 Final cleanliness and completion.
- .3 No additional costs will be allowed by Contractor for additional labour or materials required to provide specified performance level.

### **3.6 FINAL CLEANUP**

- .1 When the Department Representative has passed the inspection for final cleanliness in the work area, proceed with final cleanup.
- .2 Remove polyethylene sheet by rolling it away from walls to centre of work area. Vacuum visible lead containing particles observed during cleanup, immediately, using HEPA vacuum.
- .3 Place polyethylene sheets, tape, cleaning material, clothing, and contaminated waste in plastic bags and sealed labelled waste containers for transport.
- .4 Conduct final check to ensure no dust or debris remains on surfaces as result of dismantling operations.

### **3.7 TRANSPORTATION AND PERMANENT DISPOSAL**

- .1 Transport waste lead waste in accordance with the Provincial and Federal legislation and regulations.
- .2 Ensure that all materials are properly packaged and labeled prior to transportation.
- .3 Transport hazardous waste materials in properly placarded vehicles.
- .4 Each load shall be accompanied by a properly completed Transportation of Dangerous Goods Regulation (TDGR) Waste Manifest.

### **3.8 RE-ESTABLISHMENT OF OBJECTS AND SYSTEMS**

- .1 Repair or replace objects damaged in course of work to their original state or better, as directed by the Departmental Representative.

**END OF SECTION**

**Part 1            General**

**1.1            SECTION INCLUDES**

- .1        This Section includes requirements for identification, removal, preparation for disposal, transportation, and permanent disposal or recycling of lead products.

**1.2            RELATED WORK**

- .1        Section 02 82 00 Asbestos Removal
- .2        Section 02 83 00 Lead Abatement
- .3        Section 02 84 00 PCB Ballast Removal
- .4        Section 02 87 00 Mercury Products Removal

**1.3            DISPOSAL CONTRACTOR QUALIFICATIONS**

- .1        Handling and transportation of lead products and sheeting shall be performed by a hazardous waste company registered as a carrier with Alberta Environment. A listing of qualified companies may be obtained from the Industrial Program Development Branch, or sent to a metal recycling company.
- .2        Carrier of hazardous wastes shall have successfully completed a Transportation of Dangerous Goods course acceptable to the authority having jurisdiction within the past three years.

**1.4            REGULATORY REQUIREMENTS**

- .1        Comply with the following:
  - .1        Environmental Contaminants Act (Canada)
  - .2        Environmental Protection and Enhancement Act (Alberta)
  - .3        Transportation of Dangerous Goods Act, 1992 (Canada)
  - .4        Other legislation and regulations which apply to the performance of the work of this section.

**1.5            PERSONAL PROTECTIVE EQUIPMENT**

- .1        Provide all necessary skin, eye and respiratory protective equipment for the safe handling of lead as per the Alberta Occupational Health and Safety Act Regulation and Code.

**1.6            INSPECTION**

- .1        The Department Representative will periodically inspect site conditions and work procedures inside and outside of the work area.
- .2        The Department Representative will perform the following milestone inspections:
  - .1        Milestone Inspection A – Final clearance inspection of work area following the removal of lead products.

**Part 2            Execution**

**2.1            LEAD PRODUCTS**

- .1      Locate and remove lead products designated to be disposed of as indicated in the Pinchin report "Hazardous Building Materials Assessment, Edmonton Institution, 21611 Meridian Street, Edmonton AB," dated June 23, 2017, and the Associated Engineering Preliminary Mechanical and Electrical Drawings, Revision No. A. Work will include the removal of all settled dust, over spray and debris materials.
- .2      Stockpile all lead products and sheeting ready for pickup by a hazardous waste disposal company, or by a metal recycling company.
- .3      Notify Department Representative to perform Milestone Inspection A.

**2.2            TRANSPORTATION AND PERMANENT DISPOSAL**

- .1      Transport waste lead products and sheeting in accordance with the Provincial and Federal legislation and regulations.
- .2      Ensure that all materials are properly packaged and labeled prior to transportation.
- .3      Transport hazardous waste materials in properly placarded vehicles.
- .4      Each load shall be accompanied by a properly completed Transportation of Dangerous Goods Regulation (TDGR) Waste Manifest.

**2.3            DOCUMENTATION**

- .1      Provide the Department Representative a copy of each waste manifest and or a letter from the recycling agency acknowledging receipt of the materials.

**END OF SECTION**

**Part 1 General**

**1.1 SCOPE OF WORK**

- .1 This specification covers the removal and destruction of Polychlorinated Biphenyl (PCB) containing light ballasts
- .2 Work will be subject to inspection by the Department Representative.

**1.2 WORK INCLUDED**

- .1 Furnish all labour, materials, services, insurance and equipment to complete the work of this section.
- .2 De-energize and disconnect power service and distribution to equipment and luminaries scheduled for removal.
- .1 Remove luminaries and accessories including light ballasts, identify, sort and separate. Dispose of non-PCB ballasts as normal construction waste.

**1.3 RELATED WORK**

- .1 Section 02 82 00 - Asbestos Removal
- .2 Section 02 83 00 - Lead Abatement
- .3 Section 02 83 01 - Removal and Disposal of Lead Products
- .4 Section 02 87 00 - Mercury Products Removal

**1.4 QUALITY ASSURANCE**

- .1 The current issue of the following regulations shall govern. Where conflict among these requirements or with these specifications exist, the more stringent requirements shall apply.
  - .1 Occupational Health and Safety Act, Regulation and Code.
  - .2 PCB Regulation, SOR/2008-273.
  - .3 Alberta Regulation 192/96, Environmental Protection and Enhancement Act, Waste Control Regulation Alberta Environment.
  - .4 Transportation of Dangerous Goods Act Regulations.

**1.5 REGULATORY REQUIREMENTS**

- .1 Comply with the following:
  - .1 Environmental Contaminants Act (Canada)
  - .2 Environmental Protection and Enhancement Act (Alberta)
  - .3 Transportation of Dangerous Goods Act, 1992 (Canada)
  - .4 Other legislation and regulations which apply to the performance of the work of this section.

## **1.6 SUBMITTALS**

- .1 Before commencing work, Contractor shall:
  - .1 Submit proof satisfactory to the Department Representative that the site location, required permits, licenses, placards and arrangements for transport and destruction of PCB-containing or contaminated materials have been obtained. Ensure required manifest documentation regarding transport of special wastes is submitted in accordance with Part 3.3 of these specifications.
  - .2 Post caution signs where access to the work area is possible. Such signs shall delineate entry and protective equipment requirements and provide warning of potential health consequences.
  - .3 Submit written and individually signed forms to the Department Representative establishing that all workers handling PCB-containing or contaminated ballasts are trained in decommissioning procedures, spill response procedures, electrical lock-out procedures, use of protective equipment, entry and exit procedures from the work area and the applicability of federal and provincial regulations.
  - .4 Submit a form or letter, from a qualified journeyman electrician, identifying the panel location and circuit numbers of de-energized electrical lines. Detail re-energization and lock-out procedures. Provide a statement certifying same in accordance with applicable electrical codes and regulations.
  - .5 Submit, for approval by the Department Representative, site work procedures including entry and exit from the work area, worker decontamination, a respiratory protection program and contingency procedures for spill response, fire and other emergencies.
  - .6 Submit detailed inventory list of ballasts including manufacturer, model, serial number, date code, PCB content and weight.
  - .7 Provide certificate of destruction.

## **1.7 SCHEDULING OF WORK**

- .1 The Contractor shall prepare and submit the construction schedule for review by the Department Representative three (3) days prior to the start of work. The schedule shall include milestone inspections and all other critical events relating to the work of this section and the work of others. The construction schedule shall incorporate Substantial Performance dates, turnover dates respecting related work elsewhere and time constraints as outlined by the building Department Representative.
- .2 The Contractor shall ensure Department Representatives approval of work area preparation and clean-up is obtained as specified.
- .3 The Contractor shall allow sufficient time for inspection of site by Department Representative following site preparations and prior to the execution of the work of this section.

## **1.8 PERSONAL PROTECTION**

- .1 Observe posted decontamination and work procedures.
- .2 Workers handling PCB ballasts are advised to avoid skin and eye contact. Protective clothing and materials shall be treated as PCB- contaminated waste and disposed of



accordingly. Provide other body protection, including CSA approved safety footwear, required under applicable safety regulations.

- .3 Workers shall not eat, drink, smoke or chew gum in work area.
- .4 Workers shall be fully protected with protective clothing at all times when handling PCB-ballasts.

## **1.9 DEFINITIONS**

- .1 Words and phrases used in this section shall have common meaning as implied by the context in which they are used and their common use in the industry or profession to which they apply.
- .2 Specific words and phrases used in this section shall have the following definitions:
  - .1 Work Area: Areas where work involving contact with PCB-containing materials is to take place.
  - .2 Contaminated: defines the state of materials, equipment, surfaces or areas which by virtue of physical contact with PCB-containing materials shall require decontamination, removal, storage or disposal, as specified in this section.

## **1.10 INSPECTION**

- .1 The Department Representative will periodically inspect site conditions and work procedures inside and outside of the work area.
- .2 The Department Representative will perform the following milestone inspections:
  - .1 Milestone Inspection A - Pre-inspection of work area preparation and set-up prior to removal of PCBs.
  - .2 Milestone Inspection B - Final clearance inspection of work area following the removal of PCBs, but prior to removal from the site.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Storage Containers: 16 gauge, 205 litre (45 gallon) drums, lined with suitably sized, 10 mil plastic bags, fitted with removable steel lids and sealed with PCB-resistant gasket materials including nitrile rubber, cork or Teflon.
- .2 Packing and Absorbent Materials: Sawdust or non-asbestos vermiculite.
- .3 Solvents: Varsol, kerosene or turpentine.
- .4 Disposable gloves (nitrile).
- .5 Protective eye wear.
- .6 Wood Pallets: of suitable size to allow transport, handling and storage.

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**Part 3            Execution**

**3.1                DECOMMISSIONING**

- .1      Cordon off work area for decommissioning of PCB-containing equipment. Post PCB warning signs at points of entry to the work area.
- .2      Remove all sources of ignition. Remove all moveable objects.
- .3      Notify Department Representative of Milestone Inspection A.
- .4      Provide and wear specified protective equipment.
- .5      De-energize and disconnect, using a qualified journeyman electrician, all existing cable and conduit to luminaries and equipment scheduled for removal by this section.
- .6      Disconnect luminaries and remove ballasts and identify.
- .7      Pack identified PCB-containing ballasts in storage containers an absorbent material. Provide an accurate inventory of the contents of each container including number of ballasts, manufacturer numbers, serial numbers and an estimate of the total weight of the container in kilograms.
- .8      Place all other waste materials including disposable clothing, gloves, aprons, absorbent materials in separate storage containers and dispose as PCB-contaminated waste.
- .9      Clearly mark individual containers with a PCB warning label in such a manner as to indicate contents and required inventory information.
- .10     Notify Department Representative of Milestone Inspection B.

**3.2                DISPOSAL / DESTRUCTION**

- .1      As work progresses, and to prevent exceeding available storage capacity on site, remove sealed and labelled storage containers and transport to an authorized destruction facility in accordance with the requirements of the disposal authority and the Ministry of Environment.
- .2      Storage containers shall be placed on wooden pallets to allow periodic inspection of the container for leaks. Containers are to be stored no higher than two (2) containers high and shall be placed to allow movement, handling and chronological removal from the temporary storage facility in accordance with facility waste, maintenance and inspection records.
- .3      The Contractor's representative shall ensure proper handling, storage and disposal of containers in accordance with applicable guidelines and regulations. Each shipment shall require completion and signing of waste manifest forms. Consignor's copies of manifests to be retained by Department Representative. Ensure compliance of manifest system requirements for disposal of hazardous waste.
- .4      Co-operate with Ministry of Environment supervisors and immediately carry out instructions for remedial work at storage or disposal facilities to maintain environment at no additional cost to Department Representative.
- .5      Ensure facility operator is fully aware of the hazardous material being disposed of or stored.

**END OF SECTION**

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 This Section includes requirements for identification, removal, preparation for disposal, transportation, and permanent disposal of mercury-containing fluorescent and mercury vapour lamps and thermostats.

**1.2 RELATED WORK**

- .1 Section 02 82 00 - Asbestos Removal
- .2 Section 02 83 00 - Lead Abatement
- .3 Section 02 83 01 - Removal and Disposal of Lead Products
- .4 Section 02 87 00 - PCB Ballast Removal

**1.3 REMOVAL CONTRACTOR QUALIFICATIONS**

- .1 Use qualified electrician to isolate the power and for removal of fluorescent and mercury vapour lamps or other mercury-containing equipment.

**1.4 DISPOSAL CONTRACTOR QUALIFICATIONS**

- .1 Handling, transportation and disposal of fluorescent and mercury vapour lamps and thermostats shall be performed by a hazardous waste company registered with Alberta Environment.
- .2 Carrier of hazardous wastes shall have successfully completed a Transportation of Dangerous Goods course acceptable to the authority having jurisdiction within the past three years.

**1.5 REGULATORY REQUIREMENTS**

- .1 Comply with the following:
  - .1 Environmental Contaminants Act (Canada)
  - .2 Environmental Protection and Enhancement Act (Alberta)
  - .3 Transportation of Dangerous Goods Act, 1992 (Canada)
  - .4 Other legislation and regulations which apply to the performance of the work of this section.

**1.6 PERSONAL PROTECTIVE EQUIPMENT**

- .1 Provide all personal protective equipment as per the Alberta Occupational Health and Safety Act Regulation and Code.

**1.7 INSPECTION**

- .1 The Department Representative will periodically inspect site conditions and work procedures inside and outside of the work area.
- .2 The Department Representative will perform the following milestone inspections:
  - .1 Milestone Inspection A – Final clearance inspection of work area following the removal of mercury, but prior to removal from the site.

**Part 2            Execution**

**2.1                EQUIPMENT REMOVAL**

- .1      Locate and remove fluorescent, mercury vapour lamps and switches designated to be disposed of.
- .2      Place all lamps, switches and equipment into containers to prevent breakage.
- .3      Provide an accurate inventory of the contents of each container including number of light tubes, switches and lamps and an estimate of the total weight of the container in kilograms.
- .4      Notify Department Representative of Milestone Inspection A.

**2.2                TRANSPORTATION AND PERMANENT DISPOSAL**

- .1      Transport mercury-containing materials in accordance with the Provincial and Federal legislation and regulations.
- .2      Ensure that all mercury-containing materials are properly packaged and labeled prior to transportation.
- .3      Transport hazardous waste materials in properly placarded vehicles.
- .4      Each load shall be accompanied by a properly completed Transportation of Dangerous Goods Regulation (TDGR) Waste Manifest.
- .5      Use an approved lamp recycling company to transport and permanently dispose of mercury-containing materials.

**2.3                DOCUMENTATION**

- .1      Provide the Department Representative a copy of each waste manifest and or a letter from the recycling agency acknowledging receipt of the materials.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - .2 CSA-O86S1, Supplement No. 1 to CAN/CSA-O86-2014, Engineering Design in Wood.
  - .3 CSA O121, Douglas Fir Plywood.
  - .4 CSA O151, Canadian Softwood Plywood.
  - .5 CSA O153, Poplar Plywood.
  - .6 CAN/CSA-O325.0, Construction Sheathing.
  - .7 CSA O437 Series, Standards for OSB and Waferboard.
  - .8 CSA S269.1, Falsework for Construction Purposes.
  - .9 CAN/CSA-S269.3, Concrete Formwork, National Standard of Canada
- .2 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC-S701, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit two copies WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 43 - Environmental Procedures and Section 01 35 29.06 - Health and Safety Requirements.
- .3 Co-ordinate submittal requirements and provide submittals required.
- .4 Indicate formwork design data: permissible rate of concrete placement, and temperature of concrete, in forms.
- .5 The design and inspection of the formwork and falsework is the responsibility of the Contractor.

**1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Store and manage hazardous materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Waste Management and Disposal: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Formwork materials:
  - .1 Wood and wood product formwork materials to CSA-O121 and CAN/CSA-S269.3.
- .2 Form ties:
  - .1 Use snap ties complete with plastic cones and light grey concrete plugs.
- .3 Form release agent: non-toxic, biodegradable, low VOC.
- .4 Falsework materials: to CSA-S269.1.

**Part 3 Execution**

**3.1 FABRICATION AND ERECTION**

- .1 Verify lines, levels and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.
- .2 Fabricate and erect falsework in accordance with CSA S269.1.
- .3 Do not place shores and mud sills on frozen ground.
- .4 Fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1/A23.2.
- .5 Align form joints and make watertight.
  - .1 Keep form joints to minimum.
- .6 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
- .7 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections.
  - .1 Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.
- .8 Clean formwork in accordance with CSA-A23.1/A23.2, before placing concrete.
- .9 Obtain Departmental Representative's approval before framing openings not indicated.

**3.2 REMOVAL AND RESHORING**

- .1 Remove formwork when concrete has reached 70% of its design strength or minimum 3 days, whichever comes later, and replace immediately with adequate re-shoring.
- .2 Re-use formwork and falsework subject to requirements of CSA-A23.1/A23.2.

**3.3 CLEANING**

- .1 Cleaning: in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 American Concrete Institute (ACI)
  - .1 SP-66, ACI Detailing Manual.
- .2 ASTM International
  - .1 ASTM A82/A82M, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
  - .2 ASTM A143/A143M, Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
  - .3 ASTM A185/A185M, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
  - .4 ASTM A775/A775M, Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
- .3 CSA International
  - .1 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
  - .2 CAN/CSA-A23.3, Design of Concrete Structures.
  - .3 CSA-G30.18, Carbon Steel Bars for Concrete Reinforcement.
  - .4 CSA-G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .5 CAN/CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles.
  - .6 CSA W186, Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .4 Reinforcing Steel Institute of Canada (RSIC)
  - .1 RSIC, Reinforcing Steel Manual of Standard Practice.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice SP-66.
- .3 Shop Drawings:
  - .1 Submit drawings.
    - .1 Indicate placing of reinforcement and:
      - .1 Bar bending details.
      - .2 Lists.
      - .3 Quantities of reinforcement.
      - .4 Sizes, spacings, locations of reinforcement and mechanical splices if approved by Departmental Representative, with

identifying code marks to permit correct placement without reference to structural drawings.

- .2 Detail lap lengths and bar development lengths to CAN/CSA-A23.3, unless otherwise indicated.
  - .1 Provide type B unless otherwise indicated.

### **1.3 QUALITY ASSURANCE**

- .1 Submit in accordance with 01 45 00 - Quality Control
  - .1 Mill Test Report: upon request, provide Departmental Representative with certified copy of mill test report of reinforcing steel, minimum 2 weeks prior to beginning reinforcing work.
  - .2 Upon request submit in writing to Departmental Representative proposed source of reinforcement material to be supplied.

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

- .1 Deliver, store and handle materials in a manner to prevent damage and contamination.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Substitute different size bars only if permitted in writing by Departmental Representative.
- .2 Reinforcing steel: billet steel, grade 400, deformed bars to CSA-G30.18, unless indicated otherwise.
- .3 Cold-drawn annealed steel wire ties: to CSA-G30.3.
- .4 Chairs, bolsters, bar supports, spacers: to CSA-A23.1/A23.2.
- .5 Mechanical splices: subject to approval of Departmental Representative.
- .6 Plain round bars: to CSA-G40.20/G40.21.

### **2.2 FABRICATION**

- .1 Fabricate reinforcing steel in accordance with CSA-A23.1/A23.2 Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
- .2 Obtain Departmental Representative's written approval for locations of reinforcement splices other than those shown on placing drawings.



- .3 Upon approval of Departmental Representative, weld reinforcement in accordance with CSA W186.
- .4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

### **Part 3 Execution**

#### **3.1 FIELD BENDING**

- .1 Do not field bend or field weld reinforcement except where indicated or authorized by Departmental Representative.
- .2 When field bending is authorized, bend without heat, applying slow and steady pressure.
- .3 Replace bars, which develop cracks or splits.

#### **3.2 PLACING REINFORCEMENT**

- .1 Place reinforcing steel as indicated on reviewed placing drawings in accordance with CSA-A23.1/A23.2.
- .2 Use plain round bars as slip dowels in concrete.
- .3 Prior to placing concrete, obtain Departmental Representative's approval of reinforcing material and placement. Provide a minimum of 72 hours' notice prior to placing of concrete.
- .4 Ensure cover to reinforcement is maintained during concrete pour.
- .5 Do not use bury bars unless authorized in writing by Departmental Representative.
- .6 Protect projecting dowels from damage and cold bending.

#### **3.3 CLEANING**

- .1 Cleaning: in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 Reference Standards:
  - .1 ASTM International
    - .1 ASTM C260/C260M, Standard Specification for Air-Entraining Admixtures for Concrete.
    - .2 ASTM C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
    - .3 ASTM C494/C494M, Standard Specification for Chemical Admixtures for Concrete.
    - .4 ASTM C1017/C1017M, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
    - .5 ASTM D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
    - .6 ASTM D624, Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.
  - .2 CSA International
    - .1 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
    - .2 CSA A283, Qualification Code for Concrete Testing Laboratories.
    - .3 CSA A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide testing and inspection results and reports for review by Departmental Representative and do not proceed without written approval when deviations from mix design or parameters are found.
- .3 Concrete pours: provide accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described in Section 3.3 - FIELD QUALITY CONTROL.
- .4 Concrete hauling time: provide for review by Departmental Representative deviations exceeding maximum allowable time of 120 minutes for concrete to be delivered to site of Work and discharged after batching.
- .5 Submit proposed mix design stamped and signed by professional engineer registered or licensed in Province of Alberta, Canada to Departmental Representative for review 2 weeks prior to placing concrete.

**1.3 QUALITY ASSURANCE**

- .1 Quality Assurance: in accordance with 01 45 00 - Quality Control

- .2 Provide Departmental Representative, minimum 2 weeks prior to starting concrete work, with valid and recognized certificate from plant delivering concrete.
  - .1 Provide test data and certification by qualified independent inspection and testing laboratory that materials and mix designs used in concrete mixture will meet specified requirements.
- .3 Minimum 2 weeks prior to starting concrete work, provide proposed quality control procedures for review by Departmental Representative on following items:
  - .1 Falsework erection.
  - .2 Hot weather concrete.
  - .3 Cold weather concrete.
  - .4 Curing.
  - .5 Finishes.
  - .6 Formwork removal.
- .4 Quality Control Plan: provide written report to Departmental Representative verifying compliance that concrete in place meets performance requirements of concrete as established in PART 2 - PRODUCTS.

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

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
  - .1 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.
    - .1 Do not modify maximum time limit without receipt of prior written agreement from Departmental Representative and concrete producer as described in CSA A23.1/A23.2.
    - .2 Deviations to be submitted for review by Departmental Representative.
  - .2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

### **Part 2 Products**

#### **2.1 MATERIALS**

- .1 Portland Cement: to CSA A3001
- .2 Water: to CSA A23.1.
- .3 Aggregates: to CSA A23.1/A23.2.
- .4 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents to CSA A23.1/A23.2.
  - .1 Compressive strength: 40 MPa at 28 days.
  - .2 Net shrinkage at 28 days: maximum 0.2%.

## 2.2 MIXES

- .1 Proportion normal density concrete in accordance with CAN/CSA A23.1 unless noted otherwise.
- .2 Mix designs for the performance and properties as per following table:

Component	Exposure Class	Cement type	Comp. Strength MPa/days	Air Content %	Nominal Max Aggregate Size mm	Water / Cement Ratio, max	Flyash %
Exterior concrete pad	F-1	HS	30/28	5-8	20	0.45	<25
Interior concrete pad	N	Gu	25/28	1-3	20	0.45	

## Part 3 Execution

### 3.1 PREPARATION

- .1 Obtain Departmental Representative's written approval before placing concrete.
  - .1 Provide 72 hours minimum notice prior to placing of concrete.
- .2 Place concrete reinforcing in accordance with Section 03 20 00 - Concrete Reinforcing.
- .3 During concreting operations:
  - .1 Development of cold joints not allowed.
  - .2 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.
- .4 Pumping of concrete is permitted only after approval of equipment and mix.
- .5 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .6 Prior to placing of concrete obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing.
- .7 Protect previous Work from staining.
- .8 Clean and remove stains prior to application for concrete finishes.
- .9 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .10 Do not place load upon new concrete until authorized by Departmental Representative.

### 3.2 INSTALLATION/APPLICATION

- .1 Do cast-in-place concrete work to CSA A23.1/A23.2.
- .2 Sleeves and inserts:

- .1 Do not permit penetrations, sleeves, ducts, pipes or other openings to pass through concrete, except where indicated or approved by Departmental Representative.
- .2 Where approved by Departmental Representative, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere.
- .3 Sleeves and openings greater than 300 mm not indicated, must be reviewed by Departmental Representative.
- .4 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain written approval of modifications from Departmental Representative before placing of concrete.
- .5 Confirm locations and sizes of sleeves and openings shown on drawings.
- .3 Grout under base plates using procedures in accordance with manufacturer's recommendations which result in 100% contact over grouted area.
- .4 Finishing and curing:
  - .1 Finish concrete to CSA A23.1/A23.2.
  - .2 Use procedures as reviewed by Departmental Representative to remove excess bleed water. Ensure surface is not damaged.
  - .3 Use curing compounds compatible with applied finish on concrete surfaces.
  - .4 Formed surfaces exposed to view: sack rubbed finish to CAN/CSA A23.1.
  - .5 Rub exposed sharp edges of concrete with carborundum to produce 3 mm minimum radius edges unless otherwise indicated.
  - .6 Roughen top of equipment bases to provide bond for grout.

### **3.3 FIELD QUALITY CONTROL**

- .1 Site tests: conduct tests as follows in accordance with 01 45 00 - Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
  - .1 Concrete pours.
  - .2 Slump.
  - .3 Air content.
  - .4 Compressive strength at 7, 28 and 56 days minimum.
  - .5 Air and concrete temperature.
- .2 Take concrete samples for testing in accordance with CSA A23.2. One (1) strength test shall consist of test cylinders for each 50 m<sup>3</sup> of concrete, or portions of each mix type of concrete or each separate type of structural element in any one (1)-day's pour. For concrete with specified twenty-eight (28) day strength, strength test shall consist of minimum three (3) test cylinders. Test first cylinder at seven (7) days and remaining two (2) at twenty-eight (28) days.
- .3 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory designated by Contractor for review to CSA A23.1/A23.2.
- .4 Ensure testing laboratory is certified to CSA A283.
- .5 Pay for costs of tests as specified in 01 45 00 - Quality Control

- .6 Take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.
- .7 Inspection or testing by Departmental Representative will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

### **3.4 CLEANING**

- .1 Cleaning: in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**

**Part 1            General**

**1.1                REFERENCES**

- .1        CSA A165 Series-04 - Standards on Concrete Masonry Units.
- .2        CSA A371-04 - Masonry Construction for Buildings.

**Part 2            Products**

**2.1                CONCRETE BLOCK MASONRY UNITS**

- .1        Standard Concrete Block Masonry Units (CMU): CSA A165 Series (CSA A165.1),  
Type H/15/A/M.
  - .1        Standard size: modular 190 mm high x 390 mm long x width indicated (190 mm  
width, confirm on site).  
Rated and unrated masonry units as necessary.

**2.2                FABRICATION**

- .1        Manufacture masonry units to CSA A371 and CSA S304.1.
- .2        Mortar: Type S
- .3        Grout: CSA A179-04 for block fill.

**Part 3            Execution**

**3.1                INSTALLATION**

- .1        Install masonry units will only be required should removal of existing masonry wall result in  
significant damage to the existing wall in the demolition area.
- .2        Retained existing brick masonry to be reused as noted on drawings.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCES**

- .1 ASTM-A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
- .2 ASTM-A325M, Specification for High-Strength Bolts for Structural Steel Joints.
- .3 CGSB-85-GP-14M, Painting Steel Surfaces Exposed to Normally Dry Weather.
- .4 CGSB.1.40, Primer Structural Steel, Oil Alkyd Type.
- .5 CSA-G40.20, General Requirements for Rolled or Welded Structural Quality Steel.
- .6 CSA-G40.21, Structural Quality Steels.
- .7 ASTM A132M: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- .8 ASTM A153M: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Hardware.
- .9 CSA-S16.1, Limit States Design of Steel Structures.
- .10 CSA-S136, Cold Formed Steel Structural Members.
- .11 CSA-W47.1, Certification of Companies for Fusion Welding of Steel Structures.
- .12 CSA-W59, Welded Steel Construction (Metal Arc Welding).

### **1.2 SOURCE OF QUALITY CONTROL**

- .1 Prior to fabrication of structural steel, submit three (3) copies of mill test reports showing chemical and physical properties and other details of steel to be incorporated into Work. Such mill test reports shall be certified by qualified metallurgists confirming that tests conform to requirements of CSA-G40.20 and CSA-G40.21.

### **1.3 QUALITY ASSURANCE**

- .1 Qualifications of Welders:
  - .1 Welding of load supporting components shall be performed by companies certified by Canadian Welding Bureau in accordance with CSA W47.1.
  - .2 Welders shall be qualified by Canadian Welding Bureau for classification of Work being performed.
- .2 Workmanship Standards:
  - .1 Resistance Welding: to CSA W55.3, Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.
  - .2 Fusion welding: to CSA W59, Welded Steel Construction (Metal Arc Welding).

### **1.4 DESIGN OF DETAILS AND CONNECTIONS**

- .1 Design details and connections in accordance with requirements of CSA-S16.1 to resist forces, moments and shears indicated.
- .2 If connection for shear only (standard double angle connection) is required:



- .1 Select framed beam shear connections from an industry-accepted publication such as "Handbook of the Canadian Institute of Steel Construction".
- .2 If shears are not indicated, select or design connections to support reaction from maximum uniformly distributed load that can be safely supported by beam in bending, provided no point loads act on beam.
- .3 For non-standard connections, submit sketches and design calculations stamped and signed by qualified Professional Engineer registered in the Province of Alberta.
- .4 Anchor bolts for securing equipment to concrete or steel supports to be designed and supplied by the equipment manufacturer.

## **1.5 SHOP DRAWINGS**

- .1 Submit Shop Drawings in accordance with Section 01 33 00 - Submittals.
- .2 Indicate welds by welding symbols in accordance with CSA-W59.
- .3 On erection Drawings, indicate all details and information necessary for assembly and erection purposes such as, description of methods, sequence of erection, type of equipment used in erection and temporary bracings.
- .4 Reproduction of Contract Drawings for use as erection Drawings is not permitted unless approved in writing by Department Representative.
- .5 Each Drawing submission shall bear the signature and stamp of qualified Professional Engineer registered in the Province of Alberta for all fabricator-designed assemblies, components and connections.
- .6 Indicate materials, core-thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.

## **1.6 PRODUCT DELIVERY AND STORAGE**

- .1 Schedule delivery of components to site to coincide with installation of this work.
- .2 Store components to prevent damage and distortion.
- .3 Protect finishes from scratches and soiling.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Steel plate, angle and channel sections: to CSA-G40.21, Grade 300W.
- .2 Round reinforcing bars: 400W (weldable grade 400)
- .3 Welding materials: to CSA-W59.
- .4 Anchor bolts and nuts: to ASTM-A307, hot-dip galvanized where noted.
- .5 Bolts: to ASTM-A325.
- .6 Expansion anchors: hot dipped galvanized or stainless steel 304 as applicable.
- .7 Adhesive anchors: hot dipped galvanized or stainless steel 304 as applicable. Adhesive epoxy or epoxy acrylate.

**2.2 FABRICATION**

- .1 Fabricate Work square, true, straight and accurate to required size, with joints closely fitted and properly secured.
- .2 Fabricate structural steel, as indicated, in accordance with CSA-S16.1 and in accordance with reviewed Shop Drawings.
- .3 Weld to CSA-W59.
- .4 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush. Seal exterior steel fabrications to provide corrosion protection in accordance with CSA S16.1.
- .5 Where possible, fit and shop assemble Work, ready for erection.
- .6 Use self-tapping shake-proof flat-headed screws on items requiring assembly by screws or as indicated. Use screws for interior metal Work. Use welded connections for exterior metal Work unless otherwise approved by Department Representative.
- .7 Work of this Section, supplied for installation under other Sections, shall be prepared as required ready for installation.

**2.3 SHOP PAINTING**

- .1 Clean, prepare surfaces and shop prime structural steel in accordance with CAN/CSA-S16.
- .2 Clean members, remove loose mill scale, rust, oil, dirt and foreign matter. Prepare surface according to NACE No.3/SSPC-SP-6.
- .3 Apply paint under cover, on dry surfaces when surface and air temperatures are above 5°C.
- .4 Maintain dry condition and 5°C minimum temperature until paint is thoroughly dry.
- .5 Strip paint from bolts, nuts, sharp edges and corners before prime coat is dry.

**2.4 STEEL FINISH**

- .1 Interior steel: MPI #153 light industrial coating, colour to match with the existing steel.
- .2 Exterior steel: hot-dip galvanized

**2.5 GENERAL**

- .1 Do structural metal work in accordance with CSA S16.1.
- .2 Do welding in accordance with CSA-W59.
- .3 Companies to be certified under CSA-W47.1 for fusion welding of steel structures.

**2.6 ERECTION**

- .1 Verify dimensions and condition of existing Work before commencing fabrication and report any discrepancy and potential problem areas to Departmental Representative and await instructions.
- .2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections. Stair treads shall be level.

- .3 Provide suitable means of anchorage acceptable to Departmental Representative such as dowels, anchor clips, bar anchors, adhesive anchors and shields, and toggles.
- .4 Make field connections with high tensile bolts to CSA-S16.1.
- .5 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.
- .6 Touch-up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection with primer.
- .7 Paint complete item with zinc rich primer if necessary to obtain uniform finish after touch-up.

**END OF SECTION**

**Part 1            General**

**1.1            REFERENCES**

- .1    Canadian Standards Association (CSA)
  - .1    CSA G40.20/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel.
  - .2    CAN/CSA-G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
- .2    Steel Structures Painting Council (SSPC), Systems and Specifications Manual, Volume 2.

**1.2            SUBMITTALS**

- .1    Submit shop drawings to requirements of Section 01 33 00 – Submittal Procedures.
- .2    Submit shop drawing bearing stamp of a qualified professional engineer registered in Province of Alberta.
- .3    Indicate on shop drawings, profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.

**Part 2           Products**

**2.1           MATERIALS**

- .1    Steel Sections: CAN/CSA-G40.21, Grade W.
- .2    Primer: SSPC 15 Type 1, red, for shop application and field touch-up.
- .3    Touch-up Primer for Galvanized Surfaces: Zinc rich type.

**2.2           FABRICATION**

- .1    Fabricate components to CSA S136.
- .2    Fit and shop assemble in largest practical sections, for delivery to site.
- .3    Grind exposed welds flush and smooth with adjacent finish surface.
- .4    Make exposed joints butt tight, flush, and hairline.
- .5    Supply components required for anchorage of metal fabrications.

**2.3 FINISHES**

- .1 Do not prime surfaces in direct contact bond with concrete or where field welding is required.
- .2 Prime paint items with one coat.
- .3 Galvanized items to minimum Z275 (G90) zinc coating to CSA G164.
- .4 Field Painting: to Section 09 91 00.

**Part 3 Execution**

**3.1 PREPARATION**

- .1 Make provisions for erection loads with temporary bracing.

**3.2 INSTALLATION**

- .1 Install items plumb and level, accurately fitted, free from distortion or defects.
- .2 After installation, touch-up field welds scratched or damaged surfaces with primer.

**3.3 SCHEDULE**

- .1 Refer to Drawing details for items not specifically scheduled.
- .2 Lintels: Galvanized finish (exterior); field painted to Section 09 91 00. Fabricate to suit masonry coursing, unit size and span.

**END OF SECTION**

**Part 1            General**

**1.1            REFERENCES**

- .1    Canadian Standards Association (CSA)
  - .1    CSA B111-1974, Wire Nails, Spikes and Staples.
  - .2    CAN/CSA-G164-M92, Hot Dip Galvanizing of Irregularly Shaped Articles.
  - .3    CAN/CSA-O80 SERIES-97, Wood Preservation.
  - .4    CAN/CSA-O141-91, Softwood Lumber.
  - .5    CSA O151-M1978, Canadian Softwood Plywood.
  - .6    CAN3-O437 Series-93, Standards on OSB and Waferboard.
- .2    American Society for Testing and Materials (ASTM).
  - .1    ASTM C645-04 - Specifications for Non-Structural Steel Framing Members.
- .3    National Lumber Grades Authority (NLGA)
  - .1    Standard Grading Rules for Canadian Lumber 2010.

**1.2            QUALITY ASSURANCE**

- .1    Refer to Section 01 45 00 – Quality Control.

**Part 2            Products**

**2.1            LUMBER MATERIALS**

- .1    Framing Lumber: to CSA O141, softwood, S4S, S-dry moisture control 19% or less, grade stamped in accordance with NLGA and scheduled for use as follows:
  - .1    Dimension sizes: Stud or No. 2.
- .2    Furring, blocking, nailing strips, grounds, rough bucks, curbs, fascia backing and sleepers:
  - .1    Dimension sizes: Standard light framing or better grade.

**2.2            PANEL MATERIALS**

- .1    Canadian softwood plywood (CSP): to CSA O151, exterior grade, thickness as indicated, grade stamped in accordance with CANPLY and as follows:
  - .1    General use, gypsum wall backing, concrete curb forms and equipment mounting boards: Sheathing (SHG).

**2.3            ACCESSORIES**

- .1    Nails, spikes and staples: to CSA B111.

- .2 Anchors: Toggle bolt type for anchorage to hollow masonry, expansion shield and lag bolt type for anchorage to solid masonry or concrete, bolts or ballistic fasteners for anchorages to steel.
- .3 Fastener Finish: Hot dipped galvanized steel for exterior, high humidity and treated wood locations, plain finish elsewhere.

**Part 3 Execution**

**3.1 FRAMING**

- .1 Erect wood framing and blocking members level and plumb, unless indicated otherwise. Place horizontal members laid flat, crown side up. Construct members full length without splices.

**3.2 OPENINGS**

- .1 Frame and block openings for support of door and window frames, and other equipment, as indicated.

**3.3 BLOCKING, CURBS, AND CANTS**

- .1 Provide solid blocking in walls where required for support of wall mounted fixtures and assemblies.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM C665-06, Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
  - .2 ASTM C1320-05, Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction.
  - .3 ASTM E84-06a, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .2 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102-03, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Coverings.
  - .3 CAN/ULC-S702-97, Standard for Thermal Insulation, Mineral Fibre, for Buildings.
- .3 NFPA 255 - Test of Surface Burning Characteristics of Building Materials.
- .4 UL 723 - Tests for Surface Burning Characteristics of Building Materials.
- .5 Scientific Certification Systems (SCS)
  - .1 Specification SCS-RRC-01, Certification Specifications for Recycled and Recovered Content.
- .6 Greenguard Environmental Institute (GEI)
  - .1 Greenguard Certification Standards for Low Emitting Products for the Indoor Environment.

**1.2 SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit product data and manufacturer's installation recommendations for each product specified.
- .3 When requested, provide information concerning installer experience which is similar in scope and scale to requirements of the Project, including location of work and persons to be contracted as references.

**1.3 ENVIRONMENTAL REQUIREMENTS**

- .1 Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.



#### **1.4 COORDINATION**

- .1 Coordinate the work with Section 07 26 00 for installation of vapour retarder and Section 07 27 00 for air seal materials.

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

- .1 Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- .2 Protect from exposure to harmful environmental conditions at temperature and humidity conditions recommended by manufacturer.

### **Part 2 Products**

#### **2.1 RIGID INSULATION**

- .1 Extruded Polystyrene Insulation (XPS): to CAN/ULC-S701, Type IV, shiplapped edge, CFC free and HCFC free, compressive strength 30 psi, thickness as indicated; Acceptable Manufacturers: Dow Styrofoam, Owens Corning Celfort.

#### **2.2 BATT INSULATION**

- .1 Fibreglass Batt: CAN/ULC-S702 Type 1 and ASTM C 665 Type 1, unfaced, Greenguard IAQ certified, SCS certified minimum 25% recycled content, thickness required to fill stud depth indicated on roof parapets.

#### **2.3 SOUND ATTENUATION AND BATT INSULATION**

- .1 Acoustic Fiberglas Batt: CAN/ULC-S702 Type 1 and ASTM C665 Type 1, unfaced, EcoLogo certified with minimum 35% recycled content, thickness required to fill stud depth indicated; Acceptable Products: Johns Manville Sound-SHIELD, Owens Corning QuietZone.
- .2 Mineral Wool Fire Batt Insulation: CAN/ULC-S702 Type 1 and ASTM C665 Type 1, ULC listed and tested to CAN/ULC-S102, thickness required indicated; Acceptable Products: Fibrex SAFB, Roxul AFB.

#### **2.4 ATTACHMENT DEVICES AND ACCESSORIES**

- .1 Impaling Pins and Clips: Corrosion-resistant spindle anchor and self-locking washer type consisting of perforated metal plates with spindle welded to center and self-locking washers.
- .2 Foam-in-Place Insulation: low-expansion, single component polyurethane insulation. Compatible with specified rigid insulation.
- .3 Adhesive: Type recommended by insulation manufacturer for application.

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**Part 3            Execution**

**3.1                EXAMINATION**

- .1      Section 01 71 00 – Examination and Preparation: Verify existing conditions before starting work.
- .2      Verify that substrate, adjacent materials, and insulation boards are dry and ready to receive insulation and adhesive.
- .3      Verify substrate surface is flat, free of honeycomb, fins, irregularities, materials or substances that may impede adhesive bond.

**3.2                PREPARATION**

- .1      Clean substrates of substances harmful to insulation or vapour retarders, including removing projections capable of puncturing vapour retarders or interfering with insulation attachment.
- .2      Clean all surfaces free of dirt, grime, grease, oil or other substances which would be detrimental to proper bond of adhesives.

**3.3                INSTALLATION - GENERAL**

- .1      Install insulation after building substrate materials are dry.
- .2      Comply with insulation manufacturer's written instructions and recommendation applicable to products and application indicated.
- .3      Install insulation in largest possible size to cover areas indicated on Drawings, closely butted together at sides, ends, and against walls, and structural members.
- .4      Extend insulation to the full thickness shown over entire area to be insulated. Neatly cut and fit insulation tightly around obstructions, projections such as pipes, conduits, hangers and other elements, and fill voids with insulation. Remove debris in conflict with insulation installation.
- .5      Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- .6      Fit insulation tight around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows and other protrusions.
- .7      Keep insulation minimum 3 inches from heat emitting devices such as recessed light fixtures.
- .8      Do not install any insulation that becomes damaged during the course of installation or is no longer in a physical condition to function for the use intended and replace with new material.
- .9      Exercise care to avoid damage and soiling of faces on insulation units which will remain exposed to view. Abut joints accurately with adjoining surfaces set flush.
- .10     Attach insulation in a manner to ensure stability and eliminate sagging.

- .11 Apply a single layer of insulation to the required thickness, unless a double layer is required, to make up the total thickness shown. Concealed layers of material must not have a vapour retarder facing.
- .12 Offset both vertical and horizontal joints in multiple layer applications.
- .13 Do not enclose insulation until it has been inspected by Departmental Representative.

### **3.4 INSTALLATION OF BATT INSULATION**

- .1 Install insulation in accordance with ASTM C 1320.
- .2 Install batts in cavities formed by framing members as follows:
- .3 Use batt widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
- .4 Place batts in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

### **3.5 PROTECTION OF FINISHED WORK**

- .1 Do not permit work to be damaged prior to covering insulation.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 ASTM E 1643-98 - Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

**1.2 DEFINITION**

- .1 Vapour Retarder: A material or assembly of materials that resists water vapour diffusion through it.

**1.3 SUBMITTALS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Product Data: Provide data indicating material characteristics, performance criteria, limitations.

**Part 2 Products**

**2.1 SHEET MATERIALS**

- .1 Air/Vapour Barrier (Peel and Stick Membrane): Self-adhering air and vapour retarder, waterproofing and transition membrane, SBS-modified membrane, minimum 1.0 mm (40 mil) thickness. Top face of membrane to be compatible with subsequent coverings. Provide primer and lap sealant where recommended by manufacturer
  - .1 Air permeability to ASTM E283: 0.02 L/sec·m<sup>2</sup> (0.004 cfm/ft<sup>2</sup>)
  - .2 Water vapour permeability to ASTM E96: 2.0 ng/Pa·s·m<sup>2</sup> (0.035 perm)

**2.2 ACCESSORIES**

- .1 Seam tape: pressure sensitive type recommended by manufacturer.
- .2 Pipe Boot: Construct pipe boots from vapour retarder material and pressure sensitive tape per manufacturer's instructions; alternatively, provide manufacturers' pre-moulded pipe boot.
- .3 Sealant: Butyl, specified in Section 07 92 00 - Joint Sealants.

**Part 3 Execution**

**3.1 EXTERIOR WALL VAPOUR RETARDER**

- .1 Install vapour retarder in exterior walls without gaps or voids. Lap joints minimum 6 inch and seal with butyl sealant.

- .2 Place vapour retarder so that it is on the warm side of the insulation.
- .3 Adhere vapour retarder to steel framing using butyl sealant.
- .4 Extend vapour retarder tight to full perimeter of adjacent window and door frames and other items interrupting the plane of membrane.
  - .1 Seal in place with butyl sealant.
  - .2 Coordinate vapour retarder and air seal sections.

### **3.2 SELF-ADHESIVE MEMBRANE INSTALLATION**

- .1 Install in accordance with manufacturer's instructions.
- .2 Verify compatibility of membrane top face with coverings, including metal flashings and stucco finishes.
- .3 Prime surfaces to receive membranes where required by manufacturer.
- .4 Extend and seal membranes through openings and wall and roof interfaces to provide continuity of vapour and air barrier envelope.
- .5 Install membranes to waterproof locations as indicated.

**END OF SECTION**

**Part 1            General**

**1.1                REFERENCES**

- .1        ASTM E 1186 - Standard Practices for Air Leakage Site Detection in Building Envelope and Air Retarder Systems.
- .2        SWRI (Sealant, Waterproofing and Restoration Institute) - Sealant and Caulking Guide Specification.

**1.2                PERFORMANCE REQUIREMENTS**

- .1        Provide continuity of air seal materials and assemblies in conjunction with other materials and assemblies.

**1.3                SUBMITTALS**

- .1        Submit to Section 01 33 00 - Submittal Procedures.
- .2        Product Data: Provide data on material characteristics, performance criteria, limitations.

**1.4                QUALITY ASSURANCE**

- .1        Perform Work to SWRI - Sealant and Caulking Guide Specification requirements for materials and installation.
- .2        Applicator: Company specializing in performing the work of this section with minimum five years documented experience.

**1.5                COORDINATION**

- .1        Coordinate the work of this section with all sections referencing this section.

**Part 2            Products**

**2.1                SHEET MATERIALS**

- .1        Peel and Stick Membrane:
  - .1        Self-adhering air and vapour retarder.
  - .2        Waterproofing and transition membrane.
  - .3        SBS-modified membrane, minimum 1.0 mm (40 mil) thickness.
  - .4        Top face of membrane compatible with subsequent coverings.
  - .5        Provide primer and lap sealant where recommended by manufacturer.

- .6 Air permeability to ASTM E283: 0.02 L/sec·m<sup>2</sup> (0.004 cfm/ft<sup>2</sup>).
- .7 Water vapour permeability to ASTM E96: 2.0 ng/Pa·s·m<sup>2</sup> (0.035 perm)

## **2.2 ACCESSORIES**

- .1 Seam tape: Air barrier manufacturer's proprietary or recommended tape, high tack adhesive, UV resistant.
- .2 Sealant: Butyl type; to Section 07 92 00 - Joint Sealants.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verify that surfaces and conditions are ready to accept the Work of this section.

### **3.2 PREPARATION**

- .1 Remove loose or foreign matter which might impair adhesion of materials.
- .2 Clean and prime substrate surfaces to receive adhesive and sealants to manufacturer's instructions.

### **3.3 INSTALLATION**

- .1 Install materials to manufacturer's written instructions.
- .2 Sheet Seal Over Solid Substrate: Secure sheet seal to gypsum board materials. Caulk with Butyl sealant to ensure complete seal. Position lap seal over firm bearing.
- .3 Air Seal For Wall/Roof Junction: Lap sheet seal onto roof vapour retarder, ice dam protection, and air barrier materials and seal with sealant. Caulk to ensure complete air seal. Position lap seal over firm bearing.
- .4 Install sheet seal between window and door frames and adjacent wall seal materials with sealant. Caulk to ensure complete seal. Position lap seal over firm bearing.
- .5 Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

### **3.4 SELF-ADHESIVE MEMBRANE INSTALLATION**

- .1 Install in accordance with manufacturer's instructions.
- .2 Verify compatibility of membrane top face with coverings, including metal flashings and stucco finishes.
- .3 Prime surfaces to receive membranes where required by manufacturer.

- .4 Extend and seal membranes through openings and wall and roof interfaces to provide continuity of vapour and air barrier envelope.
- .5 Install membranes to waterproof locations as indicated.

### **3.5 PROTECTION OF FINISHED WORK**

- .1 Do not permit adjacent work to damage work of this section.

**END OF SECTION**



**Part 1 General**

**1.1 REFERENCES**

- .1 ASTM C1002-07 -Steel Self-Piercing, Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
- .2 ASTM C1396/C1396M-06a -Gypsum Board.
- .3 CAN/CGSB-37.5-M89 -Cutback Asphalt Plastic Cement.
- .4 CAN/CGSB-37-GP-56M-1985-Membrane Modified, Bituminous, Prefabricated, and Reinforced for Roofing.
- .5 CAN/ULC-S704-03 -Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Fixed.
- .6 Province of Alberta Roofing Contractors Association – Roofing Specifications Manual.

**1.2 SYSTEM DESCRIPTION**

- .1 Assembly of components include two ply membrane system, bitumen adhered, with granulated surface, with vapour retarder and insulation.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Coordination:
  - .1 Coordinate with other work having a direct bearing on work of this section.
  - .2 Coordinate the work with the installation of associated metal flashings, as the work of this section proceeds.

**1.4 SUBMITTALS FOR REVIEW**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings: Indicate setting plan for tapered insulation, layout of seams, direction of laps, base flashing details.
- .3 Product Data: Provide membrane materials, base flashing materials, insulation, vapour retarders, deck covering.

**1.5 SUBMITTALS FOR INFORMATION**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Installation Data: Manufacturer's special installation requirements, including special precautions required for seaming the membrane.

**1.6 QUALITY ASSURANCE**

- .1 Perform Work in accordance with ARCA Manual and manufacturer's instructions.
- .2 Maintain one (1) copy of each document on site.
- .3 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten (10) years documented experience.

- .4 Installer Qualifications: Company specializing in performing the work of this section with minimum ten (10) years documented experience.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver products in manufacturer's original containers, dry, undamaged, seals and labels intact.
- .2 Store products in weather protected environment, clear of ground and moisture.
- .3 Stand roll materials on end.

## **1.8 ENVIRONMENTAL REQUIREMENTS**

- .1 Do not apply roofing membrane during inclement weather.
- .2 Do not apply roofing membrane to damp or frozen deck surface.
- .3 Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.

## **1.9 WARRANTY**

- .1 Contractor's Warranty: Provide ARCA five (5) year Certificate of Assurance on roofing, dated from time of Substantial Performance.

# **Part 2 Products**

## **2.1 MEMBRANE MATERIALS**

- .1 Membrane: CAN/CGSB-37-GP-56M, Asphalt and polymer modifiers of styrene-butadiene-styrene (SBS) prefabricated sheet.
  - .1 Base Sheet Membrane: non-woven polyester reinforcement, weighing 180 g/m<sup>2</sup>.
    - .1 Application: fully adhered:
      - .1 Top surface thermofusible plastic film.
      - .2 Underside sanded.
  - .2 Base Sheet Flashing: non-woven polyester reinforcement, weighing 180 g/m<sup>2</sup>.
    - .1 Application: fully adhered:
      - .1 Both sides thermofusible plastic film.
- .3 Cap Sheet Membrane and Cap Sheet Flashing: non-woven polyester reinforcement and elastomeric bitumen with flame-retarding agent, weighing 250 g/m<sup>2</sup>.

## **2.2 BITUMEN MATERIALS**

- .1 Asphalt: CSA-A123.4, Type 2
- .2 Asphalt Primer: CGSB-37-GP-9Ma.

## **2.3 DECK COVERING MATERIALS**

- .1 Gypsum Sheathing: ASTM C1396/C1396M, sheathing grade 16 mm thick; uncoated face, fire rated type, with sheathing joint tape.

## **2.4 VAPOUR RETARDER**

- .1 Self-adhesive vapour barrier membrane.

## **2.5 INSULATION**

- .1 Insulation: CAN/ULC-S701, CAN/ULC-S102.2 EPS rigid board.
  - .1 Use sloped EPS insulation for all sloped roof areas and back slopes.

## **2.6 COVER BOARD**

- .1 Cellulose Fibreboard: CAN/ULC-S706, 13 mm thick; ship lapped asphalt saturated.

## **2.7 METAL FLASHINGS**

- .1 Counter Flashings: Prefinished metal, specified in Section 07 62 00 - Sheet Metal Flashing and Trim.

## **2.8 ACCESSORIES**

- .1 Sheathing Fasteners: ASTM C1002, steel drill type, for mechanical attachment of gypsum sheathing to metal deck.
- .2 Fasteners: Galvanized, appropriate for purpose intended and approved by Factory Mutual and system manufacturer; length required for thickness of material with metal washers.
- .3 Sealants: As recommended by membrane manufacturer.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verify that surfaces and site conditions are ready to receive work.
- .2 Verify deck is supported and secured.
- .3 Verify deck is clean and smooth, free of depressions, waves, or projections, properly sloped to drains, valleys or eaves.
- .4 Verify deck surfaces are dry and free of snow or ice. Verify flutes of metal deck are clean and dry.
- .5 Verify roof openings, curbs, pipes, conduit, sleeves, ducts, and vents through roof are solidly set, and wood cant strips and wood nailing strips are in place.

### **3.2 PREPARATION - METAL DECK**

- .1 Install deck sheathing onto the steel deck to Factory Mutual requirements, bulletin 1-28 for installation of boards to roof perimeters and corners, to meet 1-90.
- .2 Lay with long side at right angle to flutes; stagger end joints; provide support at ends.
- .3 Cut sheathing cleanly and accurately at roof breaks and protrusions to provide smooth surface.

### **3.3 VAPOUR RETARDER APPLICATION**

- .1 Install in accordance with manufacturer's written instructions.

### **3.4 INSULATION APPLICATION**

- .1 Install insulation to manufacturer written instructions.
- .2 Mop first layer of insulation to vapour retarder with hot asphalt at rate of 1 kg/m<sup>2</sup>.
- .3 Mop second layer of insulation to first layer of insulation with hot asphalt at rate of 1 kg/m<sup>2</sup>.
- .4 Install the second layer of insulation with joints staggered minimum 150 mm from joints of first layer.
- .5 Place the constant thickness first layer and the tapered thickness insulation second layer to the required slope pattern in accordance with manufacturer's written instructions.
- .6 Minimum Total Insulation Thickness: To match existing roof insulation thickness.
- .7 Lay boards with edges in moderate contact without forcing. Cut insulation to fit nearly to perimeter blocking and around penetrations through roof.
- .8 Apply no more insulation than can be covered with membrane in same day.
- .9 Install cover boards in full mopping of bitumen in accordance with manufacturer's written instructions.

### **3.5 MEMBRANE APPLICATION**

- .1 Apply membrane and primer to manufacturer written instructions.
- .2 Apply membrane; lap and seal edges and ends permanently waterproof.
- .3 Apply membrane smooth, free from air pockets, wrinkles, or tears. Ensure full bond of membrane to substrate.
- .4 Extend membrane up cant strips and minimum of 200 mm onto vertical surfaces.
- .5 Extend membrane over vapour and air barrier of wall construction and seal.
- .6 Mop and seal membrane around roof protrusions and penetrations.
- .7 Provide waterproof cut-off to membrane at end of day's operation. Remove cut-off before resuming roofing.

### **3.6 FLASHINGS AND ACCESSORIES**

- .1 Apply base flashings to seal membrane to vertical elements.
- .2 Fabricate roofing control and expansion joints to isolate roof into areas as indicated.
- .3 Coordinate installation of roof drains, sumps, curbs, and related flashings.
- .4 Seal flashings and flanges of items penetrating or protruding through the membrane.
- .5 Install vent stack covers and other roof penetration flashings and seal to membrane and vapour barrier in accordance with the manufacturer's recommendations and details.
- .6 Seal pipe and other penetrations through roof deck using backer rod and sealant.
- .7 Coordinate placement and waterproofing of roof drains.

**3.7 METAL WORK**

- .1 Fabricate metal flashing to profiles indicated and in accordance with Section 07 62 00 - Sheet Metal Flashing and Trim.
- .2 Install metal flashings as detailed and in longest practical lengths.
- .3 Use concealed fastenings except where approved before installation.
- .4 Lock end joints using "S" lock style and caulk with sealant.

**3.8 FIELD QUALITY CONTROL**

- .1 Section 01 45 00 – Quality Control.
- .2 Provide inspection services in accordance with ARCA warranty requirements.
- .3 Monitor and report installation procedures, unacceptable conditions and environmental conditions.
- .4 Correct identified defects or irregularities.

**3.9 CLEANING**

- .1 In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.
- .2 Repair or replace defaced or disfigured finishes caused by work of this section.

**3.10 PROTECTION OF FINISHED WORK**

- .1 Protect building surfaces against damage from roofing work.
- .2 Where traffic must continue over finished roof membrane, protect surfaces.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 American Society for Testing and Materials (ASTM International).
  - .1 ASTM A653/A653M-01a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .2 ASTM B209-06, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

**1.2 SUBMITTALS**

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
- .3 Submit two samples 50 x 50 mm (2 x 2 inch) in size illustrating metal finish colour.

**1.3 QUALIFICATIONS**

- .1 Fabricator and Installer: Company specializing in sheet metal flashing work with 5 years documented experience.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver, store, protect and handle products to site.
- .2 Stack preformed and prefinished material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- .3 Prevent contact with materials which may cause discolouration or staining.

**Part 2 Products**

**2.1 SHEET MATERIALS**

- .1 Prepainted Galvanized Steel Sheet: ASTM A653/A653M, 0.66 mm (0.026 inch, 24 gauge) zinc coated galvanized steel sheet. Colour selection by Departmental Representative from unrestricted Baycoat 8000 series.
- .2 Aluminum Sheet: ASTM B209, 1.2 mm (0.050 inch) thickness, brake formed. Clear anodized to AA-C22-A41 Class I finish.

**2.2 ACCESSORIES**

- .1 Fasteners: Finish exposed fasteners same as flashing metal. Permitted only on approval of Departmental Representative.
- .2 Exposed Sealant: Silicone type, as specified in Section 07 92 00; colour to match sheet metal finish.
- .3 Bedding Sealant: Butyl, as specified in Section 07 92 00.
- .4 Protective Backing Paint: Bituminous.

## **2.3 FABRICATION**

- .1 Form sections true to shape, accurate in size, square, and free from distortion or defects.
- .2 Fabricate cleats of same material as sheet, minimum 50 mm (2 inches) wide, interlockable with sheet.
- .3 Form pieces in longest possible lengths.
- .4 Hem exposed edges on underside 13 mm (1/2 inch); mitre and seam corners.
- .5 Form material with flat lock seams.
- .6 Fabricate vertical faces with bottom edge formed outward 6 mm (1/4 inch) and hemmed to form drip.
- .7 Fabricate flashings to allow toe to extend 50 mm (2 inches) over roofing gravel. Return and brake edges.

## **2.4 FINISH**

- .1 Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 0.4 mm (15 mil).

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, reglets in place, and nailing strips located.
- .2 Verify roofing termination and base flashings are in place, sealed, and secure.

### **3.2 PREPARATION**

- .1 Install starter and edge strips, and cleats before starting installation.

### **3.3 INSTALLATION**

- .1 Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted.
- .2 Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- .3 Seal metal joints watertight.

**END OF SECTION**

**Part 1            General**

**1.1            REFERENCES**

- .1      Underwriters' Laboratories of Canada (ULC).
  - .1          Guide BXUVC, Fire Resistance Ratings.
  - .2          Guide CHPXC, Spray-Applied Fire Resistive Material.
  - .3          CAN/ULC-S101-1989, Standard Methods of Fire Endurance Tests of Building Construction and Materials.
- .2      Underwriters Laboratories Inc. (UL).
  - .1          Guide BXRH7, Fire Resistance Ratings Certified for Canada.
  - .2          Guide CHPX7, Spray-applied Fire Resistive Materials Certified for Canada.
- .3      American Society for Testing and Materials (ASTM).
  - .1          ASTM E 605-93(2000), Standard Test Methods for Thickness and Density of Sprayed Fire Resistive Material (SFRM) Applied to Structural Members.
- .4      Association of the Wall and Ceiling Industry (AWCI).
  - .1          Technical Manual 12-A, 3rd Edition; Standard Practice for the Testing and Inspection of Field Applied Sprayed Fire-Resistive Materials; an Annotated Guide - 122

**1.2            DEFINITIONS**

- .1      SFRM: Spray-applied Fire Resistive Materials, as defined by Underwriters' Laboratories of Canada.

**1.3            QUALITY ASSURANCE**

- .1      Refer to Section 01 45 00 - Quality Control.

**1.4            STORAGE AND HANDLING**

- .1      Deliver materials to the project in manufacturer's unopened packages, fully identified as to trade name, type and other identifying data. Packaging shall bear the UL and ULC labels for fire hazard and fire-resistance classifications.
- .2      Store materials above ground, in a dry location, protected from weather, moisture and areas of high humidity. Damaged packages found unsuitable for use should be rejected and removed from the project.

**1.5            SUBMITTALS**

- .1      Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2      Submit proof of installer approval by manufacturer.



- .3 Manufacturer's Data: Submit manufacturer's instructions for proper application of fireproofing.
- .4 Fire Testing: Submit evidence that the fireproofing has been subjected to full-scale ASTM E119 fire testing at Underwriters Laboratories Inc. by the manufacturer.
- .5 Thickness Schedule: Provide schedule indicating material to be used, building elements to be protected with spray applied fireproofing, hourly rating and material thickness provided and appropriate references.
- .6 Submit WHMIS Material Safety Data Sheets.
- .7 Engineering Judgement: For assemblies not tested and rated, submit proposals based on related ULC designs using accepted fireproofing design criteria. Proposals will be reviewed by Departmental Representative and Authority Having Jurisdiction. Allow 14 days for review of proposals.

## **1.6 ENVIRONMENTAL CONDITIONS**

- .1 At outdoor temperatures less than 5°C, ensure that a 5°C air and substrate temperature is maintained during and for 24 hours after application. Provide heated enclosures to maintain temperatures.
- .2 Provide ventilation to allow for drying of fireproofing during and subsequent to its application. In enclosed areas, ventilation shall be not less than 4 complete air changes per hour.
- .3 Provide temporary enclosures to prevent spray from contaminating air beyond application area.
- .4 Protect adjacent surfaces, flooring and equipment from damage by overspray, fall-out, and dusting of fireproofing materials.

## **Part 2 Products**

### **2.1 SPRAY-APPLIED FIRE RESISTIVE MATERIALS (SFRM)**

- .1 SFRM: Cementitious wet or dry mix, ULC Listed or UL Certified for use in Canada when tested in accordance with CAN/ULC-S101.
- .2 Fire Resistance Rating: as indicated.
- .3 Density: Medium, minimum 22 pcf when tested to ASTM E605.
- .4 Water: Potable and free from mineral or organic substances that may affect set of the SFRM.

### **2.2 ACCESSORIES**

- .1 Provide installation accessories required by ULC/UL fire resistance design or site conditions including, but not limited to; bonding agents, mechanical attachments, metal lath, scrim, or netting, curing compound, and sealer.

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**Part 3            Execution**

**3.1            EXAMINATION**

- .1      All surfaces to receive SFRM/SFRTB to be free of oil, grease, loose mill scale, dirt, paints/primers (other than those listed and tested) or other foreign materials, which would impair bonding.
- .2      Where necessary, cleaning or other corrections of surfaces shall be the responsibility of the supplier of the incompatible substrate.
- .3      Application of the fireproofing shall not begin until the Departmental Representative, applicator and testing laboratory (inspector) have examined surfaces and determined that surfaces are acceptable to receive the material.
- .4      Verify that spray-applied foam insulation has cured prior to application of SFRTB. Coordinate with Section 07 21 00 – Thermal Insulation.

**3.2            PREPARATION**

- .1      Clips, hangers, supports, sleeves and other attachments to the substrate are to be placed prior to the application of SFRM/SFRTB.
- .2      Verify that ducts, piping, equipment, or other items which would interfere with application of SFRM/SFRTB are not positioned until SFRM/SFRTB work is completed.
- .3      Complete placing of concrete on floor and roof decking prior to application of the SFRM to the underside of steel deck and supporting beams and joists.
- .4      On roof decks without concrete cover, complete roofing application and roof mounted equipment installation prior to application of the SFRM to the underside of roof decking and supporting beams and joists.
- .5      Prohibit all roof traffic upon commencement of the SFRM application and until the SFRM material is dry.
- .6      Provide masking, drop cloths or other suitable coverings to prevent overspray from coming in contact with surfaces not intended to be sprayed.

**3.3            APPLICATION**

- .1      Equipment, mixing and application shall be in accordance with the manufacturer's written application instructions.
- .2      Bonding materials (adhesives, catch coats, metal lath, mesh, stud pins, etc.) shall be applied as per the appropriate ULC/UL fire resistance design and manufacturer's written recommendations.
- .3      Apply bonding adhesive, primer and spatter coat to substrate if recommended by manufacturer.

- .4 Apply SFRM/SFRTB over substrate, building up to required thickness to cover substrate with monolithic blanket of uniform density and texture.

### **3.4 INSPECTION AND TESTING**

- .1 Inspection and testing of SFRM/SFRTB will be carried out by Testing Laboratory designated by Departmental Representative.
- .2 The spray-applied fire resistive material and thermal barrier shall be tested for thickness and density in accordance with ASTM E605 or AWCI.

### **3.5 PATCHING**

- .1 Patch damage to fireproofing caused by testing or by other trades before fireproofing is concealed, or if exposed, before final inspection.
- .2 All patching of and repair to sprayed fire protection, due to damage by other trades, shall be performed under this Section and paid for by the trade responsible for the damage.
- .3 Appearance of patches in exposed areas to be identical to main field application in colour, texture and thickness, when viewed from expected vantage points.

### **3.6 CLEANING**

- .1 Refer to Section 01 74 11 - Cleaning.

**END OF SECTION**

## **Part 1        General**

### **1.1        REFERENCES**

- .1 Underwriters' Laboratories of Canada (ULC).
  - .1 Guide BXUVC, Fire Resistance Ratings.
  - .2 Guide XHEZC, Firestop Systems.
  - .3 CAN/ULC-S101, Standard Methods of Fire Endurance Tests of Building Construction and Materials.
  - .4 CAN/ULC-S102, Standard Test Method for Surface Burning Characteristics of Building Materials.
  - .5 CAN/ULC-S115, Standard Method of Fire Tests of Firestop Systems.
- .2 Underwriters Laboratories Inc. (UL).
  - .1 Guide BXUV7, Fire Resistance Ratings Certified for Canada.
  - .2 Guide XHEZ7, Through-penetration Firestop Systems Certified for Canada.
  - .3 UL 2079, Tests for Resistance of Building Joint Systems.
- .3 American Society for Testing and Materials (ASTM).
  - .1 ASTM E2174, Standard Practice for On-site Inspection of Installed Fire Stops.
  - .2 ASTM E2307, Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story Test Apparatus.
  - .3 ASTM E2393, Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.
- .4 International Firestop Council (IFC).
  - .1 Guidelines for Evaluating Firestop Systems Engineering Judgments.

### **1.2        DEFINITIONS**

- .1 Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, water and hot gases through penetrations and joints between fire rated wall, floor and roof assemblies.
- .2 System Design: An assembly of products designed to maintain the integrity of fire-rated construction when tested in accordance with CAN/ULC-S115, designed by a voting IFC member, certified by an independent ULC licensed testing agency, and ULC/UL Listed.

### **1.3        QUALITY ASSURANCE**

- .1 Firestop installation must meet requirements of CAN/ULC-S115 tested assemblies.
- .2 For firestop applications for which no ULC or UL System Design is available through a manufacturer, a manufacturer's Engineering Judgment to be submitted to local Authorities Having Jurisdiction for review and approval prior to installation. Engineer

Judgment drawings must follow requirements set forth by the International Firestop Council.

- .3 Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience, certified by the firestop manufacturer.

#### **1.4 QUALITY CONTROL**

- .1 Refer to Section 01 45 00 - Quality Control.

#### **1.5 SUBMITTALS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Product Data: Provide data on product characteristics, performance and limitation criteria.
- .3 Shop Drawings: Submit System Design listings, indicating ULC or UL design number and including illustrations, applicable to each firestop configuration. Where there is no System Design available for a particular firestop configuration, the Installer to pay for and obtain, from the firestop manufacturer, an Engineering Judgment (EJ) or Equivalent Fire Resistance Rated Assembly (EFRRA) for submittal.
- .4 Schedule: Provide schedule indicating material to be used, building elements to be protected, hourly rating and appropriate references.
- .5 Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
- .6 Submit material safety data sheets (MSDS) provided with products delivered to job site.

#### **1.6 PERFORMANCE REQUIREMENTS**

- .1 Penetrations: Provide and install firestopping systems produced to resist the spread of fire, and the passage of smoke and other gases according to requirements indicated, including but not limited to the following:
  - .1 Firestop all penetrations passing through fire resistance rated wall and floor assemblies and other locations as indicated on the drawings.
  - .2 Provide and install complete penetration firestopping systems that have been tested and approved by third party testing agency.
  - .3 F - Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with F ratings indicated, but not less than one hour or the fire-resistance rating of the construction being penetrated.
  - .4 T - Rated Through-Penetration Firestop Systems: Provide firestop systems with T ratings, in addition to F ratings, where required by Code.
  - .5 L - Rated Through-Penetration Firestop Systems: Provide firestop systems with L ratings, in addition to F and T ratings, where required by Code.
  - .6 W - Rated Through-Penetration Firestop Systems: Provide firestop systems with W Water Resistance ratings, in addition to F, T and L ratings, where indicated.
- .2 Perimeter Fire Containment Systems: Provide interior perimeter joint systems with fire-resistance ratings indicated, but not less than the fire-resistance rating of the floor construction.

- .3 Fire-Resistive Joints: Provide joint systems with fire-resistance ratings indicated, but not less than the fire-resistance rating of the construction in which the joint occurs.
- .4 For firestopping exposed to view, traffic, moisture, and physical damage, provide appropriate firestop systems for these conditions.

## **1.7 ENVIRONMENTAL REQUIREMENTS**

- .1 Comply with manufacturer's recommended requirements for temperature, relative humidity and substrate moisture content during application and curing of materials.
- .2 Do not proceed with installation of firestopping materials when temperatures or weather conditions exceed manufacturer's recommendations.
- .3 Ventilate solvent based and moisture-cure firestopping per manufacturer's instructions by natural means or, where inadequate, by forced air circulation.

## **1.8 SINGLE SOURCE RESPONSIBILITY**

- .1 Obtain firestop systems for each kind of penetration and construction condition indicated from a single primary firestop systems manufacturer.
- .2 Where selected firestop system manufacturer cannot provide a System Design to suit site conditions, provide a tested and listed firestop System Design from an alternate manufacturer before using an Engineering Judgment (EJ) or Equivalent Fire Resistance Rated Assembly (EFRRA).

## **1.9 SEQUENCING AND SCHEDULING**

- .1 Do not cover up firestopping installations until receipt of written notice from the Departmental Representative.

## **1.10 PRE-INSTALLATION CONFERENCE**

- .1 Conduct conference at Project site. Review methods and procedures related to firestopping including, but not limited to, the following:
- .2 Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
- .3 Review methods and procedures related to firestopping installation.
- .4 Verify reinforcement, blocking and other ancillary components required by the System Design, installed by others, are in place.

## **Part 2 Products**

### **2.1 ACCEPTABLE MANUFACTURERS**

- .1 Provide firestopping and smoke seal systems only from manufacturers publishing ULC Listed or UL Certified For Use In Canada System Designs tested in accordance with CAN/ULC-S115.

## **2.2 ACCEPTABLE PRODUCTS**

- .1 Selection of appropriate system to maintain required fire resistance rating is the responsibility of the Installer.
- .2 Selection to be based on specified performance requirements and is limited to ULC Listed or UL Certified For Use In Canada System Designs tested in accordance with CAN/ULC-S115.
- .3 Substitution of products, components or accessories forming part of a System Design is not acceptable, unless accompanied by an EJ or EFRRA from the system manufacturer.

## **2.3 ACCESSORIES**

- .1 Primer: Type recommended by firestopping manufacturer for specific substrate surfaces.
- .2 Installation Accessories: Clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place, as required by System Design.

# **Part 3 Execution**

## **3.1 EXAMINATION**

- .1 Verify openings are ready to receive the work of this section.
- .2 Examine substrates and conditions for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of firestopping.
- .3 Verify that blocking, anchoring devices, back-up materials, clips, sleeves, supports and other related materials is in place where required by System Design.
- .4 Do not apply firestopping to painted surfaces or surfaces treated with sealers, curing compounds, water repellent or other coatings unless compatibility of materials has been verified.
- .5 Notify the Departmental Representative of unsatisfactory conditions. Do not proceed with installation until unsatisfactory conditions have been corrected.
- .6 Commencement of Work will be considered acceptance of conditions.

## **3.2 PREPARATION**

- .1 Prime substrates where recommended by firestopping manufacturer using manufacturer's recommended products and methods. Limit priming to area of bond.
- .2 Use masking tape to prevent firestopping from contacting adjoining surfaces scheduled to remain exposed. Remove tape on completion of installation, without disturbing the firestopping seal with substrates.
- .3 Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter which may affect bond of firestopping material.
- .4 Remove incompatible materials which may affect bond.

### **3.3           INSTALLATION – GENERAL**

- .1     Install firestopping material and components in accordance with System Design and manufacturer's written instructions.
- .2     Install permanent warning labels, provided by firestopping manufacturer, adjacent to openings that may be re-penetrated or disturbed. Include following information:
  - .1       Warning that opening has being firestop protected.
  - .2       System Design number.
  - .3       F rating or FT rating.
  - .4       Fire stop products used.
  - .5       Contact person and phone number in case of modification or new penetration of firestop system.

### **3.4           INSTALLING PENETRATION FIRESTOPS**

- .1     Verify that pipes, conduit, cable, and other items penetrating fire rated construction have been permanently installed prior to firestopping.
- .2     Schedule work so partitions and other construction that conceals penetrations are not erected prior to firestopping.
- .3     Install forming/damming materials and other accessories in accordance with manufacturers written instructions.
- .4     Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.
- .5     Install materials to contact and adhere to substrates formed by openings and penetrating items.
- .6     Finish to produce smooth, uniform surfaces for fill materials to remain exposed.

### **3.5           INSTALLING FIRESTOP JOINT SYSTEMS**

- .1     Install joint fillers to provide support of firestop materials during application.
- .2     Install in full contact with joint substrates.
- .3     Completely fill recesses provided for joint configuration.
- .4     Provide uniform, cross-sectional shapes and depths relative to joint width that optimize movement capability.
- .5     Tool immediately after application and prior to skinning. Form smooth, uniform beads of configuration required to produce fire-resistance rating, eliminate air pockets and ensure contact and adhesion with sides of joint.

### **3.6           INSTALLING PERIMETER FIRE BARRIER SYSTEMS**

- .1     Install metal framing, curtain wall insulation, mechanical attachments, safing materials and firestop materials in accordance with System Design.



**3.7 FIELD QUALITY CONTROL**

- .1 Notify Departmental Representative when completed installations are ready for inspection prior to concealing or enclosing area containing firestopping materials.
- .2 Arrange for inspections by independent inspection agency.
- .3 Where no deficiencies are found, provide repair of inspected installations, as required to comply with requirements of the System Design.
- .4 Where deficiencies are found, repair or replace the fire stopping, at no cost, to comply with requirements of the System Design.

**3.8 CLEANING**

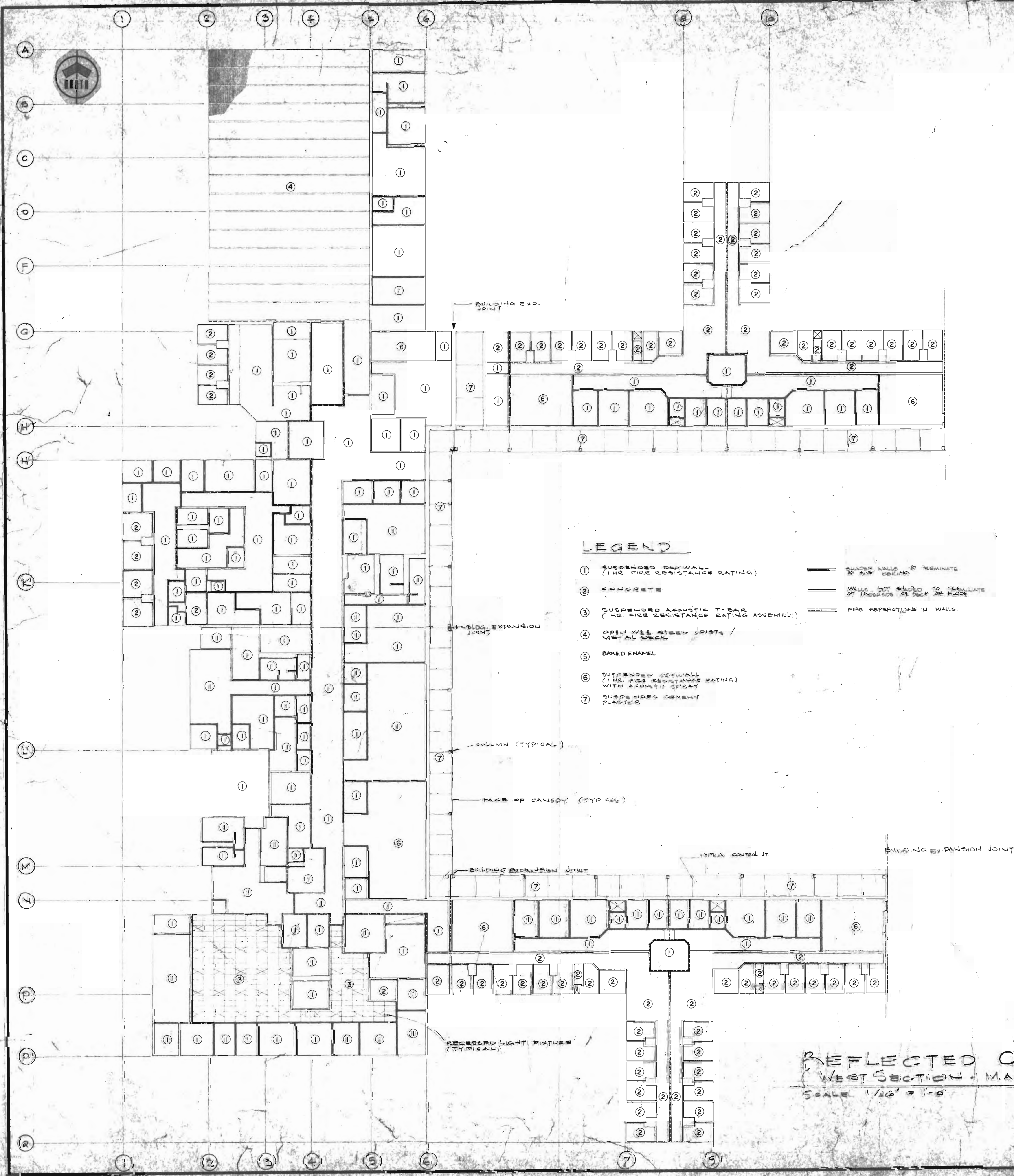
- .1 Refer to Section 01 74 11 - Cleaning.

**3.9 PROTECTION OF FINISHED WORK**

- .1 Protect firestopping during and after curing period from contact with contaminating substances. If damage caused by others, make appropriate repairs at no cost to Department Representative.

**END OF SECTION**





### LEGEND

- ① SUSPENDED CEILING (1 HR. FIRE RESISTANCE RATING)
- ② CONCRETE
- ③ SUSPENDED ACOUSTIC T-BAR (1 HR. FIRE RESISTANCE RATING ASSEMBLY)
- ④ OPEN WELDED STEEL JOISTS / METAL DECK
- ⑤ BAKED ENAMEL
- ⑥ SUSPENDED CEILING (1 HR. FIRE RESISTANCE RATING) WITH ACOUSTIC GREY
- ⑦ SUSPENDED CEILING PLASTER

## REFLECTED CEILING PLAN (WEST SECTION - MAIN FLOOR)

SCALE 1/16" = 1'-0"

**NOTE:**  
HOLD DOWN SLIDE NOT SHOWN  
1 HOUR FIRE RESISTANCE RATED ASSEMBLY REQ'D.

**NOTE:**  
1 HOUR FIRE RESISTANCE RATING REQUIRED

**KEY PLAN**

Public Works Canada / Travaux publics Canada

Western Region / Région de l'Ouest

**J.W. ROSE ARCHITECTS INC.**  
SUITE 201, 251 BROADVIEW AVE. S.W.  
CALGARY, ALBERTA, T2C 1G5

**UTR** Unsworth, McNeil & Associates Limited  
CONSULTING PROFESSIONAL ENGINEERS

**AS BUILT**  
This drawing has been revised to show this building as built.  
Certified [Signature]  
Date: Nov 21/80

**EDMONTON - ALBERTA**  
**MAXIMUM SECURITY INSTITUTION**  
CANADIAN PENITENTIARY SERVICE

**REFLECTED CEILING PLAN & DETAILS**

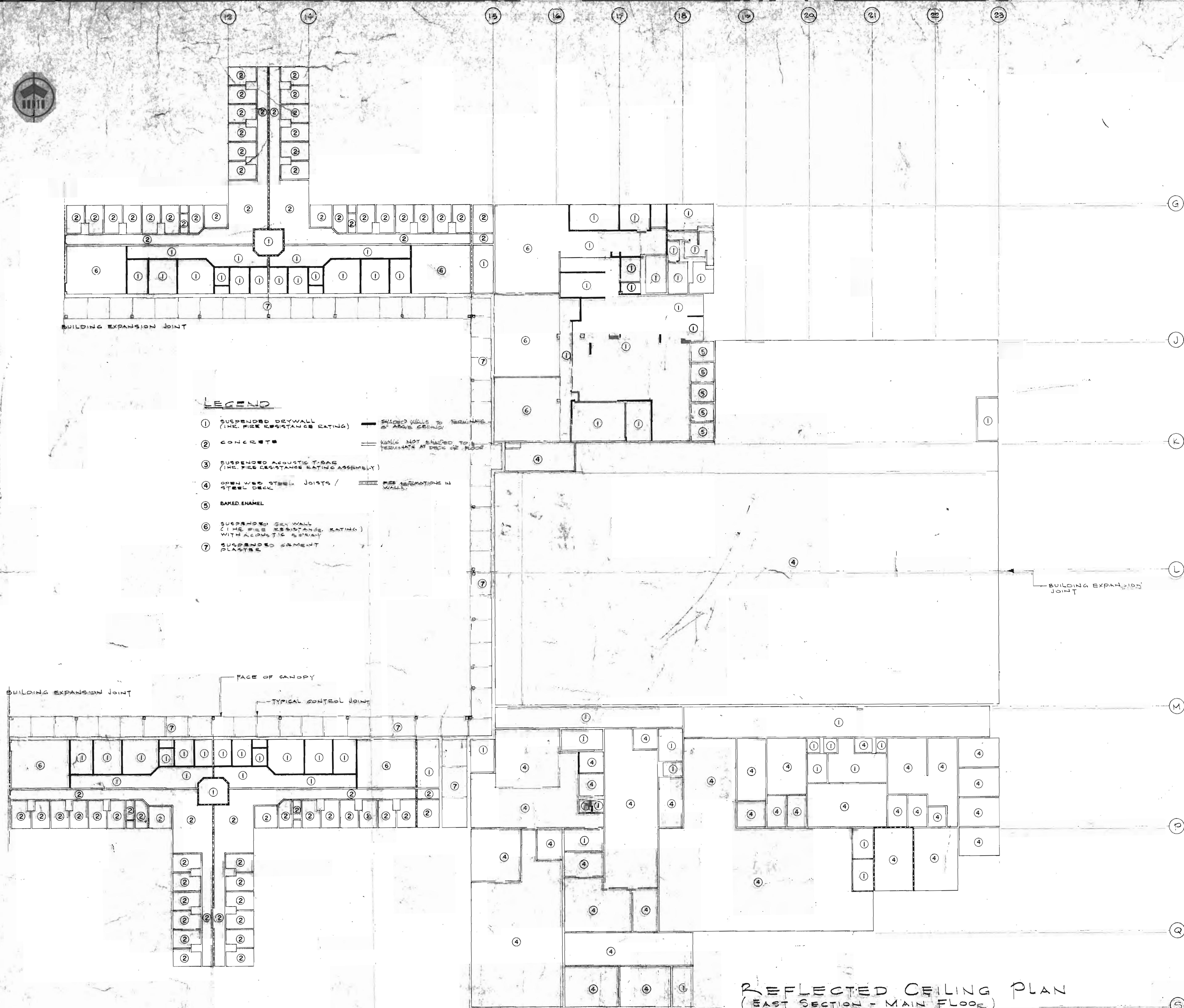
Prepared by: J. ROSE  
Date: OCT. 1976  
Checked by: D. JANCZAK/MOZNER  
Date: OCT. 1976  
Approved by: [Signature]  
Date: Oct 76

Project number: **B5451**

Drawing no: **A0-A36-RD**

Scale: 1/16" = 1'-0"

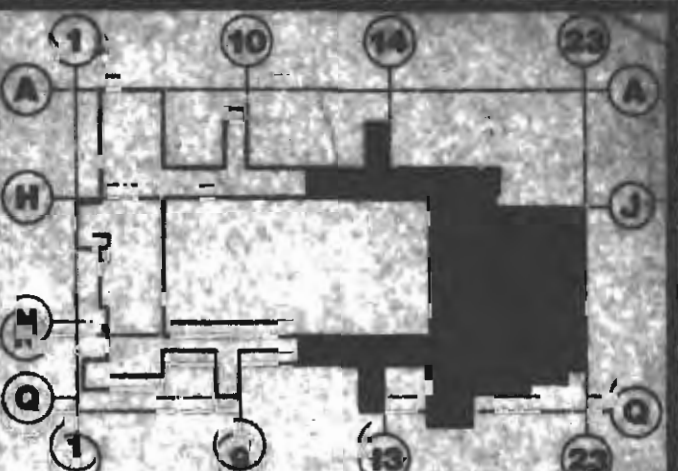




# REFLECTED CEILING PLAN (EAST SECTION - MAIN FLOOR)

SCALE 1/16" = 1'-0"

SCALE 1/16" = 1'-0"



## KEY PLAN

Public Works Canada / Travaux publics Canada

Western Region / Région de l'Ouest



Underwood McLellan & Associates, Limited  
CONSULTING PROFESSIONAL ENGINEERS

UMA

A detail no. B detail no. C detail no. D detail no.

0-1 ISSUE FOR TENDER OCT. 18/76

1- MODIFIED FOR 'AS BUILT' SEPT. 18/80

## AS BUILT

This drawing has been reviewed to show this building as built.

Date: Nov. 28/80

project title

EDMONTON, ALBERTA  
MAXIMUM SECURITY  
INSTITUTION

CANADIAN PENITENTIARY  
SERVICE

drawing title

REFLECTED CEILING  
PLAN

designed by J. ROSE

date OCT. 1976

drawn by D. JANCZAK

date OCT. 1976

checked by [signature]

date Oct. 76

approved by [signature]

date

D.P.W. Project No.

project number

85451

APPROVED

DATE

11/28/80



**Part 1 General**

**1.1 REFERENCES**

- .1 American Society for Testing of Materials (ASTM).
  - .1 ASTM C834-00e1, Standard Specification for Latex Sealants.
  - .2 ASTM C919-02, Standard Practice for Use of Sealants in Acoustical Applications.
  - .3 ASTM C920-02, Standard Specification for Elastomeric Joint Sealants.
  - .4 ASTM D2369-04, Standard Test Method for Volatile Content of Coatings.
  - .5 ASTM D5893-96, Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements.

**1.2 SUBMITTALS FOR REVIEW**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Product Data: Provide data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and colour availability.
- .3 Samples: Submit two sample ribbons of sealant, illustrating sealant colours for selection.
- .4 Submit laboratory tests or data validating product compliance with performance criteria specified. Include SWRI validation certificate where required.
- .5 Closeout Submittals: Sealant applicator to submit copies of the Manufacturer's Warranty.

**1.3 QUALITY ASSURANCE**

- .1 Installer Qualifications: Qualified to perform work specified by reason of experience or training provided by product manufacturer. Submit reference list including minimum three projects of similar size and scope.
- .2 Adhesion Pull Tests: the number of adhesion pull tests to be determined by manufacturers weatherseal warranty. Adhesion pull tests to be conducted by or in the presence of manufacturers representative. Manufacturer to supply Departmental Representative with results of adhesion pull tests. Sealant installer responsible for repairing areas where adhesion pull tests are conducted, without change to the Contract price.
- .3 Manufacturer's Representative: Coordinate with manufacturers representative to provide access to completed work areas until adhesion pull tests can be completed.

**1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver and store materials in original wrappings and containers with manufacturer's seals and labels, intact. Protect from freezing, moisture, water and contact with ground or floor.
- .2 Store products in a location protected from freezing, damage, construction activity, precipitation, and direct sunlight in strict accordance with manufacturer's recommendations.
- .3 Condition products to approximately 16 to 21°C for use in accordance with manufacturer's recommendations.

## **1.5 ENVIRONMENTAL AND SAFETY REQUIREMENTS**

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of material safety data sheets acceptable to Labour Canada.
- .2 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.

## **1.6 WARRANTY**

- .1 Provide manufacturer's two-year material warranty for installed silicone sealant.

## **Part 2 Products**

### **2.1 SEALANT MATERIALS**

- .1 Acoustical sealant: to ASTM C919, single component, non-hardening, non-skinning, synthetic rubber. Acceptable product: Tremco Acoustical Sealant.
- .2 Butyl Sealant: to ASTM C1311, single component, solvent release, non-skinning, non-sagging, black colour.
- .3 Polyurethane Sealant: Two-component, non-sag to ASTM C920, Type M, Grade NS, Class 25; with  $\pm 25\%$  movement capability for vertical joints.
- .4 Silicone, one part: to ASTM C 920, Type S, Grade NS, Class 25, single component neutral cure silicone sealant, plus minus 50% joint movement capability. Silicone, mildew resistant: to ASTM C 920, single component mildew resistant silicone sealant, +/- 25% movement capability.
- .5 Low Modulus STP: single component, low modulus, silyl-terminated polyether (STP), to ASTM C920, Type M, Grade NS, Class 100/50; with +100% and -50% movement capability for vertical joints, colour as selected by Departmental Representative from full range.
- .6 Polyurethane, self-levelling: to ASTM C 920, Type S, Grade P, Class 25, single component self-levelling polyurethane sealant with plus or minus 25 percent movement capability for horizontal joints.
- .7 Epoxy, flexible: Poured flexible 100% solids epoxy joint filler. Acrylic latex: to ASTM C 834, single component general purpose siliconized acrylic latex sealant.

### **2.2 ACCESSORIES**

- .1 Primer: Type recommended by the sealant manufacturer and compatible with joint forming materials.
- .2 Joint Cleaner: Non-corrosive and non-staining type recommended by sealant manufacturer and compatible with joint forming materials.
- .3 Soft Backer Rod: to ASTM C 1330, non-gassing, reticulated closed-cell polyethylene rod designed for use with cold-applied joint sealants. Size required for joint design.

- .4 Closed-Cell Backer Rod: to ASTM C 1330, closed-cell polyethylene rod designed for use with cold-applied joint sealants for on-grade or below-grade applications. Size required for joint design.
- .5 Joint Filler: closed-cell polyethylene joint filler designed for use in cold joints, construction joints, or isolation joints wider than 6 mm. Size required for joint design.
- .6 Bond Breaker: Pressure-sensitive tape recommended by sealant manufacturer to suit application.

## **2.3 COLOURS**

- .1 Unless indicated otherwise in respective technical specification sections, colour selection is at the option of the Departmental Representative.

## **2.4 SEALANT SCHEDULE**

- .1 Perimeters of exterior openings where frames meet exterior facade of building. All other exterior applications.
  - .1 Sealant type: Silicone, one part.
- .2 Perimeters of interior door/window frames and surfaces, where required.
  - .1 Sealant type: Acrylic latex.
- .3 Perimeter of washroom fixtures, countertop backsplash at wall.
  - .1 Sealant type: Silicone, mildew resistant.
- .4 Building envelope applications (vapour barrier/vapour barrier, vapour barrier/wall opening, etc.):
  - .1 Sealant type: Acoustical sealant.
- .5 Interior partitions and acoustic applications:
  - .1 Sealant type: Acoustical sealant.
- .6 Brick veneer control joints.
  - .1 Sealant type: Silicone, one part.
- .7 Interior concrete control joints and sawcuts.
  - .1 Sealant type: Epoxy, flexible.
- .8 Perimeter of interior concrete slab.
  - .1 Sealant type: Polyurethane, self-levelling.
- .9 For locations not included in this schedule, consult with Departmental Representative for proper selection of sealants.

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**Part 3            Execution**

**3.1                EXAMINATION**

- .1      Section 01 71 00 – Examination and Preparation: Verify existing conditions before starting work.
- .2      Verify that substrate surfaces and joint openings are clean, dry, and free of frost and ready to receive work.
- .3      Verify that joint backing and release tapes are compatible with sealant.

**3.2                PREPARATION**

- .1      Remove loose materials and foreign matter which might impair adhesion of sealant.
- .2      Clean and prime joints in accordance with sealant manufacturer's written instructions.
- .3      Perform preparation in accordance with sealant manufacturer's written instructions.
- .4      Protect elements surrounding the work of this section from damage or disfiguration.

**3.3                INSTALLATION**

- .1      Install sealant in accordance with sealant manufacturer's written instructions.
- .2      Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.
- .3      Measure joint dimensions and size materials to achieve required 2:1 width/depth ratios.
- .4      Install joint backing to achieve a neck dimension no greater than 1/3 of the joint width.
- .5      Install bond breaker where joint backing is not used.
- .6      Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- .7      Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- .8      Tool joints concave.

**3.4                FIELD QUALITY CONTROL**

- .1      Joint Sealants: Perform adhesion tests in accordance with manufacturer's written instructions.
  - .1      Perform test    21 days after installation at a rate of one test every 300 m (1000 feet) of installed sealant.
- .2      Remove sealants failing adhesion test, clean substrates, reinstall sealants and perform retesting.
- .3      Maintain test log and submit report to Departmental Representative indicating tests, locations, dates, results, and remedial actions.

**3.5 MANUFACTURER'S FIELD SERVICES**

- .1 Monitor and report installation procedures and unacceptable conditions.

**3.6 CLEANING**

- .1 Section 01 74 11 - Cleaning: Cleaning installed work.
- .2 Clean adjacent soiled surfaces.

**3.7 PROTECTION OF FINISHED WORK**

- .1 Remove masking tape and excess sealant.
- .2 Protect sealants until cured.

**END OF SECTION**



**Part 1 General**

**1.1 REFERENCES**

- .1 Canadian Steel Door and Frame Manufacturers Association - Manufacturing Standard for Steel Doors and Frames.
- .2 Canadian Steel Door and Frame Manufacturers Association - Manufacturing Specifications for Steel Doors and Frames.
- .3 Canadian Steel Door and Frame Manufacturers Association - Canadian Metric Guide for Steel Doors and Frames (Modular Construction).
- .4 CAN/ULC-S701-05 - Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .5 CAN/ULC-S710.1-05 - Standard for Thermal Insulation - Bead-Applied One Component Polyurethane Air Sealant Foam, Part 1.
- .6 CAN4-S104-M80 (R1985) - Fire Tests of Door Assemblies.
- .7 CAN4-S105-85 (R1992) - Fire Door Frames Meeting the Performance Required by CAN4-S104.
- .8 CGSB 41-GP-19MA - Exterior Top Caps - Rigid polyvinylchloride extrusion.
- .9 NFPA 80-2007 - Standard for Fire Doors and Fire Windows.

**1.2 SUBMITTALS FOR REVIEW**

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Product Data: Indicate door and frame configurations and finishes, location of cut-outs for hardware reinforcement.
- .3 Shop Drawings:
  - .1 Indicate frame elevations, reinforcement, anchor types and spacing, location of cut-outs for hardware, and finish.
  - .2 Indicate door elevations, internal reinforcement, closure method, and cut-outs for glazing, and finishes.

**1.3 QUALITY ASSURANCE**

- .1 Refer to Section 01 45 00 - Quality Control.

**1.4 REGULATORY REQUIREMENTS**

- .1 Fire Rated Door and Frame Construction: Labelled and listed to CAN4-S104M.
- .2 Installed Door and Frame Assembly: Conform to NFPA 80 for fire rated class as indicated.

**1.5 DELIVERY, STORAGE, AND PROTECTION**

- .1 Remove doors and frames from wrappings or coverings upon receipt on site and inspect for damage.
- .2 Store in vertical position, spaced with blocking to permit air circulation between components.
- .3 Store materials on planks or dunnage, out of water and covered to protect from damage.

- .4 Clean and touch up scratches or disfigurement caused by shipping or handling with zinc-rich primer.

## **1.6 COORDINATION AND SPECIAL REQUIREMENTS**

- .1 Coordinate the work with frame opening construction, door, and hardware installation.
- .2 Refer to Specification Section 08 70 00 Hardware for the detailed requirements regarding the supply and installation of doors and hardware.
- .3 Sequence installation to ensure wire connections are achieved in an orderly and expeditious manner.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Sheet Steel: Galvanized steel to ASTM A653/A653M, commercial grade (CS), Type B,
  - .1 Coating designation Z275 (G90) for exterior doors and frames,
  - .2 Coating designation ZF001 (A01) for interior doors and frames.
- .2 Reinforcement Channel: To CSA G40.20/G40.21, Type 44W, coating designation to ASTM A653M, ZF75.

### **2.2 DOOR CORE MATERIALS**

- .1 Polystyrene Core: Rigid extruded fire retardant, closed cell board, density 16 to 32 kg/m<sup>3</sup> (1 to 2 pcf), thermal values RSI 1.0 (R-6.0) minimum, Type 1, in accordance with CAN/ULC-S701.

### **2.3 ADHESIVES**

- .1 Cores and Steel Components: Heat resistant, structural reinforced epoxy, resin based adhesive.
- .2 Lock Seam: Reinforced epoxy resin, high viscosity, thicksotropic sealant.

### **2.4 ACCESSORIES**

- .1 Primer: Zinc chromate type.
- .2 Foam Sealant: CAN-ULC-S710.1, single component, expanding polyurethane foam.
- .3 Joint Sealers - Interior: Acrylic, to Section 07 92 00.
- .4 Joint Sealers - Exterior: Silicone, to Section 07 92 00; colour to match adjacent wall finish.
- .5 Door Silencers: Single stud rubber/neoprene.
- .6 Exterior Top Caps: Rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19MA.
- .7 Frame Thermal Breaks: Rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19MA.

### **2.5 FABRICATION - DOORS**

- .1 Exterior Doors: Both face sheets 1.519 mm (0.0598 inch, 16 gauge) steel.

- .1 Reinforce doors with vertical stiffeners, welded to each face sheet at 150 mm (6 inches) on center maximum.
- .2 Fill voids between vertical stiffeners with polystyrene insulation.
- .2 Longitudinal Edges: Mechanically interlocked, tack welded.
- .3 Mortised, blanked, reinforced, drilled and tapped for templated hardware, in accordance with templates provided by hardware supplier.
- .4 Reinforce for surface mounted hardware, anchor hinges, thrust pivots, pivot reinforced hinges, or non-templated hardware.
- .5 Top and Bottom Channels: Inverted, recessed, welded steel channels.
- .6 Exterior Door: Flush PVC top caps.
- .7 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.
- .8 Attach fire rated label to each fire rated door unit.

## **2.6 FABRICATION - FRAMES**

- .1 Exterior Frames: 1.897 mm (0.0747 inch, 14 gauge) thick base metal thickness.
  - .1 Door Frames: Welded type construction.
- .2 Mortised, blanked, reinforced, drilled and tapped for templated hardware, in accordance with templates provided by hardware supplier.
- .3 Reinforce frames wider than 1200 mm (48 inches) with roll formed steel channels fitted tightly into frame head, flush with top.
- .4 Prepare frames for silencers. Provide three single silencers for single doors and mullions of double doors on strike side. Provide two silencers on frame head at double doors without mullions.
- .5 Attach fire rated label to each fire rated frame unit.

## **2.7 FINISH**

- .1 Doors and Frames: ZF180 (A60) galvanized.
- .2 Finish: Field painted in accordance with Section 09 91 00.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Section 01 71 00 – Examination and Preparation: Verify existing conditions before starting work.
- .2 Verify that opening sizes and tolerances are acceptable; check floor area within path of door swing for flatness.
- .3 Verify doors and frames are correct size, swing, rating and opening number.
- .4 Remove temporary shipping spreaders.

### **3.2 INSTALLATION**

- .1 Install doors and frames to CSDMA.

- .2 Install fire-rated doors and frames in accordance with NFPA 80, and local authority having jurisdiction.
- .3 Coordinate with wall construction for anchor placement.
- .4 Coordinate installation of glass and glazing.
- .5 Coordinate installation of doors and frames with installation of hardware specified in Section 08 70 00
- .6 Set frames plumb, square, level and at correct elevation.
- .7 Secure anchorages and connections to adjacent construction.
- .8 Brace frames rigidly in position while building-in. Install wood spreaders at third points of frame rebate height to maintain frame width. Provide vertical support at centre of head for openings exceeding 1200 mm (48 inches) in width.
- .9 Remove wood spreaders after frames have been built-in.
- .10 Make allowance for deflection to ensure structural loads are not transmitted to frame product.
- .11 Install doors, and hardware in accordance with hardware templates and manufacturer's instructions.
- .12 Adjust operable parts for correct clearances and function.
- .13 Install louvre and door silencers.
- .14 Finish paint in accordance with Section 09 91 00.
- .15 Install roll formed steel reinforcement channels between two abutting frames. Anchor to structure and floor.

### **3.3 ERECTION TOLERANCES**

- .1 Maximum Diagonal Distortion: 3 mm (1/8 inch) measured with straight edges, crossed corner to corner.

**END OF SECTION**

**Part 1 General**

**1.1 COORDINATION**

- .1 Provide inserts and anchoring devices that will be built into other Work for installation of access door assemblies.
- .2 Coordinate delivery with other Work to avoid delay.

**1.2 SUBMITTALS**

- .1 Comply with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
  - .1 Door and panel units: Show types, elevations, thickness of metals, full size profiles of door members.
  - .2 Hardware: Show materials, finishes, locations of fasteners, types of fasteners, locations and types of operating hardware, and details of installation.
  - .3 General: Show connections of units and hardware to other Work. Include schedules showing location of each type and size of door and panel units.
- .3 Product Data: Manufacturer's technical data for each type of access door and panel assembly, including setting drawings, templates, fire-resistive characteristics, finish requirements, and details of anchorage devices.
  - .1 Include complete schedule, types, locations, construction details, finishes, latching or locking provisions, and other pertinent data.
- .4 Manufacturer's Installation Instructions: Indicate installation requirements and rough-in dimensions.

**1.3 QUALITY ASSURANCE**

- .1 Refer to Section 01 45 00 - Quality Control.

**1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Package and ship per manufacturer's recommendations.
- .2 Store per manufacturer's instructions.
  - .1 Store in dry area out of direct sunlight.

**1.5 WARRANTY**

- .1 Provide manufacturer's 12-month written warranty.
- .2 Warrant materials and fabrication against defects after completion and final acceptance of Work.
  - .1 Repair defects, or replace with new materials, faulty materials or fabrication developed during the warranty period at no expense to Department Representative.

**Part 2 Products**

**2.1 DESIGN REQUIREMENTS**

- .1 Obtain specific locations and sizes for required access doors and frames from trades, including mechanical and electrical, requiring access to concealed equipment and indicate on submittal schedule.

**2.2 MATERIALS**

- .1 Commercial quality, cold steel sheet.

**2.3 NON-RATED ACCESS DOORS AND FRAMES**

- .1 Flush Access Doors with Exposed Flanges (Non-Rated Access Door with Gasket)
  - .1 Basis-of-Design Product: Subject to compliance with requirements, provide Nystrom; MNTC Architectural – Alternate submission as per section 01 33 00 - Submittal Procedures.
  - .2 Description: Face of door flush with frame, with 3/4 inch (25.4 mm) (25.4 mm) (19.05 mm) exposed flange.
  - .3 Locations: Wall and ceiling.
  - .4 Door Size: Refer to drawings.
  - .5 Galvannealed Steel:
    - .1 Door Material: Nominal 0.064 inch (1.6 mm) (1.6 mm), 16 gauge.
    - .2 Frame Material: Nominal 0.064 inch (1.6 mm) (1.6 mm), 16 gauge.
    - .3 Finish: rust inhibitive prime coat.
  - .6 Hinges: continuous stainless steel piano hinge.
  - .7 Latch and Lock: Cam latch, screwdriver operated.  
Secure steel post for padlock use.
  - .8 Gasket: 1/8 inch by (3.175 mm) by 1/2 inch by (12.7 mm) on all four sides.

**2.4 FABRICATION**

- .1 Manufacture each access panel assembly as an integral unit ready for installation.
- .2 Welded construction: Furnish with a sufficient quantity of 1/4 inch (6.35 mm) mounting holes to secure access panels to types of supports indicated.
- .3 Recessed panel: Form face of panel to provide specified recess for application of finish material. Reinforce panel as required to prevent buckling.
- .4 Furnish number of latches required to hold door in flush, smooth plane when closed.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verify that rough openings for door and frame are correctly sized and located.
- .2 Verify mechanical and electrical requirements for ceiling or wall access panels.

**3.2           INSTALLATION**

- .1       Install access door and frame units per manufacturer's written instructions.
- .2       Install frames plumb and level in opening. Secure rigidly in place.
- .3       Position units to provide convenient access to concealed Work requiring access.
- .4       Fire-rated units: Include UL or Warnock-Hersey labels.

**3.3           ADJUSTING AND CLEANING**

- .1       Adjust panel after installation for proper operation.
- .2       Remove and replace panels or frames that are warped, bowed, or damaged.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE DOCUMENTS**

- .1 Canadian Steel Door and Frame Manufacturer's Association:
  - .1 Standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction).

**1.2 ADMINISTRATIVE REQUIREMENTS**

- .1 Sequencing: deliver hardware required for shop application in ample time so as not to impede the progress of the Work.

**1.3 SUBMITTALS**

- .1 Product Data
  - .1 Refer to Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
  - .1 Hardware Schedule: submit a detailed hardware schedule indicating the following:
    - .1 Door and frame types, sizes, door swings.
    - .2 Type, style, function, size and finish of each hardware item.
    - .3 Mounting heights, fastenings and other pertinent information.
    - .4 Name and manufacturer of each item.
    - .5 Location of all hardware items cross-referenced to door numbers indicated on floor plans and in door and frame schedule.
    - .6 Explanation of all abbreviations, symbols and codes contained in schedule.
- .3 Certificates:
  - .1 After completion of all construction work, certify on a form acceptable to the Departmental Representative, that all items of finish hardware have been adjusted and are working properly and that all hardware on fire rated labeled doors conforms to the requirements of (ULC) Underwriters Laboratories of Canada.
- .4 Manufacturers' Instructions:
  - .1 Include, with each item of hardware the following:
    - .1 Installation instructions.
    - .2 Deliver finish hardware with all items in individual packages, legibly marked and adequately labelled indicating the part of the work for which it is intended.



## **1.4 CLOSEOUT SUBMITTALS**

- .1 Operation and Maintenance Data:
  - .1 Comply with requirements of Section 01 78 00 - Closeout Procedures.
  - .2 Provide the following:
    - .1 One copy of manufacturer's key biting list. Forward by hand, together with keys.
    - .2 Manufacturer's maintenance instructions.
    - .3 Complete parts lists.
    - .4 Manufacturer's installation and operation instructions for all operable hardware.

## **1.5 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Tools:
  - .1 Provide two sets of wrenches for door closers, lock and latch sets and exit devices.
  - .2 Provide special tools required for installation.

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

- .1 Storage and Handling Requirements:
  - .1 Provide a locked storage room with adequate shelving and bin space to properly receive and stock hardware prior to installation.
  - .2 Protect knobs, handles, push plates and pulls with adhesive release paper, of type that is easily removed without marring finish.

## **Part 2 Products**

### **2.1 FASTENINGS**

- .1 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.
- .2 Match exposed fastening devices to finish of hardware.
- .3 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices, and install so pull can be secured through door from reverse side. Install push plate to cover fasteners.
- .4 Use fasteners compatible with material through which they pass.
- .5 Use sex nuts and bolts for doors without special reinforcing for closers.

## **2.2 KEYING**

- .1 Determine detailed requirements for master keying system upon consultation with the Department Representative, prior to finalizing keying schedule.
- .2 Form keys from nickel silver.
- .3 Provide two change keys for each lock except where otherwise required. Provide all other keys as required to meet keying system requirements.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Provide metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.
- .2 Install all hardware items to manufacturer's instructions and recommendations.
- .3 Where hardware items are required to be installed onto or into surfaces that are to be later painted or finished, install hardware completely to ensure proper fit, remove and store until finishing is complete, and then re-install.
- .4 Drill and countersink units which are pre-prepared for anchorage of fasteners. Space fasteners and anchors to manufacturer's recommendations. Use only fasteners supplied by hardware manufacturers
- .5 Install hardware to heights and centers as indicated in hardware schedule, as reviewed by the Departmental Representative.
- .6 Protect doors and frames from damage due to installation of hardware.

### **3.2 INSTRUCTION**

- .1 Instruct user's personnel in:
  - .1 Proper care, cleaning and general maintenance of hardware.
  - .2 Operation of key control system. Make periodic checks during warranty period to ensure functional efficiency of the system.

### 3.3            **HARDWARE SCHEDULE**

#### **Hardware Group 1**

#### **2/915 x 2135 x 45 x IHMD x PSF**

#### **Roof Access Drs.**

6	only Butts	A5111 114 x 101 x NRP x ANSI A156.1	630
1	Mortise Lockset	ANSI 156.13 F07 x Lever x Plain Rose	626
1	Mortise Cylinder Key To Existing System		626
2	Door Closer	C02021 x PT 4G x ANSI A156.4	689
2	Kickplate	J102 x 250 x DW x ANSI A156.6	630
2	Flushbolts	L04081 x 300 mm x ANSI A156.16	626
1	Weatherstrip	R3E164 2/DW x 2/DH x ANSI A156.22	689
1	Astragal	R5Y636 x DH x ANSI A156.22	630

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Related Requirements:
  - .1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
  - .2 Section 01 33 00 - Submittal Procedures: For administrative and procedural requirements for processing of submittals during the construction phase.
  - .3 Section 01 77 00 - Closeout Procedures: For administrative and procedural requirements for completion of the Work.
  - .4 Section 09 91 00 - Painting: For field painting of door louvres.

**1.2 REFERENCES**

- .1 Reference Standards:
  - .1 ASTM International (ASTM):
    - .1 ASTM A153/A153M-09, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
    - .2 ASTM A240/A240M-13b, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
    - .3 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process
    - .4 ASTM A879/A879M-12, Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface
    - .5 ASTM A1008/A1008M-12a, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
    - .6 ASTM F2329-11, Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

**1.3 ACTION SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
  - .1 Product Data:
    - .1 Materials description for door louvres including details showing mounting type, frame type, materials, and construction.
    - .2 Installation instructions for each product specified.

- .2 Shop Drawings:
  - .1 Include details of each frame type, elevation of frame and louvre, anchorage and accessory items.
  - .2 Schedule showing each type of door louvre, locations, sizes, and other data pertinent to installation
  - .3 Indicate installation procedures and accessories required for a complete installation.

## **1.4 QUALITY ASSURANCE**

- .1 Refer to Section 01 45 00 - Quality Control.

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

- .1 Deliver, store, and handle door louvres using means and methods that will prevent damage, deterioration, or loss.
  - .1 Deliver units in manufacturer's original packaging, properly labeled for identification.

## **Part 2 Products**

### **2.1 PERFORMANCE REQUIREMENTS**

- .1 Free Air Flow Area:
  - .1 50 percent.

### **2.2 700 SERIES - INVERTED SPLIT Y-BLADE LOUVRE**

- .1 Inverted Split Y-Blade Louvre Assembly. Two rows of Inverted split Y-blades with 1-inch (25.40 mm) blade spacing, resulting in a non-vision or sight-restrictive view, attached to 3/4-inch (19.05 mm) deep welded frame, by interlocking construction, and subsequently mounted in a surrounding frame.
  - .1 Louvre and Frame Material: 18-gauge cold-rolled steel (CRS).
  - .2 Surrounding Frame: 2-piece frame 1-1/4 inches (31.75 mm) high with corners mitered and welded, and with pre-punched mounting holes for attachment to door from 2 sides.
  - .3 Louvre and Frame Finish: Factory-applied powder coat finish.
    - .1 Color Options: Gray Primer (G).
  - .4 Frame Size: 24"x18"
  - .5 Fasteners: Tamper proof security fasteners.

### **2.3 MATERIALS**

- .1 Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, cold rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.

- .2 Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

## **2.4 FABRICATION**

- .1 General: Furnish each louvre and frame assembly manufactured as an integral unit, complete and ready for installation.
- .2 Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes.
- .3 Frames: Grind exposed welds smooth and flush with adjacent surfaces.
  - .1 Provide mounting holes in frames for attachment of units to doors.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - .1 Notify the Contractor in writing of conditions detrimental to proper and timely completion of the installation.
  - .2 Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- .1 General: Comply with manufacturer's written instructions for installing door louvres.
- .2 Install door louvres in door openings to result in finished assembly which meets the applicable fire rating of doors, if any.

### **3.3 ADJUSTING**

- .1 Remove louvre frames that are warped, bowed, or otherwise damaged, and replace with new components.

### **3.4 CLEANING**

- .1 Refer to Section 01 74 11 - Cleaning.

**END OF SECTION**

**Part 1            General**

**1.1            REFERENCES**

- .1     ASTM C475/C475M-02 - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- .2     ASTM C645-04 - Specifications for Non-Structural Steel Framing Members.
- .3     ASTM C754-00 - Installation of Steel Framing Members to Receive Screw-Attached Gypsum Board.
- .4     ASTM C840-04a - Standard Specification for Application and Finishing of Gypsum Board.
- .5     ASTM C1002-01 - Steel Self-Piercing, Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
- .6     ASTM C1280-04 - Standard Specification for Application of Gypsum Sheathing.
- .7     ASTM C1396/C1396M-04 - Standard Specification for Gypsum Board.
- .8     ASTM D3273-00(2005) - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
- .9     ASTM E90-04 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .10    ASTM E119-00a - Method for Fire Tests of Building Construction and Materials.
- .11    GA-201 (Gypsum Association) - Gypsum Board for Walls and Ceilings.
- .12    GA-214 (Gypsum Association) - Recommended Specification: Levels of Gypsum Board Finish.
- .13    GA-216 (Gypsum Association) - Application and Finishing of Gypsum Board.
- .14    GA-801 (Gypsum Association) - Handling Gypsum Board.

**1.2            SUBMITTALS FOR REVIEW**

- .1     Section 01 33 00 – Submittal Procedures.
- .2     Product Data: Provide data on metal framing, gypsum board, joint tape.

**1.3            QUALITY ASSURANCE**

- .1     Perform Work in accordance with ASTM C840.
- .2     Perform Work in shaftwalls in accordance with ASTM C1280.
- .3     Applicator Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience.
- .4     Handling Gypsum Board: Comply with GA-801.

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**Part 2            Products**

**2.1                FRAMING MATERIALS**

- .1       Studs and Tracks: ASTM C645; galvanized sheet steel, 0.792 mm (20 gauge / 30 mils) thick unless indicated otherwise, C-shape, with knurled faces.
- .2       Furring, Framing, and Accessories: ASTM C645 and GA-216.
- .3       Fasteners: ASTM C1002.
- .4       Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

**2.2                GYPSUM BOARD MATERIALS**

- .1       Standard Gypsum Board: ASTM C1396/C1396M, thickness as indicated, maximum available length in place; ends square cut, tapered edges.
- .2       Fire Rated Gypsum Board: ASTM C1396/C1396M, fire resistive type, UL, ULC, or ITS rated; thickness as indicated, maximum available length in place; ends square cut, tapered edges.
- .3       Water-Resistant Board: ASTM C1396/C1396M, thickness as indicated, maximum available length in place; ends square cut, tapered edges.

**2.3                ACCESSORIES**

- .1       Acoustic Sealant: Butyl, to Section 07 92 00.
- .2       Corner Beads: GA-216, Metal corner bead.
- .3       Edge Trim: GA-216; Casing bead, L-bead, LK-bead, LC-bead and Control joints, as required.
- .4       Joint Materials: ASTM C475; paper reinforcing tape, joint compound, adhesive, and water. Mesh tape only where required by ULC Design.
- .5       Gypsum Board Fasteners: ASTM C1002, Type S12 screws.
- .6       Compressible Foam Gasket: sill plate gasket; polyethylene foam, minimum thickness 6 mm x full width of sill plate.
- .7       Acoustic Insulation: Conforming to requirements set out in Section 07 21 00 - Thermal Insulation.

**Part 3            Execution**

**3.1                EXAMINATION**

- .1       Section 01 71 00 – Examination and Preparation: Verification of existing conditions before starting work.



- .2 Verify that site conditions are ready to receive work and opening dimensions are as instructed by the manufacturer.

### **3.2 METAL STUD INSTALLATION**

- .1 Install studs in accordance with ASTM C754 and manufacturer's instructions.
- .2 Install sill plate gaskets to all tracks in contact with concrete, top and bottom.
- .3 Metal Stud Spacing: as indicated.
- .4 Refer to Drawings for indication of partitions extending stud framing through the ceiling to the structure above. Maintain clearance under structural building members to avoid deflection transfer to studs. Provide extended leg ceiling runners.
- .5 Door and Window Opening Framing: Install double studs at frame jambs. Install stud tracks on each side of opening, at frame head height, and between studs and adjacent studs.
- .6 Blocking: Install blocking for support of plumbing fixtures, toilet partitions, wall cabinets, wood frame opening, toilet accessories, hardware, and firestopping.

### **3.3 WALL FURRING INSTALLATION**

- .1 Erect furring for direct attachment to concrete masonry and concrete walls.
- .2 Erect furring channels; space maximum 400 mm (16 inches) on centre, not more than 100 mm (4 inches) from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 600 mm (24 inches) on centre.

### **3.4 FURRING FOR FIRE RATINGS**

- .1 Install furring as required for fire resistance ratings indicated.

### **3.5 CEILING FRAMING INSTALLATION**

- .1 Install in accordance with ASTM C754 and manufacturer's instructions.
- .2 Coordinate location of hangers with other work.
- .3 Install ceiling framing independent of walls, columns, and above ceiling work.
- .4 Reinforce openings in ceiling suspension system which interrupt main carrying channels or furring channels, with lateral channel bracing. Extend bracing minimum 600 mm (24 inches) past each end of openings.
- .5 Laterally brace entire suspension system.

### **3.6 ACCESSORIES INSTALLATION**

- .1 Install access panels to locations required for access.
- .2 Install resilient channels at maximum 600 mm (24 inches) on centre. Locate joints over framing members.

- .3 Place acoustic insulation in partitions tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind partitions, and tight to items passing through partitions.
- .4 Install acoustic sealant at gypsum board perimeter at:
  - .1 Metal Framing: Two beads.
  - .2 Base Layer.
  - .3 Face Layer.
  - .4 Caulk all penetrations of partitions by conduit, pipe, duct work, rough-in boxes.

### **3.7 GYPSUM BOARD INSTALLATION**

- .1 Install gypsum board in accordance with manufacturer's written instructions.
- .2 Erect single layer standard board in most economical direction, with ends and edges occurring over firm bearing.
- .3 Erect single layer fire rated gypsum board vertically, with edges and ends occurring over firm bearing.
- .4 Use screws when fastening gypsum board to metal furring or framing.
- .5 Double Layer Applications: Secure second layer to first with fasteners. Offset joints of second layer from joints of first layer.
- .6 Treat cut edges and holes in moisture resistant gypsum board with sealant.
- .7 Place control joints consistent with lines of building spaces or as directed.
- .8 Place corner beads at external corners. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials.

### **3.8 JOINT TREATMENT**

- .1 Finish in accordance with GA-214 Level 5.
- .2 Feather coats on to adjoining surfaces so that camber is maximum 0.8 mm (1/32 inch).
- .3 Taping, filling, and sanding is not required at surfaces behind adhesive applied ceramic tile.

### **3.9 TOLERANCES**

- .1 Maximum Variation of Finished Gypsum Board Surface from True Flatness: 3 mm in 3 m (1/8 inch in 10 feet) in any direction.

**END OF SECTION**

**Part 1            General**

**1.1                REFERENCES**

- .1        ASTM C635 - Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
- .2        ASTM C636 - Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
- .3        ASTM E1264 – 98 Classification of Acoustical Ceiling Products.
- .4        CAN/CGSB-92.1-M92 Sound Absorptive Prefabricated Acoustical Panels.

**1.2                SUBMITTALS FOR REVIEW**

- .1        Section 01 33 00 - Submittal Procedures.
- .2        Product Data: Provide data on metal grid system components, and acoustic units.
- .3        Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.

**1.3                QUALITY ASSURANCE**

- .1        Refer to Section 01 45 00 - Quality Control.

**1.4                ENVIRONMENTAL REQUIREMENTS**

- .1        Maintain uniform temperature of minimum 16 degrees C (60 degrees F) and maximum humidity of 40 percent prior to, during, and after acoustic unit installation.

**1.5                PROJECT CONDITIONS**

- .1        Sequence work to ensure acoustic ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- .2        Install acoustic units after interior wet work is dry.

**Part 2            Products**

**2.1                CEILING PANELS**

- .1        Acoustical Tiles: New Ceilings and Replacement of existing to match existing fissured tiles in composition and thickness.

**2.2                SUSPENSION SYSTEM**

- .1        Suspension system: Non-fire rated, intermediate duty system to ASTM C 635, commercial quality hot dipped galvanized rolled steel.

- .2 Accessories: Stabilizer bars, clips, splices, perimeter mouldings, hold down clips, required for suspended grid system.
- .3 Support Channels and Hangers: Galvanized steel; size and type to suit application and ceiling system flatness requirement specified.
- .4 All supplied materials shall match existing whenever possible. Alternates to be reviewed during construction as they are deemed necessary.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- .1 Verify that layout of hangers will not interfere with other work.

#### **3.2 INSTALLATION - LAY-IN GRID SUSPENSION SYSTEM**

- .1 Install suspension system in accordance with ASTM C636 and manufacturer's written instructions and as supplemented in this section.
- .2 Install system capable of supporting imposed loads to a deflection of 1/360 maximum.
- .3 Locate system according to reflected plan.
- .4 Install after major above ceiling work is complete. Coordinate the location of hangers with other work.
- .5 Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- .6 Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- .7 Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability. Support fixture loads by supplementary hangers located within 150 mm (6 inches) of each corner; or support components independently.
- .8 Do not eccentrically load system, or produce rotation of runners.
- .9 Perimeter Moulding:
  - .1 Install edge moulding at intersection of ceiling and vertical surfaces into bed of acoustic sealant with continuous gasket.
  - .2 Use longest practical lengths.
  - .3 Overlap and rivet corners.
  - .4 Provide at junctions with other interruptions.
- .10 Form expansion joints to accommodate plus or minus 25 mm (1 inch) movement. Maintain visual closure.

### **3.3            INSTALLATION - ACOUSTIC UNITS**

- .1        Install acoustic units in accordance with manufacturer's instructions.
- .2        Fit acoustic units in place, free from damaged edges or other defects detrimental to appearance and function.
- .3        Install units after above ceiling work is complete.
- .4        Install acoustic units level, in uniform plane, and free from twist, warp, and dents.
- .5        Cutting Acoustic Units:
  - .1            Cut to fit irregular grid and perimeter edge trim.
  - .2            Cut square reveal edges to field cut units.
- .6        Install hold-down clips to retain panels tight to grid system within 6 m (20 ft) of an exterior door.

### **3.4            ERECTION TOLERANCES**

- .1        Maximum Variation from Flat and Level Surface: 3 mm in 3 m (1/8 inch in 10 feet).
- .2        Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

**END OF SECTION**

**Part 1            General**

**1.1            REFERENCES**

- .1    American Society for Testing and Materials (ASTM)
  - .1        ASTM F 1861-02, Standard Specification for Resilient Wall Base.

**1.2            SUBMITTALS**

- .1    Section 01 33 00 - Submittal Procedures.
- .2    Product Data: Provide data on specified products, describing physical and performance characteristics; sizes and colours available.

**1.3            ENVIRONMENTAL REQUIREMENTS**

- .1    Store materials for three days prior to installation in area of installation to achieve temperature stability.
- .2    Maintain ambient temperature required by adhesive manufacturer three days prior to, during, and 24 hours after installation of materials.

**Part 2           Products**

**2.1           WALL BASE**

- .1    Base: ASTM F1861, thermoplastic rubber; top set coved:
  - .1        Height: 100 mm (4 inch).
  - .2        Thickness: 3 mm (1/8 inch) thick.
  - .3        Length: Roll.
  - .4        Colour: Selection by Departmental Representative.

**2.2           ACCESSORIES**

- .1    Primers and Adhesives: Waterproof; types recommended by flooring manufacturer.

**Part 3           Execution**

**3.1           WALL BASE INSTALLATION**

- .1    Clean substrate and prime with one coat of adhesive.
- .2    Apply wall base to walls, cabinetwork, columns, and other permanent fixtures in areas where base is required and as scheduled. Install in lengths as long as practical. Tightly bond base to vertical substrate with continuous contact at horizontal and vertical surfaces.
- .3    Scribe and fit to door frames and other obstructions. Provide V-shaped notch on back of base and continuously wrap inside and outside corners. Fit all base before applying adhesive. Install without discolouration at bends.

- .4 Install base on solid backing. Bond tight to wall and floor surfaces.

### **3.2 CLEANING**

- .1 Refer to Section 01 74 11 - Cleaning.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED DOCUMENTS**

- .1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- .1 Definitions: Resinous floor system includes a two-component, general service epoxy coating and a selected, graded aggregate.
- .2 Related Work:
  - .1 07 92 00 - Joint Sealants.

**1.3 SUBMITTALS**

- .1 Product Data: Submit manufacturer's technical data, installation instructions, and general recommendations for each resinous flooring material required. Include certification indicating compliance of materials with requirements.
- .2 Samples: Submit, for verification purposes, 4-inch square samples of each type of resinous flooring required, applied to a rigid backing, in color and finish indicated.
  - .1 For initial selection of colors and finishes, submit manufacturer's color charts showing full range of colors and finishes available.

**1.4 QUALITY ASSURANCE**

- .1 Single Source Responsibility: Obtain primary resinous flooring materials including primers, resins, hardening agents, finish or sealing coats from a single manufacturer with not less than 10 years of successful experience in manufacturing and installing principal materials described in this section. Contractor shall have completed at least five projects of similar size and complexity. Provide secondary materials only of type and from source recommended by manufacturer of primary materials.
- .2 Pre-Installation Conference
  - .1 General contractor shall arrange a meeting not less than thirty days prior to starting work.
  - .2 Attendance
    - a. General Contractor
    - b. Departmental Representative
    - c. Manufacturer/Installer's Representative
- .3 ISO 9002: All materials, including primers, resins, curing agents, finish coats, aggregates and sealants are manufactured and tested under an ISO 9002 registered quality system.

**1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Material shall be delivered to job site and checked by flooring contractor for completeness and shipping damage prior to job start.



- .2 All materials used shall be factory pre-weighed and pre-packaged in single, easy to manage batches to eliminate on site mixing errors. No on site weighing or volumetric measurements allowed.
- .3 Material shall be stored in a dry, enclosed area protected from exposure to moisture. Temperature of storage area shall be maintained between 60 and 85°F/16 and 30°C.

## **1.6 PROJECT CONDITIONS**

- .1 Concrete substrate shall be properly cured for a minimum of 30 days. A vapor barrier must be present for concrete subfloors on or below grade. Otherwise, an osmotic pressure resistant grout must be installed prior to the resinous flooring.
- .2 Utilities, including electric, water, heat (air temperature between 60 and 85°F/16 and 30°C) and finished lighting to be supplied by General Contractor.
- .3 Job area to be free of other trades during, and for a period of 24 hours, after floor installation.
- .4 Protection of finished floor from damage by subsequent trades shall be the responsibility of the General Contractor.

## **1.7 WARRANTY**

- .1 Manufacturer shall furnish a single, written warranty covering both material and workmanship against delamination for a period of one (1) full year from date of installation.

## **Part 2 Products**

### **2.1 COLORS**

- .1 Colors: As selected by Departmental Representative from manufacturer's standard colors.

### **2.2 EPOXY COATING**

- .1 Material
  - .1 Physical Properties: Provide flooring system in which physical properties of topping including aggregate, when tested in accordance with standards or procedures referenced below, are as follows:

Hardness.....	85-90
(ASTM D-2240/Shore D Durometer)	
Bond Strength.....	>400 psi
(ASTM D-4541)	(100% concrete failure)
Abrasion Resistance.....	0.081 gm max. weight loss
(ASTM D-4060, Taber Abrader CS-17 wheel)	
Coefficient of Friction .....	0.75
(ASTM D-2047/Neoprene-Dry)	
Flammability .....	Self Extinguishing
(ASTM D-635)	Extent of burning 0.25 inches max.
Heat Resistance Limitation .....	140°F/60°C
	(for continuous exposure)
	..... 200°F/93°C
	(for intermittent spills)
Cure Rate allow .....	8 hours for foot traffic
(at 77°F/25°C)	24 hours for normal operations

## 2.3 JOINT SEALANT MATERIALS

- .1 Type produced by manufacturer of resinous flooring system for type of service and joint condition indicated.

## Part 3 Execution

### 3.1 PREPARATION

- .1 Substrate: Concrete preparation shall be by mechanical means and include use of a scabbler, scarifier or shot blast machine for removal of bond inhibiting materials such as curing compounds or laitance.

### 3.2 APPLICATION

- .1 General: Apply each component of resinous flooring system in compliance with manufacturer's directions to produce a uniform monolithic wearing surface of thickness indicated, uninterrupted except at divider strips, sawn joints or other types of joints (if any), indicated or required.
- .2 Coating/Texture: Remove any surface imperfections by lightly abrading and vacuuming the floor surface. Mix coating and texture according to manufacturer's recommended procedures. Squeegee apply and backroll textured coating with strict adherence to manufacturer's installation procedures and coverage rates.

### 3.3 FIELD QUALITY CONTROL

- .1 The right is reserved to invoke the following material testing procedure at any time, and any number of times during period of flooring application.
- .2 The Departmental Representative will engage service of an independent testing laboratory to sample materials being used on the job site. Samples of material will be taken, identified and sealed, and certified in presence of Contractor.

- .3 Testing laboratory will perform tests for any of characteristics specified, using applicable testing procedures referenced herein, or if none referenced, in manufacturer's product data.
- .4 If test results show materials being used do not comply with specified requirements, Contractor may be directed by Departmental Representative to stop work; remove non-complying materials; pay for testing; reapply flooring materials to properly prepared surfaces which had previously been coated with unacceptable materials.

### **3.4 CURING, PROTECTION AND CLEANING**

- .1 Cure resinous flooring materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of application and prior to completion of curing process. Close area of application for a minimum of 24 hours.
- .2 Protect resinous flooring materials from damage and wear during construction operation. Where temporary covering is required for this purpose, comply with manufacturer's recommendations for protective materials and method of application. General Contractor is responsible for protection and cleaning of surfaces after final coats.
- .3 Cleaning: Remove temporary covering and clean resinous flooring just prior to final inspection. Use cleaning materials and procedures recommended by resinous flooring manufacturer.

**END OF SECTION**

**Part 1            General**

**1.1            REFERENCES**

- .1    Master Painters Institute (MPI)
  - .1       MPI Architectural Painting Specifications Manual, 2014.

**1.2            QUALITY ASSURANCE**

- .1    Refer to Section 01 45 00 - Quality Control.

**1.3            SUBMITTALS**

- .1    Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2    Submit product data and instructions for each paint and coating product to be used.
- .3    Samples: Submit full range colour sample chips to indicate where colour availability is restricted.

**1.4            DELIVERY, STORAGE AND HANDLING**

- .1    Packing, Shipping, Handling and Unloading: in accordance with manufacturer's written instructions.
- .2    Remove damaged, opened and rejected materials from site.
- .3    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°C to 30°C.

**1.5            SITE CONDITIONS**

- .1    Heating, Ventilation and Lighting:
  - .1       Provide heating facilities to maintain ambient air and substrate temperatures above 10°C for 24 hours before, during and after paint application until paint has cured sufficiently.
  - .2       Provide continuous ventilation for seven days after completion of application of paint.
  - .3       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.
- .2    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.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Paint materials listed in the current MPI Approved Products List (APL) are acceptable for use on this project.
- .2 All interior paint materials selected from the MPI APL must meet the MPI Green Performance Standard (GPS) where available, unless otherwise directed by the Departmental Representative.
- .3 Provide paint materials for paint systems from single manufacturer.
- .4 Conform to latest MPI requirements for interior and exterior painting work including preparation and priming.

### **2.2 COLOURS**

- .1 Departmental Representative will provide Colour Schedule after Contract award. Preliminary colour selection is indicated on Finish Schedule.
- .2 Selection of colours from manufacturer's full range of colours.
- .3 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.
- .2 Use and add thinner in accordance with paint manufacturer's recommendations. Do not use kerosene or similar organic solvents to thin water-based paints.
- .3 Thin paint for spraying in accordance with paint manufacturer's instructions.

### **2.4 GLOSS/SHEEN RATINGS**

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

<u>Gloss Level Category</u>	<u>Units @ 60°</u>	<u>Units @ 85°</u>
G1 - matte	0 to 5	max. 10
G2 - velvet	0 to 10	10 to 35
G3 - eggshell	10 to 25	10 to 35
G4 - satin	20 to 35	min. 35
G5 - semi-gloss	35 to 70	
G6 - gloss	70 to 85	
G7 - high gloss	> 85	

- .2 Gloss level ratings of painted surfaces shall be selected by Departmental Representative after Contract Award, unless noted otherwise.

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**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.
- .2       Apply paint materials in accordance with paint manufacturer's written application instructions.

**3.3            PREPARATION**

- .1       Protection:
  - .1       Protect existing building surfaces and adjacent structures from paint spatters, 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       Clean and prepare surfaces in accordance with MPI Architectural Painting Specification Manual requirements.
- .3       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.

**3.4            APPLICATION**

- .1       Conform to manufacturer's application instructions unless specified otherwise.
- .2       Apply coats of paint continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.
- .3       Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
- .4       Sand and dust between coats to remove visible defects.
- .5       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.
- .6       Finish top, bottom, edges and cut-outs of doors after fitting as specified for door surfaces.

**3.5            INTERIOR PAINT AND COATING SYSTEMS**

- .1       Interior painting systems to be based on MPI Custom grade unless noted otherwise.

- .2 Concrete horizontal surfaces: floors and stairs:
  - .1 INT 3.2C - Epoxy finish: Two coats epoxy finish.
- .3 Concrete Masonry Units:
  - .1 INT 4.2D - High performance architectural latex finish: one coat MPI #4 latex block filler, two finish coats latex.
  - .2 INT 4.2G - Epoxy (tile-like) finish for wet environments and as scheduled: one coat MPI #116 epoxy block filler, two finish coats epoxy.
- .4 Structural Steel: overhead and structural members; columns, beams, joists, etc. and adjacent fabrications.
  - .1 INT 5.1C - Waterborne Dry Fall Finish: one coat alkyd metal primer, one finish coat waterborne dry fall (MPI Custom grade).
- .5 Galvanized Metal: doors and frames.
  - .1 INT 5.3L - Alkyd Finish: One coat non-cementitious primer, two finish coats alkyd (to MPI Premium Grade).
- .6 Dressed lumber: including door frames, casings, mouldings:
  - .1 INT 6.3E - Polyurethane Varnish Finish (over stain): one coat stain, minimum two coats polyurethane finish.
- .7 Hardboard: Pre-primed doors and frames:
  - .1 INT 6.3T - Latex Finish (over factory primer): two coats latex.
- .8 Plywood Mounting Boards: electrical room.
  - .1 INT 6.4P - Pigmented Fire Retardant finish: apply to ULC approved procedures.
- .9 Gypsum Board:
  - .1 INT 9.2A - Latex (over latex sealer): one coat primer/sealer MPI#50, two finish coats latex (to MPI Premium Grade).
- .10 Canvas and Cotton Coverings.
  - .1 INT 10.1A - Latex: two finish coats latex; alternatively use INT 5.1C.

### **3.6 EXTERIOR PAINT COATING SYSTEMS**

- .1 Asphalt Surfaces: zone/traffic marking for drive and parking areas, etc.
  - .1 EXT 2.1B - Alkyd Zone/Traffic Marking Finish: minimum dry film thickness 7 mil.
- .2 Galvanized Metal: fabrications, gates, bollards, doors and frames.
  - .1 EXT 5.3B - Alkyd Finish: One coat non-cementitious primer, two finish coats alkyd (to MPI Premium Grade).

### **3.7 MECHANICAL AND 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 Other unfinished areas: leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.

- .3 Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.
- .4 Boiler room, mechanical and electrical rooms: paint exposed conduits, canvas wrapped piping, ductwork and other mechanical to match existing system color scheme.
- .5 Do not paint over nameplates.
- .6 Keep sprinkler heads free of paint.

### **3.8 SITE TOLERANCES**

- .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.

### **3.9 RESTORATION**

- .1 Clean and re-install hardware items removed before undertaken 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. Avoid scuffing newly applied paint.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 01 - Common Work Results for Mechanical.

**1.2 REFERENCES**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .2 National Fire Protection Association (NFPA)
  - .1 NFPA 10, Standard for Portable Fire Extinguishers.

**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 and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Provide shop drawings.
- .4 Quality control submittals: submit following in accordance with Section 01 45 00 - Quality Control.
  - .1 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.
  - .2 Manufacturer's Field Reports: submit manufacturer's written reports within three (3) days of review, verifying compliance of Work, as described in PART 3, FIELD QUALITY CONTROL.
- .5 Closeout Submittals:
  - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

**1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**Part 2            Products**

**2.1            WATER PUMP TANK EXTINGUISHERS**

- .1       Not used.

**2.2            WATER PRESSURIZED EXTINGUISHERS**

- .1       Not used.

**2.3            MULTI-PURPOSE DRY CHEMICAL EXTINGUISHERS (CLASS A:B:C)**

- .1       Stored pressure rechargeable type with hose and shut-off nozzle, ULC labelled for A, B and C class protection.
  - .1       Agent: Ammonium phosphate, powder type
  - .2       Size: 4.5 kg.
  - .3       Minimum Rating: 4A80BC

**2.4            ORDINARY DRY CHEMICAL EXTINGUISHERS**

- .1       Not used.

**2.5            CARBON DIOXIDE EXTINGUISHERS (CLASS B:C)**

- .1       Stored pressure rechargeable type with insulated handle, horn discharge assembly, self-closing lever or squeeze-grip operation, fully charged, ULC labelled for B and C class protection.
  - .1       Agent: Carbon dioxide
  - .2       Size: 4.5 kg.
  - .3       Minimum Rating: 10BC

**2.6            DRY CHEMICAL EXTINGUISHERS (CLASS D)**

- .1       Not used.

**2.7            KITCHEN WET CHEMICAL EXTINGUISHERS (CLASS A:K)**

- .1       Stored pressure rechargeable type ULC labelled for A and K class protection.
  - .1       Agent: Potassium acetate, wet agent type
  - .2       Minimum Rating: 2AK

**2.8            EXTINGUISHER BRACKETS**

- .1       Type recommended by extinguisher manufacturer.

**2.9            CABINETS**

- .1       Semi-recessed Flat Style:
  - .1       Semi-recessed cabinet constructed of 1.6 mm thick steel with a 25 mm reveal, and a 180 degree opening door of 2.5 mm thick steel with latching device. Door

- fitted with 5 mm clear glass, stainless steel concealed latch, reinforced piano hinges and a 25 mm turnback.
- .2 Finish:
  - .1 Tub: prime coated.
  - .2 Door and frame: No.4 satin finish stainless steel.
- .3 Size: to suit extinguisher.
- .4 Locations: as indicated.
- .2 Semi-recessed Canopy Style:
  - .1 Semi-recessed cabinet constructed of 1.6 mm thick steel with door of 2.5 mm thick steel with latching device. Door fitted with a clear polycarbonate bubble canopy, stainless steel concealed latch, reinforced piano hinges and a 25 mm turnback.
    - .1 Finish:
      - .1 Tub: prime coated.
      - .2 Door and frame: No.4 satin finish stainless steel.
    - .2 Size: to suit extinguisher.
    - .3 Locations: as indicated.
- .3 Surface Mount Style
  - .1 Surface mount cabinet constructed of 1.2 mm thick steel with keyed door. Door fitted with a scored plexiglass panel that is removable and replaceable.
  - .2 Size: to suit extinguisher.
  - .3 Locations: as indicated.
- .4 Cabinet to maintain fire resistive rating of construction in which they occur.

## **2.10 IDENTIFICATION**

- .1 Identify extinguishers in accordance with recommendations of NFPA 10 and CAN/ULC-S508.
- .2 Attach tag or label to extinguishers, indicating month and year of installation. Provide space for service dates.

## **2.11 FIRE SAFETY BLANKETS**

- .1 Not used.

## **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 fire extinguisher cabinet with top of cabinet 1.5 m above floor.
- .2     Install or mount extinguishers in cabinets or on brackets as indicated.
- .3     Provide extinguisher and mounting of the type listed for the following areas.
  - .1       Electrical and Telephone Rooms: carbon dioxide w/ bracket
  - .2       Mechanical Rooms: multi-purpose dry chemical w/ bracket
  - .3       Elevator Machine Rooms: carbon dioxide w/bracket
  - .4       Emergency Generator Rooms: carbon dioxide w/ bracket
  - .5       Garbage Rooms: multi-purpose dry chemical w/bracket
  - .6       Loading Docks: multi-purpose dry chemical w/bracket
  - .7       Maintenance Workshops: multi-purpose dry chemical w/bracket
  - .8       Kitchens: kitchen wet chemical w/bracket
  - .9       Server/Computer Rooms: carbon dioxide w/bracket
  - .10      Corridors: multi-purpose dry chemical w/ cabinet
  - .11      Office Areas: multi-purpose dry chemical w/cabinet
- .4     Extinguisher quantities and locations as identified on the drawings.

### **3.3           FIELD QUALITY CONTROL**

- .1     Manufacturer's Field Services:
  - .1       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.

**END OF SECTION**

**Part 1        General**

**1.1           ACTION AND INFORMATIONAL SUBMITTALS**

- .1      Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2      Shop Drawings:
  - .1          Indicate on drawings:
    - .1            Mounting arrangements.
    - .2            Operating and maintenance clearances.
  - .2          Shop drawings and product data accompanied by:
    - .1            Detailed drawings of bases, supports, and anchor bolts.
    - .2            Acoustical sound power data, where applicable.
    - .3            Points of operation on performance curves.
    - .4            Manufacturer to certify current model production.
    - .5            Certification of compliance to applicable codes.
- .3      In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

**1.2           CLOSEOUT SUBMITTALS**

- .1      Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2      Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
  - .1          Operation and maintenance manual reviewed by, and final copies deposited with, Departmental Representative before final inspection.
  - .2          Operation data to include:
    - .1            Control schematics for systems including environmental controls.
    - .2            Description of systems and their controls.
    - .3            Description of operation of systems at various loads together with reset schedules and seasonal variances.
    - .4            Operation instruction for systems and component.
    - .5            Description of actions to be taken in event of equipment failure.
    - .6            Valves schedule and flow diagram.
    - .7            Colour coding chart.
  - .3          Maintenance data to include:
    - .1            Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
    - .2            Data to include schedules of tasks, frequency, tools required and task time.
  - .4          Performance data to include:

- .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
- .2 Equipment performance verification test results.
- .3 Special performance data as specified.
- .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .5 Approvals:
  - .1 Submit two (2) copies of draft Operation and Maintenance Manual to Departmental Representative for review. Submission of individual data will not be accepted unless directed by Departmental Representative.
  - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .6 Additional data:
  - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 Site records:
  - .1 Departmental Representative will provide one (1) set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur.
  - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed. Maintain at least one (1) copy at the site trailer for review by Departmental Representative.
  - .3 Use different colour waterproof ink for each service.
  - .4 Make available for reference purposes and inspection.
- .8 As-Built drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
  - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
  - .3 Submit to Departmental Representative for review and make corrections as directed.
  - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
  - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

### **1.3 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Furnish spare parts as follows:
  - .1 One set of packing for each pump.

- .2 One casing joint gasket for each size pump.
- .3 One glass for each gauge glass.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

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

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

### **Part 2 Products**

#### **2.1 Supplier Requirements**

- .1 Supplier Service and Support
  - .1 The supplier must have existing factory trained sales force locally available for applications assistance and to answer maintenance questions.
  - .2 The Supplier is to provide a 24 hour, seven (7) day a week, assistance call line for maintenance and troubleshooting requirements with the equipment operation.
  - .3 Supplier is to be capable of providing factory trained on-site technical support of the within a four (4) hour time period from notification.
- .2 Supplier Spare Parts Availability
  - .1 The supplier is to have a distributor organization, which locally stocks standard parts, modification kits, and spare parts.
  - .2 Components not regularly stocked are to be capable of being provided to the site in less than 36 hours.
- .3 Supplier Organization
  - .1 The supplier must have been in operation within the local Edmonton area for at least 5 years with product installed within the local area.
  - .2 The local supplier must have at least 5 years of representation history of the equipment brand.

- .3 The supplier must have factory trained service representatives within the local Edmonton area. The factory representatives must be trained in the maintenance and troubleshooting of the equipment as specified herein.
- .4 The factory representative is to be conversant in the requirements of the specific equipment.
- .4 Supplier Maintenance and Training Schools
  - .1 Supplier must offer maintenance and training in North America on the equipment supplied.
  - .2 Training programs are to be offered by the supplier on a yearly cycle (minimum).

### **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 material 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 PAINTING REPAIRS AND RESTORATION**

- .1 Do painting in accordance with Section 09 91 00 – Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

#### **3.3 SYSTEM CLEANING**

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

#### **3.4 FIELD QUALITY CONTROL**

- .1 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 - ACTION AND INFORMATIONAL 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.



**3.5 DEMONSTRATION**

- .1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Trial usage to apply to following equipment and systems:
  - .1 Delco Controls.
- .3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .4 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .5 Instruction duration time requirements as specified in appropriate sections.
- .6 Departmental Representative will record these demonstrations on video tape for future reference.

**3.6 CLEANING**

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

**3.7 PROTECTION**

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

**END OF SECTION**

Approved: 2016-10-26

## **Part 1            General**

### **1.1            REFERENCE STANDARDS**

- .1 American Society of Mechanical Engineers International (ASME)
  - .1 ANSI/ASME B16.15-13, Cast Copper Alloy Threaded Fittings, Classes 125 and 250.
  - .2 ANSI/ASME B16.18-12, Cast Copper Alloy Solder Joint Pressure Fittings.
  - .3 ANSI/ASME B16.22-13, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
  - .4 ANSI/ASME B16.24-11, Cast Copper Alloy Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
  - .5 ASME B16.26-13, Cast Copper Alloy Fittings for Flared Copper Tubes.
  - .6 ASME B31.9-14, Building Services Piping.
  - .7 ASME B36.19M-04, Stainless Steel Pipe.
- .2 ASTM International
  - .1 ASTM A182/A 182M-16, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
  - .2 ASTM A269-15a, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
  - .3 ASTM A307-14, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .4 ASTM A312/A312M-16, Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
  - .5 ASTM A351/A351M-16, Castings, Austenitic, for Pressure Containing Parts.
  - .6 ASTM A403/A403M-16, Wrought Austenitic Stainless Steel Piping Fittings.
  - .7 ASTM A536-84(2014), Standard Specification for Ductile Iron Castings.
  - .8 ASTM B32-08(2014), Standard Specification for Solder Metal.
  - .9 ASTM B42-15a, Seamless Copper Tube, Standard Sizes.
  - .10 ASTM B88M-14, Standard Specification for Seamless Copper Water Tube (Metric).
- .3 American National Standards Institute/American Water Works Association (ANSI)/(AWWA)
  - .1 ANSI/AWWA C111/A21.11-12, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
  - .2 ANSI/AWWA C151/A21.51-09, Ductile Iron Pipe, Centrifugally Cast, for Water.
  - .3 AWWA C904-06, Crosslinked Polyethylene (PEX) Pressure Pipe, ½ In. (12 mm) through 3 In. (76mm), for Water Service.

- .4 CSA Group
  - .1 CSA B137.5-13, Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications.
  - .2 CSA B242-05, Groove and Shoulder Type Mechanical Pipe Couplings.
- .5 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC S101-07, Fire Endurance Tests of Buildings Construction and Materials.
  - .2 CAN/ULC S102.2-10, Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies.
  - .3 CAN/ULC S115-11, Standard Method of Fire Tests of Firestop.
- .6 National Sanitation foundation (NSF)
  - .1 NSF/ANSI 61-13, Drinking Water System Components-Health Effects.
  - .2 NSF 372-11, Drinking Water System Components - Lead Content.
- .7 Department of Justice Canada (Jus)
  - .1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).
- .8 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .9 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
  - .1 MSS-SP-67-02a, Butterfly Valves.
  - .2 MSS-SP-70-06, Grey Iron Gate Valves, Flanged and Threaded Ends.
  - .3 MSS-SP-71-05, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
  - .4 MSS-SP-80-03, Bronze Gate, Globe, Angle and Check Valves.
- .10 National Research Council (NRC)
  - .1 National Plumbing Code of Canada (NPC) 2015.
- .11 Transport Canada (TC)
  - .1 Transportation of Dangerous Goods Act, 1992, c. 34 (TDGA).

## **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets. Include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

### **1.3 DELIVERY, STORAGE AND HANDLING**

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

## **Part 2 Products**

### **2.1 PIPING**

- .1 Domestic hot, cold and recirculation systems, within building.
  - .1 Above ground: copper tube, hard drawn, type L: to ASTM B88M.
  - .2 Buried or embedded: copper tube, soft annealed, type K: to ASTM B88M, in long lengths and with no buried joints.

### **2.2 FITTINGS**

- .1 Bronze pipe flanges and flanged fittings, Class 150 and 300: to ANSI/ASME B16.24.
- .2 Cast bronze threaded fittings, Class 125 and 250: to ANSI/ASME B16.15.
- .3 Cast copper, solder type: to ANSI/ASME B16.18.
- .4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.
- .5 NPS 2 and larger: ANSI/ASME B16.18 or ANSI/ASME B16.22 roll grooved to CSA B242.
- .6 NPS 1 and smaller: cast copper to ANSI/ASME B16.18; with 301 stainless steel internal components and EPDM seals. Suitable for operating pressure to 1380 kPa.

### **2.3 JOINTS**

- .1 Rubber gaskets, latex-free 1.6 mm thick: to AWWA C111.
- .2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.
- .3 Solder: 95/5 tin copper alloy. (LEAD Free)
- .4 Teflon tape: for threaded joints.
- .5 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM flush seal gasket. Gasket to be classified in accordance with ANSI/NSF 61 for

potable water service. Couplings to be manufactured to copper-tube dimensions. Flaring of tube or fitting ends to accommodate IPS sized couplings is not permitted.

- .6 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.

## **2.4 GATE VALVES**

- .1 NPS2 and under, soldered:
  - .1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc as specified Section 23 05 23.01 – Valves - Bronze.
- .2 NPS2 and under, screwed:
  - .1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc as specified Section 23 05 23.01 – Valves - Bronze.
- .3 NPS2-1/2 and over, in mechanical rooms, flanged:
  - .1 Rising stem: to MSS-SP-70, Class 125, 860 kPa, flat flange faces, cast-iron body, OS&Y bronze trim specified Section 23 05 23.02 – Valves – Cast Iron.
- .4 NPS2-1/2 and over, other than mechanical rooms, flanged:
  - .1 Non-rising stem: to MSS-SP-70, Class 125, 860 kPa, flat flange faces, cast-iron body, bronze trim, bolted bonnet specified Section 23 05 23.02 – Valves – Cast Iron.

## **2.5 GLOBE VALVES**

- .1 NPS2 and under, soldered:
  - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, renewable composition disc, screwed over bonnet as specified Section 23 05 23.01 – Valves – Bronze.
  - .2 Lockshield handles: as indicated.
- .2 NPS2 and under, screwed:
  - .1 To MSS-SP-80, Class 150, 1 MPa, bronze body, screwed over bonnet, renewable composition disc as specified Section 23 05 23.01 – Valves – Bronze.
  - .2 Lockshield handles: as indicated.

## **2.6 SWING CHECK VALVES**

- .1 NPS 2 and under, soldered:
  - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 23.01 – Valves - Bronze.
- .2 NPS2 and under, screwed:
  - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 23.01 – Valves - Bronze.
- .3 NPS 2 and under, push-to-connect, lift-disc type:
  - .1 To MSS-SP-80, 1380 kPa CWP, bronze body, stainless steel disc, spring, and shaft, suitable for installation in horizontal or vertical lines.

- .4 NPS2-1/2 and over, flanged:
  - .1 To MSS-SP-71, Class 125, 860 kPa, cast iron body, flat flange faces, or renewable seat, bronze disc, bolted cap specified Section 23 05 23.02 – Valves – Cast Iron.

## **2.7 BALL VALVES**

- .1 NPS2 and under:
  - .1 Body and cap: cast high tensile bronze to ASTM B16 or ASTM B62.
  - .2 Pressure rating: Class 150, 860 MPa steam.
  - .3 Connections: Screwed ends to ANSI B1.20.1 and with hex. shoulders. Push-to-connect, Pressfit ends.
  - .4 Stem: tamperproof ball drive.
  - .5 Stem packing nut: external to body.
  - .6 Ball and seat: replaceable stainless steel or hard chrome, plated brass solid ball and Teflon seats.
  - .7 Stem seal: TFE, EPDM, Nitrile, Fluoroelastomer with external packing nut.
  - .8 Operator: removable lever handle with extension for insulated pipe.
  - .9 Cap and drain for drain service.

## **2.8 BUTTERFLY VALVES**

- .1 NPS 2-1/2 and over, lug:
  - .1 To MSS-SP-67, Class 200, 1.4 MPa.
  - .2 Cast iron body, ductile iron chrome plated disc, stainless steel stem, EPT liner.
  - .3 Lever operated,
- .2 NPS 2-1/2 and over, grooved ends:
  - .1 Class 300 psig CWP, bubble tight shut-off, bronze body EPDM coated ductile iron disc with integrally cast stem.
  - .2 Operator:
    - .1 NPS 4 and under: lever handle.
    - .2 NPS 6 and over: gear operated.

## **Part 3 Execution**

### **3.1 PREPARATION**

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

### **3.2 INSTALLATION**

- .1 Install in accordance with National Plumbing Code of Canada and local authority having jurisdiction.

- .2 Install pipe work in accordance with Section 23 05 05 – Installation of Pipework and by certified journey person supplemented as specified herein.
- .3 Assemble piping using fittings manufactured to ANSI standards.
- .4 Install CWS piping below and away from HWS and HWC and other hot piping so as to maintain temperature of cold water as low as possible.
- .5 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.
- .6 Buried tubing:
  - .1 Lay in well compacted washed sand in accordance with AWWA Class B bedding.
  - .2 Bend tubing without crimping or constriction. Minimize use of fittings.

### **3.3 VALVES**

- .1 Isolate equipment, fixtures and branches with ball valves.
- .2 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.

### **3.4 PRESSURE TESTS**

- .1 Conform to requirements of Section 22 05 00 - Common Work Results for Plumbing.
- .2 Application of Tests
  - .1 After a section of a potable water system has been completed, and before it is placed in operation, a water pressure test shall be conducted, except that an air pressure test may be used in freezing conditions.
  - .2 A pressure test may be applied to each section of the system or to the system as a whole.
  - .3 Where a prefabricated system is installed as part of a water system,
    - .1 all other plumbing work shall be tested and inspected, and
    - .2 the complete system shall be pressure tested when requested.
- .3 Pressure Tests of Potable Water Systems
  - .1 The potable water system shall be able to withstand
    - .1 without leaking, a water pressure that is at least equal to the maximum in-service pressure, or
    - .2 an air pressure of not less than 700 kPa for at least 2 h without a drop in pressure.
  - .2 If a manufacturer states that an air pressure test is not recommended, a water pressure test shall be performed.
- .4 Water Pressure Tests
  - .1 Where a water pressure test is made, all air shall be expelled from the system before fixture control valves or faucets are closed.
    - .1 Potable water shall be used to test a potable water system.

### **3.5 FLUSHING**

- .1 Flush entire system for 8 h. Ensure outlets flushed for 2 h. Let stand for 24 h, then draw one sample off longest run. Submit to testing laboratory for bacteriological testing to verify that system is clean to Provincial potable water guidelines. Let system flush for additional 2 h, then draw off another sample for testing.

### **3.6 PRE-START-UP INSPECTIONS**

- .1 Systems to be complete, prior to flushing, testing and start-up.
- .2 Verify that system can be completely drained.
- .3 Ensure that pressure booster systems are operating properly.
- .4 Ensure that air chambers, expansion compensators are installed properly.

### **3.7 DISINFECTION**

- .1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction and approval of the Departmental Representative.
- .2 Upon completion, provide laboratory test reports on water quality for Departmental Representative approval.

### **3.8 START-UP**

- .1 Timing: start up after:
  - .1 Pressure tests have been completed.
  - .2 Disinfection procedures have been completed.
  - .3 Certificate of static completion has been issued.
  - .4 Water treatment systems operational.
- .2 Provide continuous supervision during start-up.
- .3 Start-up procedures:
  - .1 Establish circulation and ensure that air is eliminated.
  - .2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.
  - .3 Bring DHW storage tank up to design temperature slowly.
  - .4 Monitor DHW and DHWR piping systems for freedom of movement, pipe expansion as designed.
  - .5 Check control, limit, safety devices for normal and safe operation.
- .4 Rectify start-up deficiencies.

### **3.9 PERFORMANCE VERIFICATION**

- .1 Scheduling:
  - .1 Verify system performance after pressure and leakage tests and disinfection are completed, and Certificate of Completion has been issued by authority having jurisdiction.



- .2 Procedures:
  - .1 Verify that flow rate and pressure meet Design Criteria.
  - .2 TAB HWC in accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
  - .3 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.
  - .4 Sterilize HWS and HWC systems for Legionella control.
  - .5 Verify performance of temperature controls.
  - .6 Verify compliance with safety and health requirements.
  - .7 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.
  - .8 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.
- .3 Reports:
  - .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Reports, using report forms as specified in Section 01 91 13 - General Commissioning (Cx) Requirements: Report Forms and Schematics.
  - .2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

### **3.10 OPERATION REQUIREMENTS**

- .1 Co-ordinate operation and maintenance requirements including, cleaning and maintenance of specified materials and products with Section 23 05 05 - Installation of Pipework.

### **3.11 CLEANING**

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

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 American Iron and Steel Institute (AISI)
  - .1 AISI 304, Stainless Steel.
- .2 American Society for Testing and Materials (ASTM)
  - .1 ASTM B32, Specification for Solder Metal.
  - .2 ASTM B306, Specification for Copper Drainage Tube (DWV).
  - .3 ASTM C564, Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- .3 Canadian Standards Association (CSA International)
  - .1 CAN/CSA-B70, Cast Iron Soil Pipe, Fittings and Means of Joining.
  - .2 CAN/CSA- B125.3, Plumbing Fittings.
- .4 National Research Council Canada (NRC)
  - .1 National Plumbing Code of Canada 2015 (NPC).

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and datasheets for adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

**1.3 DELIVERY, STORAGE AND HANDLING**

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

**Part 2 Products**

**2.1 COPPER TUBE AND FITTINGS**

- .1 Above ground sanitary, storm and vent Type DWV to: ASTM B306.

- .1 Fittings
  - .1 Cast brass: to CAN/CSA-B125.
  - .2 Wrought copper: to CAN/CSA-B125.
- .2 Solder: tin-lead, 50:50, type 50A or tin-antimony only 95:5, type TA to ASTM B32.

## **2.2 CAST IRON PIPING AND FITTINGS**

- .1 Buried sanitary, storm and vent minimum NPS2, to: CAN/CSA-B70, with one layer of protective coating of Bitumous.
  - .1 Joints
    - .1 Mechanical joints.
      - .1 Neoprene or butyl rubber compression gaskets: to ASTM C564 or CAN/CSA-B70.
      - .2 Stainless steel clamps.
    - .2 Hub and spigot
      - .1 Neoprene gasket: to CSA B70.
      - .2 Cold caulking compounds.
  - .2 Above ground sanitary, storm and vent: to CAN/CSA-B70.
    - .1 Joints
      - .1 Mechanical joints
        - .1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

## **2.3 STAINLESS STEEL PIPE AND FITTINGS**

- .1 Above ground and buried sanitary, storm and vent, NPS 2 to NPS 10, stainless steel, type AISI 304.
  - .1 Mechanical Joints: Push-fit socket joint with EPDM sealing ring.

## **Part 3 Execution**

### **3.1 APPLICATION**

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

### **3.2 INSTALLATION**

- .1 In accordance with Section 23 05 05 – Installation of Pipework and by certified journey person.
- .2 Install in accordance with National Plumbing Code of Canada and local authority having jurisdiction.

### **3.3 TESTING**

- .1 Pressure test buried systems before backfilling.

- .2      Hydraulically test to verify grades and freedom from obstructions.

### **3.4            PERFORMANCE VERIFICATION**

- .1      Cleanouts:
  - .1          Ensure accessible and that access doors are correctly located.
  - .2          Open, cover with linseed oil and re-seal.
  - .3          Verify that cleanout rods can probe as far as the next cleanout, at least.
- .2      Test to ensure traps are fully and permanently primed.
- .3      Storm water drainage:
  - .1          Verify domes are secure.
  - .2          Ensure weirs are correctly sized and installed correctly.
  - .3          Verify provisions for movement of roof system.
- .4      Ensure that fixtures are properly anchored, connected to system and effectively vented.
- .5      Affix applicable label (storm, sanitary, vent, pump discharge etc.) c/w directional arrows every floor or 4.5 m (whichever is less).

### **3.5            CLEANING**

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

**END OF SECTION**

**Part 1            General**

**1.1            REFERENCES**

- .1    ASTM International Inc.
  - .1    ASTM D2235, Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
  - .2    ASTM D2564, Standard Specification for Solvent Cements for Poly(Vinyl-Chloride) (PVC) Plastic Piping Systems.
- .2    Canadian Standards Association (CSA International)
  - .1    CAN/CSA-Series B1800, Thermoplastic Nonpressure Pipe Compendium - B1800 Series.
- .3    Green Seal Environmental Standards (GSES)
  - .1    Standard GS-36, Commercial Adhesives.
- .4    Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1    Material Safety Data Sheets (MSDS).
- .5    South Coast Air Quality Management District (SCAQMD), California State
  - .1    SCAQMD Rule 1168, Adhesive and Sealant Applications.

**1.2            ACTION AND INFORMATIONAL SUBMITTALS**

- .1    Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2    Product Data:
  - .1    Provide manufacturer's printed product literature and datasheets for piping and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2    Provide two copies WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 43 - Environmental Procedures and Section 01 35 29.06 - Health and Safety Requirements.

**1.3            DELIVERY, STORAGE AND HANDLING**

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

**Part 2            Products**

**2.1            PIPING AND FITTINGS**

- .1 For buried DWV piping to:
  - .1 CSA-B181.1.
  - .2 CSA-B181.2.
  - .3 CSA-B182.1.
- .2 For aboveground DWV piping for non-combustible construction:
  - .1 Flame spread rating less than 25 and smoke developed classification less than 50.
  - .2 CSA B181.2

**2.2            JOINTS**

- .1 Solvent weld for PVC: to ASTM D2564.
  - .1 NPS 1½ to 6: one step or two step cement.
  - .2 NPS 8 and above: two step cement.
- .2 Solvent weld for ABS: to ASTM D2235.

**Part 3            .Execution**

**3.1            APPLICATION**

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

**3.2            INSTALLATION**

- .1 In accordance with Section 23 05 05 - Installation of Pipework.
- .2 Install in accordance with National Plumbing Code and local authority having jurisdiction.

**3.3            TESTING**

- .1 Pressure test buried systems before backfilling.
- .2 Hydraulically test to verify grades and freedom from obstructions.

**3.4            PERFORMANCE VERIFICATION**

- .1 Cleanouts:
  - .1 Ensure accessible and that access doors are correctly located.
  - .2 Open, cover with linseed oil and re-seal.
  - .3 Verify cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Storm water drainage:
  - .1 Verify domes are secure.

- .2 Ensure weirs are correctly sized and installed correctly.
- .3 Verify provisions for movement of roof system.
- .4 Ensure fixtures are properly anchored, connected to system and effectively vented.
- .5 Affix applicable label (storm, sanitary, vent, pump discharge) c/w directional arrows every floor or 4.5 m (whichever is less).

### **3.5 CLEANING**

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

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 American National Standards Institute/Canadian Standards Association (ANSI/CSA)
  - .1 ANSI Z21.10.1-2004/CSA 4.1-2004, Gas Water Heaters - Volume I, Storage Water Heaters With Input Ratings of 75,000 Btu Per Hour or Less.
  - .2 ANSI Z21.10.1A-2006/CSA 4.1A-2006, Addenda 1 to ANSI Z21.10.1-2004/CSA 4.1-2004, Gas Water Heaters Volume I, Storage Water Heaters With Input Ratings of 75,000 Btu Per Hour or Less.
  - .3 ANSI Z21.10.1b-2006/CSA 4.1b-2006, Addenda 2 to ANSI Z21.10.1-2004/CSA 4.1-2004, Gas Water Heaters - Volume I, Storage Water Heaters With Input Ratings of 75,000 Btu Per Hour or Less.
  - .4 ANSI Z21.10.3A-2007/CSA 4.3-2007, Gas Water Heaters - Volume III - Storage Water Heaters, with Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous.
- .2 Canadian Standards Association (CSA International)
  - .1 CSA B51-03(R2007), Boiler, Pressure Vessel, and Pressure Piping Code.
  - .2 CAN/CSA-B139-04, Installation Code for Oil Burning Equipment.
  - .3 CAN/CSA-B140.0-03, Oil Burning Equipment: General Requirements.
  - .4 CAN/CSA-B149.1-05, Natural Gas and Propane Installation Code.
  - .5 CAN/CSA-B149.2-05, Propane Storage and Handling Code.
  - .6 CSA B140.12-03, Oil-Burning Equipment: Service Water Heaters for Domestic Hot Water, Space Heating, and Swimming Pools.
  - .7 CAN/CSA C22.2 No.110-94(R2004), Construction and Test of Electric Storage Tank Water Heaters.
  - .8 CAN/CSA-C191-04, Performance of Electric Storage Tank Water Heaters for Household Service.
  - .9 CAN/CSA-C309-M90(R2003), Performance Requirements for Glass-Lined Storage Tanks for Household Hot Water Service.
- .3 National Research Council Canada (NRC)
  - .1 National Plumbing Code of Canada 2015(NPC).

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and datasheets for domestic water heater, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Indicate:



- .1 Equipment, including connections, fittings, control assemblies and ancillaries, identifying factory and field assembled.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

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

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

### **1.5 WARRANTY**

- .1 For the Work of this Section 22 30 05 - Domestic Water Heaters, 12 months' warranty period prescribed in subsection GC 32.1 of General Conditions "C" is extended to number of years specified for each product.
- .2 Contractor hereby warrants domestic water heaters in accordance with CCDC2, but for number of years specified for each product.

## **Part 2 Products**

### **2.1 COMPONENTS**

- .1 Refer to Equipment schedule on drawings.

### **2.1 CONDENSING WATER HEATER (TANK)**

- .1 Natural gas water heater(s) shall be modulating condensing water heater with a minimum 95% thermal efficiency and a maximum hydrostatic working pressure of 160 psi.
  - .1 Provide 3-year warranty certificate.
- .2 Water heater(s) shall:
  - .1 Modulating gas burner that automatically adjusts the input based on demand.
  - .2 Powered anodes that are non-sacrificial and maintenance free.
  - .3 Have seamless glass-lined steel tank construction, with glass lining applied to all waterside surfaces after the tank has been assembled and welded;

- .4 Meets the thermal efficiency and/or standby loss requirements of the U. S. Department of Energy and current edition of ASHRAE/IES 90.1;
- .5 Have foam insulation and a CSA Certified and ASME rated T&P relief valve;
- .6 Have a down-fired power burner designed for precise mixing of air and gas for optimum efficiency, requiring no special calibration on start-up;
- .7 Be approved for 0" clearance to combustibles.
- .3 The control shall be an integrated solid-state temperature and ignition control device with integral diagnostics, graphic user interface, fault history display, and shall have digital temperature readout.
  - .1 All models are design certified by Underwriters Laboratories (UL), Inc., according to ANSI Z21.10.3 - CSA 4.3 standards governing storage type water heaters;
  - .2 Meet the thermal efficiency and standby loss requirements of the U. S. Department of Energy and current edition ASHRAE/IES 90.1. Complies with SCAQMD Rule 1146.2 and other air quality management districts with similar requirements for low NOx emissions.
  - .3 System to include BMS Gateway for connection to EMCS for monitoring.
- .4 Venting: The flue shall be manufacturers approved Stainless Steel sealed vent material/system size per the model requirements. Terminations shall be with the manufacturers specified vent termination.
- .5 Provide Room air vent kits where combustion air is from the room.
- .6 Provide Condensate Neutralization Kit.

## **2.2 DHW HEATER (DHWH)**

- .1 The DHWH shall be capable of full modulation firing down to 20% of rated input with a turn down ratio of 5:1.
- .2 General: packaged unit to ASME standards, stamped for 1100 kPa WP. Provide CGA certification. There shall be no banding material, bolts, gaskets or "O" rings in the header configuration. The stainless steel combustion chamber shall be designed to drain condensation to the bottom of the heat exchanger assembly. A built-in trap shall allow condensation to drain from the heat exchanger assembly. The complete heat exchanger assembly shall carry a five (5) year limited warranty.
- .3 The DHWH shall be certified and listed by C.S.A. International under the latest edition of the harmonized ANSI Z21.10.3 test standard for the US and Canada The DHWH shall comply with the energy efficiency requirements of the latest edition of the ASHRAE 90.1 Standard. The DHWH shall be AHRI certified to 96% thermal efficiency. The DHWH shall be certified for indoor installation.
- .4 The DHWH shall be constructed with a heavy gauge steel jacket assembly, primed and pre-painted on both sides. The combustion chamber shall be sealed and completely enclosed, independent of the outer jacket assembly, so that integrity of the outer jacket does not affect a proper seal. A burner/flame observation port shall be provided. The burner shall be a premix design and constructed of high temperature stainless steel with a woven metal fiber outer covering to provide modulating firing rates. The DHWH shall be supplied with a gas valve designed with negative pressure regulation and be equipped

with a variable speed blower system, to precisely control the fuel/air mixture to provide modulating DHWH firing rates for maximum efficiency. The DHWH shall operate in a safe condition at a derated output with gas supply pressures as low as 4 inches of water column.

- .5 Venting: The flue shall be manufacturers approved Stainless Steel sealed vent material/system size per the model requirements. Terminations shall be with the manufacturers specified vent termination.
- .6 Controls:
  - .1 The DHWH shall utilize a 24 VAC control circuit and components. The control system shall have an electronic display for DHWH set-up, DHWH status, and DHWH diagnostics. All components shall be easily accessed and serviceable from the front and top of the jacket. The DHWH shall be equipped with; a high limit temperature control certified to UL353, ASME certified pressure relief valve, outlet water temperature sensor, inlet water temperature sensor, a UL 353 certified flue temperature sensor, low water flow protection and built-in freeze protection. The manufacturer shall verify proper operation of the burner, all controls and the heat exchanger by connection to water and venting for a factory fire test prior to shipping.
  - .2 The DHWH shall include a factory installed digital control with a Multi-Colored Graphic LCD display with Navigation Dial and Soft Keys, password security, pump delay with freeze protection, pump exercise, and USB PC port connection. The DHWH shall feature night setback for the domestic hot water tank and shall be capable of controlling a building recirculation pump while utilizing the night setback schedule for the building recirculation pump. The DHWH shall have the capability to accept a 0-10 VDC input connection for BMS control of modulation or setpoint and enable/disable of the DHWH, and a 0-10VDC output of DHWH modulation rate. The DHWH shall have a built-in cascading sequencer with modulation logic options of "lead lag" or "efficiency optimized". Both modulation logic options should be capable of rotation while maintaining modulation of up to eight DHWHs without utilization of an external controller. Supply voltage shall be 120 volt / 60 hertz / single phase.
  - .3 The DHWH shall be equipped with two terminal strips for electrical connection. A low voltage connection board with data points for safety and operating controls, i.e., Auxiliary Relay, Auxiliary Proving Switch, Alarm Contacts, Runtime Contacts, Manual Reset Low Water Cutoff, Flow Switch, High and Low Gas Pressure Switches, Tank Thermostat, Tank Sensor, Building Management System Signal, Modbus Control Contacts and Cascade Control Circuit. A high voltage terminal strip shall be provided for supply voltage. The high voltage terminal strip plus integral relays are provided for independent control of the Domestic Hot Water Pump and Building Re-circulation Pump.
  - .4 System to include BMS Gateway for connection to EMCS.
- .7 Provide Room air vent kits where combustion air is from the room.
- .8 Provide High and low gas pressure switches
- .9 Provide Condensate Neutralization Kit.

**2.3 TRIM AND INSTRUMENTATION**

- .1 Drain valve: NPS 1 with hose end.
- .2 Thermometer: 100 mm dial type with red pointer and thermowell filled with conductive paste.
- .3 Pressure gauge: 75 mm dial type with red pointer, syphon, and shut-off cock.
- .4 Thermowell filled with conductive paste for control valve temperature sensor.
- .5 ASME rated temperature and pressure relief valve sized for full capacity of heater, having discharge terminating over floor drain and visible to operators.
- .6 Magnesium anodes adequate for 20 years of operation and located for easy replacement.

**Part 3 Execution**

**3.1 APPLICATION**

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

**3.2 INSTALLATION**

- .1 Install in accordance with manufacturer's recommendations and authority having jurisdiction.
- .2 Install natural gas fired domestic water heaters in accordance with CAN/CSA-B149.1.

**3.3 FIELD QUALITY CONTROL**

- .1 Manufacturer's factory trained, certified Engineer to start up and commission DHW heaters.

**3.4 PERFORMANCE VERIFICATION**

- .1 Scheduling:
  - .1 Verify system performance after pressure and leakage tests and disinfection are completed.
- .2 Procedures:
  - .1 Sterilize HWS and HWC systems for Legionella control.
  - .2 Verify performance of temperature controls.
  - .3 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.

- .3 Reports:
  - .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Reports, using report forms as specified in Section 01 91 13 - General Commissioning (Cx) Requirements: Report Forms and Schematics.
  - .2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

### **3.5 CLEANING**

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

**END OF SECTION**

**Part 1        General**

**1.1        REFERENCES**

- .1    ASTM International
  - .1    ASTM A126, Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
  - .2    ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .2    American National Standards Institute (ANSI)/American Water Works Association (AWWA)
  - .1    ANSI/AWWA C700, Standard for Cold Water Meters-Displacement Type, Bronze Main Case.
  - .2    ANSI/AWWA C701, Standard for Cold Water Meters-Turbine Type for Customer Service.
  - .3    ANSI/AWWA C702, Standard for Cold Water Meters-Compound Type.
- .3    American National Standards Institute (ANSI)
  - .1    ANSI Z358.1 Emergency eyewash and shower equipment.
- .4    American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
  - .1    ASNSI/ASME A112.6.3, Floor and Trench Drains
- .5    CSA International
  - .1    CSA-B64 Series, Backflow Preventers and Vacuum Breakers.
  - .2    CSA B79, Commercial and Residential Drains and Cleanouts.
  - .3    CAN/CSA-B356, Water Pressure Reducing Valves for Domestic Water Supply Systems.
- .6    Efficiency Valuation Organization (EVO)
  - .1    International Performance Measurement and Verification Protocol (IPMVP).
    - .1    IPMVP Version.
- .7    Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1    Material Safety Data Sheets (MSDS).
- .8    National Research Council of Canada (NRC)
  - .1    2015 National Plumbing Code
- .9    Plumbing and Drainage Institute (PDI)
  - .1    PDI-G101, Testing and Rating Procedure for Grease Interceptors with Appendix of Installation and Maintenance.
  - .2    PDI-WH201, Water Hammer Arresters Standard.

## **1.2 ADMINISTRATIVE REQUIREMENTS**

- .1 Pre-installation Meetings:
  - .1 Convene pre-installation meeting one (1) week prior to beginning work of this Section and on-site installation.
    - .1 Verify project requirements.
    - .2 Review installation and substrate conditions.
    - .3 Co-ordination with other building construction subtrades.
    - .4 Review manufacturer's written installation instructions and warranty requirements.
  - .2 Health and Safety:
    - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

## **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 plumbing products and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit two (2) copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements and Section 01 35 43 - Environmental Procedures. Indicate VOC's for adhesive and solvents during application and curing.
- .3 Shop Drawings:
  - .1 Indicate on drawings to indicate materials, finishes, method of anchorage, number of anchors, dimensions, construction and assembly details, and accessories.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Start-Up: submit manufacturers pre-start up and Start-up procedure and check sheets.
- .6 Instructions: submit manufacturer's installation instructions.
- .7 Manufacturers' Field Reports: submit manufacturers' field reports.

## **1.4 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
  - .1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.
  - .2 Details of operation, servicing and maintenance.
  - .3 Recommended spare parts list.

**1.5 DELIVERY, STORAGE AND HANDLING**

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

**1.6 WARRANTY**

- .1 Provide a written guarantee, signed and issued in the name of the Department Representative, against defective materials and workmanship for a period of one (1) year from the date of Substantial Completion.

**Part 2 Products**

**2.1 FLOOR DRAINS**

- .1 Not used.

**2.2 ROOF DRAINS**

- .1 Not used.

**2.3 CLEANOUTS**

- .1 Not used.

**2.4 NON-FREEZE WALL HYDRANTS**

- .1 Not used.

**2.5 NON-FREEZE GROUND HYDRANT**

- .1 Not used.

**2.6 WATER HAMMER ARRESTORS**

- .1 Stainless steel or copper construction, piston type: to PDI-WH201.
- .2 Design Standard: Zurn
- .3 Acceptable Manufacturers: Mifab, Wade, Watts, Zurn



**2.7 BACK FLOW PREVENTERS**

- .1 Back Flow Preventers: to CSA-B64 Series.
- .2 Fire Protection Service: FM and ULC approved for fire protection service.
- .3 Acceptable Manufacturers: Watts, Wilkins, Zurn

**2.8 VACUUM BREAKERS**

- .1 Vacuum Breakers: to CSA-B64 Series.
- .2 Atmospheric vacuum breaker, where indicated:
  - .1 Plain brass body with silicone disc.
  - .2 Suitable for temperatures up to 82°C.
  - .3 Maximum operating pressure: 860 kPa.
  - .4 Size: as indicated.
- .3 Hose connection vacuum breaker:
  - .1 female hose threaded inlet, male hose threaded outlet, brass finish.
  - .2 Size: as indicated.
- .4 Acceptable Manufacturers: Mifab, Watts, Wilkins, Zurn

**2.9 PRESSURE REGULATORS**

- .1 Capacity: as indicated.
  - .1 Inlet pressure: 1,034 kPa.
  - .2 Outlet pressure: 413 kPa.
- .2 Up to DN 40 (NPS 1 ½) bronze bodies, screwed, with strainer and stainless steel screen: to ASTM B62.
- .3 DN 50 (NPS 2) and over, semi-steel bodies, Class 125, flanged with strainer: to ASTM A126, Class B.
- .4 Semi-steel spring chambers with bronze trim.
- .5 Acceptable Manufacturers: Watts

**2.10 BACKWATER VALVES**

- .1 Coated extra heavy cast iron body with bronze seat, revolving bronze flapper and threaded cover.
- .2 Access:
  - .1 Surface access.
  - .2 Access pipe with cover: maximum 300 mm depth.
  - .3 Concrete access pit with steel cover, as indicated.

**2.11 HOSE BIBBS AND SEDIMENT FAUCETS**

- .1 HB-2: Bronze construction complete with integral back flow preventer, DN 20 (NPS ¾) hose thread spout, replaceable composition disc, and chrome plated in finished areas.
- .2 Acceptable Manufacturers: Acorn, Watts, Zurn

**2.12 HOSE REEL AND HOSE**

- .1 Not used.

**2.13 WATER MAKE-UP ASSEMBLY**

- .1 Complete with backflow preventer, pressure gauge on inlet and outlet, pressure reducing valve to CAN/CSA-B356, pressure relief valve on low pressure side and gate valves on inlet and outlet.

**2.14 WATER METERS**

- .1 Not used.

**2.15 TRAP SEAL PRIMERS**

- .1 Pressure drop actuated:
  - .1 Brass body construction with inlet opening of DN 15 (½ NPT) and outlet opening of female DN 15 (½ NPT).
  - .2 Provide complete with four-hole view built-in air gap to prevent any backflow from trap being fed into the water supply.
  - .3 Provide removable inlet filter screen.
  - .4 Provide complete with trap seal primer distribution unit as follows:
    - .1 Brass body construction.
    - .2 DN 15 (½ NPT) inlet connection.
    - .3 DN 10 (3/8 FPT) brass nipple outlet connections.
    - .4 6 mm diameter vent holes in lid to provide air gap and backflow protection.
  - .5 Up to 12 floor drains: Electronic trap priming manifold with:
    - .1 Vacuum breaker
    - .2 Pre-set 24-hour time clock
    - .3 Manual override switch
    - .4 120V solenoid valve
    - .5 120V or 3 wire connection.
    - .6 DN 20 (NPS ¾) inlet connection.
    - .7 Calibrated manifold.
    - .8 Water hammer arrestor
    - .9 Mounted in steel cabinet
    - .10 Compression outlet fittings
    - .11 Inlet shut off valve
    - .12 Supplies minimum 59 ml @ 138 kPa.
- .2 Trap guard:
  - .1 All elastomeric normally closed trap guard device utilizes a normally closed seal to prevent evaporation of the trap seal and to protect against sewer gases from backing up into habitable areas. It opens with fluid flow and allows liquid drainage to flow through into the building drain.

- .2 Waterless trap guards shall be tested in accordance with ASSE 1072 test standard for ANSI/ASME A112.6.3 drain and by Warnock Hersey for CSA B19.
- .3 Acceptable Manufacturers: JR Smith, Mifab, ProVent, Watts, Zurn

## **2.16 STRAINERS**

- .1 860 kPa, Y type with 20 mesh, monel, bronze or stainless steel removable screen.
- .2 DN 50 (NPS 2) and under, bronze body, screwed ends, with brass cap, tapped blow off and plug.
- .3 DN 65 (NPS 2 ½) and over, cast iron body, flanged ends, with bolted cap, tapped blow off connection and bronze ball valve.

## **2.17 POTABLE WATER THERMAL EXPANSION TANK**

- .1 Quantity: as indicated.
- .2 Application: absorb expanded water from domestic hot water tanks because of the inability to expand back into the Town potable water system due to the presence of a backflow preventer on the incoming water supply to the building.
- .3 ASME Section VIII construction and label.
- .4 FDA approved butyl bladder.
- .5 DN 25 (1 NPT) stainless steel system connection.
- .6 Standard tire air charging valve connection.
- .7 1,033 kPa maximum working pressure.
- .8 Vertical tank, floor mounted.
- .9 Dimensions: as indicated.
- .10 Tank volume: as indicated.
- .11 Acceptance volume: as indicated.
- .12 Red primer exterior finish.
- .13 Air pre-charge to be adjusted in field by the Mechanical Contractor to equal the residual cold water pressure on the discharge side of the pressure reducing valve on the domestic water service entrance by the Mechanical Contractor.
- .14 Acceptable Product: ExpanFlex, Amtrol, Taco, S. A. Armstrong, Bell and Gossett, Zurn, Wilkins, Watts.

**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 material 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                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.

**3.3                INSTALLATION**

- .1      Install in accordance with Alberta Plumbing Code and Authority having Jurisdiction.
- .2      Install in accordance with manufacturer's instructions and as specified.

**3.4                CLEANOUTS**

- .1      Not Used

**3.5                NON-FREEZE WALL HYDRANTS**

- .1      Not Used

**3.6                WATER HAMMER ARRESTORS**

- .1      Install on branch supplies to fixtures or group of fixtures.

**3.7                BACK FLOW PREVENTERS**

- .1      Install in accordance with CSA-B64 Series, where indicated and elsewhere as required by code.
- .2      Application:
  - .1          Reduced pressure type where backflow would constitute a health hazard.
  - .2          Double check type where backflow would constitute a nuisance or be aesthetically objectionable or material which would not constitute a health hazard.
  - .3          Domestic water premise isolation:
    - .1              Type of Facility: Buildings with low hazard classification
      - .1                  Back Flow Preventer: As required by Authority having Jurisdiction but no less than a double check valve assembly (DCVA).

- .2 Type of Facility: Buildings with moderate to high hazard classification
  - .1 Back Flow Preventer: Reduced pressure principle type double check valve assembly (RP-DVCA).
- .4 Non-potable water system:
  - .1 Water Supply:
    - .1 Domestic water source
      - .1 Reduced pressure principle type double check valve assembly (RP-DVCA).
  - .5 Fire protection system:
    - .1 With FM and ULC approval for fire protection service.
    - .2 Water Supply:
      - .1 Dedicated fire water source
        - .1 Not required.
      - .2 Domestic water source
        - .1 Double check valve assembly (DCVA) where water treatment, including anti-freeze, IS NOT added to the fire water.
        - .2 Reduced pressure principle type double check valve assembly (RP-DVCA) where water treatment, including anti-freeze, IS added to the fire water.
- .3 Pipe discharge to terminate over nearest floor drain, indirect drain, or service sink.

### **3.8 BACKWATER VALVES**

- .1 Install in main sewer lines where indicated.
- .2 Install in access pit as indicated.

### **3.9 HOSE BIBBS AND SEDIMENT FAUCETS**

- .1 Not Used.

### **3.10 TRAP SEAL PRIMERS**

- .1 Install for floor drains and elsewhere, as indicated.
- .2 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space, to approval of Department Representative.
- .3 Install Type K soft copper tubing to floor drain.

### **3.11 STRAINERS**

- .1 Install with sufficient room to remove basket for ease of maintenance.

### **3.12 GREASE INTERCEPTORS**

- .1 Install with sufficient space, as indicated, for ease of maintenance.

### **3.13 WATER METERS**

- .1 Not Used.

**3.14 WATER MAKE-UP ASSEMBLY**

- .1 Install on valved bypass.
- .2 Pipe discharge from relief valve to nearest floor drain.

**3.15 ACID DILUTION DEVICES**

- .1 Install with sufficient space, as indicated, for ease of maintenance.

**3.16 START-UP AND COMMISSIONING**

- .1 General:
  - .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements, supplemented as specified herein.
- .2 Timing: start-up only after:
  - .1 Pressure tests have been completed.
  - .2 Disinfection procedures have been completed.
  - .3 Water treatment systems operational.
- .3 Provide continuous supervision during start-up.

**3.17 TESTING AND ADJUSTING**

- .1 General:
  - .1 Test and adjust plumbing specialties and accessories in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements, supplemented as specified.
- .2 Timing:
  - .1 After start-up deficiencies rectified.
  - .2 After certificate of completion has been issued by Authority having Jurisdiction.
- .3 Application tolerances:
  - .1 Pressure at fixtures: +/- 70 kPa.
  - .2 Flow rate at fixtures: +/- 20%.
- .4 Adjustments:
  - .1 Verify that flow rate and pressure meet design criteria.
  - .2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.
- .5 Floor drains:
  - .1 Verify operation of trap seal primer.
  - .2 Prime, using trap primer. Adjust flow rate to suit site conditions.
  - .3 Check operations of flushing features.
  - .4 Check security, accessibility, removability of strainer.
  - .5 Clean out baskets.
- .6 Vacuum breakers, backflow preventers, backwater valves:

- .1 Test tightness, accessibility for O&M of cover and of valve.
- .2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.
- .3 Verify visibility of discharge from open ports.
- .7 Roof drains:
  - .1 Check location at low points in roof.
  - .2 Check security, removability of dome.
  - .3 Adjust weirs to suit actual roof slopes, meet requirements of design.
  - .4 Clean out sumps.
  - .5 Verify provisions for movement of roof systems.
- .8 Access doors:
  - .1 Verify size and location relative to items to be accessed.
- .9 Cleanouts:
  - .1 Verify covers are gas-tight, secure, yet readily removable.
- .10 Water hammer arrestors:
  - .1 Verify proper installation of correct type of water hammer arrester.
- .11 Wall, ground hydrants:
  - .1 Verify complete drainage, freeze protection.
  - .2 Verify operation of vacuum breakers.
- .12 Pressure regulators, PRV assemblies:
  - .1 Adjust settings to suit locations, flow rates, pressure conditions.
- .13 Strainers:
  - .1 Clean out repeatedly until clear.
  - .2 Verify accessibility of cleanout plug and basket.
  - .3 Verify that cleanout plug does not leak.
- .14 Grease interceptors:
  - .1 Activate, using manufacturer's recommended procedures and materials.
- .15 Hose bibbs, sediment faucets:
  - .1 Verify operation.
  - .2 Check for leaks, replace compression washer if required.
- .16 Hydronic system water Make-up Assembly:
  - .1 Verify flow, pressure, and connection.
- .17 Water meters:
  - .1 Verify location and accessibility.
  - .2 Verify calibration certificate.
  - .3 Test meter reading accuracy.
- .18 Dilution Tank:

- .1 Install as per manufacturer's instructions.
- .2 Fill with limestone chips.
- .19 Tempered water assemblies:
  - .1 Verify operation of Hi/Lo tempered water assemblies at both high and low flow conditions.
  - .2 Verify proper discharge temperature setpoint for all tempered water assemblies including those serving emergency fixtures.
  - .3 Test alarms on emergency fixtures.

### **3.18 CLOSEOUT ACTIVITIES**

- .1 Commissioning Reports: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements, supplemented as specified.
- .2 Training: provide training in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements, supplemented as specified.
  - .1 Demonstrate full compliance with Design Criteria.

### **3.19 CLEANING**

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

### **3.20 PROTECTION**

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

**END OF SECTION**



**Part 1        General**

**1.1           ACTION AND INFORMATIONAL SUBMITTALS**

- .1      Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2      Shop drawings; submit drawings stamped and signed for approval by Department Representative.
- .3      Shop Drawings:
  - .1          Indicate on drawings:
    - .1            Mounting arrangements.
    - .2            Operating and maintenance clearances.
  - .2          Shop drawings and product data accompanied by:
    - .1            Detailed drawings of bases, supports, and anchor bolts.
    - .2            Acoustical sound power data, where applicable.
    - .3            Points of operation on performance curves.
    - .4            Manufacturer to certify current model production.
    - .5            Certification of compliance to applicable codes.
  - .3          In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet".

**1.2           CLOSEOUT SUBMITTALS**

- .1      Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2      Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
  - .1          Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
  - .2          Operation data to include:
    - .1            Control schematics for systems including environmental controls.
    - .2            Description of systems and their controls.
    - .3            Description of operation of systems at various loads together with reset schedules and seasonal variances.
    - .4            Operation instruction for systems and component.
    - .5            Description of actions to be taken in event of equipment failure.
    - .6            Valves schedule and flow diagram.
    - .7            Colour coding chart.
  - .3          Maintenance data to include:
    - .1            Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
    - .2            Data to include schedules of tasks, frequency, tools required and task time.

- .4 Performance data to include:
  - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
  - .2 Equipment performance verification test results.
  - .3 Special performance data as specified.
  - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .5 Approvals:
  - .1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
  - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .6 Additional data:
  - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 Site records:
  - .1 Department Representative will provide 1 set of digital mechanical drawings in pdf format. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
  - .2 Transfer information weekly to reproducible, revising reproducible to show work as actually installed.
  - .3 Use different colour for each service.
  - .4 Make available for reference purposes and inspection.
- .8 As-built drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
  - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
  - .3 Submit to Departmental Representative for approval and make corrections as directed.
  - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
  - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

### **1.3 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

- .2 Furnish spare parts as follows:
  - .1 One set of packing for each pump.
  - .2 One casing joint gasket for each size pump.
  - .3 One head gasket set for each heat exchanger.
  - .4 One glass for each gauge glass.
  - .5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

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

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

### **Part 2 Products**

#### **2.1 MATERIALS**

- .1 All materials used on this project shall be new and CSA approved unless noted otherwise.

### **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 material 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 PAINTING REPAIRS AND RESTORATION**

- .1 Do painting in accordance with Section 09 91 00 - Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

### **3.3 SYSTEM CLEANING**

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

### **3.4 FIELD QUALITY CONTROL**

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS.
  - .1 Submit tests as specified in other sections of this specification.
- .2 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 - ACTION AND INFORMATIONAL 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.

### **3.5 COORDINATION WITH THE ELECTRICAL CONTRACTOR**

- .1 review all drawings and specified equipment requiring electrical hook-up with Electrical Contractor prior to ordering equipment. Ensure proper electrical characteristics are determined for all affected and related work.
- .2 Motors, electric heating, controls, distribution devices and equipment shall operate satisfactorily at 60 Hz within normal operating limits established.
- .3 Packaged mechanical equipment shall be supplied with one main power connection.
- .4 This Contractor shall arrange for controls associated power to be supplied and installed by Division 26. Otherwise all controls work, including wiring, shall be supplied and installed by Controls Contractor.
- .5 Provide wiring diagrams indicating all power and control wiring requirements for equipment supplied by Division 23, with accurate locations of electrical connection points and all necessary schematics and other drawings to facilitate electric work. These diagrams, schematics, and / or drawings shall be enclosed within the O&M Manuals.
- .6 Provide wiring of items supplied by equipment Manufacturers such as filter advance motors and control, high level alarms, low water cut-offs, anti vibration lock-outs, flow switches, remote and local thermostats for all equipment, sump pump alternators, level

controllers, water treatment equipment, and oil / grease interceptor alarms, and control wiring between starters and control panels (e.g. air cooled condensers, cooling towers and condensing units). Also provide wiring for communications interface panels, sensors, oil pumps, purge pumps and oil heaters supplied with water chillers.

### **3.6 COOPERATION WITH COMMISSIONING TEAM**

- .1 The Mechanical Contractor to complete commissioning activities as per Section 01 91 13 - General Commissioning (Cx) Requirements. In addition, advise the Commissioning Authority of dates for the commissioning schedule when mechanical systems will be ready for commissioning reviews.
- .2 Cooperate with the Commissioning Team as follows:
  - .1 Inform Commissioning Team in advance of degreasing and flushing of heating system, hydrostatic and air tests.
  - .2 Allow Commissioning Team free access to the site during construction phase.
  - .3 Coordinate site visits during warranty period.
- .3 In-Contract Test:
  - .1 Include all formal tests required by the contract documents and carried out by the Mechanical Contractor or his testing agency. These tests are the responsibility of the Mechanical Contractor but are within the scope of the Commissioning Team. The Commissioning Team will witness selected in-contract tests. Provide documentation confirming of test and sign-off acceptance of each test by the Mechanical Contractor or his testing agency.
- .4 Allow for work necessary to assist Commissioning Team in completion of the commissioning process. The Mechanical Contractor shall fill a complete system of check sheets. Format of one checks sheet will be provided by the Commissioning Team.
- .5 Demonstrate all equipment and system operation and fail modes for all elements of mechanical work as defined by the project documents, and in accordance with the commissioning authorities' direction.

### **3.7 DEMONSTRATION**

- .1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.
- .5 Departmental Representative will record these demonstrations on video tape for future reference.

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

### **3.9**

#### **PROTECTION**

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

**END OF SECTION**

**Part 1 General**

**1.1 USE OF SYSTEMS**

- .1 Use of existing and new permanent heating and/or ventilating systems for supplying temporary heat and/or ventilation is permitted only under following conditions:
  - .1 Upon request and approval of Department Representative.
  - .2 Entire system is complete, pressure tested, cleaned, flushed out.
  - .3 Specified water treatment system has been commissioned, water treatment is being continuously monitored.
  - .4 Building has been closed in, areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.
  - .5 There is no possibility of damage from any cause.
  - .6 Supply ventilation systems are protected by 60% filters, inspected daily, changed every week or more frequently as required.
  - .7 Return systems have approved filters over openings, inlets, outlets.
  - .8 Systems will be:
    - .1 Operated as per manufacturer's recommendations and instructions.
    - .2 Operated by Contractor.
    - .3 Monitored continuously by Contractor.
  - .9 Warranties and guarantees are not relaxed and shall not begin until after final acceptance upon completion of Commissioning Functional Testing.
  - .10 Regular preventive and other manufacturers recommended maintenance routines are performed by Contractor at own expense and under supervision of Department Representative.
  - .11 Refurbish entire system before static completion; clean internally and externally, restore to "as- new" condition, replace filters in air systems.
- .2 Filters specified in this Section are over and above those specified in other Sections of this project.

**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 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheets for piping and equipment and include product characteristics, performance criteria, physical size, finish and limitations.

**1.2 QUALITY ASSURANCE**

- .1 Sustainability Standards Certification:
  - .1 Low-Emitting Materials: provide listing of sealants and coatings used in building, comply with VOC and chemical component limits or restriction requirements.

**1.3 DELIVERY, STORAGE AND HANDLING**

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

**Part 2 Products**

**2.1 MATERIAL**

- .1 Paint: zinc-rich to CAN/CGSB-1.181.
  - .1 Primers, Paints and Coatings: in accordance with manufacturer's recommendations for surface conditions.
  - .2 Primer: maximum VOC limit 250 g/L to Standard GS-11 and to SCAQMD Rule 1113.
  - .3 Paints: maximum VOC limit 150 g/L to Standard GS-11 and to SCAQMD Rule 1113.



- .2 Sealants: in accordance with Section 07 92 00 - Joint Sealants.
  - .1 Sealants: maximum VOC limit to SCAQMD Rule 1168 and to GSES GS-36.
- .3 Sealants: maximum VOC limit to SCAQMD Rule 1168 and to GSES GS-36.
- .4 Adhesives: maximum VOC limit to SCAQMD Rule 1168 and to GSES GS-36.

## **Part 3 Execution**

### **3.1 APPLICATION**

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

### **3.2 CONNECTIONS TO EQUIPMENT**

- .1 In accordance with manufacturer's instructions unless otherwise indicated.
- .2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.
  - .1 Unions are not required in installations using grooved mechanical couplings (the couplings shall serve as unions).
- .3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.
- .4 The flexible type grooved joint couplings may be used in lieu of a flexible connector at equipment connections for vibration attenuation and stress relief. Couplings shall be placed in close proximity to the source of the vibration, as per manufacturer's recommendations.

### **3.3 CLEARANCES**

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer and National Fire Code.
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, components.

### **3.4 DRAINS**

- .1 Install piping with grade in direction of flow except as indicated.
- .2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.
- .3 Pipe each drain valve discharge separately to above floor drain.
  - .1 Discharge to be visible.

- .4 Drain valves: DN 20 (NPS ¾) gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

### **3.5 AIR VENTS**

- .1 Install automatic air vents to at high points in piping systems.
- .2 Install isolating valve at each automatic air valve.
- .3 Install drain piping to approved location and terminate where discharge is visible.

### **3.6 DIELECTRIC WATERWAY FITTINGS AND COUPLINGS**

- .1 General: compatible with system, to suit pressure rating of system.
- .2 Locations: where dissimilar metals are joined.
- .3 DN 50 (NPS 2) and under: isolating waterway fittings, unions or bronze valves.
  - .1 Waterway fittings shall be complete with thermoplastic liner.
- .4 Over DN 50 (NPS 2): isolating waterway fittings and flanges.
  - .1 Waterway fittings shall be complete with thermoplastic liner.

### **3.7 PIPEWORK INSTALLATION**

- .1 Installation by certified journeyperson.
- .2 Screwed fittings jointed with Teflon tape or pipe dope as recommended by manufacturer.
- .3 Grooved joint couplings and fittings shall be installed in accordance with the manufacturer's written installation instructions.
  - .1 Gaskets shall be verified as suitable for the intended service prior to installation. Gaskets shall be molded and produced by the coupling manufacturer.
  - .2 The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer's representative shall periodically visit the jobsite and review installation. Contractor shall remove and replace any joints deemed improperly installed.
- .4 Protect openings against entry of foreign material.
- .5 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .6 Assemble piping using fittings manufactured to ANSI standards.
- .7 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.
  - .1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.
- .8 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

- .9 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .10 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .11 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .12 Group piping wherever possible and as indicated.
- .13 Ream pipes, remove scale and other foreign material before assembly.
- .14 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .15 Provide for thermal expansion as indicated.
- .16 Valves:
  - .1 Install in accessible locations.
  - .2 Remove interior parts before soldering.
  - .3 Install with stems above horizontal position unless indicated.
  - .4 Valves accessible for maintenance without removing adjacent piping.
  - .5 Install globe valves in bypass around control valves.
  - .6 Use ball or butterfly valves at branch take-offs for isolating purposes except where specified.
  - .7 Install butterfly valves on chilled water and related condenser water systems only.
  - .8 Install butterfly valves between weld neck flanges to ensure full compression of liner.
  - .9 Install ball valves for glycol service.
  - .10 Use chain operators on valves DN 65 (NPS 2 ½) and larger where installed more than 2,400 mm above floor in Mechanical Rooms.
- .17 Check Valves:
  - .1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and as indicated.
  - .2 Install swing check valves in horizontal lines on discharge of pumps and as indicated.

### **3.8 SLEEVES**

- .1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and as indicated.
- .2 Material: schedule 40 black steel pipe.
- .3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.
- .4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.

- .5 Installation:
  - .1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.
  - .2 Other floors: terminate 25 mm above finished floor.
  - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.
- .6 Sealing:
  - .1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.
  - .2 Elsewhere:
    - .1 Provide space for firestopping.
    - .2 Maintain fire rating integrity.
  - .3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.
  - .4 Ensure no contact between copper pipe or tube and sleeve.

### **3.9 ESCUTCHEONS**

- .1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.
- .2 Construction: one-piece type with set screws.
  - .1 Chrome or nickel plated brass or type 302 stainless steel.
- .3 Sizes: outside diameter to cover opening or sleeve.
  - .1 Inside diameter to fit around pipe or outside of insulation if so provided.

### **3.10 PREPARATION FOR FIRESTOPPING**

- .1 Install firestopping within annular space between pipes, ducts, insulation and adjacent fire separation in accordance with Section 07 84 00 - Firestopping.
- .2 Uninsulated unheated pipes not subject to movement: no special preparation.
- .3 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe movement without damaging firestopping material or installation, or install per manufacturer's recommendation as specified within the associated approval.
- .4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

### **3.11 FLUSHING OUT OF PIPING SYSTEMS**

- .1 Flush system in accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
- .2 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 11 - Cleaning supplemented as specified in relevant mechanical sections.
- .3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

### **3.12 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK**

- .1 Advise Department Representative 48 hours minimum prior to performance of pressure tests.
- .2 Pipework: test as specified in relevant sections or Divisions.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .5 Conduct tests in presence of Department Representative.
- .6 Pay costs for repairs or replacement, retesting, and making good. Department Representative to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests Department Representative.

### **3.13 CLEANING**

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

**END OF SECTION**

**Part 1            General**

**1.1            REFERENCES**

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
  - .1 ASHRAE 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).
- .2 Canadian Environmental Assessment Agency (CEAA)
- .3 Canadian Environmental Protection Act (CEPA)
- .4 Electrical Equipment Manufacturers' Association Council (EEMAC)
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .6 National Electrical Manufacturers Association (NEMA)
- .7 Natural Resources Canada (NRC)
  - .1 National Energy Code for Buildings (NECB).
- .8 Transportation of Dangerous Goods Act (TDGA)

**1.2            ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
    - .1 Submit two (2) copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Quality Control: in accordance with Section 01 45 00 - Quality Control.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.
    - .1 Department Representative will make available one (1) copy of systems supplier's installation instructions.
- .4 Closeout Submittals
  - .1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

### **1.3 QUALITY ASSURANCE**

- .1 Regulatory Requirements: work to be performed in compliance with CEPA, CEEA, TDGA, applicable Provincial regulations.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

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

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

## **Part 2 Products**

### **2.1 GENERAL**

- .1 Motors: premium efficiency, in accordance with local Electric/Hydro company standards and the requirements of NECB and ASHRAE 90.1, which ever is most stringent.

### **2.2 MOTORS**

- .1 Provide motors for mechanical equipment as specified.
- .2 Motors under 560 W (3/4 HP): speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.
- .3 Motors 560 W (3/4 HP) and larger: NEMA Class B, 1.15 service factor, squirrel cage induction, premium efficiency, speed as indicated, continuous duty, enclosure as indicated, ball bearing, maximum temperature rise 40°C, 3 phase, 600 V, unless otherwise indicated, suitable for inverted duty variable frequency drives (VFD).

- .4 Minimum certified motor efficiency shall be as outlined below:

MINIMUM EFFICIENCY (%) *				
HP	3600 RPM	1800 RPM	1200 RPM	900 RPM
1	75.5	82.5	80.0	74.0
1.5	82.5	84.0	85.5	77.0
2	84.0	84.0	86.5	82.5
3	85.5	87.5	87.5	84.0
5	87.5	87.5	87.5	85.5
7.5	88.5	89.5	89.5	85.5
10	89.5	89.5	89.5	88.5
15	90.2	91.0	90.2	88.5
20	90.2	91.0	90.2	89.5
25	90.5	91.7	91.3	89.6
30	90.8	91.9	91.4	90.7
40	91.4	92.5	92.3	90.6
50	91.9	92.7	92.3	91.3
60	92.4	93.2	92.9	91.6
75	92.5	93.5	93.1	92.8

(\*) As defined in CSA C390 or IEEE 112B Nominal Standards

## 2.3 TEMPORARY MOTORS

- .1 If delivery of specified motor will delay completion or commissioning work, install motor approved by Department Representative for temporary use. Work will only be accepted when specified motor is installed.

## 2.4 BELT DRIVES

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.
- .3 For motors under 7.5 kW (10 HP): standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- .4 For motors 7.5 kW (10 HP) and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
- .5 Correct size of sheave determined during commissioning.
- .6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .7 Motor slide rail adjustment plates to allow for centre line adjustment.
- .8 Supply one set of spare belts for each set installed in accordance with Section 01 78 00 - Closeout Submittals.



## **2.5 DRIVE GUARDS**

- .1 Provide guards for unprotected drives.
- .2 Guards for belt drives;
  - .1 Expanded metal screen welded to steel frame.
  - .2 Minimum 1.2 mm thick sheet metal tops and bottoms.
  - .3 38 mm diameter holes on both shaft centres for insertion of tachometer.
  - .4 Removable for servicing.
- .3 Provide means to permit lubrication and use of test instruments with guards in place.
- .4 Install belt guards to allow movement of motors for adjusting belt tension.
- .5 Guard for flexible coupling:
  - .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
  - .2 Securely fasten in place.
  - .3 Removable for servicing.
- .6 Guard for unprotected fan inlets or outlets:
  - .1 Wire or expanded metal screen, galvanized, 19 mm mesh.
  - .2 Net free area of guard: not less than 80% of fan openings.
  - .3 Securely fasten in place.
  - .4 Removable for servicing.

## **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 datasheet.

### **3.2 INSTALLATION**

- .1 Fasten securely in place.
- .2 Make removable for servicing, easily returned into, and positively in position.

### **3.3 FIELD QUALITY CONTROL**

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS.
  - .1 As specified in other sections of this specification.
- .2 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.

### **3.4 CLEANING**

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

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 ASTM International Inc.:
  - .1 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
  - .2 ASTM A105/A105M, Standard Specification for Carbon Steel Forgings, for Piping Applications.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data and indicate for items as applicable:
  - .1 Manufacturer, model number, line contents, pressure and temperature rating.
  - .2 Movement handled, axial, lateral, angular and the amounts of each.
  - .3 Nominal size and dimensions including details of construction and assembly.

**1.3 CLOSEOUT SUBMITTALS**

- .1 Submit maintenance data in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Data to include:
  - .1 Servicing requirements, including special requirements, stuffing box packing, lubrication and recommended procedures.

**1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .4 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .5 Collect, separate and place in designated containers for reuse and recycling, paper, plastic, polystyrene, corrugated cardboard packaging, steel, metal, in accordance with Waste Management Plan.
- .6 Unused sealant materials must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.
- .7 Fold up metal banding, flatten and place in designated area for recycling.

**Part 2 Products**

**2.1 BELLOWS TYPE EXPANSION JOINTS**

- .1 For axial, lateral or angular movements, as indicated.

- .2 Maximum operating pressure: same as pipe rating.
- .3 Maximum operating temperature: same as pipe rating.
- .4 Type A: controlled free flexing, factory tested to 1½ times maximum working pressure. Furnish test certificates.
- .5 Type B: externally pressurized, constant volume, pressure balanced, designed to eliminate pressure thrust, factory tested to 1 ½ times maximum working pressure. Furnish test certificates.
- .6 Bellows:
  - .1 Multiple bellows, hydraulically formed, single or two ply, austenitic stainless steel, monel, or inconel for specified fluid, pressure and temperature, water treatment and pipeline cleaning procedures.
- .7 Reinforcing or control rings:
  - .1 2-piece nickel iron.
- .8 Ends:
  - .1 Raised face, slip-on or weld neck flanges to match pipe.
- .9 Liner:
  - .1 Austenitic stainless steel in direction of flow.
- .10 Shroud:
  - .1 Carbon steel, painted.

## **2.2 GROOVED END EXPANSION JOINTS**

- .1 Packless, Gasketed, Slip, Expansion Joints:
  - .1 2413 kPa maximum working pressure.
  - .2 Steel pipe fitting consisting of telescoping body and slip-pipe sections.
  - .3 PTFE modified polyphenylene sulfide coated slide section.
  - .4 Suitable for axial end movement to 75 mm.
- .2 Expansion joint consisting of series of grooved end pipe nipples joined in tandem with flexible couplings. Total joint movement dependent on number of couplings and nipples used.

## **2.3 FLEXIBLE CONNECTION**

- .1 Application: to suit motion as indicated.
- .2 Minimum length in accordance with manufacturer's recommendations to suit offset.
- .3 Inner hose: bronze or stainless steel corrugated.
- .4 Braided wire mesh bronze or stainless steel outer jacket.
- .5 Diameter and type of end connection: threaded or flanged, same as pipe joint for the pipe size.
- .6 Operating conditions:
  - .1 Working pressure: 1034 kPa.

- .2 Working temperature: to match system requirements.
- .3 To match system requirements.
- .7 Three flexible grooved couplings placed in close proximity to vibration source for vibration attenuation and stress relief.

## **2.4 ANCHORS AND GUIDES**

- .1 Anchors:
  - .1 Provide as indicated.
  - .2 Concrete: to Section 03 30 00 - Cast-in-Place Concrete.
  - .3 Reinforcement: to Section 03 20 00 - Concrete Reinforcing.
- .2 Alignment guides:
  - .1 Provide as indicated.
  - .2 To accommodate specified thickness of insulation.
  - .3 Vapour barriers, jackets to remain uninterrupted.

## **Part 3 Execution**

### **3.1 APPLICATION**

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

### **3.2 INSTALLATION**

- .1 Install expansion joints with cold setting, as indicated. Make record of cold settings.
- .2 Install expansion joints and flexible connections in accordance with manufacturer's instructions.
- .3 Install pipe anchors and guides as indicated. Anchors to withstand 150% of axial thrust.
- .4 Do welding in accordance with section 23 05 17 - Pipe Welding.

### **3.3 PIPE CLEANING AND START-UP**

- .1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

### **3.4 PERFORMANCE VERIFICATION**

- .1 In accordance with Section 23 08 01 - Performance Verification: Mechanical Piping Systems.

### **3.5 CLEANING**

- .1 Clean in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
  - .1 ANSI/ASME B31.1, Power Piping.
  - .2 ANSI/ASME B31.3, Process Piping.
  - .3 ANSI/ASME B31.5, Refrigeration Piping and Heat Transfer Components
  - .4 ANSI/ASME B31.9, Building Services
  - .5 ANSI/ASME Boiler and Pressure Vessel Code:
    - .1 Section I: Power Boilers.
    - .2 Section V: Non-destructive Examination.
    - .3 Section IX: Welding and Brazing Qualifications.
- .2 American National Standards Institute/American Water Works Association (ANSI/AWWA)
  - .1 ANSI/AWWA C206, Field Welding of Steel Water Pipe.
- .3 American Welding Society (AWS)
  - .1 AWS B3.0, Welding Procedure and Performance Qualification
  - .2 AWS C1.1M/C1.1, Recommended Practices for Resistance Welding.
  - .3 AWS Z49.1, Safety in Welding, Cutting and Allied Process.
  - .4 AWS W1, Welding Inspection Handbook.
- .4 Canadian Standards Association (CSA International)
  - .1 CSA W47.2, Certification of Companies for Fusion Welding of Aluminum.
  - .2 CSA W48, Filler Metals and Allied Materials for Metal Arc Welding.
  - .3 CSA B51, Boiler, Pressure Vessel and Pressure Piping Code.
  - .4 CSA B52, Mechanical Refrigeration Code
  - .5 CSA-W117.2, Safety in Welding, Cutting and Allied Processes.
  - .6 CSA W178.1, Certification of Welding Inspection Organizations.
  - .7 CSA W178.2, Certification of Welding Inspectors.
- .5 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-48.2, Spot Radiography of Welded Butt Joints in Ferrous Materials.
- .6 Provincial Regulations: Boiler, Pressure Vessel and Compressed Gas Regulations.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

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

### **1.3 QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Welders:
    - .1 Welding qualifications in accordance with CSA B51.
    - .2 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.
    - .3 Submit welder's qualifications to Department Representative.
    - .4 Each welder to possess identification symbol issued by authority having jurisdiction.
    - .5 Certification of companies for fusion welding of aluminum in accordance with CSA W47.2.
  - .2 Inspectors:
    - .1 Inspectors qualified to CSA W178.2.
  - .3 Certifications:
    - .1 Registration of welding procedures in accordance with CSA B51, CSA B52 and provincial regulations.
    - .2 Copy of welding procedures available for inspection.
    - .3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

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

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

## **Part 2 Products**

### **2.1 ELECTRODES**

- .1 Electrodes: in accordance with CSA W48 Series.

## **Part 3            Execution**

### **3.1                APPLICATION**

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

### **3.2                QUALITY OF WORK**

- .1        Welding: in accordance with ANSI/ASME B31.1, B31.3, B31.5, B31.9, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS B3.0, AWS C1.1, and special procedures specified elsewhere in Mechanical Divisions and applicable requirements of provincial authority having jurisdiction.

### **3.3                INSTALLATION REQUIREMENTS**

- .1        Identify each weld with welder's identification symbol.
- .2        Backing rings:
  - .1            Where used, fit to minimize gaps between ring and pipe bore.
  - .2            Do not install at orifice flanges.
- .3        Fittings:
  - .1            DN 50 (NPS 2) and smaller: install welding type sockets.
  - .2            Branch connections: install welding tees or forged branch outlet fittings.

### **3.4                INSPECTION AND TESTS - GENERAL REQUIREMENTS**

- .1        Review weld quality requirements and defect limits of applicable codes and standards with Department Representative before work is started.
- .2        Formulate "Inspection and Test Plan" in co-operation with Department Representative.
- .3        Do not conceal welds until they have been inspected, tested and approved by inspector.
- .4        Provide for inspector to visually inspect welds during early stages of welding procedures in accordance with Welding Inspection Handbook. Repair or replace defects as required by codes and as specified.

### **3.5                SPECIALIST EXAMINATIONS AND TESTS**

- .1        General:
  - .1            Perform examinations and tests by specialist qualified to CSA W178.1 and CSA W178.2 and approved by Department Representative.
  - .2            To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.
  - .3            Inspect and test in accordance with "Inspection and Test Plan" by non-destructive visual examination and magnetic particle (hereinafter referred to as "particle") tests and/or spot or full gamma ray radiographic (hereinafter referred to as "radiography") tests.



- .4 As per applicable reference standard or as specified.
- .2 Hydrostatically test welds to ANSI/ASME B31.1.
- .3 Visual examinations: include entire circumference of weld externally and wherever possible internally.
- .4 Failure of visual examinations:
  - .1 Upon failure of welds by visual examination, perform additional testing as directed by Department Representative of total of up to 10% of welds, selected at random by Department Representative by radiographic tests.
- .5 Full radiographic tests for piping systems.
  - .1 Spot radiography to CAN/CGSB-48.2.
    - .1 Conduct spot radiographic tests of up to 10% of welds, selected at random by Department Representative from welds which would be most difficult to repair in event of failure after system is operational.
  - .2 Radiographic film:
    - .1 Identify each radiographic film with date, location, name of welder, and submit to Department Representative. Replace film if rejected because of poor quality.
  - .3 Interpretation of radiographic films:
    - .1 By qualified radiographer.
  - .4 Failure of radiographic tests:
    - .1 Extend tests to welds by welder responsible when those welds fail tests.
- .6 Magnetic particle tests for piping systems as indicated.

### **3.6 DEFECTS CAUSING REJECTION**

- .1 As described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code.
- .2 In addition, chilled water systems below 1,000 kPa:
  - .1 Undercutting greater than 0.8 mm adjacent to cover bead on outside of pipe.
  - .2 Undercutting greater than 0.8 mm adjacent to root bead on inside of pipe.
  - .3 Undercutting greater than 0.8 mm at combination of internal surface and external surface.
  - .4 Incomplete penetration and incomplete fusion greater than total length of 38 mm in 1,500 mm length of weld depth of such defects being greater than 0.8 mm.
  - .5 Repair cracks and defects in excess of 0.8 mm in depth.
  - .6 Repair defects whose depth cannot be determined accurately on basis of visual examination or radiographic tests.

### **3.7 REPAIR OF WELDS WHICH FAILED TESTS**

- .1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

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

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME Fluid Meter's Handbook: Their Theory and Application, Sixth Edition.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
    - .1 Submit 2 copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Submittals to include:
  - .1 Piping configuration and sizing - straight pipe upstream and downstream, distances to first weld, protrusion, thermowell, pressure tap.
  - .2 Service conditions.
  - .3 Full details of primary element - standard of design and construction, materials, type serial number, flow rate, differential pressure, irrecoverable head loss (IHL), calculation sheets.
  - .4 Accuracy statements for each component at specified flow rates and other conditions.
  - .5 Flow and temperature ranges.
  - .6 Signal processor calibration data.
  - .7 Minimum turndown ratio.
- .4 Samples:
  - .1 Submit sample in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Samples to include:
- .5 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

- .2 Instructions: submit manufacturer's installation instructions.
  - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.
- .6 Closeout Submittals:
  - .1 Submit maintenance data including monitoring requirements for incorporation into manuals specified in Section 01 78 00 - Closeout Submittals.

### **1.3 QUALITY ASSURANCE**

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

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

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

## **Part 2 Products**

### **2.1 ACCURACY**

- .1 Calculate overall accuracy of each installation using following expression: Overall accuracy =  $(E(\text{accuracy of individual components of system})^2)^{1/2}$ .
- .2 Components to include:
  - .1 Primary flow measuring elements.
  - .2 Transmitters: flow, differential pressure, pressure, temperature, temperature difference.
  - .3 RTDs.
  - .4 Signal processors, recorders.
  - .5 Calibration of signal processors: assume 0.20% per processor.
  - .6 Installation tolerances: assume 1% for concentricity of pipe, difference in height of transmitter piping.

- .3 Show in proposal overall accuracy at 100%, 70%, 10%, minimum specified design flow rate.
- .4 Indicate minimum measurable flow rate.

### **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 datasheet.

#### **3.2 PREPARATION**

- .1 Before final calculations for orifice diameter, and before purchase of orifice plate, nozzle, venturi, measure:
  - .1 Internal diameter of main at the primary element to +/-0.01 mm accuracy.
  - .2 For concentricity of pipe.

#### **3.3 INSTALLATION OF PRIMARY ELEMENT**

- .1 Follow manufacturer's instructions.

#### **3.4 INSTALLATION OF DIFFERENTIAL PRESSURE TAPS AND PIPING**

- .1 Differential pressure taps horizontal and level with each other to within +/- 1.5 mm.
- .2 Tubing: straight, supported throughout its length, sloped 5-10% upward to main for drainage and venting, without air pockets, with blowdown valves at bottom.

#### **3.5 INSTALLATION OF TRANSMITTERS NOT FORMING INTEGRAL PART OF PRIMARY ELEMENT**

- .1 Mount on pipe stand installed and located to ensure no damage by passing traffic.

#### **3.6 INSTALLATION OF SIGNAL TRANSMISSION CABLE**

- .1 Ground shielding at one point only.
- .2 Protect against RF interference.
- .3 Cross electrical cables, conduits at 90 degrees leaving at least 150 mm space between.

#### **3.7 START-UP**

- .1 Follow manufacturer's recommendations.

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

**END OF SECTION**

**Part 1            General**

**1.1            REFERENCES**

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME B40.100, Pressure Gauges and Gauge Attachments.
  - .2 ASME B40.200, Thermometers, Direct Reading and Remote Reading.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-14.4, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.
  - .2 CAN/CGSB-14.5, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.
- .3 Efficiency Valuation Organization (EVO)
  - .1 International Performance Measurement and Verification Protocol (IPMVP)
- .4 Green Seal Environmental Standards (GS)
  - .1 GS-11, Standard for Paints and Coatings.
  - .2 GS-36, Standard for Commercial Adhesives.

**1.2            ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations. Submit for the following items:
    - .1 Thermometers
    - .2 Pressure Gauges
    - .3 Ball Valves
    - .4 Syphons
    - .5 Wells
- .3 Certificates:
  - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Test and Evaluation Reports:
  - .1 Submit certified test reports for product from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

### **1.3 DELIVERY, STORAGE AND HANDLING**

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

## **Part 2 Products**

### **2.1 GENERAL**

- .1 Design point to be at mid-point of scale or range.
- .2 Ranges: dual metric and imperial.

### **2.2 DIRECT READING THERMOMETERS**

- .1 Industrial, variable angle type, mercury-free, liquid filled, accuracy  $\pm$  one (1) scale division, 225 mm scale length: to CAN/CGSB-14.4 or ASME B40.200.
  - .1 Resistance to shock and vibration.
  - .2 Acceptable Manufacturers: Ashcroft, Terice, Wika, Winters

### **2.3 REMOTE READING THERMOMETERS**

- .1 100 mm diameter, mercury-free, liquid filled or vapour activated dial type: to CAN/CGSB-14.5 or ASME B40.200, accuracy  $\pm$  one (1) scale division, brass movement, stainless steel capillary, stainless steel spiral armour, stainless steel bulb and polished brass or stainless steel case for wall mounting.
  - .1 Acceptable Manufacturers: Ashcroft, Terice, Wika, Winters

### **2.4 THERMOMETER WELLS**

- .1 Copper pipe: copper or bronze.
- .2 Steel pipe: brass or stainless steel.

### **2.5 PRESSURE GAUGES**

- .1 112 mm diameter, dial type: to ASME B40.100, Grade 2A, stainless steel or phosphor bronze bourdon tube having 0.5% accuracy full scale or 1% accuracy for liquid filled, unless otherwise specified.



- .1 Acceptable Manufacturers: Ashcroft, Terice, Wika, Winters.
- .2 Provide:
  - .1 Siphon for steam service.
  - .2 Snubber for pulsating operation.
  - .3 Diaphragm assembly for corrosive service.
  - .4 Gasketed pressure relief back with solid front.
  - .5 Bronze ball valve to Section 23 05 23.01 - Valves - Bronze.
  - .6 Oil filled for high vibration applications, including pumps.

### **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 material 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 GENERAL**

- .1 Install thermometers and gauges so they can be easily read from floor or platform.
  - .1 If this cannot be accomplished, install remote reading units.
- .2 Install between equipment and first fitting or valve.

#### **3.3 THERMOMETERS**

- .1 Install in wells on piping. Include heat conductive material inside well.
- .2 Install on inlet and outlet of:
  - .1 Heat exchangers.
  - .2 Heating and cooling coils.
  - .3 Boilers.
  - .4 Chillers.
  - .5 Cooling towers, closed circuit coolers and evaporative condensers.
  - .6 DHW tanks.
  - .7 In other locations as indicated.
- .3 Install wells for balancing purposes.
- .4 Use extensions where thermometers are installed through insulation.

### **3.4 PRESSURE GAUGES**

- .1 Install in locations as follows:
  - .1 Suction and discharge of pumps, using liquid filled type.
  - .2 Upstream and downstream of PRVs.
  - .3 Upstream and downstream of control valves.
  - .4 Inlet and outlet of coils.
  - .5 Inlet and outlet of heat exchangers.
  - .6 Outlet of boilers.
  - .7 In other locations as indicated.
- .2 Install balls valves for balancing purposes.
- .3 Use extensions where pressure gauges are installed through insulation.

### **3.5 NAMEPLATES**

- .1 Install engraved lamicoid nameplates in accordance with Section 23 05 53.01 - Mechanical Identification, identifying medium.

### **3.6 CLEANING**

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

### **3.7 PROTECTION**

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

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCES**

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME).
  - .1 ANSI/ASME B1.20.1, Pipe Threads, General Purpose (Inch).
  - .2 ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
  - .3 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- .2 ASTM International
  - .1 ASTM A276, Standard Specification for Stainless Steel Bars and Shapes.
  - .2 ASTM A536, Standard Specification for Ductile Iron Castings.
  - .3 ASTM B16, Standard Specification for Free-Cutting Brass Rod Bar and Shapes for Use in Screw Machines.
  - .4 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
  - .5 ASTM B283, Standard Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
  - .6 ASTM B505/B505M, Standard Specification for Copper-Base Alloy Continuous Castings.
  - .7 ASTM B584, Specification for Copper Alloy Sand Castings for General Applications.
- .3 Canadian Standards Association (CSA)
  - .1 CSA B242, Groove and Solder Type Mechanical Pipe Couplings.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .5 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
  - .1 MSS-SP-25, Standard Marking System for Valves, Fittings, Flanges and Unions.
  - .2 MSS-SP-80, Bronze Gate Globe, Angle and Check Valves.
  - .3 MSS-SP-110, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.
  - .1 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 43 - Environmental Procedures and Section 01 35 29.06 - Health and Safety Requirements.

- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Alberta, Canada.
  - .2 Submit data for valves specified in this Section.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

### **1.4 QUALITY ASSURANCE**

- .1 Health and Safety
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .2 All grooved joint couplings, fittings, valves, and specialties to be the products of a single manufacturer. Grooving tools to be of the same manufacturer as the grooved components.

### **1.5 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra Materials/Spare Parts:
  - .1 Furnish following spare parts:
    - .1 Valve seats: one (1) for every ten (10) valves each size. Minimum one (1).
    - .2 Discs: one (1) for every ten (10) valves, each size. Minimum one (1).
    - .3 Stem packing: one (1) for every ten (10) valves, each size. Minimum one (1).
    - .4 Valve handles: two (2) of each size.
    - .5 Gaskets for flanges: one (1) for every ten (10) flanged joints.
    - .6 Grooved couplings: IPS and copper tube dimensioned, one (1) for every ten (10) grooved joints.
  - .2 Tools:
    - .1 Furnish special tools for maintenance of systems and equipment.
    - .2 Include following:
      - .1 Lubricant gun for expansion joints.

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

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground in a dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect materials from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

- .4 Packaging Waste Management: remove for reuse and/or recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Valves:
  - .1 Except for specialty valves, to be single manufacturer.
  - .2 Products to have CRN registration numbers.
- .2 End Connections:
  - .1 Connection into adjacent piping/tubing:
    - .1 Steel pipe systems: screwed ends to ANSI/ASME B1.20.1.
    - .2 Copper tube systems:
      - .1 Solder ends to ANSI/ASME B16.18.
      - .2 Grooved ends to copper tube dimensions and CSA B242.
- .3 Lockshield Keys:
  - .1 Where lockshield valves are specified, provide ten (10) keys of each size: malleable iron cadmium plated.

### **2.2 GATE VALVES**

- .1 Requirements common to gate valves, unless specified otherwise:
  - .1 Standard specification: MSS SP-80.
  - .2 Bonnet: union with hexagonal shoulders.
  - .3 Connections: screwed with hexagonal shoulders.
  - .4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.
  - .5 Packing: high grade non-asbestos.
  - .6 Handwheel: non-ferrous.
  - .7 Handwheel Nut: bronze to ASTM B62.
  - .8 Class 125, 860 kPa steam working pressure; Class 200, 1,400 kPa water-oil-gas (WOG).
  - .9 Class 150, 1,030 kPa steam working pressure; Class 300, 2,070 kPa WOG.
- .2 DN 50 (NPS 2) and under, non-rising stem, solid wedge disc, Class 125
  - .1 Body: with long disc guides, screwed bonnet with stem retaining nut.
  - .2 Operator: handwheel.
- .3 DN 50 (NPS 2) and under, non-rising stem, solid wedge disc, Class 150:
  - .1 Body: with long disc guides, screwed bonnet with stem retaining nut.
  - .2 Operator: handwheel.
- .4 DN 50 (NPS 2) and under, rising stem, split wedge disc, Class 125:
  - .1 Body: with long disc guides, screwed bonnet.
  - .2 Disc: split wedge, bronze to ASTM B283, loosely secured to stem.

- .3 Operator: handwheel.
- .5 DN 50 (NPS 2) and under, rising stem, solid wedge disc, Class 125:
  - .1 Body: with long disc guides, screwed bonnet.
  - .2 Operator: handwheel.
- .6 DN 50 (NPS 2) and under, rising stem, solid wedge disc, Class 150:
  - .1 Body: with long disc guides, screwed bonnet.
  - .2 Operator: handwheel.

## 2.3 GLOBE VALVES

- .1 Requirements common to globe valves, unless specified otherwise:
  - .1 Standard specification: MSS SP-80.
  - .2 Bonnet: union with hexagonal shoulders.
  - .3 Connections: screwed with hexagonal shoulders.
  - .4 Pressure testing: to MSS SP-80. Tests to be hydrostatic.
  - .5 Stuffing box: threaded to bonnet with gland follower, packing nut, high grade non-asbestos packing.
  - .6 Handwheel: non-ferrous.
  - .7 Handwheel Nut: bronze to ASTM B62.
  - .8 Class 125, 860 kPa steam working pressure; Class 200, 1,400 kPa water-oil-gas (WOG).
  - .9 Class 150, 1,030 kPa steam working pressure; Class 300, 2,070 kPa WOG.
- .2 DN 50 (NPS 2) and under, composition disc, Class 125:
  - .1 Body and bonnet: screwed bonnet.
  - .2 Disc and seat: renewable rotating PTFE disc in easily removable disc holder, regrindable bronze seat, loosely secured to bronze stem to ASTM B505.
  - .3 Operator: handwheel.
- .3 DN 50 (NPS 2) and under, composition disc, Class 150:
  - .1 Body and bonnet: union bonnet.
  - .2 Disc and seat: renewable rotating PTFE disc in easily removable disc holder, regrindable bronze seat, loosely secured to bronze stem to ASTM B505.
  - .3 Operator: handwheel.
- .4 DN 50 (NPS 2) and under, plug disc, Class 150, screwed ends:
  - .1 Body and bonnet: union bonnet.
  - .2 Disc and seat ring: tapered plug type with disc stem ring of stainless steel to ASTM A276, loosely secured to stem.
  - .3 Operator: handwheel.
- .5 Angle valve, DN 50 (NPS 2) and under, composition disc, Class 150:
  - .1 Body and bonnet: union bonnet.
  - .2 Disc and seat: renewable rotating PTFE disc in slip-on easily removable disc holder having integral guides, regrindable bronze seat, loosely secured to stem.

- .3 Operator: handwheel.

## 2.4 CHECK VALVES

- .1 Requirements common to check valves, unless specified otherwise:
  - .1 Standard specification: MSS SP-80.
  - .2 Connections: screwed with hexagonal shoulders.
  - .3 Class 125, 860 kPa steam working pressure; Class 200, 1,400 kPa water-oil-gas (WOG).
  - .4 Class 150, 1,030 kPa steam working pressure; Class 300, 2,070 kPa WOG.
  - .5 Class 200, 1,400 kPa cold working pressure (CWP).
- .2 DN 50 (NPS 2) and under, swing type, bronze disc, Class 125:
  - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
  - .2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.
- .3 DN 50 (NPS 2) and under, swing type, bronze disc, Class 150:
  - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
  - .2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.
- .4 DN 50 (NPS 2) and under, swing type, composition disc, Class 200:
  - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
  - .2 Disc: renewable rotating disc of #6 composition to suit service conditions, bronze two-piece hinge disc construction.
- .5 DN 50 (NPS 2) and under, horizontal lift type, composition disc, Class 150:
  - .1 Body: with integral seat, union bonnet ring with hex shoulders, cap.
  - .2 Disc: renewable PTFE for steam, #6 composition rotating disc for water-oil-gas in disc holder having guides top and bottom, of bronze to ASTM B62.
- .6 DN 50 (NPS 2) and under, vertical lift type, bronze disc, Class 125:
  - .1 Disc: rotating disc having guides top and bottom, disc guides, retaining rings.
- .7 DN 50 (NPS 2) and under, vertical or horizontal lift type, 1,380 kPa cold working pressure.
  - .1 Disc: 301 stainless steel, center guided.

## 2.5 SILENT CHECK VALVES

- .1 DN 50 (NPS 2) and under:
  - .1 Body: cast high tensile bronze to ASTM B62 with integral seat.
  - .2 Pressure rating: Class 125.
  - .3 Connections: screwed ends to ANSI B1.20.1 and with hex. shoulders.
  - .4 Disc and seat: renewable rotating disc.
  - .5 Heavy duty stainless steel spring required in vertical downflow applications.
  - .6 Seat: regrindable.

## **2.6 BALL VALVES**

- .1 DN 50 (NPS 2) and under:
  - .1 Body and cap: cast high tensile bronze to ASTM B16 or ASTM B62.
  - .2 Pressure rating: Class 125, 860 kPa steam.
  - .3 Connections: screwed ends to ANSI B1.20.1 and with hexagonal shoulders.
  - .4 Stem: tamperproof ball drive.
  - .5 Stem packing nut: external to body.
  - .6 Ball and seat: replaceable stainless steel or hard chrome plated solid brass ball and Teflon seats.
  - .7 Port: Standard or full port.
  - .8 Stem seal: TFE, EPDM, Nitrile, Fluoroelastomer with external packing nut.
  - .9 Operator: removable lever handle with extension for insulated pipe.
  - .10 Cap and drain for drain service.
- .2 DN 65 (NPS 2 ½) through DN 100 (NPS 4).
  - .1 Body and cap: cast high tensile bronze to ASTM B16 or ASTM B62.
  - .2 Pressure rating: Class 150, 1,030 kPa steam working pressure; Class 600, 4,140 kPa CWP.
  - .3 Connections: Solder ends to ANSI/ASME B16.18.
  - .4 Stem: tamperproof ball drive.
  - .5 Stem packing nut: external to body.
  - .6 Ball and seat: replaceable stainless steel or hard chrome plated solid brass ball and Teflon seats.
  - .7 Port: Standard or full port.
  - .8 Stem seal: TFE, EPDM, Nitrile, Fluoroelastomer with external packing nut.
  - .9 Operator: removable lever handle with extension for insulated pipe.

## **2.7 BUTTERFLY VALVES**

- .1 DN 65 (NPS 2 ½) through DN 150 (NPS 6).
  - .1 Body: cast bronze per CDA-836 (85-5-5-5).
  - .2 Pressure rating: 2,065 kPa cold working pressure.
  - .3 Connections: copper tube dimensioned grooved ends.
  - .4 Disc: ductile iron per ASTM A536 with elastomer coating.
  - .5 Stem: integrally cast with disc.
  - .6 Stem Nuts: nickel plated 416 stainless steel.
  - .7 Operator:
    - .1 DN 80 (NPS 3) and under: removable lever handle with extension for insulated pipe.
    - .2 DN 100 (NPS 4) and over: gear operator.

## **2.8 ACCEPTABLE PRODUCT**

- .1 Acceptable Product: Jenkins, Crane, Watts, Newman Hattersley, Milwaukee, Conbraco, Kitz, Red White, M.A. Stewart, Nibco, Victaulic.



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**Part 3            Execution**

**3.1            APPLICATION**

- .1    Ball Valve: for fully open/closed service and frequent operation.
  - .1        Use for all fully open/closed service whenever possible.
- .2    Butterfly Valve: for fully open/closed or throttling service and frequent operation.
  - .1        Use for all fully open/closed service where ball valves are impractical and/or required size is not available.
- .3    Gate Valve: for limited use only; for fully open/closed service and infrequent operation.
  - .1        Use with rising stem only where valve position indication is required.
    - .1            Use solid wedge disc where severe turbulence is expected.
  - .2        Use with non-rising stem for fully open/closed service only where ball valves or butterfly valves are impractical.
    - .1            Use solid wedge disc where severe turbulence is expected.
- .4    Globe Valve: for throttling service and frequent operation.
  - .1        Use composition or plug disc for general service and tight seating only.
  - .2        Use PTFE disc for tight seating and close throttling.

**3.2            INSTALLATION**

- .1    Install rising stem valves in upright position with stem above horizontal.
- .2    Remove internal parts before soldering.
- .3    Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.

**3.3            COMMISSIONING**

- .1    As part of commissioning activities, develop schedule of valves and record thereon identifier, location, service, purchase order number and date, manufacturer, identification data specified above.

**3.4            CLEANING**

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

**END OF SECTION**

Approved: 2009-06-30

## **Part 1            General**

### **1.1            REFERENCES**

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME B16.1, Cast Iron Pipe Flanges and Flanged Fittings.
- .2 ASTM International Inc.
  - .1 ASTM A49, Standard Specification for Heat-Treated Carbon Steel Joint Bars.
  - .2 ASTM A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
  - .3 ASTM A536, Standard Specification for Ductile Iron Castings.
  - .4 ASTM B61, Standard Specification for Steam or Valve Bronze Castings.
  - .5 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
  - .6 ASTM B85/B85M, Standard Specification for Aluminum-Alloy Die Castings.
  - .7 ASTM B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .4 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
  - .1 MSS SP-61, Pressure Testing of Steel Valves.
  - .2 MSS SP 67, Butterfly Valves.
  - .3 MSS SP-70, Grey Iron Gate Valves, Flanged and Threaded Ends.
  - .4 MSS SP-71, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
  - .5 MSS SP-82, Valve Pressure Testing Methods.
  - .6 MSS SP-85, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

### **1.2            ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheets for valves and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 43 - Environmental Procedures and Section 01 35 29.06 - Health and Safety Requirements.
- .3 Shop Drawings:
  - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Alberta, Canada.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

### **1.4 QUALITY ASSURANCE**

- .1 Health and Safety
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .2 All grooved joint couplings, fittings, valves, and specialties to be the products of a single manufacturer. Grooving tools to be of the same manufacturer as the grooved components.

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

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

### **1.6 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra Materials/Spare Parts:
- .2 Furnish following spare parts:
  - .1 Valve seats: one (1) for every ten (10) valves each size. Minimum one (1).
  - .2 Discs: one (1) for every ten (10) valves, each size. Minimum one (1).
  - .3 Stem packing: one (1) for every ten (10) valves, each size. Minimum one (1).
  - .4 Valve handles: two (2) of each size.
  - .5 Gaskets for flanges: one (1) for every ten (10) flanged joints.
  - .6 Grooved couplings: IPS and copper tube dimensioned, one (1) for every ten (10) grooved joints. Valve seats: one for every (10) valves each size, minimum (1).
- .3 Tools:
  - .1 Furnish special tools for maintenance of systems and equipment.
  - .2 Include following:
    - .1 Lubricant gun for expansion joints.

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**Part 2            Products**

**2.1            MATERIAL**

- .1    Except for specialty valves, to be of single manufacturer.
- .2    Standard specifications:
  - .1    Gate valves: MSS SP-70.
  - .2    Globe valves: MSS SP-85.
  - .3    Check valves: MSS SP-71.
- .3    Requirements common to valves, unless specified otherwise:
  - .1    Body, bonnet: cast iron to ASTM B209 Class B.
  - .2    Connections: flanged ends, plain face to ANSI B16.1.
  - .3    Inspection and pressure testing: to MSS SP-82.
  - .4    Bonnet gasket: non-asbestos.
  - .5    Stem: to have precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut.
  - .6    Stuffing box: non-galling two-piece ball-jointed packing gland, gland bolts and nuts.
  - .7    Gland packing: non-asbestos.
  - .8    Handwheel: die-cast aluminum alloy to ASTM B85/B85M or malleable iron to ASTM A49. Nut of bronze to ASTM B62.
  - .9    Identification tag: with catalogue number, size, other pertinent data.
- .4    All products to have Canadian Registration Numbers (CRN).
- .5    Bronze trim for steam, water, air or glycol service.
- .6    Iron trim for oil, gas, or gasoline.
- .7    Acceptable Product: Crane, Jenkins, Milwaukee, Newman Hattersley, Kitz, M.A. Stewart, NIBCO.

**2.2            GATE VALVES**

- .1    DN 50 (NPS 2 ½) through DN 200 (NPS 8): non rising stem, inside screw, bronze or iron trim, solid wedge disc.
  - .1    Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, Class 125.
  - .2    Bronze trim:
    - .1    Disc: solid offset taper wedge, bronze to ASTM B62.
    - .2    Seat rings: renewable bronze to ASTM B62, screwed into body.
    - .3    Stem: bronze to ASTM B62.
  - .3    Iron trim:
    - .1    Disc: solid offset taper wedge, cast iron to ASTM A126 Class B, secured to wrought steel stem.
    - .2    Seat: integral with body.

- .3 Stem: wrought steel.
  - .4 Operator: handwheel.
- .2 DN 250 (NPS 10) through DN 600 (NPS 24): non rising stem, inside crew, bronze or iron trim, solid wedge disc.
  - .1 Body and multiple-bolted bonnet: cast iron to ASTM A126 Class B for sizes up to DN 350 (NPS 14), Class C for sizes DN 400 (NPS 16) and over, with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, body tie ribs between bonnet and end flanges.
  - .2 Pressure ratings: Class 125.
  - .3 Bronze trim:
    - .1 Disc: solid offset taper wedge, with bronze rings to ASTM B62 rolled into cast iron disc, secured to stem.
    - .2 Seat rings: renewable bronze to ASTM B62 screwed into body.
    - .3 Stem: bronze to ASTM B62.
  - .4 Iron trim:
    - .1 Disc: solid offset taper wedge, cast iron secured to stem.
    - .2 Seat: integral with body up to 350 DN (NPS 14), renewable nodular iron on other sizes.
    - .3 Stem: wrought steel.
    - .4 Operator: handwheel.
- .3 DN 65 (NPS 2 ½) through DN 200 (NPS 8): outside screw and yoke (OS&Y), bronze or iron trim, solid wedge disc.
  - .1 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, yoke, yoke hub, yoke sleeve and nut. Class 125.
  - .2 Bronze trim:
    - .1 Disc: solid offset taper wedge, bronze to ASTM B62 up to DN 80 (NPS 3), cast iron with bronze disc rings on other sizes, secured to stem through integral forged T-head disc-stem connection.
    - .2 Seat rings: renewable bronze screwed into body.
    - .3 Stem: manganese-bronze.
  - .3 Iron trim:
    - .1 Disc: solid offset taper all-cast iron, secured to stem through integral forged T-head disc-stem connection.
    - .2 Seat rings: integral with body.
    - .3 Stem: nickel-plated steel for iron trim.
  - .4 Pressure-lubricated operating mechanism.
  - .5 Operator: handwheel.
- .4 DN 250 (NPS 10) through DN 600 (NPS 24): outside screw and yoke (OS&Y), bronze or iron trim, solid wedge disc.

- .1 Body and multiple-bolted bonnet: With bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, body tie ribs between bonnet and end flanges, yoke, yoke hub, yoke sleeve and nut.
  - .1 DN 250-350 (NPS 10-14): cast iron to ASTM A126 Class B.
  - .2 DN 400-600 (NPS 16-24): cast iron to ASTM A126 Class B.
- .2 Pressure ratings: Class 125.
  - .1 DN 250-300 (NPS 10-12): WP = 1.4 MPa CWP.
  - .2 DN 350-600 (NPS 14-24): WP = 1.03 MPa CWP.
- .3 Bronze trim:
  - .1 Disc: solid offset taper wedge, bronze disc rings to ASTM B62 rolled into cast iron disc, secured to stem through integral forged T-head disc-stem connection.
  - .2 Seat rings: renewable bronze to ASTM B62 screwed into body.
  - .3 Stem: manganese-bronze.
- .4 Iron trim:
  - .1 Disc: solid offset taper all-cast iron, secured to stem through integral forged T-head disc-stem connection.
  - .2 Seat: integral with body up to DN 350 (NPS 14), renewable nodular iron on other sizes.
  - .3 Stem: nickel-plated steel.
- .5 Pressure-lubricated operating mechanism.
- .6 Operator: handwheel.

## 2.3

### UNDERWRITERS APPROVED GATE VALVE

- .1 DN 65 (NPS 2 ½) through DN 350 (NPS 14), OS&Y:
  - .1 Approvals: UL and FM approved for fire service.
  - .2 UL and FM Label: on valve yoke.
  - .3 Body, Bonnet: cast iron to ASTM A126 Class B. Wall thicknesses to ANSI B16.1 and ULC C-262 (B).
  - .4 Bonnet bushing, yoke sleeve: bronze, to FM requirements.
  - .5 Packing gland: bronze.
  - .6 Stem: manganese bronze. Diameter to ULC C-262 (B).
  - .7 Stuffing box dimensions, gland bolt diameter: to ULC C-262 (B).
  - .8 Bosses for bypass valve, drain: on DN 100 (NPS 4) and over.
  - .9 Disc: solid taper wedge.
    - .1 Up to DN 80 (NPS 3): bronze.
    - .2 DN 100 (NPS 4) and over: EPDM coated cast iron with bronze disc rings.
  - .10 Disc seat ring: self-aligning, Milwood undercut on DN 80-300 (NPS 3-12).
  - .11 Pressure rating:
    - .1 DN 65-300 (NPS 2 ½-12): 1.7 MPa CWP.
    - .2 DN 350 (NPS 14): 1.2 MPa CWP.

- .12 Operator: handwheel.

## **2.4 GLOBE VALVES**

- .1 DN 65 (NPS 2 ½) through DN 250 (NPS 10), OS&Y:
  - .1 Body: with multiple-bolted bonnet.
  - .2 WP: 860 kPa steam, 1.4 MPa CWP.
  - .3 Bonnet-yoke gasket: non-asbestos.
  - .4 Disc: bronze to ASTM B62, fully guided from bottom, securely yet freely connected to stem for swivel action and accurate engagement with disc.
  - .5 Seat ring: renewable, regrindable, screwed into body.
  - .6 Stem: bronze to ASTM B62.
  - .7 Operator: handwheel.

## **2.5 BYPASSES FOR GATE AND GLOBE VALVES**

- .1 Locations: on valves as indicated.
- .2 Position of bypass valve on main valves: spindle uprights or parallel position.
- .3 Size of bypass valve:
  - .1 Main valve up to DN 200 (NPS 8): DN 20 (NPS ¾).
  - .2 Main valve DN 250 (NPS 10) and over: DN 25 (NPS 1).
- .4 Type of bypass valves:
  - .1 On gate valve: globe, with composition disc, trim, to Section 23 05 23.01 – Valves - Bronze. Pressure rating to match main valve.
  - .2 On globe valve: globe, with composition disc, bronze trim, to Section 23 05 23.01 - Valves - Bronze. Pressure rating to match main valve.

## **2.6 VALVE OPERATORS**

- .1 Install valve operators as follows:
  - .1 Handwheel: on valves except as specified.
  - .2 Handwheel with chain operators: on valves installed more than 2,400 mm above floor in boiler rooms and mechanical equipment rooms.

## **2.7 CHECK VALVES**

- .1 Swing check valves, Class 125:
  - .1 Body and bolted cover: with tapped and plugged opening on each side for hinge pin. Grooved or flanged ends: plain faced with smooth finish.
    - .1 Up to DN 400 (NPS 16): cast iron to ASTM A126 Class B.
    - .2 DN 450 (NPS 18) and over: cast iron to ASTM A126 Class C.
  - .2 Ratings:
    - .1 DN 65-300 (NPS 2 ½-12): 860 kPa steam; 1.4 MPa CWP.
    - .2 DN 350-400 (NPS 14-16): 860 kPa steam; 1.03 MPa CWP.
    - .3 DN 450 (NPS 18) and over: 1.03 MPa CWP.

- .3 Bronze trim:
  - .1 Disc: rotating for extended life.
    - .1 Up to DN 150 (NPS 6): bronze to ASTM B62.
    - .2 DN 200 (NPS 8) and over: bronze-faced cast iron.
  - .2 Seat rings: renewable bronze to ASTM B62 screwed into body.
  - .3 Hinge pin, bushings: renewable bronze to ASTM B62.
- .4 Iron trim:
  - .1 Disc: A126 Class B, secured to stem, rotating for extended life.
  - .2 Seat: cast iron, integral with body.
  - .3 Hinge pin: exelloy; bushings: malleable iron.
- .5 Identification tag: fastened to cover.
- .6 Hinge: galvanized malleable iron.
- .2 Swing check valves, DN 65 through DN 200 (NPS 2 1/2 through NPS 8) Class 250:
  - .1 Body and bolted cover: cast iron to ASTM A126 Class B with tapped and plugged opening on each side for hinge pin.
  - .2 Flanged ends: 2 mm raised face with serrated finish.
  - .3 Rating: 1.7 MPa steam; 3.4 MPa CWP.
  - .4 Disc: rotating for extended life.
    - .1 Up to DN 80 (NPS 3): bronze to ASTM B61.
    - .2 DN 100-200 (NPS 4-8): iron faced with ASTM B61 bronze.
  - .5 Seat rings: renewable bronze to ASTM B61, screwed into body.
  - .6 Hinge pin, bushings: renewable, bronze to ASTM B61.
  - .7 Hinge: galvanized malleable iron.
  - .8 Identification tag: fastened to cover.

## **2.8 SILENT CHECK VALVES**

- .1 Body: malleable or ductile iron with integral seat.
- .2 Pressure rating: Class 125, WP = 860 kPa.
- .3 Connections: grooved ends or flanged.
- .4 Disc: bronze or stainless steel renewable rotating disc.
- .5 Seat: renewable, EPDM.
- .6 Stainless steel spring, heavy duty.

## **2.9 GROOVED-END BUTTERFLY VALVES**

- .1 Butterfly valves: to MSS-SP-67.
  - .1 DN 50 (NPS 2) and over: Grooved ends.
  - .2 2,068 kPa WOG and be both bi-directional and dead end service capable to full rated pressure. Ductile iron body with blow-out proof stainless steel stems and nickel coated ductile iron disc. Seat shall be "EPDM" and have a full 360° continuous contact with the seating surface.



- .3 Valve Operators: Lever DN 50-100 (NPS 2-4); gear operator DN 150 (NPS 6) and over.
- .4 Application: Isolating cells or section of multiple component equipment (eg. multi section coils, multi cell cooling towers).

## **2.10 ACCEPTABLE PRODUCT**

- .1 Jenkins, Crane, Milwaukee, Conbraco, Kitz, Red White, M. A. Stewart, Nibco, Victaulic.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install rising stem valves in upright position with stem above horizontal. Ensure sufficient room for valve stem in fully open position.
- .2 Grooved end valves to be supplied by the same manufacture of the grooved fittings.
- .3 Grooved end valves to be installed in accordance with the manufacturer's written installation instructions. Grooved ends to be clean and free from indentations and projections. Gaskets to be verified as suitable for the intended service prior to installation. Gaskets to be molded and produced by the coupling manufacturer. The grooved coupling manufacturer's factory trained representative to provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer's representative to periodically visit the jobsite and review installation. Contractor to remove and replace any joints deemed improperly installed.

### **3.2 COMMISSIONING**

- .1 As part of commissioning activities, develop schedule of valves and record thereon identifier, location, service, purchase order number and date, manufacturer, identification data specified above.

### **3.3 CLEANING**

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

**END OF SECTION**

Approved: 2012-12-31

**Part 1            General**

**1.1            REFERENCES**

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
  - .1 ASME B16, Fittings and Valves Package.
  - .2 ASME B16.5, Pipe Flanges and Flanged Fittings: NPS through NPS 24 Metric/Inch Standard.
  - .3 ANSI/ASME B16.10, Face-to-Face and End-to-End Dimensions Valves.
  - .4 ANSI/ASME B16.25, Buttwelding Ends.
  - .5 ANSI/ASME B16.34, Valves Flanged, Threaded and Welding End.
- .2 American Petroleum Institute (API)
  - .1 API STD 598, Valve Inspection and Testing.
- .3 ASTM International
  - .1 ASTM A49, Standard Specification for Heat-Treated Carbon Steel Joint Bars, Micro Alloyed Joint Bars, and Forged Carbon Steel Comprise Joint Bars.
  - .2 ASTM A182/A182M, Standard Specification for Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valve Parts for High Temperature Service.
  - .3 ASTM A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature or High Pressure Service and Other Special Purpose Applications.
  - .4 ASTM A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service, or Both.
  - .5 ASTM A216/A216M, Standard Specification for Steel Castings, Carbon Suitable for Fusion Welding for High-Temperature Service.
  - .6 ASTM B85/B85M, Standard Specification for Aluminum-Alloy Die Castings.
- .4 Efficiency Valuation Organization (EVO)
  - .1 International Performance Measurement and Verification Protocol (IPMVP)
    - .1 IPMVP.
- .5 Green Seal Environmental Standards (GS)
  - .1 GS-11, Standard for Paints and Coatings.
  - .2 GS-36, Standard for Commercial Adhesives.
- .6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .7 Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)
  - .1 MSS SP-25, Standard Marking System for Valves, Fittings, Flanges and Unions.

- .2 MSS SP-61, Pressure Testing of Valves.

## **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for valves and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 43 - Environmental Procedures and Section 01 35 29.06 - Health and Safety Requirements.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Alberta, Canada.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

## **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for valves for incorporation into manual.

## **1.4 QUALITY ASSURANCE**

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

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

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

## **1.6 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Extra Stock Materials:
- .3 Furnish following spare parts:
  - .1 Valve seats: one (1) for every ten (10) valves each size. Minimum one (1).
  - .2 Discs: one (1) for every ten (10) valves, each size. Minimum one (1).
  - .3 Stem packing: one (1) for every ten (10) valves, each size. Minimum one (1).
  - .4 Valve handles: two (2) of each size.
  - .5 Gaskets for flanges: one (1) for every ten (10) flanged joints.

## **Part 2 Products**

### **2.1 MATERIAL**

- .1 Except for specialty valves, to be of single manufacturer.
- .2 Valves to be individually tested.
- .3 Requirements common to valves, unless specified otherwise:
  - .1 Pressure-temperature ratings: to ANSI B16.34.
  - .2 Inspections and tests: to API 598.
  - .3 Pressure testing: to MSS SP-61.
  - .4 Flanged valves:
    - .1 Face-to-face dimensions: to ANSI B16.10.
    - .2 Flange dimensions: to ANSI B16.5 with 1.6 mm raised face.
  - .5 Butt-weld valves:
    - .1 End-to-end dimensions: to ANSI B16.10.
    - .2 End dimensions: to ANSI B16.25 bored for standard pipe schedule.
  - .6 Handwheel: non-heating type with raised rim of die-cast aluminum alloy to ASTM B85 or malleable iron to ASTM A49.
  - .7 Markings: to MSS SP-25.
  - .8 Identification:
    - .1 Plate showing catalogue number, size, material of body disc, stem seat, fluid, pressure-temperature rating.
    - .2 Body markings: manufacturer, size, primary service rating, material symbol.
  - .9 Canadian Registration Number (CRN) required for all products.

### **2.2 GATE VALVES**

- .1 DN 65 through DN 300 (NPS 2 ½ through NPS 12), rising stem, OS&Y, flexible wedge disc, flanged ends, Class 150 or 300:

- .1 Body and multiple-bolted integral yoke and bonnet: cast steel to ASTM A216/A216M WCB, with full length disc guides designed to ensure correct re-assembly.
- .2 Body/bonnet joint: flat face with corrugated metallic gasket.
- .3 Bonnet studs: to ASTM A193/A193M Type B7.
- .4 Bonnet nuts: to ASTM A194/A194M Type 2H.
- .5 Stuffing box: including non-galling two-piece ball jointed packing gland, with swing-type eye bolts and nuts.
- .6 Gland packing: containing corrosion inhibitor to prevent stem pitting.
- .7 Yoke sleeve: Ni-Resist, minimum melting point above 954°C.
- .8 Hydraulic grease fitting: for lubrication of yoke sleeve bearing surfaces.
- .9 Disc: with disc stem ring to connect to stem, guided throughout its travel.
  - .1 DN 65-150 (NPS 2 ½-6): solid corrosion and heat resistant 13% chromium steel with minimum hardness of 350 HB.
  - .2 DN 200 (NPS 8) and larger: carbon steel faced with corrosion and heat resistant 13 chromium steel with minimum hardness of 350 HB.
- .10 Seat ring: seamless carbon steel with hard-faced cobalt-chromium-tungsten alloy seating surface, slipped in, seal welded, ground to match disc.
- .11 Stem: heat treated corrosion and heat resistant 13% chromium steel with accurately-cut precision-machined Acme or 60° V threads, top screwed for handwheel nut, T-head disc-stem connection.
- .12 Operator: see elsewhere in this Section.

## 2.3 GLOBE VALVES

- .1 DN 65 through DN 300 (NPS 2 ½ through NPS 12), rising stem, OS&Y, flanged ends, Class 150 or 300:
  - .1 Body and multiple-bolted integral yoke and bonnet: cast steel to ASTM A216/A216M WCB.
  - .2 Body/bonnet joint: male-female face with corrugated metallic gasket.
  - .3 Bonnet studs: to ASTM A193/A193M Type B7.
  - .4 Bonnet nuts: to ASTM A194/A194M Type 2H.
  - .5 Stuffing box: including non-galling two-piece ball-jointed packing gland, with swing-type eye bolts and nuts.
  - .6 Gland packing: containing corrosion inhibitor to prevent stem pitting.
  - .7 Yoke bushing: Ni-Resist, minimum melting point above 954°C.
  - .8 Hydraulic grease fitting: for lubrication of yoke sleeve bearing surfaces.
  - .9 Disc: plug type with 15° taper seat and bottom guide.
  - .10 Seat rings: with 1.6 mm thick cobalt-chromium-tungsten alloy facings with minimum hardness of 375 HB (cold), slipped in, seal welded, ground to match disc.
  - .11 Stem: heat treated corrosion and heat resistant 13% chromium steel with bonnet bushing, long engagement with yoke bushing for accurate seating, accurately-cut precision-machined Acme or 60° V threads, top screwed for handwheel nut.

- .12 Operator: see elsewhere in this Section.

## **2.4 VALVE OPERATORS**

- .1 Handwheel: on all gate and globe valves except as specified.
- .2 Handwheel with chain operators: on valves installed more than 2,400 mm above floor in boiler rooms and mechanical equipment rooms.

## **2.5 BYPASSES FOR GATE AND GLOBE VALVES**

- .1 Locations: on valves as indicated.
- .2 Position of bypass valve on main valves: stem vertical or parallel position.
- .3 Size of bypass valve:
  - .1 Main valve up to DN 200 (NPS 8): DN 20 (NPS ¾).
  - .2 Main valve DN 250 (NPS 10) and over: DN 25 (NPS 1).
- .4 Type of bypass valves:
  - .1 On gate valve: globe, with composition disc, bronze trim, to Section 23 05 23.01 - Valves - Bronze.
  - .2 On globe valve: globe, with composition disc, bronze trim, to Section 23 05 23.01 - Valves - Bronze.

## **2.6 CHECK VALVES**

- .1 DN 65 (NPS 2 ½) and over, flanged ends, Class 150 or 300: swing check.
  - .1 Body and multiple-bolted cap: cast steel to ASTM A216/A216M WCB.
  - .2 Cap studs: to ASTM A193/A193M Type B7.
  - .3 Cap nuts: to ASTM A194/A194M Type 2H.
  - .4 Body/cap joint: male-female face with corrugated metallic gasket.
  - .5 Disc: heat treated corrosion and heat resistant 13% chromium steel.
  - .6 Seat rings: heat treated corrosion and heat resistant 13% chromium steel, slipped in, seal welded, ground to match disc.
  - .7 Hinge: ASTM A182/A182M.
  - .8 Hinge pin: 410 stainless steel.

## **2.7 SILENT CHECK VALVES**

- .1 Construction:
  - .1 Body: cast steel to ASTM A216/A216M WCB with integral seat.
  - .2 Pressure rating: Class 125, 250.
  - .3 Connections: flanged ends.
  - .4 Double bronze disc with SS seat and stem. Renewable disc, seat, stem and spring. Spring rating must match system design for silent operation and installation.
  - .5 Stainless steel spring, heavy duty.

- .6      Seat: regrindable.

## **2.8            ACCEPTABLE PRODUCT**

- .1      Crane, Jenkins, M. A. Stewart, Milwaukee (Silent Check Valves).

## **Part 3            Execution**

### **3.1            INSTALLATION**

- .1      Install in accordance with manufacturer's recommendations in upright position with stem above horizontal.

### **3.2            COMMISSIONING**

- .1      As part of commissioning activities, develop schedule of valves and record thereon identifier, location, service, purchase order number and date, manufacturer, identification data specified above.

### **3.3            CLEANING**

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

**END OF SECTION**

Approved: 2009-06-30

## **Part 1           General**

### **1.1           REFERENCES**

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
  - .1 ASME B1.20.1, Pipe Threads, General Purpose (Inch).
  - .2 ASME B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125 and 250.
  - .3 ANSI/ASME B16.5, Pipe Flanges and Flanged Fittings: NPS through 24.
  - .4 ANSI/ASME B16.11, Forged Fittings, Socket-Welding and Threaded.
  - .5 ANSI/ASME B16.25, Buttwelding Ends.
  - .6 ANSI/ASME B16.34, Valves - Flanged, Threaded and Welding Ends.
- .2 American Petroleum Institute (API)
  - .1 API Std. 609, Butterfly Valves: Double Flanged, Lug- and Wafer-Type.
- .3 ASTM International Inc.
  - .1 ASTM A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
  - .2 ASTM A536, Standard Specification for Ductile Iron Castings.
  - .3 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
  - .4 ASTM B209M, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .5 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
  - .1 MSS SP-67, Butterfly Valves.

### **1.2           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 datasheets for valves and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 43 - Environmental Procedures and Section 01 35 29.06 - Health and Safety Requirements.



- .3 Shop Drawings:
  - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Alberta, Canada.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for valves for incorporation into manual.

### **1.4 QUALITY ASSURANCE**

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

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

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

### **1.6 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Extra Materials/Spare Parts:
- .3 Furnish following spare parts:
  - .1 Valve seats: one (1) for every ten (10) valves each size. Minimum one (1).
  - .2 Discs: one (1) for every ten (10) valves, each size. Minimum one (1).
  - .3 Stem packing: one (1) for every ten (10) valves, each size. Minimum one (1).
  - .4 Valve handles: two (2) of each size.
  - .5 Gaskets for flanges: one (1) for every ten (10) flanged joints.
- .4 Tools:
  - .1 Furnish special tools for maintenance of systems and equipment.
  - .2 Include following:
    - .1 Lubricant gun for expansion joints.

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**Part 2            Products**

**2.1            MATERIAL**

- .1    Except for specialty valves, to be of single manufacturer.
- .2    Valves to be individually tested.
- .3    Requirements common to valves, unless specified otherwise:
  - .1    Pressure-temperature ratings: to ANSI B16.34.
  - .2    Identification:
    - .1    Plate showing catalogue number, size, material of body disc, stem seat, fluid, pressure-temperature rating.
    - .2    Body markings: manufacturer, size, primary service rating, material symbol.
  - .3    Canadian Registration Number (CRN) required for all products.

**2.2            BUTTERFLY VALVES - RESILIENT SEAT – 1.4 MPAG**

- .1    To be suitable for dead-end service.
- .2    Sizes:
  - .1    Wafer or Lug type: DN 50 (NPS 2) to DN 750 (NPS 30).
- .3    Pressure rating for tight shut-off at temperatures up to maximum for seat material.
  - .1    DN 50-300 (NPS 2-12): 1.4 MPa CWP.
  - .2    DN 350-1,200 (NPS 14-48): 1.4 MPa CWP.
- .4    Minimum seat temperature ratings to 135°C.
- .5    Application: on-off operation.
- .6    Full lug body (threaded).
- .7    Operators:
  - .1    DN 50-150 (NPS 2-6): handles capable of locking in any of ten (10) positions - 0° to 90°. Handle and release trigger - ductile iron. Return spring and hinge pin: carbon steel. Latch plate and mounting hardware: cadmium plated carbon steel. Standard coating: black laquer.
  - .2    DN 200-750 (NPS 8-30): manual enclosed gear operator.
- .8    Designed to comply with MSS SP-67 and API 609.
- .9    Compatible with ANSI Class 125/Class 150 flanges.
- .10   Construction:
  - .1    Body ductile iron.
  - .2    Disc: aluminum bronze.
  - .3    Seat: EPDM.
  - .4    Shaft: 416 stainless steel.
  - .5    Taper pin: 316 stainless steel.
  - .6    Key: carbon steel or stainless.

- .7 O-Ring: Buna-N.
- .8 Bushings: luberized bronze or Teflon.

## **2.3 BUTTERFLY VALVES - RESILIENT SEAT – 1.97 MPAG**

- .1 Sizes:
  - .1 Lug type: DN 50 (NPS 2) to DN 1200 (48).
- .2 Pressure rating: 1.97 MPa at 135°C.
- .3 Lug body: 150 ANSI bolt pattern.
- .4 Full lug body (threaded).
- .5 Application: for on-off service.
- .6 Operators:
  - .1 DN 50-150 (NPS 2-6): handles capable of locking in any of ten (10) positions - 0° to 90°. Handle and release trigger - ductile iron. Return spring and hinge pin: carbon steel. Latch plate and mounting hardware: cadmium plated carbon steel.
  - .2 DN 200-600 (NPS 8-24): manual enclosed gear operator.
  - .3 Install parallel or perpendicular to pipeline.
- .7 Designed to comply with MSS SP-67 and API 609.
- .8 Compatible with ANSI B16.1 Class 125 (iron) and ANSI B16.5 Class 150 (steel) flanges.
- .9 Construction:
  - .1 Body: ductile iron.
  - .2 Disc: aluminum bronze.
  - .3 Seat: EPDM.
  - .4 Refer to manufacturer's literature for additional materials.
  - .5 Shaft:
    - .1 DN 50-300 (NPS 2-12): 416 stainless steel.
    - .2 DN 350-1200 (NPS 14-48): 316 stainless steel.
  - .6 Taper pin: 316 SS.
  - .7 Blowout proof stem.
  - .8 O-Ring: Buna-N.
  - .9 Bushings: Teflon.
  - .10 Disc shall not be pinned to shaft.
  - .11 Bubble tight shutoff with downstream flanges removed, class 6 shutoff.

## **2.4 BUTTERFLY VALVES – 2.1 MPAG**

- .1 Sizes:
  - .1 Grooved ends: DN 50 (NPS 2) to DN 300 (NPS 12).
- .2 Pressure rating: 2.1 MPa WOG.
- .3 Body: Ductile Iron to ASTM A-536 with polypropylene coating.
- .4 Disc: Ductile Iron to ASTM A-536.

- .5 Disc coating: EPDM.
- .6 Body coating: Polyphenylene Sulfide Blend.
- .7 Drive Hub Adapter and Operation Bracket: hot rolled steel, enamel coated.
- .8 Upper bearing/lower Trunnion seals: EPDM
- .9 Upper bearing/lower Trunnion: Navel brass or Bronze alloy.
- .10 Bolts and washers: Cold rolled steel, zinc plated.
- .11 Operator:
  - .1 DN 50-75 (NPS 2-3): two position manual handle
  - .2 DN 75-150 (NPS 3-6): Manual level lock
  - .3 DN 200-300 (NPS 8-12): Manual gear operator with handwheel
  - .4 Handwheel with chain operator: on valves installed more than 2,400 mm above floor in boiler rooms and mechanical equipment rooms.

## **2.5 MOUNTING FLANGES**

- .1 Class 125 cast iron to ANSI B16.1 or Class 150 steel to B16.5 pipe flanges.

## **2.6 ELECTRIC ACTUATORS**

- .1 Operation: designed to provide precise quarter turn electric operation.
  - .1 Torque range: up to 1,130 N-m and speed ranges from 10 seconds to 30 seconds to move from fully open to fully closed.
  - .2 Gear train within actuator to provide smooth continuous rotary power stroke for accurate automatic valve positioning. Factory-set, field adjustable cam-actuated travel limit switches to provide precise control of shaft rotation.
- .2 Construction:
  - .1 Castings: heavy duty industrial grade for rugged use.
  - .2 Actuators: continuous duty with high efficiency single phase reversing capacitor motor with thermal overload protection.
  - .3 Gears and pinions constructed from hardened steel.
  - .4 Gear train to be permanently lubricated.
  - .5 Mechanical brake to ensure that gear is locked in precise position.
- .3 Electrical:
  - .1 Standard voltage: 120 VAC. 60 Hz.
  - .2 Control options: 4-20 Ma DC or 0-10 V DC.
  - .3 CSA approved.
  - .4 Electrical rating: NEMA IV.

## **Part 3 Execution**

### **3.1 PREPARATION**

- .1 Valve and mating flange preparation.

- .1 Inspect adjacent pipeline, remove rust, scale, welding slag, other foreign material.
- .2 Ensure that valve seats and pipe flange faces are free of dirt or surface irregularities which may disrupt flange seating and cause external leakage.
- .3 Install butterfly valves with disc in almost closed position.
- .4 Inspect valve disc seating surfaces and waterway and eliminate dirt or foreign material.

### **3.2 INSTALLATION OF VALVES**

- .1 Install in accordance with manufacturer's instructions.
- .2 Do not use gaskets between pipe flanges and valves unless instructed otherwise by valve manufacturer.
- .3 Verify suitability of valve for application by inspection of identification tag.
- .4 Mount actuator on to valve prior to installation.
- .5 Handle valve with care so as to prevent damage to disc and seat faces.
- .6 Valves in horizontal pipe lines should be installed with stem in horizontal position to minimize liner and seal wear.
- .7 Ensure that valves are centered between bolts before bolts are tightened and then opened and closed to ensure unobstructed disc movement. If interference occurs due, for example to pipe wall thickness, taper bore adjacent piping to remove interference.

### **3.3 ACTUATOR INSTALLATION**

- .1 Air hoses or electrical connections to be made by actuator manufacturer.
- .2 Cycle valve operation from fully closed to fully open then back to fully closed.
- .3 At same time, check travel stop settings for proper disc alignment.

### **3.4 COMMISSIONING**

- .1 As part of commissioning activities, develop schedule of valves and record thereon identifier, location, service, purchase order number and date, manufacturer, identification data specified above.

### **3.5 CLEANING**

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

**END OF SECTION**

Approved: 2009-12-31

**Part 1            General**

**1.1            REFERENCES**

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME B31.1, Power Piping.
- .2 ASTM International
  - .1 ASTM A125, Standard Specification for Steel Springs, Helical, Heat-Treated.
  - .2 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .3 ASTM A563, Standard Specification for Carbon and Alloy Steel Nuts.
- .3 Factory Mutual (FM)
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .5 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
  - .1 MSS SP58, Pipe Hangers and Supports - Materials, Design and Manufacture.
  - .2 MSS SP69, Pipe Hangers and Supports - Selection and Application.
  - .3 MSS SP89, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .6 National Resources Canada (NRC)
  - .1 Alberta Building Code (ABC).
  - .2 Alberta Fire Code (AFC).
  - .3 Alberta Plumbing Code (APC).
- .7 Underwriter's Laboratories of Canada (ULC)

**1.2            ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 43 - Environmental Procedures and Section 01 35 29.06 - Health and Safety Requirements.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Alberta, Canada.

- .2 Submit shop drawings for:
  - .1 Bases, hangers and supports.
  - .2 Connections to equipment and structure.
  - .3 Structural assemblies.
- .4 Certificates:
  - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Manufacturers' Instructions:
  - .1 Provide manufacturer's installation instructions.
    - .1 Department's Representative will make available one (1) copy of systems supplier's installation instructions.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

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

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

## **Part 2 Products**

### **2.1 SYSTEM DESCRIPTION**

- .1 Design Requirements:
  - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
  - .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.
  - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.

- .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
- .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.
- .2 Performance Requirements:
  - .1 Design supports, platforms, catwalks, hangers to withstand seismic events for location as per the Alberta Building Code.

## 2.2 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with MSS SP58.

## 2.3 PIPE HANGERS

- .1 Finishes:
  - .1 Pipe hangers and supports: galvanized or painted with zinc-rich paint after manufacture.
  - .2 Use electro-plating galvanizing process or hot dipped galvanizing process.
  - .3 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.
- .2 Upper attachment structural: suspension from lower flange of I-Beam:
  - .1 Cold piping DN 50 (NPS 2) maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
    - .1 Rod: 9 mm UL listed, 13 mm FM approved.
  - .2 Cold piping DN 65 (NPS 2 ½) or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed, FM approved where required to MSS-SP58 and MSS-SP69.
- .3 Upper attachment structural: suspension from upper flange of I-Beam:
  - .1 Cold piping DN 50 (NPS 2) maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed, FM approved where required to MSS SP69.
  - .2 Cold piping DN 65 (NPS 2 ½) or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut, UL listed, FM approved where required.
- .4 Upper attachment to concrete:
  - .1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
  - .2 Concrete inserts: wedge shaped body with knockout protector plate, UL listed, FM approved where required to MSS SP69.



- .5 Shop and field-fabricated assemblies:
  - .1 Trapeze hanger assemblies: to MSS SP89.
  - .2 Steel brackets: to MSS SP89.
  - .3 Sway braces for seismic restraint systems: to MSS SP89.
- .6 Hanger rods: threaded rod material to MSS SP58:
  - .1 Ensure that hanger rods are subject to tensile loading only.
  - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
  - .3 Do not use 22 mm or 28 mm rod.
- .7 Pipe attachments: material to MSS SP58:
  - .1 Attachments for steel piping: carbon steel, galvanized.
  - .2 Attachments for copper piping: copper plated black steel.
  - .3 Use insulation shields for hot pipework.
  - .4 Oversize pipe hangers and supports for insulated pipe.
- .8 Adjustable clevis: material to MSS SP69, UL listed, FM approved where required, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
  - .1 Ensure "U" has hole in bottom for rivetting to insulation shields.
- .9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.
- .10 U-bolts: carbon steel to MSS SP69 with two (2) nuts at each end to ASTM A563.
  - .1 Finishes for steel pipework: galvanized.
  - .2 Finishes for copper, glass, brass or aluminum pipework: black, with formed portion plastic coated or epoxy coated.
- .11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

## **2.4 RISER CLAMPS**

- .1 Steel or cast iron pipe: galvanized carbon steel to MSS SP58, type 42, UL listed, FM approved where required.
- .2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.
- .3 Bolts: to ASTM A307.
- .4 Nuts: to ASTM A563.

## **2.5 INSULATION PROTECTION SHIELDS**

- .1 Insulated cold piping:
  - .1 64 kg/m<sup>3</sup> density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.

- .2 Insulated hot piping:
  - .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes DN 300 (NPS 12) and over, carbon steel to comply with MSS SP69.

## **2.6 CONSTANT SUPPORT SPRING HANGERS**

- .1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR).
- .2 Load adjustability: 10% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.
- .3 Provide upper and lower factory set travel stops.
- .4 Provide load adjustment scale for field adjustments.
- .5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.
- .6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

## **2.7 VARIABLE SUPPORT SPRING HANGERS**

- .1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.
- .2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with two (2) springs in series in single casing.
- .3 Variable spring hanger complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.
- .4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

## **2.8 EQUIPMENT SUPPORTS**

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 12 23 - Structural Steel and Miscellaneous Metals. Submit calculations with shop drawings.

## **2.9 EQUIPMENT ANCHOR BOLTS AND TEMPLATES**

- .1 Provide templates to ensure accurate location of anchor bolts.

## **2.10 PLATFORMS AND CATWALKS**

- .1 To Section 05 50 10 - Metal Fabrications.

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**2.11 HOUSEKEEPING PADS**

- .1 Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 50 mm larger than equipment; chamfer pad edges.
- .2 Concrete: to Section 03 30 00 - Cast-in-Place Concrete by Division 03.

**2.12 RUBBER SUPPORT SYSTEM FOR ROOF PIPE AND EQUIPMENT.**

- .1 Furnishing all labor, equipment, materials and accessories, and performing all operations required for the correct installation of modular recycled rubber pipe/equipment supports.
- .2 Rubber base must be made of 100% recycled rubber and polyurethane prepolymer with a uniform load capacity per linear foot of support.
- .3 Steel frame: Steel, strut galvanized per ASTM A653 or strut galvanized per ASTM A653 for bridge series.
- .4 Attaching hardware: Zinc-plated threaded rod, nuts and attaching hardware per ASTM B633.
- .5 Any products claiming to be a similar, like, or equal must demonstrate (meet or exceed) the same physical and performance characteristics as specified on below:
  - .1 Density: 0.52 oz/cu in ASTM C642
  - .2 Durometer Hardness: 67.2A  $\pm$  1 ASTM D2240
  - .3 Tensile Strength: 231 psi minimum ASTM D412
  - .4 Compression Deformation: 5% at 70psi and 72°F ASTM D395
  - .5 Brittleness at Low Temp: -50°F ASTM D746
  - .6 Freeze and thaw when exposed to deicing chemicals: No loss after 50 cycles ASTM C672
  - .7 Coefficient of Thermal Expansion: 8 x 10<sup>-6</sup> in/in/°F (min) ASTM C531
  - .8 Weathering: 70 hours at 120°F ASTM D573
    - .1 Hardness retained: 100% ( $\pm$ 5%)
    - .2 Compressive strength: 100% ( $\pm$ 5%)
    - .3 Tensile strength: 100% ( $\pm$ 5%)
    - .4 Elongation retained: 100% ( $\pm$ 5%)
- .6 Rubber block supports Accessories are fastened directly into rubber material with weather resistant screws.
- .7 Continuous block channel supports shall include gaps between blocks for free flow of water. Standard strut accessories can be used for attachment.

**2.13 OTHER EQUIPMENT SUPPORTS**

- .1 Fabricate equipment supports from structural grade steel meeting requirements of Structural Steel and Miscellaneous Metals.
- .2 Submit structural calculations with shop drawings.

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**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 datasheet.

**3.2            INSTALLATION**

- .1       Install in accordance with:
  - .1           Manufacturer's instructions and recommendations.
- .2       Vibration Control Devices:
  - .1           Install on piping systems at pumps, boilers, chillers, cooling towers, and as indicated.
- .3       Clamps on riser piping:
  - .1           Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
  - .2           Bolt-tightening torques to industry standards.
  - .3           Steel pipes: install below coupling or shear lugs welded to pipe.
  - .4           Cast iron pipes: install below joint.
- .4       Clevis plates:
  - .1           Attach to concrete with four (4) minimum concrete inserts, one (1) at each corner.
- .5       Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .6       Use approved constant support type hangers where:
  - .1           Vertical movement of pipework is 13 mm or more,
  - .2           Transfer of load to adjacent hangers or connected equipment is not permitted.
- .7       Use variable support spring hangers where:
  - .1           Transfer of load to adjacent piping or to connected equipment is not critical.
  - .2           Variation in supporting effect does not exceed 25 % of total load.

**3.3            HANGER SPACING**

- .1       Plumbing piping: to Alberta Plumbing Code and authority having jurisdiction.
- .2       Fire protection: to Alberta Fire Code and authority having jurisdiction.
- .3       Gas and fuel oil piping: up to DN 10 (NPS ½): every 1.8 m.
- .4       Copper piping: up to DN 10 (NPS ½): every 1.5 m.
- .5       Hydronic, steam, condensate, rigid, and flexible joint roll groove pipe: in accordance with table below, but not less than one (1) hanger at joints.

Maximum Pipe Size: DN (NPS)	Maximum Spacing Steel	Maximum Spacing Copper
up to 32 (1 ¼)	2.1 m	1.5 m
40 (1 ½)	2.7 m	2.4 m
50 (2)	3.0 m	2.4 m
65 (2 ½)	3.4 m	2.7 m
80 (3)	3.7 m	3.0 m
90 (3 ½)	3.7 m	3.0 m
100 (4)	4.3 m	3.7 m
125 (5)	4.3 m	
150 (6)	5.2 m	
200 (8)	5.2 m	
250 (10)	6.1 m	
300 (12)	6.1 m	

- .6 Within 300 mm of each elbow.
- .7 Pipework greater than DN 300 (NPS 12): to MSS SP69.

### 3.4 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members, comprised of angle iron or c-channel.

### 3.5 HORIZONTAL MOVEMENT

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 ° from vertical.
- .2 Where horizontal pipe movement is less than 13 m/m, offset pipe hanger and support so that rod hanger is vertical in the hot position.

### 3.6 FINAL ADJUSTMENT

- .1 Adjust hangers and supports:
  - .1 Ensure that rod is vertical under operating conditions.
  - .2 Equalize loads.
- .2 Adjustable clevis:
  - .1 Tighten hanger load nut securely to ensure proper hanger performance.
  - .2 Tighten upper nut after adjustment.
- .3 C-clamps:
  - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.

- .4 Beam clamps:
  - .1 Hammer jaw firmly against underside of beam.

### **3.7 FIELD QUALITY CONTROL**

- .1 Verification requirements in accordance with Section 01 45 00 - Quality Control, include:
  - .1 Materials and resources.
  - .2 Storage and collection of recyclables.
  - .3 Construction waste management.
  - .4 Resource reuse.
  - .5 Recycled content.
  - .6 Local/regional materials.
  - .7 Certified wood.
  - .8 Low-emitting materials.

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

**END OF SECTION**

**Part 1            General**

**1.1            REFERENCES**

- .1    Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1        Material Safety Data Sheets (MSDS).
- .2    National Fire Protection Association (NFPA)
  - .1        NFPA 13, Standard for the Installation of Sprinkler Systems.
- .3    Natural Resource Canada (NRC)

**1.2            ACTION AND INFORMATIONAL SUBMITTALS**

- .1    Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
  - .1        Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
    - .1            Submit two (2) copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 35 43 - Environmental Procedures and Section 01 35 29.06 - Health and Safety Requirements.
- .2    Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
  - .1        Provide separate shop drawings for each isolated system complete with performance and product data.
  - .2        Provide detailed drawings of seismic control measures for equipment and piping.
- .3    Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
  - .1        Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2        Instructions: submit manufacturer's installation instructions.
    - .1            Department's Representative will make available one (1) copy of systems supplier's installation instructions.
  - .3        Manufacturer's Field Reports: manufacturer's field reports specified.

**1.3            QUALITY ASSURANCE**

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

**1.4            DELIVERY, STORAGE, AND HANDLING**

- .1    Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground in a dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect materials from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and/or recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **Part 2 Products**

### **2.1 GENERAL**

- .1 Size and shape of bases type and performance of vibration isolation as indicated.

### **2.2 ELASTOMERIC PADS**

- .1 Type EP1 - neoprene waffle or ribbed; 9 mm minimum thick; 50 durometer; maximum loading 350 kPa.
- .2 Type EP2 - rubber waffle or ribbed; 9 mm minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.
- .3 Type EP3 - neoprene-steel-neoprene; 9 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.
- .4 Type EP4 - rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.

### **2.3 ELASTOMERIC MOUNTS**

- .1 Type M1 - colour coded; neoprene in shear; maximum durometer of 60; threaded insert and two (2) bolt-down holes; ribbed top and bottom surfaces.

### **2.4 SPRINGS**

- .1 Design stable springs: ratio of lateral to axial stiffness is equal to or greater than 1.2 times the ratio of static deflection to working height. Select for 50% travel beyond rated load. Units complete with levelling devices.
- .2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.
- .3 Cadmium plate for outdoor and 100% relative humidity installations.
- .4 Colour code springs.



## **2.5 SPRING MOUNT**

- .1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.
- .2 Type M2 - stable open spring: support on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad.
- .3 Type M3 - stable open spring: 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.
- .4 Type M4 - restrained stable open spring: supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.
- .5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg maximum.
- .6 Acceptable Product: Korfund, Mason, Vibron, Vibro Acoustics.

## **2.6 HANGERS**

- .1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30° arc without metal to metal contact.
- .2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.
- .3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.
- .4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.
- .5 Acceptable Product: Korfund, Mason, Vibron, Vibro Acoustics.

## **2.7 ACOUSTIC BARRIERS FOR ANCHORS AND GUIDES**

- .1 Acoustic barriers: between pipe and support, consisting of 25 mm minimum thick heavy duty duck and neoprene isolation material.

## **2.8 HORIZONTAL THRUST RESTRAINT**

- .1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 9 mm.
- .2 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.

## **2.9 STRUCTURAL BASES**

- .1 Type B1 - Prefabricated steel base: integrally welded on sizes up to 2,400 mm on smallest dimension, split for field welding on sizes over 2,400 mm on smallest dimension and reinforced for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; pre-drilled holes to receive equipment anchor bolts; and complete with adjustable built-in motor slide rail where indicated.

- .2 Type B2 - Steel rail base: structural steel, positioned for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; and pre-drilled holes to receive equipment anchor bolts.
- .3 Bases to clear housekeeping pads by 25 mm minimum.
- .4 Acceptable Product: Korfund, Mason, Vibron, Vibro Acoustics.

## **2.10 INERTIA BASE**

- .1 Type B3 - Full depth perimeter structural or formed channels, frames: welded in place reinforcing rods running in both directions; spring mounted, carried by gusseted height-saving brackets welded to frame; and clear housekeeping pads by 50 mm minimum.
- .2 Pump bases: "T" shaped, where applicable, to provide support for elbows.
- .3 Concrete: to Section 03 30 00 - Cast-in-Place Concrete.
- .4 Acceptable Product: Korfund, Mason, Vibron, Vibro Acoustics.

## **2.11 ROOF CURB ISOLATION RAILS**

- .1 General: complete factory assembled without need for sub-base.
- .2 Lower member: continuous rectangular steel tube or extruded aluminum channel.
- .3 Upper member: continuous rectangular steel tube or extruded aluminum channel to provide continuous support for equipment, complete with all-directional neoprene snubber bushings 6 mm thick to resist wind and seismic forces.
- .4 Springs: steel, adjustable, removable, selected for 25 mm maximum static deflection plus 50% additional travel to solid, cadmium plated, sized and positioned to ensure uniform deflection.
- .5 High frequency isolation: 6 mm minimum thick continuous gasket on top and bottom of complete assembly or pads on top and bottom of each spring. Material: closed cell neoprene.
- .6 Weatherproofing: continuous flexible counterflashing to curb and providing access to springs. Material: aluminum and/or neoprene.
- .7 Hardware: cadmium plated or galvanized.

## **2.12 SEISMIC CONTROL MEASURES**

- .1 General:
  - .1 Following systems and/or equipment to remain operational during and after earthquakes:
    - .1 N/A

## 2.13 ISOLATION SCHEDULE

Isolated Equipment	Base		Isolation	
	Type	Thickness	Type	Deflection (mm)
Vertical Inline Pumps	None	N/A	EP1	2.5
Boilers	None	N/A	EP4	2.5
Centrifugal Fans	None	N/A	H2	20
Inline Fans	None	N/A	H2	20
Condensing Units	None	N/A	M4	20
Air Handling units on stand	None	N/A	M4	25
Roof mounted Utility fan	None	N/A	M4	25

## 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 datasheet.

### 3.2 INSTALLATION

- .1 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.
- .2 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.
- .3 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:
  - .1 Up to DN 100 (NPS 4): first 3 points of support.
  - .2 DN 125 (NPS 5) to DN 200 (NPS 8): first 4 points of support.
  - .3 DN 250 (NPS 10) and Over: first 6 points of support.
  - .4 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.
- .4 Where isolation is bolted to floor use vibration isolation rubber washers.
- .5 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

### 3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:

- .1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.
- .2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:
  - .1 After delivery and storage of Products.
  - .2 After preparatory work is complete but before installation commences.
  - .3 Twice during the installation, at 25% and 60% completion stages.
  - .4 Upon completion of installation.
- .3 Submit manufacturer's reports to Department's Representative within three (3) days of manufacturer representative's review.
- .4 Make adjustments and corrections in accordance with written report.
- .2 Inspection and Certification:
  - .1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC systems after start up and TAB of systems to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .3 Provide Departmental Representative with notice 24 h in advance of commencement of tests.
- .4 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations (including sound curves).
- .5 Submit complete report of test results including sound curves.

### **3.4 CLEANING**

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

**END OF SECTION**

**Part 1            General**

**1.1            REFERENCES**

- .1 Canadian Gas Association (CGA)
  - .1 CSA/CGA B149.1, Natural Gas and Propane Installation Code.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.
  - .2 CAN/CGSB-24.3, Identification of Piping Systems.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .4 National Fire Protection Association (NFPA)
  - .1 NFPA 13, Standard for the Installation of Sprinkler Systems.

**1.2            ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
- .2 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Product data to include paint colour chips, other products specified in this section.
- .4 Samples:
  - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Samples to include nameplates, labels, tags, lists of proposed legends.

**1.3            QUALITY ASSURANCE**

- .1 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

**1.4            DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground in a dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect materials from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

- .4 Packaging Waste Management: remove for reuse and/or recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **Part 2 Products**

### **2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES**

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers raised or recessed.
- .3 Information to include, as appropriate:
  - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
  - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

### **2.2 SYSTEM NAMEPLATES**

- .1 Colours:
  - .1 Hazardous: red letters, white background.
  - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
  - .1 3 mm thick laminated plastic or white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
  - .1 Conform to following table:

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

- .2 Use maximum of 25 letters/numbers per line.
- .4 Locations:
  - .1 Terminal cabinets, control panels: use size # 5.
  - .2 Equipment in Mechanical Rooms: use size # 9.

### **2.3 PIPING SYSTEMS GOVERNED BY CODES**

- .1 Identification:
  - .1 Natural gas: to CSA/CGA B149.1 and authority having jurisdiction.

- .2 Propane gas: to CSA/CGA B149.1 and authority having jurisdiction.
- .3 Sprinklers: to NFPA 13.

## 2.4 IDENTIFICATION OF PIPING SYSTEMS

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
- .2 Pictograms:
  - .1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.
- .3 Legend:
  - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.
- .4 Arrows showing direction of flow:
  - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
  - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
  - .3 Use double-headed arrows where flow is reversible.
- .5 Extent of background colour marking:
  - .1 To full circumference of pipe or insulation.
  - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
  - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
  - .2 Other pipes: pressure sensitive plastic-coated cloth or vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150°C and intermittent temperature of 200°C.
- .7 Colours and Legends:
  - .1 Where not listed, obtain direction from Departmental Representative.
  - .2 Colours for legends, arrows: to following table:

Background Colour:	Legend, Arrows:
Yellow	BLACK
Green	WHITE
Red	WHITE

.3 Background colour marking and legends for piping systems:

Contents	Background Colour Marking	Legend
** Add design temperature		
++ Add design temperature and pressure		
City water	Green	CITY WATER
Treated water	Green	TREATED WATER
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
High temp HW Htg. supply	Yellow	HTHW HTG. SUPPLY++
High temp HW Htg. return	Yellow	HTHW HTG. RETURN++
Make-up water	Yellow	MAKE-UP WTR
Boiler feed water	Yellow	BLR. FEED WTR
Steam	Yellow	kPa STEAM
Steam condensate (gravity)	Yellow	ST.COND.RET (GRAVITY)
Steam condensate (pumped)	Yellow	ST.COND.RET (PUMPED)
Drinking water return	Green	CH. DRINK WTR. CIRC
Domestic hot water supply	Green	DOM. HW SUPPLY
Dom. HWS recirculation	Green	DOM. HW CIRC
Domestic cold water supply	Green	DOM. CWS
Waste water	Green	WASTE WATER
Storm water	Green	STORM
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Refrigeration suction	Yellow	REF. SUCTION
Refrigeration liquid	Yellow	REF. LIQUID
Refrigeration hot gas	Yellow	REF. HOT GAS
Natural gas	to Codes	
Propane	to Codes	
Gas regulator vents	to Codes	
Distilled water	Green	DISTILL. WTR
Demineralized water	Green	DEMIN. WATER
Compressed air	Green	COMP. AIR kPa
Compressed air (700kPa)	Yellow	COMP. AIR 700 kPa
Vacuum	Green	VACUUM
Fire protection water	Red	FIRE PROT. WTR
Sprinklers	Red	SPRINKLERS
Carbon dioxide	Red	CO2
Instrument air	Green	INSTRUMENT AIR
Control (EMCS) air tubing	To Section 25 05 54 – EMCS: Identification	To Section 25 05 54 – EMCS: Identification
Conduit for low voltage control wiring	To Section 25 05 54 – EMCS: Identification	To Section 25 05 54 – EMCS: Identification



## **2.5 IDENTIFICATION DUCTWORK SYSTEMS**

- .1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.
- .2 Colours: back, or co-ordinated with base colour to ensure strong contrast.
- .3 Identify system: commodity with associated equipment (e.g. Supply AHU-1, Exhaust F-7).

## **2.6 VALVES, CONTROLLERS**

- .1 Brass tags with 12 mm stamped identification data filled with black paint.
- .2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

## **2.7 CONTROLS COMPONENTS IDENTIFICATION**

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in Section 25 05 54 – EMCS: Identification. If no EMCS included in the project, identification as per this section.
- .2 Inscriptions to include function and (where appropriate) fail-safe position.

## **2.8 LANGUAGE**

- .1 Identification in English.

## **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 datasheet.

### **3.2 TIMING**

- .1 Provide identification only after painting specified Section 09 91 00 - Painting has been completed.

### **3.3 INSTALLATION**

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC and/or CSA registration plates as required by respective agency.

### **3.4 NAMEPLATES**

- .1 Locations:
  - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs:
  - .1 Provide for nameplates on hot and/or insulated surfaces.

.3 Protection:

.1 Do not paint, insulate or cover in any way.

### **3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS**

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one (1) is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification easily and accurately readable from usual operating areas and from access points.
  - .1 Position of identification 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.

### **3.6 VALVES, CONTROLLERS**

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Install one (1) copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Departmental Representative. Provide one (1) copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively.

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

**END OF SECTION**

**Part 1 General**

**1.1 QUALIFICATIONS OF TAB PERSONNEL**

- .1 Submit names of personnel certified to AABC, NBC, NEBB or SMACNA to perform TAB to Department Representative within 90 days of award of contract.
- .2 Provide documentation confirming qualifications, successful experience. TAB Contractor shall have a minimum of 5 (five) years related experience performing TAB to AABC, NBC, NEBB or SMACNA.
- .3 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:
  - .1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1.
  - .2 National Balancing Council, (NBC) Certified Air Balancing Specifications and Certified Hydronic Balancing Specifications.
  - .3 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.
  - .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing.
- .4 Recommendations and suggested practices contained in the TAB Standard: mandatory.
- .5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
- .6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.
- .7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
  - .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
  - .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NBC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

**1.2 PURPOSE OF TAB**

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads.
- .2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

### **1.3 EXCEPTIONS**

- .1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.

### **1.4 CO-ORDINATION**

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.
- .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

### **1.5 PRE-TAB REVIEW**

- .1 Review contract documents before project construction is started and confirm in writing to Department Representative adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to Department Representative in writing proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

### **1.6 START-UP**

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified elsewhere in other Divisions.

### **1.7 OPERATION OF SYSTEMS DURING TAB**

- .1 Operate systems for length of time required for TAB and as required by Department Representative for verification of TAB reports.

### **1.8 START OF TAB**

- .1 Notify Department Representative seven (7) days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:
  - .1 Installation of ceilings, doors, windows, other construction affecting TAB.
  - .2 Application of weatherstripping, sealing, and caulking.
  - .3 All pressure, leakage and other tests specified elsewhere in other Divisions.
  - .4 Provisions for TAB installed and operational.
- .3 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
  - .1 Proper thermal overload protection in place for electrical equipment.
  - .2 Air systems:

- .1 Filters in place, clean.
- .2 Duct systems clean.
- .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
- .4 Correct fan rotation.
- .5 Fire, smoke, volume control dampers installed and open.
- .6 Coil fins combed, clean.
- .7 Access doors, installed, closed.
- .8 Outlets installed, volume control dampers open.
- .3 Liquid systems:
  - .1 Flushed, filled, vented.
  - .2 Correct pump rotation.
  - .3 Strainers in place, baskets clean.
  - .4 Isolating and balancing valves installed, open.
  - .5 Calibrated balancing valves installed, at factory settings.
  - .6 Chemical treatment systems complete, operational.

## **1.9 APPLICATION TOLERANCES**

- .1 Do TAB to following tolerances of design values:
  - .1 HVAC systems: plus 5 %, minus 5 %.
  - .2 Hydronic systems: plus or minus 10 %.
  - .3 Refrigeration systems: plus or minus 10%.

## **1.10 ACCURACY TOLERANCES**

- .1 Measured values accurate to within plus or minus 2 % of actual values.

## **1.11 INSTRUMENTS**

- .1 Prior to TAB, submit to Department Representative list of instruments used together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate within three (3) months of TAB. Provide certificate of calibration to Department Representative.

## **1.12 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit, prior to commencement of TAB:
- .2 Proposed methodology and procedures for performing TAB if different from referenced standard.

**1.1 COOPERATION WITH CONTROLS**

- .1 Cooperate with the controls contractor to balancing of systems in coordination with the controls settings relating to TAB values. This includes TAB for
  - .1 Pumps and pressure bypasses
  - .2 Air Handlers and damper positions
  - .3 VFDs and flow rates.

**1.2 COOPERATION WITH COMMISSIONING TEAM**

- .1 The Air balancer shall include labour for commissioning activities as per Section 01 91 13.
- .2 Inform Commissioning Team in advance of TAB activities.
- .3 Provide dedicated site visits to verify balanced values to the CX agent. Allow for work necessary to assist Commissioning Team in completion of the commissioning process.
- .4 Provide reports and check sheets for review by the Commissioning Team.
- .5 Resolve TAB issues noted by in the CX process.

**1.3 PRELIMINARY TAB REPORT**

- .1 Submit for checking and approval of Department Representative, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
  - .1 Details of instruments used.
  - .2 Details of TAB procedures employed.
  - .3 Calculations procedures.
  - .4 Summaries.

**1.4 TAB REPORT**

- .1 Format in accordance with referenced standard.
- .2 TAB report to show results in SI units and to include:
  - .1 Project record drawings.
  - .2 System schematics.
- .3 Submit three (3) copies of TAB Report to Department Representative for verification and approval, in English in D-ring binders, complete with index tabs.

**1.5 VERIFICATION**

- .1 Reported results subject to verification by Department Representative.
- .2 Provide personnel and instrumentation to verify up to 30 % of reported results.
- .3 Number and location of verified results shall be at the discretion of Department Representative.
- .4 Bear costs to repeat TAB as required to satisfaction of Department Representative.

**1.6 SETTINGS**

- .1 After TAB is completed to satisfaction of Department Representative, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings in any way.

**1.7 COMPLETION OF TAB**

- .1 TAB considered complete when final TAB Report received and approved by Department Representative.

**1.8 AIR SYSTEMS**

- .1 Standard: TAB to most stringent of this section or TAB standards of AABC, NBC, NEBB, SMACNA or ASHRAE.
- .2 Do TAB of systems, equipment, components, controls specified under Division 23 and in other Divisions.
- .3 Qualifications: personnel performing TAB shall be qualified to standards of AABC, NBC or NEBB and be in good standing with the qualifying body.
- .4 Quality assurance: perform TAB under direction of supervisor qualified to standards of AABC, NBC or NEBB and be in good standing with the qualifying body.
- .5 Balance terminal boxes, fans, and air outlets to air quantities indicated on the drawings and under Division 23. Where outlet quantities are not indicated, divide box capacity equally among all outlets.
- .6 Permanently mark balanced settings to allow restoration at any time during life of facility. Markings are not to be eradicated or covered in any way.
- .7 Permanently mark setting on splitters, dampers and other adjustment devices.
- .8 Measurements: to include, but not limited to, the following as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, amperage, noise and vibration covering all stages of operation.
- .9 Locations of equipment measurements: to include, but not limited to, the following as appropriate:
  - .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
  - .2 At controllers, controlled device.
- .10 Locations of systems measurements to include, but not limited to, the following as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

**1.9 HYDRONIC SYSTEMS**

- .1 Definitions: for purposes of this section, to include low pressure hot water heating, chilled water, condenser water, glycol systems.

- .2 Standard: TAB to most stringent of this section or TAB standards of AABC, NBC, NEBB, SMACNA or ASHRAE.
- .3 Do TAB of systems, equipment, components, controls specified under Division 23 and in other Divisions.
- .4 Qualifications: personnel performing TAB shall be qualified to standards of AABC, NBC or NEBB and be in good standing with the qualifying body.
- .5 Quality assurance: perform TAB under direction of supervisor qualified to standards of AABC, NBC or NEBB and be in good standing with the qualifying body.
- .6 Permanently mark setting on valves and other adjustment devices.
- .7 Measurements: to include, but not limited to, the following as appropriate for systems, equipment, components, controls: flow rate, static pressure, pressure drop (or loss), temperature, specific gravity, density, RPM, electrical power, voltage, amperage, noise and vibration covering all stages of operation.
- .8 Locations of equipment measurement: to include, but not limited to, the following as appropriate:
  - .1 Inlet and outlet of heat exchangers (primary and secondary sides), boiler, chiller, coil, humidifier, cooling tower, condenser, pump, PRV, control valve, other equipment causing changes in conditions.
  - .2 At controllers, controlled device.
- .9 Locations of systems measurements to include, but not limited to, the following as appropriate: supply and return of primary and secondary loops (main, main branch, branch, sub-branch) of all hydronic systems, inlet connection of make-up water.

## **1.10 DOMESTIC WATER SYSTEMS**

- .1 Meet requirements as specified for hydronic systems.
- .2 Adjust PRV on main water supply line to 415 kPa (570 kPa maximum).
- .3 Balance domestic hot water circulating system piping to ensure flow from all points in system. Ensure all hot and cold water supply valves are fully open.
- .4 Test operation of water tempering valves.
- .5 Test operation of safety eyewash and shower equipment.
- .6 Test operation of backflow preventers and other safety devices.
- .7 Test plumbing fixture operation.
- .8 Locations of equipment measurements: To include, but not be limited to, following as appropriate: inlet and outlet of heaters, tank, pump, circulator, at controllers, controlled device.
- .9 Locations of systems measurements to include, but not be limited to, following as appropriate: main, main branch, branch, sub-branch.
- .10 Measure and record all tempered water set-point temperatures and the actual tempered water supply temperatures.
- .11 Measure and record domestic hot water heater set-point temperature.



- .12 Measure and record domestic hot and cold water distribution temperatures, including domestic hot water recirculation at Mechanical Room.

## **1.11 OTHER SYSTEMS**

- .1 Plumbing systems:
  - .1 Standard: National Plumbing Code of Canada (NPC).
  - .2 TAB procedures:
    - .1 Flush valves: adjust to suit project pressure conditions.
    - .2 Pressure booster systems: test for capacity and pressures under all conditions and at all times.
    - .3 Controlled flow roof drain systems: adjust weirs to suit actual roof conditions, slopes, areas drained.
    - .4 Pumped sanitary and storm water systems: test for proper operation at all possible flow rates.
    - .5 Pressure reducing valves/stations:
      - .1 Record and measure each PRV pressure setting.
      - .2 Record and measure inlet and discharge water pressure measured at each PRV.
  - .3 For plumbing and drainage systems:
    - .1 Test plumbing fixture operation.
    - .2 Test sump pump operation and control.
    - .3 Test backflow valves.
    - .4 Test operation of drainage systems.
- .2 Wet and/or dry pipe sprinkler systems:
  - .1 Standard: NFPA.
  - .2 TAB procedures: Refer to NFPA 13, Standard for the Installation of Sprinkler Systems.
- .3 Wet and/or dry pipe standpipe systems:
  - .1 Standard: NFPA.
  - .2 TAB procedures: Refer to NFPA 14, Standard for the Installation of Standpipe and Hose Systems.
- .4 Clean agent fire suppression systems:
  - .1 Standard: NFPA.
  - .2 TAB procedures: Refer to NFPA 2001, Standard on Clean Agent Extinguishing Systems.
- .5 Refrigeration systems forming part of HVAC systems:
  - .1 Standard: CSA B52, Mechanical Refrigeration Code.
  - .2 TAB procedures: Refer to Standard as follows:
    - .1 Suction Pressure and Temperature.
    - .2 Discharge Pressure and Temperature.

- .3 Suction Superheat.
    - .4 Evaporation Pressure and Temperature.
  - .3 Record the air dry bulb and wet bulb temperatures on and off coils and for any other indoor air-conditioning equipment. Record the set-point temperature for coils and equipment. Record the corresponding outdoor air dry bulb and wet bulb temperatures near the corresponding condensing unit.
  - .4 Record refrigerant type and charge for all refrigerant systems.
- .6 Gas / Electric Heating Equipment
  - .1 Where gas-fired equipment is installed, operate on high fire and verify:
    - .1 Each combustion air intake is functioning properly.
    - .2 Flue gases are properly venting.
    - .3 Operation of each natural draft appliance and vent diverter for any back draft.
  - .2 Measure and record the air temperature in and out off all primary fan-powered equipment including unit heaters, force flow units, and furnaces. Record the set-point temperatures for equipment.
  - .3 Measure and record the air temperature in and out off all makeup air units. Record the set-point temperatures for equipment.
  - .4 Measure and record the room temperature and set-point temperature for rooms heated by radiant heaters, infrared heaters, baseboard heaters, unit heaters, force flow units, furnaces, air handling units, and any other gas / electric heating equipment.
  - .5 Measure and record the outdoor dry bulb temperature when balancing of equipment noted above is performed.
- .7 Expansion Tanks
  - .1 Record the pressure set-point.
- .8 Emergency Generator Systems Balance Sheet
  - .1 Air Side:
    - .1 Adjust air flows to design.
    - .2 Measure air flows, static pressure drops.
    - .3 Measure and record discharge air temperature off radiator.
  - .2 Measure and record room and outdoor air temperature when generator is operational
  - .3 Record and record modulating damper temperature control set-point
- .9 Mechanical Rooms:
  - .1 Where gas-fired appliances are installed, operate on high fire, and measure and record:
    - .1 Combustion air volume entering room from outside

## 1.12 OTHER TAB REQUIREMENTS

- .1 General requirements applicable to work specified this paragraph:

- .1 Qualifications of TAB personnel: as for air systems specified this section.
- .2 Quality assurance: as for air systems specified this section.
- .2 Laboratory fume hoods:
  - .1 Standard: ASHRAE 110 – Method of Testing Performance of Laboratory Fume Hoods, and applicable provincial standard.
  - .2 TAB procedures: as described in Standard and to suit provincial requirements.
- .3 Building pressure conditions:
  - .1 Adjust HVAC systems, equipment, controls to ensure specified pressure conditions at all times.
  - .2 The final balanced condition of each area shall include testing and adjusting of building pressure conditions. Test, adjust and record building and zone pressurization levels. Check doors, exits, stairwells and other structural openings for proper sealing such that exterior conditions do not cause excessive or abnormal pressures. Document abnormal building leakage conditions noted and review remedial action with Mechanical and General Contractor. Coordinate activities with other trades.
  - .3 Achieve a positive building pressurization relative to outside conditions of 25 Pa to 35 Pa measured with negligible outside wind velocity, unless otherwise instructed.
  - .4 Achieve a positive room pressurization of 12 Pa to 25 Pa for all MCC Rooms, Electrical Rooms, Control Rooms and Server Rooms relative to adjacent rooms, measured with negligible outside wind velocity.
  - .5 Achieve a positive room pressurization of at least 25 Pa relative to adjacent rooms and areas where air contamination and/or hazardous conditions exist, under all operating conditions. Obtain a list of rooms from Department Representative where such conditions may exist. Comply with Canadian Electrical Code and applicable NFPA requirements.
    - .1 Example rooms of concern are:
      - .1 Laboratories.
      - .2 Chemical storage areas including rooms where chemicals are handled, dispensed and/or mixed and these chemicals constitute a hazard and/or nuisance odours.
      - .3 Janitorial.
      - .4 Maintenance areas including rooms where welding, millwrights, wood working, vehicle maintenance and/or storage, and painting activities may occur.
- .4 Zone pressure differences:
  - .1 Adjust HVAC systems, equipment, controls to establish specified air pressure differentials, with all systems in all possible combinations of normal operating modes.
- .5 Smoke management systems:
  - .1 Test for proper operation of all smoke and fire dampers, sensors, detectors, installed as component parts of air systems specified in other Divisions.

- .6 Measurement of noise and vibration from equipment specified in Mechanical Divisions.
  - .1 Standard: as applicable, Section 23 05 48 – Vibration and Seismic Controls for HVAC Pipe and Equipment.
  - .2 Vibration measurements around each piece of rotating equipment.
  - .3 Sound measurements in each octave band around each piece of rotating equipment.
  - .4 In-duct sound measurements in each octave band at each fan inlet and discharge.
  - .5 In-duct sound measurements in each octave band at each air handling unit intake, return and discharge.
  - .6 Sound measurements in each octave band for each normally occupied rooms with operational air handling equipment.
  - .7 Sound measurements in each octave band in room(s) and corridor(s) adjacent to Mechanical Rooms with rotating equipment.
  - .8 Sound measurements in each octave band in rooms(s) and corridor(s) directly below rooftop mounted rotating equipment.

**1.13 POST-OCCUPANCY TAB**

- .1 Measure DBT, WBT (or %RH), air velocity, air flow patterns, NC levels, in occupied zone of following areas designated by Department Representative.
- .2 Participate in systems checks twice during Warranty Period - #1 approximately three (3) months after acceptance and #2 within one (1) month of termination of Warranty Period.

**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        REFERENCES**

- .1    Definitions:
  - .1    For purposes of this section:
    - .1    "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
    - .2    "EXPOSED" - means "not concealed" as previously defined.
    - .3    Insulation systems - insulation material, fasteners, jackets, and other accessories.
  - .2    TIAC Codes:
    - .1    CRD: Code Round Ductwork.
    - .2    CRF: Code Rectangular Finish.
- .2    Reference Standards:
  - .1    American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
    - .1    ANSI/ASHRAE/IESNA 90.1, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
  - .2    ASTM International Inc.
    - .1    ASTM B209M, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
    - .2    ASTM C335, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
    - .3    ASTM C411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
    - .4    ASTM C449/C449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
    - .5    ASTM C547, Standard Specification for Mineral Fiber Pipe Insulation.
    - .6    ASTM C553, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
    - .7    ASTM C612, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
    - .8    ASTM C795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
    - .9    ASTM C921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
  - .3    Canadian General Standards Board (CGSB)
    - .1    CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
  - .4    Green Seal Environmental Standards (GSES)
    - .1    Standard GS-36, Commercial Adhesives.
  - .5    Natural Resources Canada (NRC)

- .1 National Energy Code for Buildings (NECB).
- .6 South Coast Air Quality Management District (SCAQMD), California State
  - .1 SCAQMD Rule 1168, Adhesive and Sealant Applications.
- .7 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.
- .8 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S701, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

## **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations.
    - .1 Description of equipment giving manufacturer's name, type, model, year and capacity.
    - .2 Details of operation, servicing and maintenance.
    - .3 Recommended spare parts list.
- .3 Shop Drawings:
  - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Alberta, Canada.
- .4 Samples:
  - .1 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed.
  - .2 Mount sample on 12 mm plywood board.
  - .3 Affix typewritten label beneath sample indicating service.
- .5 Manufacturers' Instructions:
  - .1 Provide manufacture's written duct insulation jointing recommendations. and special handling criteria, installation sequence, and cleaning procedures].
  - .2 Installation instructions to include procedures used and installation standards achieved.

## **1.3 QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Installer: specialist certified in performing work of this section, and have at least five (5) years successful experience in this size and type of project, qualified to standards of TIAC.

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

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

### **Part 2 Products**

#### **2.1 FIRE AND SMOKE RATING**

- .1 To CAN/ULC-S102:
  - .1 Maximum flame spread rating: 25.
  - .2 Maximum smoke developed rating: 50.

#### **2.2 INSULATION**

- .1 Mineral fibre: as specified including glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 °C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).
- .4 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).
  - .1 Mineral fibre: to ASTM C553.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: to ASTM C553.

#### **2.3 JACKETS**

- .1 Canvas:
  - .1 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .2 Lagging adhesive: compatible with insulation.
  - .1 Maximum VOC limit: to SCAQMD Rule 1168, and GSES GS-36.
- .3 Aluminum:
  - .1 To ASTM B209 with moisture barrier as scheduled in PART 3 of this section.

- .2 Thickness: 0.40 mm sheet.
- .3 Finish: Stucco embossed or corrugated.
- .4 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel.
- .4 Stainless steel:
  - .1 Type: 304 or 316 where additional corrosion protection is required.
  - .2 Thickness: 0.25 mm sheet.
  - .3 Finish: Corrugated or Stucco embossed.
  - .4 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel.
- .5 . PVC:
  - .1 Type: ASTM D1785, sheet material, off-white color.
  - .2 Thickness: 0.25 mm sheet.
  - .3 PVC with Flame rating below 25 and a smoke development rating below 50
  - .4 Use if surfaces are subjected to minimal and light impact, abuse, or high humidity environments or as alternative to canvas jacket. For indoor use only.
  - .5 Apply with solvent weld adhesive to seal and lap joints, tacks, and/or pressure sensitive tape suitable for the application.

## 2.4 ACCESSORIES

- .1 Vapour retarder lap adhesive:
  - .1 Water based, fire retardant type, compatible with insulation.
- .2 Indoor Vapour Retarder Finish:
  - .1 Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.
- .4 ULC Listed Canvas Jacket:
  - .1 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921. Outdoor Vapour Retarder Mastic:
    - .1 Vinyl emulsion type acrylic, compatible with insulation.
    - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m<sup>2</sup>.
- .6 Tape: self-adhesive, aluminum, reinforced, 75 mm wide minimum.
- .7 Tie wire: 1.5 mm stainless steel.
- .8 Contact adhesive: quick-setting
- .9 Canvas adhesive: washable.
- .10 Banding: 12 mm wide, 0.5 mm thick stainless steel.
- .11 Facing: 25 mm galvanized steel hexagonal wire mesh stitched on one face of insulation.
- .12 Fasteners: 4 mm diameter pins with 35 mm diameter or square clips, length to suit thickness of insulation.



## **Part 3 Execution**

### **3.1 APPLICATION**

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

### **3.2 PRE-INSTALLATION REQUIREMENTS**

- .1 Pressure test ductwork systems complete, witness and certify.
- .2 Ensure surfaces are clean, dry, free from foreign material.

### **3.3 INSTALLATION**

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers instructions and as indicated.
- .3 Use [2] layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Ensure hangers, and supports are outside vapour retarder jacket.
- .5 Hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
  - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .6 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum [2] rows each side.

### **3.4 DUCTWORK INSULATION SCHEDULE**

- .1 Insulation types and thicknesses: conform to following table:

<b>Item</b>	<b>TIAC Code</b>	<b>Vapour Retarder</b>	<b>Thickness (mm)</b>
Rectangular cold and dual temperature supply air ducts	C-1	yes	50
Round cold and dual temperature supply air ducts	C-2	yes	50
Rectangular warm air ducts	C-1	no	50
Round warm air ducts	C-1	no	50
Supply, return and exhaust ducts exposed in space being served	none		
Outside air ducts to mixing plenum	C-1	yes	50
Mixing plenums	C-1	yes	50
Exhaust duct between dampers and louvres	C-1	no	50
Rectangular ducts outside	C-1	special	50
Round ducts outside	C-1	special	50
Acoustically lined ducts	none		

- .2 Exposed round ducts 600 mm and larger, smaller sizes where subject to abuse:
  - .1 Use TIAC code C-1 insulation, scored to suit diameter of duct.
    - .1 Finishes: conform to following table:

	TIAC Code	
	Rectangular	Round
Indoor, concealed	none	none
Indoor, exposed within mechanical room	CRF/1	CRD/2
Indoor, exposed elsewhere	CRF/2	CRD/3
Outdoor, exposed to precipitation	CRF/3	CRD/4
Outdoor, elsewhere	CRF/4	CRD/5

### 3.5 CLEANING

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

**END OF SECTION**

**Part 1            General**

**1.1            REFERENCE STANDARDS**

- .1 American Society for Testing and Materials (ASTM):
  - .1 ASTM B209M-14, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.
  - .2 ASTM C335-05, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  - .3 ASTM C411-11, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  - .4 ASTM C449/C449M-13, Standard Specification for Mineral Fibre-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .5 ASTM C533-13 Standard specification for Calcium Silicate Insulation Block and Pipe.
  - .6 ASTM C547-15 Standard Specification for Mineral Fibre Pipe Insulation.
  - .7 ASTM C795-13, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
  - .8 ASTM C921-15, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
  - .9 ASTM D1784-11, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
- .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 CAN/CGSB-51.53, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.
- .3 Department of Justice Canada (Jus):
  - .1 Canadian Environmental Assessment Act (CEAA), c. 37.
  - .2 Canadian Environmental Protection Act, (CEPA), c. 33.
  - .3 Transportation of Dangerous Goods Act (TDGA), c. 34.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets.
- .5 Manufacturer's Trade Associations:
  - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.
- .6 Underwriters' Laboratories of Canada (ULC):
  - .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.

- .2 CAN/ULC-S701, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .3 CAN/ULC-S702, Thermal Insulation, Mineral Fibre, for Buildings.
- .4 CAN/ULC-S702.2, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.
- .7 National Energy Code of Canada for Buildings (NECB).

## **1.2 DEFINITIONS**

- .1 For purposes of this section:
  - .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
  - .2 "EXPOSED" - will mean "not concealed" as specified.
- .2 TIAC ss:
  - .1 CRF: Code Rectangular Finish.
  - .2 CPF: Code Piping Finish.

## **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations:
    - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 35 43 - Environmental Procedures and Section 01 35 29.06 - Health and Safety Requirements.
- .3 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .4 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures:
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions to Department Representative.

## **1.4 QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Installer: certified in performing work of this Section, and have at least 5 years successful experience in this size and type of project, qualified to standards of TIAC.

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

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
  - .3 Deliver materials to site in original factory packaging, labeled with manufacturer's name, address.
- .2 Storage and Protection:
  - .1 Protect from weather, construction traffic.
  - .2 Protect against damage.
  - .3 Store at temperatures and conditions required by manufacturer.
- .3 Waste Management and Disposal:
  - .1 Place excess or unused insulation and insulation accessory materials in designated containers.
  - .2 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.
  - .3 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.

## **Part 2 Products**

### **2.1 FIRE AND SMOKE RATING**

- .1 In accordance with CAN/ULC-S102:
  - .1 Maximum flame spread rating: 25.
  - .2 Maximum smoke developed rating: 50.

### **2.2 INSULATION**

- .1 Mineral fibre specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket:
  - .1 Mineral fibre: to ASTM C547.
  - .2 Maximum "k" factor: to CAN/ULC-S702.
- .4 TIAC Code A-3: Rigid moulded mineral fibre with factory applied vapour retarder jacket:
  - .1 Mineral fibre: to CAN/ULC-S702 and ASTM C547.
  - .2 Jacket: to CGSB 51-GP-52Ma.

- .3 Maximum "k" factor: to CAN/ULC-S702.
- .5 TIAC Code C-2: Mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section):
  - .1 Mineral fibre: to ASTM C547.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: to CAN/ULC-S702.
- .6 TIAC Code A-6: Flexible unicellular tubular elastomer, preformed, vapour sealed, to CAN/CGSB-51.50:
  - .1 Insulation: with vapour retarder jacket to ASTM C534.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor:  $0.039 \text{ W/m} - ^\circ\text{C}$ .
  - .4 To be certified by manufacturer to be free of potential stress corrosion cracking corrodants
  - .5 Flame spread index less than 25, and smoke developed index less than 50.
- .7 TIAC Code A-2: Rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements:
  - .1 Insulation: to ASTM C533.
  - .2 Maximum "k" factor: to  $0.075 \text{ W/m } ^\circ\text{C} @ 500^\circ\text{C}$ .
  - .3 Design to permit periodic removal and re-installation.
- .8 Non-TIAC Code P-1: polyurethane rigid insulation, preformed, vapour sealed, for buried applications:
  - .1 Material: formed polyurethane rigid insulation.
  - .2 "k" Value:  $0.020 \text{ to } 0.026 \text{ W/m}^\circ\text{C}$  at  $24^\circ\text{C}$ .
  - .3 Service Temperature:  $45^\circ\text{C}$  to  $85^\circ\text{C}$ .
  - .4 Jacket: UV inhibited high density polyethylene (HDPE) "yellow" jacket, specially formulated for cold weather resistance, 1.27 mm thickness.
  - .5 Pipe insulation shall be suitable to accept heat trace cabling, where required.

## **2.3 INSULATION SECUREMENT**

- .1 Tape: Self-adhesive, aluminum, plain reinforced, 50 mm wide minimum.
- .2 Contact adhesive: Quick setting.
- .3 Canvas adhesive: Washable.
- .4 Tie wire: 1.5 mm diameter stainless steel.
- .5 Bands: Stainless steel, 19 mm wide, 0.5 mm thick.

## **2.4 CEMENT**

- .1 Thermal insulating and finishing cement:
  - .1 Hydraulic setting or air drying on mineral wool, to ASTM C449/C449M.

**2.5 VAPOUR RETARDER LAP ADHESIVE**

- .1 Water based, fire retardant type, compatible with insulation.

**2.6 INDOOR VAPOUR RETARDER FINISH**

- .1 Vinyl emulsion type acrylic, compatible with insulation.

**2.7 OUTDOOR VAPOUR RETARDER FINISH**

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: fibrous glass, untreated 305 g/m<sup>2</sup>.

**2.8 JACKETS**

- .1 Polyvinyl Chloride (PVC):
  - .1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.
  - .2 Colours: to match adjacent finish paint. Confirm colour with Departmental Representative.
  - .3 Minimum service temperatures: -20°C.
  - .4 Maximum service temperature: 65°C.
  - .5 Moisture vapour transmission: 0.02 perm.
  - .6 Thickness: 0.55 mm.
  - .7 Fastenings:
    - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
    - .2 Tacks.
    - .3 Pressure sensitive vinyl tape of matching colour.
  - .8 Special requirements:
    - .1 Indoor: flame spread rating 25, smoke developed rating 50.
    - .2 Outdoor: UV rated material at least 0.5 mm thick.
- .2 Canvas:
  - .1 To be 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
  - .2 Lagging adhesive: Compatible with insulation.
- .3 Aluminum:
  - .1 To ASTM B209.
  - .2 Thickness: 0.50 mm sheet.
  - .3 Finish: Embossed or corrugated.
  - .4 Joining: Longitudinal and circumferential slip joints with 50 mm laps.
  - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.

- .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.
- .4 Stainless steel:
  - .1 Type: 304 or type 316.
  - .2 Thickness: 0.25 mm.
  - .3 Finish: Smooth.
  - .4 Joining: Longitudinal and circumferential slip joints with 50 mm laps.
  - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
  - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

## **2.9 WEATHERPROOF CAULKING FOR JACKETS INSTALLED OUTDOORS**

- .1 Caulking to: Section 07 92 00 - Joint Sealing.

## **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 datasheet.

### **3.2 PRE-INSTALLATION REQUIREMENT**

- .1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.
- .2 Surfaces clean, dry, free from foreign material.

### **3.3 INSTALLATION**

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers instructions and this specification.
- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Install hangers, supports outside vapour retarder jacket.



- .5 Supports, Hangers:
  - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

### **3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES**

- .1 Application: at expansion joints, valves, primary flow measuring elements, flanges and unions at equipment.
- .2 Design: to permit movement of expansion joint, to permit periodic removal and replacement without damage to adjacent insulation.
- .3 Insulation:
  - .1 Insulation, fastenings and finishes: same as system.
  - .2 Jacket: to match pipe insulation jacket. PVC to be used instead of canvas.

### **3.5 INSTALLATION OF ELASTOMERIC INSULATION**

- .1 Insulation to remain dry. Overlaps to manufacturers instructions. Ensure tight joints.
- .2 Provide vapour retarder as recommended by manufacturer.

### **3.6 PIPING INSULATION SCHEDULES**

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code: A-1:
  - .1 Securements: SS bands at 300 mm on centre.
  - .2 Seals: lap seal adhesive, lagging adhesive.
  - .3 Installation: TIAC Code 1501-H.
- .3 TIAC Code: A-2:
  - .1 Insulation securements: SS bands at 300 mm on centre. oc.
  - .2 Seals: lap seal adhesive, lagging adhesive.
  - .3 Installation: TIAC Code: 1501-H.
- .4 TIAC Code: A-3:
  - .1 Securements: SS bands at 300 mm on centre.
  - .2 Seals: VR lap seal adhesive, VR lagging adhesive.
  - .3 Installation: TIAC Code: 1501-C.
- .5 TIAC Code: A-6:
  - .1 Insulation securements: SS Bands at 300 mm oc.
  - .2 Seals: lap seal adhesive, lagging adhesive.
  - .3 Installation: CANCGSB-51.40.
- .6 TIAC Code: C-2 with vapour retarder jacket:
  - .1 Insulation securements: SS bands at 300 mm oc.
  - .2 Seals: lap seal adhesive, lagging adhesive.

- .3 Installation: TIAC Code: 1501-C.
- .7 Thickness of insulation as listed in following table.
  - .1 Run-outs to individual units and equipment not exceeding 4000 mm long.
  - .2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Application	Temp °C	TIAC Code	Pipe Sizes (NPS) and Insulation Thickness (mm)					
			Run- out	to 1	1 <sup>1/4</sup> to 2	2 <sup>1/2</sup> to 4	5 to 6	8 & over
Steam, Saturated & Super Heated	over 175	A-1	38	65	65	75	90	90
Steam	up to 175	A-1	38	50	65	75	90	90
Condensate Return	60 - 94	A-1	25	25	25	38	38	38
Pumped Condensate Return	up to 94	A-1	25	25	25	38	38	38
Boiler Feed Water		A-1	25	25	25	25	25	25
Hot Water Heating	60 - 94	A-1	25	25	25	38	38	38
Hot Water Heating	up to 59	A-1	25	25	25	25	38	38
Glycol Heating	60 - 94	A-1	25	25	25	38	38	38
Glycol Heating	up to 59	A-1	25	25	25	25	38	38
Domestic HWS		A-1	25	25	25	38	38	38
Chilled Water	5- 13	A-3	25	25	25	25	25	25
Chilled Water or Glycol	below 5	A-3	25	25	38	38	38	38
Refrigerated Drinking Water		A-3	25	25	25	25	25	25
Domestic CWS		A-3	25	25	25	25	25	25
Domestic CWS with Vapour Retarder		C-2	25	25	25	25	25	25
Refrigerant	5- 13	A-6	25	25	25	25	25	25
Refrigerant [hot gas] [liquid] [suction]	below 5	A-6	25	25	38	38	38	38
RWL and RWP		C-2	25	25	25	25	25	25
Cooling Coil Cond. Drain		C-2	25	25	25	25	25	25
Diesel Generator Exhaust System		A-2	38	65	65	75	90	90

- .8 Finishes:
  - .1 Exposed indoors: aluminum or PVC jacket.
  - .2 Exposed in mechanical rooms: aluminum or PVC jacket.
  - .3 Concealed, indoors: canvas on valves, fittings. No further finish.
  - .4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.
  - .5 Outdoors: water-proof aluminum jacket.
  - .6 Finish attachments: SS bands, at 150 mm on centre. Seals: closed.
  - .7 Installation: to appropriate TIAC code CRF/1 through CPF/5.

### **3.7 CLEANING**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

**Part 1            General**

**1.1            CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS**

- .1        In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

**1.2            HYDRONIC SYSTEMS - PERFORMANCE VERIFICATION (PV)**

- .1        Perform hydronic systems performance verification after cleaning is completed and system is in full operation.
- .2        When systems are operational, perform following tests:
  - .1        Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of 48 hours to demonstrate compliance with design criteria.
  - .2        Verify performance of hydronic system circulating pumps as specified, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.
    - .1        Pump operation.
    - .2        Boiler and/or chiller operation.
    - .3        Pressure bypass open/closed.
    - .4        Control pressure failure.
    - .5        Maximum heating demand.
    - .6        Maximum cooling demand.
    - .7        Boiler and/or chiller failure.
    - .8        Cooling tower (and/or industrial fluid cooler) fan failure.
    - .9        Outdoor reset. Re-check heat exchanger output supply temperature at 100% and 50% reset, maximum water temperature.

**1.3            HYDRONIC SYSTEM CAPACITY TEST**

- .1        Perform hydronic system capacity tests after:
  - .1        TAB has been completed
  - .2        Verification of operating, limit, safety controls.
  - .3        Verification of primary and secondary pump flow rates.
  - .4        Verification of accuracy of temperature and pressure sensors and gauges.
- .2        Calculate system capacity at test conditions.
- .3        Using manufacturer's published data and calculated capacity at test conditions, extrapolate system capacity at design conditions.
- .4        When capacity test is completed, return controls and equipment status to normal operating conditions.

- .5 Submit sample of system water to approved testing agency to determine if chemical treatment is correct. Include cost.
- .6 Heating system capacity test:
  - .1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:
    - .1 Increasing OA flow rates through heating coils (in this case, monitor heating coil discharge temperatures to ensure that coils are not subjected to freezing conditions) or
    - .2 Reducing space temperature by turning of heating system for sufficient period of time before starting testing.
  - .2 Test procedures:
    - .1 Open fully heat exchanger, heating coil and radiation control valves.
    - .2 With boilers on full firing and hot water heating supply temperature stabilized, record flow rates and supply and return temperatures simultaneously.
    - .3 Conduct flue gas analysis test on boilers at full load and at low fire conditions.

#### **1.4 CONDENSER WATER AND HUMIDIFICATION SYSTEMS**

- .1 In addition to procedures specified above, perform following:
  - .1 Add chemicals once per week as required.
  - .2 Perform TAB as specified Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
  - .3 Set up and adjust drip feeders, timer controls, pump strokes as required to maintain required chemical feed rates.
  - .4 Inject inhibitor into cooling tower sump.

#### **1.5 GLYCOL SYSTEMS**

- .1 Test to prove concentration will prevent freezing to minus 40 degrees C Test inhibitor strength and include in procedural report. Refer to ASTM E202.

#### **1.6 POTABLE WATER SYSTEMS**

- .1 When cleaning is completed and system filled:
  - .1 Verify performance of equipment and systems as specified elsewhere in Division 23.
  - .2 Check for proper operation of water hammer arrestors. Run [one]outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or recharge air chambers. Repeat for each outlet and flush valve.
  - .3 Confirm water quality consistent with supply standards, verifying that no residuals remain resulting from flushing and/or cleaning.

**1.7 SANITARY AND STORM DRAINAGE SYSTEMS**

- .1 Buried systems: perform tests prior to backfilling. Perform hydraulic tests to verify grades and freedom from obstructions.
- .2 Ensure that traps are fully and permanently primed.
- .3 Ensure that fixtures are properly anchored, connected to system.
- .4 Operate flush valves, tank and operate each fixture to verify drainage and no leakage.

**1.8 REPORTS**

- .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Reports, supplemented as specified herein.

**1.9 TRAINING**

- .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Training of O&M Personnel, supplemented as specified herein.

**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            REFERENCE STANDARDS**

- .1    Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1        Material Safety Data Sheets (MSDS).

**1.2            ACTION AND INFORMATIONAL SUBMITTALS**

- .1    Product Data:
  - .1        Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .2    Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
  - .1        Instructions: submit manufacturer's installation instructions.
    - .1            Departmental Representative will make available 1 copy of systems supplier's installation instructions.

**1.3            QUALITY ASSURANCE**

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

**1.4            DELIVERY, STORAGE, AND HANDLING**

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

**Part 2            Products**

**2.1            CLEANING SOLUTIONS**

- .1      Tri-sodium phosphate: 0.40 kg per 100 L water in system.
- .2      Sodium carbonate: 0.40 kg per 100 L water in system.
- .3      Low-foaming detergent: 0.01 kg per 100 L water in system.

**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 datasheet.

**3.2            CLEANING HYDRONIC AND STEAM SYSTEMS**

- .1      Timing: systems operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.
- .2      Cleaning Agency:
  - .1      Retain qualified water treatment specialist to perform system cleaning.
- .3      Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist.
- .4      Cleaning procedures:
  - .1      Provide detailed report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:
    - .1      Cleaning procedures, flow rates, elapsed time.
    - .2      Chemicals and concentrations used.
    - .3      Inhibitors and concentrations.
    - .4      Specific requirements for completion of work.
    - .5      Special precautions for protecting piping system materials and components.
    - .6      Complete analysis of water used to ensure water will not damage systems or equipment.
- .5      Conditions at time of cleaning of systems:
  - .1      Systems: free from construction debris, dirt and other foreign material.
  - .2      Control valves: operational, fully open to ensure that terminal units can be cleaned properly.
  - .3      Strainers: clean prior to initial fill.
  - .4      Install temporary filters on pumps not equipped with permanent filters.
  - .5      Install pressure gauges on strainers to detect plugging.



- .6 Report on Completion of Cleaning:
  - .1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.
- .7 Hydronic Systems:
  - .1 Fill system with water, ensure air is vented from system.
  - .2 Fill expansion tanks 1/3 to 1/2 full, charge system with compressed air to at least 35 kPa (does not apply to diaphragm type expansion tanks).
  - .3 Use water metre to record volume of water in system to +/- 0.5%.
  - .4 Add chemicals under direct supervision of chemical treatment supplier.
  - .5 Closed loop systems: circulate system cleaner at 60 degrees C for at least 36 hours. Drain as quickly as possible. Refill with water and inhibitors. Test concentrations and adjust to recommended levels.
  - .6 Flush velocity in system mains and branches to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.
  - .7 Add chemical solution to system.
  - .8 Establish circulation, raise temperature slowly to 82 degrees C minimum maximum design. Circulate for 12 hours, ensuring flow in all circuits. Remove heat, continue to circulate until temperature is below 38 degrees C. Drain as quickly as possible. Refill with clean water. Circulate for 6 hours at design temperature. Drain and repeat procedures specified above. Flush through low point drains in system. Refill with clean water adding to sodium sulphite (test for residual sulphite).
- .8 Glycol Systems:
  - .1 In addition to procedures specified above perform specified procedures.
  - .2 Test to prove concentration will prevent freezing to minus 40 degrees C. Test inhibitor strength and include in procedural report. Refer to ASTM E202.

### 3.3 START-UP OF HYDRONIC SYSTEMS

- .1 After cleaning is completed and system is filled:
  - .1 Establish circulation and expansion tank level, set pressure controls.
  - .2 Ensure air is removed.
  - .3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.
  - .4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.
  - .5 Clean out strainers repeatedly until system is clean.
  - .6 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.
  - .7 Repeat with water at design temperature.
  - .8 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.

- .9 Bring system up to design temperature and pressure slowly over a 48-hour period.
- .10 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .11 Adjust pipe supports, hangers, springs as necessary.
- .12 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
- .13 If sliding type expansion joints bind or if bellows type expansion joints flex incorrectly, shut down system, re-align, repeat start-up procedures.
- .14 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.
- .15 Check operation of drain valves.
- .16 Adjust valve stem packings as systems settle down.
- .17 Fully open balancing valves (except those that are factory-set).
- .18 Check operation of over-temperature protection devices on circulating pumps.
- .19 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

### **3.4 FIELD QUALITY CONTROL**

- .1 Verification requirements in accordance with Section 01 45 00 – Quality Control, include:
  - .1 Materials and resources.
  - .2 Storage and collection of recyclables.
  - .3 Construction waste management.
  - .4 Resource reuse.
  - .5 Recycled content.
  - .6 Local/regional materials.
  - .7 Certified wood.
  - .8 Low-emitting materials.

### **3.5 CLEANING**

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

**END OF SECTION**

Approved: 2005-06-30

## **Part 1            General**

### **1.1            REFERENCE STANDARDS**

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME B16.5, Pipe Flanges and Flanged Fittings.
  - .2 ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
  - .3 ASME B16.22, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
  - .4 ASME B18.2.1, Square and Hex Bolts and Screws Inch Series.
- .2 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.
  - .2 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
  - .3 ASTM B75M, Standard Specification for Seamless Copper Tube.
  - .4 ASTM B837, Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems.
- .3 Canadian Standards Association (CSA International)
  - .1 CSA W47.1, Certification of Companies for Fusion Welding of Steel.
- .4 Canadian Standards Association (CSA)/Canadian Gas Association (CGA)
  - .1 CAN/CSA B149.1HB, Natural Gas and Propane Installation Code Handbook.
  - .2 CAN/CSA B149.2, Propane Storage and Handling Code.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

### **1.2            ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.
  - .2 Indicate on manufacturers catalogue literature following: valves.
  - .3 Submit WHMIS Material Safety Data Sheets in accordance with Section 01 35 43 - Environmental Procedures and Section 01 35 29.06 - Health and Safety Procedures. Indicate VOCs for adhesive and solvents during application and curing.
- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

### **1.3 QUALITY ASSURANCE**

- .1 Pre-Installation Meeting:
  - .1 Convene pre-installation meeting one week prior to beginning work of this Section in accordance with Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart.
    - .1 Verify project requirements.
    - .2 Review installation and substrate conditions.
    - .3 Co-ordination with other building subtrades.
    - .4 Review manufacturer's installation instructions and warranty requirements.
- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

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

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

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Materials and products in accordance with Section 01 61 00 – Common Product Requirements.

### **2.2 PIPE**

- .1 Steel pipe: to ASTM A53/A53M, Schedule 40, seamless as follows:

- .1 NPS 1/2 to 2, screwed.
- .2 NPS 2 1/2 and over, plain end.
- .2 Copper tube: to ASTM B837.

### **2.3 JOINTING MATERIAL**

- .1 Screwed fittings: pulverized lead paste.
- .2 Welded fittings: to CSA W47.1.
- .3 Flange gaskets: nonmetallic flat.
- .4 Brazing: to ASTM B837.

### **2.4 FITTINGS**

- .1 Steel pipe fittings, screwed, flanged or welded:
  - .1 Malleable iron: screwed, banded, Class 150.
  - .2 Steel pipe flanges and flanged fittings: to ASME B16.5.
  - .3 Welding: butt-welding fittings.
  - .4 Unions: malleable iron, brass to iron, ground seat, to ASTM A47/A47M.
  - .5 Bolts and nuts: to ASME B18.2.1.
  - .6 Nipples: schedule 40, to ASTM A53/A53M.
- .2 Copper pipe fittings, screwed, flanged or soldered:
  - .1 Cast copper fittings: to ASME B16.18.
  - .2 Wrought copper fittings: to ASME B16.22.

### **2.5 VALVES**

- .1 Provincial Code approved, lubricated plug type.

## **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 datasheet.

### **3.2 PIPING**

- .1 Install in accordance with Section 23 05 05 - Installation of Pipework, CAN/CSA B149.2, applicable Provincial/Territorial Codes, CAN/CSA B149.1, supplemented as specified.
- .2 Install drip points:
  - .1 At low points in piping system.
  - .2 At connections to equipment.

### **3.3 VALVES**

- .1 Install valves with stems upright or horizontal unless otherwise approved Departmental Representative.
- .2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.

### **3.4 FIELD QUALITY CONTROL**

- .1 Site Tests/Inspection:
  - .1 Test system in accordance with CAN/CSA B149.1 and requirements of authorities having jurisdiction.
- .2 Manufacturer's Field Services:
  - .1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its products, and submit written reports, in acceptable format, to verify compliance of work with Contract.
  - .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 at stages listed:
    - .1 After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.
    - .2 Twice during progress of work at 25% and 60% complete.
    - .3 Upon completion of work, after cleaning is carried out.
- .3 Obtain reports within 3 days of review and submit immediately to Departmental Representative.
- .4 Verification requirements in accordance with Section 01 45 00 – Quality Control, include:
  - .1 Materials and resources.
  - .2 Storage and collection of recyclables.
  - .3 Construction waste management.
  - .4 Resource reuse.
  - .5 Recycled content.
  - .6 Local/regional materials.
  - .7 Certified wood.
  - .8 Low-emitting materials.
- .5 Performance Verification:
  - .1 Refer to Section 23 08 01 - Performance Verification of Mechanical Piping Systems.
- .6 PV procedures:
  - .1 Test performance of components.

**3.5            ADJUSTING**

- .1      Purging: purge after pressure test in accordance with CAN/CSA B149.2, CAN/CSA B149.1.
- .2      Pre-Start-Up Inspections:
  - .1          Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.
  - .2          Check gas trains, entire installation is approved by authority having jurisdiction.

**3.6            CLEANING**

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

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 ASME
  - .1 ASME Boiler and Pressure Vessel Code (BPVC), Section VII.
- .2 ASTM International
  - .1 ASTM A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.
  - .2 ASTM A278/A278M, Standard Specification for Grey Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (350 degrees C).
  - .3 ASTM A516/A516M, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
  - .4 ASTM A536, Standard Specification for Ductile Iron Castings.
  - .5 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .3 CSA Group
  - .1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for expansion tanks, air vents, separators, valves, and strainers and include product characteristics, performance criteria, physical size, finish and limitations.

**1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for hydronic specialties for incorporation into manual.

**1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground in a dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect materials from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.



- .4 Packaging Waste Management: remove for reuse and/or recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **Part 2 Products**

### **2.1 AUTOMATIC AIR VENT**

- .1 Standard float vent: brass body and NPS 1/8 connection and rated at 1000 kPa working pressure.
- .2 Industrial float vent: ASTM A48 Class 30 cast iron body and NPS 1/2 connection and rated at minimum 860 kPa working pressure.
- .3 Float: solid material suitable for 115°C working temperature.

### **2.2 AIR SEPARATOR - EXPANSION TANK FITTING**

- .1 Complete with adjustable vent tube and built-in manual vent valve.
- .2 Working pressure: 860 kPa.

### **2.3 AIR SEPARATOR - IN-LINE**

- .1 Working pressure: 860 kPa.
- .2 Size: for 0.15 m/s
- .3 Shell: steel to ASME BPVC Section VIII.
- .4 Removable stainless steel collection tube.

### **2.4 COMBINATION SEPARATORS/STRAINERS**

- .1 Steel, tested and stamped in accordance with ANSI/ASME BPVC, for 860 kPa operating pressure, with stainless steel integral strainer with 5 mm perforations, tangential inlet and outlet connections, and internal stainless steel air collector tube.

### **2.5 COMBINATION LOW PRESSURE RELIEF AND REDUCING VALVE**

- .1 Adjustable pressure setting: 206 kPa relief, 55 to 172 kPa reducing or as indicated.
- .2 Low inlet pressure check valve.
- .3 Removable strainer.

### **2.6 PIPE LINE STRAINER**

- .1 NPS 1/2 to 2: 1.7 MPa steam non-shock bronze body to ASTM B62, screwed or grooved connections, Y pattern.
- .2 NPS 2 1/2 to 12: Class 150 cast steel body to ASTM A216 GR.WCB or cast iron body Class 125 to ASTM-A48, Class 30, flanged connections.
- .3 NPS 2 to 12: T type 2.1 MPa with ductile iron body to ASTM A536 or malleable iron body to ASTM A47M, grooved ends.
- .4 Blowdown connection: NPS 1.

- .5 Screen: stainless steel with 1.19 mm perforations.
- .6 Working pressure: 860 kPa.

## **2.7 SUCTION DIFFUSER**

- .1 Body: cast iron with flanged or grooved ductile iron connections 2.1 MPa.
- .2 Strainer: with built-in, disposable 1.19 mm mesh, start-up strainer, low pressure drop screen and NPS 1 blowdown connection.
- .3 Permanent magnet particle trap.
- .4 Full length straightening vanes.
- .5 Pressure gauge tapings.
- .6 Adjustable support leg.

## **2.8 Triple Duty Valve**

- .1 Center-guided non-slam drip tight check valve.
- .2 Positive shut-off valve.
- .3 Calibrated system balance valve.
- .4 Straight pattern as indicated.
- .5 Flanged or Grooved end connections.
- .6 Soft seat design for positive sealing.
- .7 Construction:
  - .1 Body: cast iron with bronze seat.
  - .2 Disc: bronze with EPDM seat insert.
  - .3 Stem: stainless steel.
  - .4 Spring: stainless steel.
  - .5 Packing: Teflon-Graphite (Asbestos-free).
  - .6 Gasket: asbestos-free.
  - .7 Readout valve: brass with EPT insert, check valve and gasket.
- .8 Maximum operating temperature: 121°C.
- .9 Maximum working pressure: 1.2 MPa.
- .10 Valve design shall permit repacking under full system pressure.
- .11 Provide complete with brass readout valves, with integral check feature, to facilitate taking differential pressure readings across the orifice for accurate system balance.
- .12 Provide CV rating at 10% increments. Manufacturer shall supply the CV rating for read-out of flow determination and system pressure drop.
- .13 Capacity: see schedule on drawings for performance criteria and model selections.

**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 material 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                APPLICATION**

- .1      Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and data sheets.

**3.3                GENERAL**

- .1      Run drain lines [and blow off connections]to terminate above nearest drain.
- .2      Maintain adequate clearance to permit service and maintenance.
- .3      Should deviations beyond allowable clearances arise, request and follow Departmental Representative's directive.
- .4      Check shop drawings for conformance of tappings for ancillaries and for equipment operating weights.

**3.4                STRAINERS**

- .1      Install in horizontal or down flow lines.
- .2      Ensure clearance for removal of basket.
- .3      Install ahead of each pump.
- .4      Install ahead of each automatic control valve larger than NPS 1 and radiation and as directed.
- .5      Clean Strainers upon completion of start-up.

**3.5                AIR VENTS**

- .1      Install at high points of systems.
- .2      Install gate valve on automatic air vent inlet. Run discharge to nearest drain or service sink or funnel floor drain.

**3.6                EXPANSION TANKS**

- .1      Adjust expansion tank pressure to suit design criteria.

- .2 Install lockshield type valve at inlet to tank.

### **3.7 PRESSURE SAFETY RELIEF VALVES**

- .1 Run discharge pipe to terminate above nearest drain.

### **3.8 SUCTION DIFFUSERS**

- .1 Install on inlet to pumps having suction size greater than 50.

### **3.9 Performance Verification**

- .1 In accordance with Section 23 08 01 - Performance Verification of Mechanical Piping Systems, supplemented as specified herein.
- .2 Provide copies of test reports for Commissioning Manuals.

### **3.10 CLEANING**

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

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE)
  - .1 ANSI/ASHRAE/IES Standard 90.1-[2010], Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 CSA Group
  - .1 CAN/CSA-B214-[12], Installation Code for Hydronic Heating Systems.
- .3 Electrical Equipment Manufacturers Association of Canada (EEMAC)
- .4 National Electrical Manufacturers' Association (NEMA)
  - .1 NEMA MG 1-[2011], Motors and Generators.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for pump, circulator, and equipment and include product characteristics, performance criteria, physical size, finish and limitations indicate point of operation, and final location in field assembly.
- .3 Shop Drawings:
  - .1 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.

**1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for hydronic pumps for incorporation into manual.

**1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground in a dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect materials from nicks, scratches, and blemishes.

- .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and/or recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **Part 2 Products**

### **2.1 EQUIPMENT**

- .1 Refer to Equipment schedule on drawings.

### **2.1 IN-LINE CIRCULATORS**

- .1 Volute: cast iron radially split, with screwed or flanged design suction and discharge connections.
- .2 Impeller: alloy steel, cast bronze, or cast iron to suit application.
- .3 Shaft: stainless steel with bronze sleeve bearing, integral thrust collar.
- .4 Seal assembly: mechanical for service to 135 °C.
- .5 Coupling: flexible self-aligning.
- .6 Motor: as per Section 23 05 13 – Common Motor Requirements for HVAC Equipment and as per manufacturer's recommendations. Speed and power as indicated in the pump schedule.
- .7 Capacity: as indicated in the pump schedule.
- .8 Design pressure: 1200 kPa.

### **2.2 VERTICAL IN-LINE CIRCULATORS**

- .1 Volute: cast iron radially split, with tapped openings for venting, draining and gauge connections, with screwed or flanged suction and discharge connections.
- .2 Impeller: bronze, cast iron, stainless steel dynamically balanced.
- .3 Shaft: stainless steel with bronze sleeve bearing, integral thrust collar.
- .4 Seal assembly: outside balanced, mechanical for service to 135 °C. Flush line fittings to include 50 micron filter and sight flow indicator, if pump differential exceeds 200 kPa replace filter with cyclone type separator.
- .5 Coupling: flexible self-aligning.
- .6 Motor: NEMA base, drip proof, ball bearing as per Section 23 05 13 – Common Motor Requirements for HVAC Equipment, speed and power as indicated in pump schedule.
- .7 Capacity: as indicated in pump schedule.
- .8 Design pressure: 1200 kPa.

### **2.3 SINGLE SUCTION CENTRIFUGAL PUMP**

- .1 General: all iron pump complete with motor.

- .2 Base: common cast iron or fabricated steel with drip rim and tapping for drain connection.
- .3 Volute: cast iron radially split, back pull out end suction, screwed or flanged suction and discharge, with drain plug and vent cock, suction and discharge pressure gauge tapings.
- .4 Impeller: cast iron or stainless steel enclosed type, keyed drive with locking nut or screw, dynamically balanced.
- .5 Shaft: stainless steel with two-point support for ball bearing mounting hardened wear rings at packing gland.
- .6 Seal assembly: mechanical seal, oil or grease lubricated. On open system, flush line with 50 micron filter and site flow indicator. When differential exceeds 200 kPa use cyclone type separator.
- .7 Coupling: flexible self-aligning complete with coupling guard.
- .8 Motor: NEMA Class B, squirrel cage induction, premium efficiency continuous duty, drip proof, ball bearing, maximum temperature rise 50 °C, as per Section 23 05 13 - Common Motor Requirements for HVAC Equipment , speed and power as indicated in pump schedule.
- .9 Capacity: as indicated in pump schedule.
- .10 Design pressure: 1200 kPa.

### **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 material 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 APPLICATION**

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and data sheets.

#### **3.3 INSTALLATION**

- .1 Install hydronic pumps to: [CAN/CSA-B214].
- .2 In line circulators: install as indicated by flow arrows.
  - .1 Support at inlet and outlet flanges or unions.

- .2 Install with bearing lubrication points accessible.
- .3 Base mounted type: supply templates for anchor bolt placement.
  - .1 Include anchor bolts with sleeves. Place level, shim unit and grout.
  - .2 Align coupling in accordance with manufacturer's recommended tolerance.
  - .3 Check oil level and lubricate. After run-in, tighten glands.
- .4 Ensure that pump body does not support piping or equipment.
  - .1 Provide stanchions or hangers for this purpose.
  - .2 Refer to manufacturer's installation instructions for details.
- .5 Pipe drain tapping to floor drain.
- .6 Install volute venting pet cock in accessible location.
- .7 Check rotation prior to start-up.
- .8 Install pressure gauge test cocks.

### **3.4 START-UP**

- .1 General:
  - .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements; supplemented as specified herein.
  - .2 In accordance with manufacturer's recommendations.
- .2 Procedures:
  - .1 Before starting pump, check that cooling water system over-temperature and other protective devices are installed and operative.
  - .2 After starting pump, check for proper, safe operation.
  - .3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
  - .4 Check base for free-floating, no obstructions under base.
  - .5 Run-in pumps for 12 continuous hours minimum.
  - .6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.
  - .7 Eliminate air from scroll casing.
  - .8 Adjust water flow rate through water-cooled bearings.
  - .9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.
  - .10 Adjust alignment of piping and conduit to ensure true flexibility.
  - .11 Eliminate cavitation, flashing and air entrainment.
  - .12 Adjust pump shaft seals, stuffing boxes, glands.
  - .13 Measure pressure drop across strainer when clean and with flow rates as finally set.
  - .14 Replace seals if pump used to degrease system or if pump used for temporary heat.



- .15 Verify lubricating oil levels.

### **3.5 PERFORMANCE VERIFICATION (PV)**

- .1 General:
  - .1 Verify performance in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified herein.
  - .2 Verify that manufacturer's performance curves are accurate.
  - .3 Ensure valves on pump suction and discharge provide tight shut-off.
  - .4 Net Positive Suction Head (NPSH):
    - .1 Application: measure NPSH for pumps which operate on open systems and with water at elevated temperatures.
    - .2 Measure using procedures prescribed in Section 01 91 13 - General Commissioning (Cx) Requirements.
    - .3 Where procedures do not exist, discontinue PV, report to Departmental Representative and await instructions.
  - .5 Multiple Pump Installations - Series and Parallel:
    - .1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.
  - .6 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.
  - .7 Commissioning Reports: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements reports supplemented as specified herein. Reports to include:
    - .1 Record of points of actual performance at maximum and minimum conditions and for single and parallel operation as finally set at completion of commissioning on pump curves.
    - .2 Use Report Forms specified in Section 01 91 13 - General Commissioning (Cx) Requirements: Report Forms and Schematics.
    - .3 Pump performance curves (family of curves).

### **3.6 CLEANING**

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

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 ASME
  - .1 ASME B16.22, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
  - .2 ASME B16.24, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 600, 900, 1500 and 2500.
  - .3 ASME B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
  - .4 ASME B31.5, Refrigeration Piping and Heat Transfer Components.
- .2 ASTM International
  - .1 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, and Threaded Rod 60,000 PSI Tensile Strength.
  - .2 ASTM B280, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- .3 CSA Group
  - .1 CSA B52, B52 Package, Mechanical Refrigeration Code.
- .4 Canada Federal Halocarbon Regulations, 2003
- .5 Canadian Correctional Service Canada
  - .1 Internal Service Directive (ISD) 318-4 – Environmental Management of Halocarbons
- .6 Environment Canada (EC)
  - .1 Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems. (2015)

**1.2 ADMINISTRATIVE REQUIREMENTS**

- .1 Pre-installation Meetings:
  - .1 Convene pre-installation meeting 1 week prior to beginning work of this Section, with Departmental Representative in accordance with Section 01 31 19 - Project Meetings to:
    - .1 Verify project requirements.
    - .2 Review installation and substrate conditions.
    - .3 Co-ordination with other building construction subtrades.
    - .4 Review manufacturer's written installation instructions and warranty requirements.

**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 refrigerant piping, fittings and equipment and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 43 - Environmental Procedures and Section 01 35 29.06 - Health and Safety Requirements. Indicate VOCs for adhesive and solvents during application and curing.
- .3 Complete the forms noted within CSC ISD 318-4.
- .4 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

#### **1.4 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for refrigerant equipment for incorporation into manual.
- .3 Submit the form for Halocarbon tracking per the CSC ISD 318-4.

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

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

### **Part 2 Products**

#### **2.1 TUBING**

- .1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.
  - .1 Hard copper: to ASTM B280, type ACR.
  - .2 Annealed copper: to ASTM B280, with minimum wall thickness as per CSA B52 and ASME B31.5.

## **2.2 FITTINGS**

- .1 Service: design pressure 4275 kPa and temperature 121 degrees C.
- .2 Brazed:
  - .1 Fittings: wrought copper to ASME B16.22.
  - .2 Joints: silver solder, 45% Ag - 80% Cu - 5% P and non-corrosive flux for copper to steel or brass; Silfoss-15 for copper to copper.
- .3 Flanged:
  - .1 Bronze or brass, to ASME B16.24, Class 150 and Class 300.
  - .2 Gaskets: suitable for service.
  - .3 Bolts, nuts and washers: to ASTM A307, heavy series.
- .4 Flared:
  - .1 Bronze or brass, for refrigeration, to ASME B16.26.

## **2.3 PIPE SLEEVES**

- .1 Hard copper or steel, sized to provide 6 mm clearance around between sleeve and uninsulated pipe or between sleeve and insulation.

## **2.4 VALVES**

- .1 22 mm and under: Class 500, 3.5 Mpa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.
- .2 Over 22 mm: Class 375, 2.5 Mpa, globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.

## **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 material 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 MANUFACTURER'S INSTRUCTIONS**

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

### **3.3 GENERAL**

- .1 Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5 Section 23 05 05-Installation of Pipework.

### **3.4 BRAZING PROCEDURES**

- .1 Bleed inert gas into pipe during brazing.
- .2 Remove valve internal parts, solenoid valve coils, sight glass.
- .3 Do not apply heat near expansion valve and bulb.

### **3.5 PIPING INSTALLATION**

- .1 General:
  - .1 Hard drawn copper tubing: do not bend. Minimize use of fittings Soft annealed copper tubing: bend without crimping or constriction.
- .2 Hot gas lines:
  - .1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.
  - .2 Provide trap at base of risers greater than 2400 mm high and at each 7600 mm thereafter.
  - .3 Provide inverted deep trap at top of risers.
  - .4 Provide double risers for compressors having capacity modulation.
    - .1 Large riser: install traps as specified.
    - .2 Small riser: size for 5.1 m<sup>3</sup>/s at minimum load. Connect upstream of traps on large riser.

### **3.6 PRESSURE AND LEAK TESTING**

- .1 Close valves on factory charged equipment and other equipment not designed for test pressures.
- .2 Leak test to CSA B52 before evacuation to 2 MPa and 1 MPa on high and low sides respectively.
- .3 Test procedure: build pressure up to 35 kPa with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.

### **3.7 FIELD QUALITY CONTROL**

- .1 Site Tests/Inspection:
  - .1 Close service valves on factory charged equipment.

- .2 Ambient temperatures to be at least 13 degrees C for at least 12 hours before and during dehydration.
- .3 Use copper lines of largest practical size to reduce evacuation time.
- .4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5 Pa absolute and filled with dehydrated oil.
- .5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.
- .6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:
  - .1 Twice to 14 Pa absolute and hold for 4 hours.
  - .2 Break vacuum with refrigerant to 14 kPa.
  - .3 Final to 5 Pa absolute and hold for at least 12 hours.
  - .4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
  - .5 Submit test results to Departmental Representative.
- .7 Charging:
  - .1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.
  - .2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.
  - .3 Re-purge charging line if refrigerant container is changed during charging process.
- .8 Checks:
  - .1 Make checks and measurements as per manufacturer's operation and maintenance instructions.
  - .2 Record and report measurements to Departmental Representative.
- .9 Manufacturer's Field Services:
  - .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its product[s] and submit written reports, in acceptable format, to verify compliance of Work with Contract.
  - .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, at stages listed:
    - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
    - .2 Twice during progress of Work at 25% and 60% complete.

- .3 Upon completion of the Work, after cleaning is carried out.
- .4 Obtain reports, within 3 days of review, and submit, immediately, to Departmental Representative.

### **3.8 DEMONSTRATION**

- .1 Instructions:
  - .1 Post instructions in frame with glass cover in accordance with Section 01 78 00 - Closeout Submittals and CSA B52.

### **3.9 CLEANING**

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

**END OF SECTION**





## INTERNAL SERVICES DIRECTIVE 318-4

In Effect: 2015-01-05

Last Review: 2015-01-05

Due for Review: 2017-01-05

### Environmental Management of Halocarbons

#### PROGRAM ALIGNMENT

Internal Services

#### OFFICE(S) OF PRIMARY INTEREST

Corporate Services Sector

#### ONLINE @

- <http://infonet/cds/cds/318-4-isd-eng.pdf>
- <http://infonet/cds/cds/318-4-isd-fra.pdf>
- <http://www.csc-scc.gc.ca/acts-and-regulations/318-4-isd-eng.shtml>
- <http://www.csc-scc.gc.ca/lois-et-reglements/318-4-isd-fra.shtml>

#### AUTHORITIES

- *Canadian Environmental Protection Act*, 1999
- *Federal Halocarbon Regulations*, 2003
- *Ozone-Depleting Substances Regulations*, 1998
- *Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems*, 1996
- *Canada's Strategy to Accelerate the Phase-Out of CFC and Halons Uses and to Dispose of the Surplus Stocks*, CCME, 2001

#### PURPOSE

- To protect the stratospheric ozone layer
- To prevent halocarbon emissions originating from federal installations on federal lands
- To formalize practices regarding the management of halocarbons in order to ensure compliance with federal and, where applicable, provincial regulatory requirements

#### APPLICATION

All Correctional Service of Canada (CSC) facilities that manage, internally or through external contractors, chillers, refrigeration and/or air-conditioning systems containing halocarbons

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7 – 12	<a href="#">Installation, Servicing, Leak Testing and Charging</a>
13 – 15	<a href="#">Recovery</a>
16 – 17	<a href="#">Requirements for Small Systems</a>
18	<a href="#">Phase-Out of Halocarbons Listed in Any Items 1 to 9 of Schedule 1</a>
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Note: The Environment Canada's *Federal Halocarbon Regulations*, 2003 (referred to as the "Regulations" henceforward) will in all cases take precedence over this directive. Institutions should always refer to the Regulations for detailed clarification on specific halocarbons management issues pertaining to applicability, scope, and required technical specifications.

## **RESPONSIBILITIES**

1. The Institutional Head and his/her delegates will be accountable to ensure compliance with the provisions of this directive.
2. The Environmental Officer will assist in meeting compliance with the requirements of the Regulations by advising on implementation aspects.

3. The Chief, Facility Management, and his/her delegates will be responsible for informing all external contractors that are hired to work on institutional [chillers](#), [refrigeration systems](#) and [air-conditioning systems](#) of the requirements set out in this directive.

## **PROCEDURES**

### **Prohibitions**

4. No person will release or allow or cause the release of a [halocarbon](#) that is contained in a refrigeration system, an air-conditioning system or any associated container or device (see [section 2.9 of the Refrigerant Code of Practice](#)).
5. No person will store, transport or purchase a halocarbon unless it is in a container designed and manufactured to be refilled and to contain that specific type of halocarbon.
6. As of January 1, 2015, no person will operate or permit the operation of any chiller that contains a halocarbon listed in any of [items 1 to 9 of Schedule 1](#).

## **REQUIREMENTS**

### **Installation, Servicing, Leak Testing and Charging**

7. Only a [certified person](#), as defined by the Regulations, may install, [service](#), [leak](#) test or [charge](#) a halocarbon to a refrigeration or air-conditioning system or do any other work on the [system](#) that may result in the release of a halocarbon. A person who does any of the work referred above must do it in accordance with the [Refrigerant Code of Practice](#). When installing a new system, the certified person must complete form [CSC/SCC 1265-01f](#) upon commissioning.
8. Any person who repairs or decommissions an apparatus that contains a halocarbon must be certified, as defined by the Regulations, and properly equipped in case the procedure causes the halocarbon to be released. The certified person must be appropriately equipped in accordance with the [Refrigerant Code of Practice](#) when assigned to leak test, repair, or decommission the parts of any apparatus that contain halocarbons.
9. For each system with a capacity over 19 kilowatts or 5.4 tons (or 64 828 BTU/hr), the Chief, Facility Management, will arrange for a certified person to conduct a leak test at least once every 12 months (on or before the exact date of the previous leak test), of all the components of a refrigeration or air-conditioning system that come into contact with a halocarbon, and confirm that the system meets all current design criteria and that the [installation](#) is equipped with halocarbon leak sensors if required by regulation (see [section 2.6.6 of the Refrigerant Code of Practice](#)).
10. A certified person who repairs and/or conducts a leak test on a refrigeration or air-conditioning system must place a permanent notice (label) on the system containing the information set out in form [CSC/SCC 1265-01c](#). In addition:
  - a. no person will remove this notice except to replace it with another such notice
  - b. the [owner](#) will keep a record of the information contained in the notice in the refrigeration and air-conditioning system [service log](#) (see [section 2.7.4 of the Refrigerant Code of Practice](#)).

11. No person will charge a refrigeration or air-conditioning system unless the system has been leak tested before charging and any leak has been repaired.
12. If a halocarbon leak is detected at any time, the assigned responsible person must, through the service of a certified person:
  - a. immediately repair the leaking portion of the system, or
  - b. if repairs are not likely to be initiated within seven days, immediately isolate the leaking portion of the system and [recover](#) the halocarbons from the leaking portion of the system pending repair of the leak in accordance with approved practices in this field.

### **Recovery**

13. A certified person that installs, services, leak tests or charges a halocarbon to a refrigeration or air-conditioning system, or that does any other work on any of those systems that may result in the release of a halocarbon, must recover, into an [appropriate container](#), any halocarbon that would otherwise be released during those procedures (see [sections 2.10 and 3.5 of the Refrigerant Code of Practice](#)).
14. Before dismantling, [decommissioning](#) or disposing of any system, measures must be taken as listed below:
  - a. recover halocarbons into an appropriate container and dispose of as hazardous waste (see [sections 2.9 and 3.4 to 3.8 of the Refrigerant Code of Practice](#))
  - b. place a notice (label) on the system containing the information set out in form [CSC/SCC 1265-01d](#) (it is prohibited to remove this notice except to replace it with another such notice)
  - c. once the decommissioning is completed, ensure that the dismantled system can never be reused.
15. In case of the dismantling, disposing or decommissioning of any system, a record of the information contained in this notice (label) must be kept on site in the service log (see form [CSC/SCC 1265-01e](#)).

### **Requirements for Small Systems**

16. When dismantling, disposing or decommissioning of equipment that contains a small air-conditioning or refrigeration system (i.e. with a refrigeration capacity of less than 19 kilowatts or 5.4 tons [or 64 828 BTU/hr]), the parts of the apparatus that contain halocarbon must be decommissioned before disposal. However, when selling or transferring used equipment containing a small system that a new owner is expected to continue to operate, it is not necessary to decommission the small system unless it leaks while in CSC custody.

17. The Chief, Facility Management, will arrange for a certified person to recover the halocarbons from any small system in which a halocarbon leak has been discovered, or which is being decommissioned (dismantled or disposed). In this situation, a notice (label) will be placed on the small system containing the information set out in form [CSC/SCC 1265-01d](#). No person will remove this notice except to replace it with another such notice. The information set out in form [CSC/SCC 1265-01e](#) will be recorded when a small system is purged.

### **Phase-Out of Halocarbons Listed in Any Items 1 to 9 of Schedule 1**

18. If any equipment is found containing any halocarbons listed in [items 1 to 9 of Schedule 1 of the Regulations](#), it must be immediately retrofitted or removed from service.

## **REPORTING**

### **Records**

19. Whenever a refrigeration or air-conditioning system is decommissioned, the Chief, Facility Management, will arrange for a written record containing the information set out in form [CSC/SCC 1265-01d](#) to be kept on site in the service log.
20. Whenever a refrigeration or air-conditioning system is installed, serviced, leak tested, repaired or charged, a written record containing the information set out in form [CSC/SCC 1265-01e](#) must be kept on site.
21. All the documents required in this directive must be kept on site in the form of a central register of halocarbons or integrated in the Environmental Information System, for a period of at least five years beginning on the date of their issuance (see [section 2.11 of the Refrigerant Code of Practice](#)).

### **Release Reports**

22. In the event of an accidental release of 100 kg or more of any halocarbon, the following reports must be submitted to:

- the appropriate regional division of Environment Canada (in priority)
  - the Regional Coordinator, Environmental Programs
  - the Environmental Protection Programs at CSC National Headquarters
- a. within 24 hours after the day on which the release is detected, a verbal or written report that indicates the type of halocarbon released and the type of system from which it was released
- b. within 14 days after the day on which the release is detected, a written report that indicates the information set out in form [CSC/SCC 1265-01a](#).

23. If more than 10 kg but less than 100 kg of a halocarbon is released, the Chief, Facility Management, will write a report that contains the information set out in form CSC/SCC 1265-01a and submit it twice a year (mid-July and mid-January) to the Regional Coordinator, Environmental Programs. The Regional Coordinator will forward this report to the Environmental Programs Section at CSC National Headquarters to allow National Headquarters to submit semi-annual corporate reports to the appropriate regional division of Environment Canada.

### **Inventory**

24. Each institution must keep an up-to-date inventory of all refrigeration and air-conditioning systems and chillers containing halocarbons that have a refrigeration capacity over 19 kilowatts or 5.4 tons. To the extent possible, the inventory will also include small refrigeration and air-conditioning systems.
25. The institutional inventory will clarify and formalize the custody and maintenance arrangements for each system with a capacity over 19 kilowatts or 5.4 tons (or 64 828 BTU/hr). Among other things, the inventory must uniquely identify and characterize each system, name its custodian, list the amount and type of halocarbon it contains, and describe its maintenance and inspection arrangements. For each of these systems, the inventory will at least contain the information set out in Annex C – Inventory Information for Chillers, Refrigeration and Air-conditioning Systems.

### **TRAINING**

26. Staff with responsibilities within this ISD must complete environmental awareness training covering all aspects of the Regulations as provided by Environment Canada. Note that this training does not replace provincial or territorial trade qualifications and certifications.

### **ENQUIRIES**

27. Environmental Protection Program  
National Headquarters  
Email: [GEN-NHQ-ENV@csc-scc.gc.ca](mailto:GEN-NHQ-ENV@csc-scc.gc.ca)

Assistant Commissioner,  
Corporate Services

Original Signed by:

Liette Dumas-Sluyter

## **ANNEX A**

### **CROSS-REFERENCES AND DEFINITIONS**

#### **CROSS-REFERENCES**

Canada's Strategy to Accelerate the Phase-Out of CFC and Halons Uses and to Dispose of the Surplus Stocks, CCME, May 2001  
Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems, Report EPS 1/RA/2, Environment Canada, March 1996. ISBN 0-660-95256-4. Cat. No. En49-26/1-2E  
Federal Halocarbon Regulations, 2003  
Halocarbon regulations and compliance guides  
<http://www.ec.gc.ca/ozone/> (for more information on issues related to halocarbons)  
Ozone-Depleting Substances Regulations, 1998  
Canadian Environmental Protection Act, 1999

#### **DEFINITIONS**

**Air-conditioning system:** an air-conditioning system, including any associated equipment, that contains or is designed to contain a halocarbon refrigerant.

**Appropriate container:** in respect of halocarbon management, a container that is designed and manufactured to be refilled and to contain a specific type of halocarbon.

**Certified person:** in respect of a refrigeration system or an air-conditioning system, a service technician who holds a certificate.

**Charging:** adding a halocarbon to a system (includes recharging or refilling).

**Chiller:** an air-conditioning system or a refrigeration system that has a compressor, an evaporator and a secondary refrigerant.

**Decommissioning:** the process of withdrawing an air-conditioning or refrigeration system to an inactive status. If the system is leaking, recover (the recovery should be done by a certified technician) the remaining halocarbon, place a notice (label) on the system, dismantle the system, dispose of the halocarbon as hazardous waste and properly dispose of the system. If the system is intended to be reused, recover halocarbon (the recovery will be done by a certified technician), place notice (label) on the system and relocate/transfer.

**Halocarbon:** a substance set out in Schedule 1, whether existing alone or in a mixture, and includes isomers of any such substance. Halocarbons consist of a group of ozone depleting substances (mainly CFCs, halons and HCFCs) largely used in refrigeration and air-conditioning systems, some fire extinguishing systems and solvent systems.

**Installation:** does not include the reactivation of a system by the same owner at the same site.

**Leak:** the release of a halocarbon from a system.

**Owner:** to hold a right in or to have possession, control or custody of, to be responsible for the maintenance, operation or management of, or to have the power to dispose of a system.

**Recovery:** in respect of a halocarbon:

- a. collection after it has been used, or
- b. collection from machinery, equipment, a system or a container during servicing or before dismantling, decommissioning or destruction of the machinery, equipment, system or container.

**Refrigeration system:** a refrigeration system, including any associated equipment, that contains or is designed to contain a halocarbon refrigerant.

**Service:** includes any modification, charging, maintenance, repair, moving, dismantling, decommissioning, destruction, start-up and testing of the system, but does not include testing related to the manufacture and production of the system.

**Service log:** in respect of halocarbon management, the institutional service log book or maintenance records of refrigeration or air-conditioning system(s) in which the information concerning the work conducted on the system(s) is entered as it is being done.

**System:** unless the context requires otherwise, an air-conditioning system, a fire extinguishing system, a refrigeration system or a solvent system.



**ANNEX B****LIST OF HALOCARBONS**

Extract from Schedule 1 of the *Federal Halocarbon Regulations*, 2003

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1. Tetrachloromethane (carbon tetrachloride)
  2. 1,1,1-trichloroethane (methyl chloroform), not including 1,1,2-trichloroethane
  3. Chlorofluorocarbons (CFC)
  4. Bromochlorodifluoromethane (Halon 1211)
  5. Bromotrifluoromethane (Halon 1301)
  6. Dibromotetrafluoroethane (Halon 2402)
  7. Bromofluorocarbons other than those set out in items 4 to 6
  8. Bromochloromethane (Halon 1011)
  9. Hydrobromofluorocarbons (HBFC)
  10. Hydrochlorofluorocarbons (HCFC)
  11. Hydrofluorocarbons (HFC)
  12. Perfluorocarbons (PFC)
- 

**Note:** As prescribed in the present document, the requirements affecting the items in the yellow shaded area are more restrictive because of the important ozone layer depletion potential of these halocarbons.

**ANNEX C****INVENTORY INFORMATION FOR CHILLERS, REFRIGERATION AND AIR-CONDITIONING SYSTEMS****Institution**

Inventory of chillers, refrigeration and air-conditioning systems	System Identification Code			
	Serial no.	Serial no.	Serial no.	Serial no.
Building no. where the system is located				
Location (name and/or room no.)				
System make				
System model				
Date of manufacture of system				
Description of system (type of system)				
Capacity of system (kW or tons or BTUs)				
Type of halocarbon				
Quantity of halocarbon (kg or lbs)				
Remarks				

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
  - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for air duct accessories and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Indicate:
    - .1 Flexible connections.
    - .2 Duct access doors.
    - .3 Turning vanes.
    - .4 Instrument test ports.

**1.3 DELIVERY, STORAGE AND HANDLING**

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

**Part 2 Products**

**2.1 GENERAL**

- .1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

**2.2 FLEXIBLE CONNECTIONS**

- .1 Frame: galvanized sheet metal frame 0.66 mm thick with fabric clenched by means of double locked seams.

- .2 Material:
  - .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at -40°C to +90°C, density of 1.3 kg/m<sup>2</sup>.

## **2.3 ACCESS DOORS IN DUCTS**

- .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- .2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .3 Gaskets: neoprene.
- .4 Hardware:
  - .1 Up to 300 x 300 mm: two sash locks complete with safety chain.
  - .2 301 to 450 mm: four sash locks complete with safety chain.
  - .3 451 to 1000 mm: piano hinge and minimum two sash locks.
  - .4 Doors over 1000 mm: piano hinge and two handles operable from both sides.
    - .1 Hold open devices.
    - .2 300 X 300 mm glass viewing panels.

## **2.4 TURNING VANES**

- .1 Factory or shop fabricated double thickness with trailing edge, to recommendations of SMACNA and as indicated.

## **2.5 INSTRUMENT TEST**

- .1 1.6 mm thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 28 mm minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.

## **2.6 SPIN-IN COLLARS**

- .1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.
- .2 Sheet metal thickness to co-responding round duct standards.

# **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 material 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 Flexible Connections:
  - .1 Install in following locations:
    - .1 Inlets and outlets to supply air units and fans.
    - .2 Inlets and outlets of exhaust and return air fans.
    - .3 As indicated.
  - .2 Length of connection: 100 mm.
  - .3 Minimum distance between metal parts when system in operation: 75 mm.
  - .4 Install in accordance with recommendations of SMACNA.
  - .5 When fan is running:
    - .1 Ducting on sides of flexible connection to be in alignment.
    - .2 Ensure slack material in flexible connection.
- .2 Access Doors and Viewing Panels:
  - .1 Size:
    - .1 600 x 600 mm for person size entry.
    - .2 450 x 450 mm for servicing entry.
    - .3 300 x 300 mm for viewing.
    - .4 As indicated.
  - .2 Locations:
    - .1 Fire and smoke dampers.
    - .2 Control dampers.
    - .3 Devices requiring maintenance.
    - .4 Required by code.
    - .5 Reheat coils.
    - .6 Elsewhere as indicated.
- .3 Instrument Test Ports:
  - .1 General:
    - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
  - .2 Locate to permit easy manipulation of instruments.
  - .3 Install insulation port extensions as required.
  - .4 Locations:
    - .1 For traverse readings:

- .1 Ducted inlets to roof and wall exhausters.
    - .2 Inlets and outlets of other fan systems.
    - .3 Main and sub-main ducts.
    - .4 And as indicated.
  - .2 For temperature readings:
    - .1 At outside air intakes.
    - .2 In mixed air applications in locations as approved by Departmental Representative.
    - .3 At inlet and outlet of coils.
    - .4 Downstream of junctions of two converging air streams of different temperatures.
    - .5 And as indicated.
- .4 Turning Vanes:
  - .1 Install in accordance with recommendations of SMACNA and as indicated.

### **3.3 CLEANING**

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

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 Sheet Metal and Air Conditioning National Association (SMACNA)
  - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for dampers and include product characteristics, performance criteria, physical size, finish and limitations.

**1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for dampers for incorporation into manual.

**1.4 DELIVERY, STORAGE AND HANDLING**

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

**Part 2 Products**

**2.1 GENERAL**

- .1 Manufacture to SMACNA standards.

**2.2 SPLITTER DAMPERS**

- .1 Fabricate from same material as duct but one sheet metal thickness heavier, with appropriate stiffening.

- .2 Single thickness construction.
- .3 Control rod with locking device and position indicator.
- .4 Rod configuration to prevent end from entering duct.
- .5 Pivot: piano hinge.
- .6 Folded leading edge.

### **2.3 SINGLE BLADE DAMPERS**

- .1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
- .2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm.
- .3 Locking quadrant with shaft extension to accommodate insulation thickness.
- .4 Inside and outside bronze end bearings.
- .5 Channel frame of same material as adjacent duct, complete with angle stop.

### **2.4 MULTI-BLADED DAMPERS**

- .1 Factory manufactured of material compatible with duct.
- .2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.
- .3 Maximum blade height: 100 mm.
- .4 Bearings: pin in bronze bushings.
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.
- .7 Low leakage construction

## **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 material 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 where indicated.
- .2       Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3       Locate balancing dampers in each branch duct, for supply, return and exhaust systems.
- .4       Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.
- .5       Dampers: vibration free.
- .6       Ensure damper operators are observable and accessible.
- .7       Corrections and adjustments conducted by Departmental Representative.

**3.3           CLEANING**

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

**END OF SECTION**

Approved: 2013-06-30

**Part 1            General**

**1.1                REFERENCES**

- .1        American National Standards Institute (ANSI) / Air Movement and Control Association (AMCA)
  - .1            ANSI/AMCA Standard 500-D, Laboratory Methods of Testing Dampers for Rating.
- .2        American Society for Testing and Materials (ASTM International)
  - .1            ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

**1.2                ACTION AND INFORMATIONAL SUBMITTALS**

- .1        Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2        Product Data:
  - .1            Submit manufacturer's instructions, printed product literature and data sheets for dampers and include product characteristics, performance criteria, physical size, finish and limitations.

**1.3                CLOSEOUT SUBMITTALS**

- .1        Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2        Operation and Maintenance Data: submit operation and maintenance data for dampers for incorporation into manual.

**1.4                DELIVERY, STORAGE AND HANDLING**

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

**Part 2            Products**

**2.1                MULTI-LEAF DAMPERS**

- .1        Opposed or parallel blade type as indicated.
- .2        Structurally formed steel or extruded aluminum, interlocking blades complete with extruded vinyl or EPDM seals, spring stainless steel or silicon side seals, structurally formed and welded galvanized steel or extruded aluminum frame.
- .3        Blade depth: 152 mm
- .4        Pressure fit self-lubricated bronze bearings.
- .5        Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.
- .6        Operator: to Section 23 30 02 - EMCS: Field Control Devices.
- .7        Performance:
  - .1        Leakage: in closed position less than 2% of rated air flow at 500 Pa differential across damper.
  - .2        Pressure drop: at full open position less than 25 Pa differential across damper at 10 m/s.
  - .3        AMCA certified for leakage and air performance.
- .8        Insulated aluminum dampers:
  - .1        Frames: 6063-T5 extruded aluminum, thermally broken frame coupled with polyurethane or polystyrene foam, with RSI factor of 0.4, flanged type.
  - .2        Seals: silicone side seals and EPDM blade seals.
  - .3        Blades: 6063-T5 extruded aluminum, air-foil profile, with internal hollows insulated with polyurethane or polystyrene foam with RSI factor of 0.4.
  - .4        Leakage: AMCA Class 1A at 250 Pa static pressure differential.
- .9        Design Standard: Tamco
- .10      Acceptable Manufacturers: Alumavent (Ventex), Ruskin, Tamco

**2.2                DISC TYPE DAMPERS**

- .1        Frame: insulated brake formed, welded, 1.6 mm thick, galvanized steel to ASTM A653/A653M.
- .2        Disc: insulated spin formed, 1.6 mm thick, galvanized steel to ASTM A653/A653M.
- .3        Gasket: extruded neoprene, field replaceable, with 10-year warranty.
- .4        Bearings: roller self lubricated and sealed.
- .5        Operator: compatible with damper, linear stroke operator, spring loaded actuator, zinc-aluminum foundry alloy casting cam follower.
- .6        Performance:

- .1 Leakage: in closed position less than 2% of rated air flow at 500 Pa differential across damper.
- .2 Pressure drop: at full open position less than 25 Pa differential across damper at 10 m/s.
- .3 AMCA certified for leakage and air performance.
- .7 Design Standard: Tamco
- .8 Acceptable Manufacturers: Alumavent (Ventex), Ruskin, Tamco

## **2.3 BACK DRAFT DAMPERS**

- .1 Automatic gravity operated, multi-leaf, aluminum or steel construction with nylon bearings, centre pivoted, spring assisted or counterweighted, as indicated.

## **2.4 RELIEF DAMPERS**

- .1 Automatic multi-leaf steel or aluminum dampers with ball bearing centre pivoted and counter-weights set to open, as indicated.

# **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 material 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 where indicated.
- .2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.
- .3 Seal multiple damper modules with silicon sealant.
- .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
- .5 Ensure dampers are observable and accessible.

## **3.3 CLEANING**

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

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

**END OF SECTION**

Approved: 2013-06-30

**Part 1 General**

**1.1 REFERENCES**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .2 National Fire Protection Association (NFPA)
  - .1 NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .3 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S112, Standard Test Method of Fire Test of Fire Damper Assemblies.
  - .2 CAN/ULC-S112.2, Standard Method of Fire Test of Ceiling Fire Stop Flap Assemblies.
  - .3 ULC-S505, Standard for Fusible Links for Fire Protection Service.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for fire and smoke dampers and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Indicate the following:
    - .1 Fire dampers.
    - .2 Smoke dampers.
    - .3 Fire stop flaps.
    - .4 Operators.
    - .5 Fusible links.
    - .6 Design details of break-away joints.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

**1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for fire and smoke dampers for incorporation into manual.

#### **1.4 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra Materials:
  - .1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
  - .2 Provide:
    - .1 Six (6) fusible links of each type.

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

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

### **Part 2 Products**

#### **2.1 FIRE DAMPERS**

- .1 Fire dampers: arrangement Type B or C with blades out of air stream, listed and bear label of ULC, meet requirements of authorities having jurisdiction and NFPA 90A. Fire damper assemblies to be fire tested in accordance with CAN/ULC-S112.
- .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
  - .1 Fire dampers: 1½ hour fire rated unless otherwise indicated.
  - .2 Fire dampers: automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.
- .3 Top hinged: multi-blade hinged or interlocking type; sized to maintain full duct cross section [as indicated].
- .4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.
- .5 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.
- .6 Equip fire dampers with steel sleeve or frame installed disruption ductwork or impair damper operation.

- .7 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.
- .8 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.
- .9 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness.
- .10 Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed.

## **2.2 SMOKE DAMPERS**

- .1 Smoke Dampers: to be ULC or UL listed and labelled.
- .2 Motorized S/D-M: folding blade type, normally open with power on. When power is interrupted damper shall close automatically. Both damper and damper operator shall be ULC listed and labelled.

## **2.3 COMBINATION FIRE AND SMOKE DAMPERS**

- .1 Damper: similar to smoke dampers specified above.
- .2 Combined actuator: electrical control system actuated from smoke sensor or smoke detection system and from fusible link.

## **2.4 FIRE STOP FLAPS**

- .1 Fire smoke flaps: ULC listed and labelled and fire tested in accordance with CAN/ULC-S112.2.
- .2 Construct of minimum 1.5 mm thick sheet steel with 1.6 mm thick non-asbestos ULC listed insulation and corrosion-resistant pins and hinges.
- .3 Flaps held open with fusible link conforming to ULC-S505 and close at 74 degrees C.

# **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 material 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 in accordance with NFPA 90A and in accordance with conditions of ULC listing.
- .2 Maintain integrity of fire separation.
- .3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
- .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
- .5 Co-ordinate with installer of fire stopping.
- .6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.
- .7 Install break-away joints of approved design on each side of fire separation.

### **3.3 CLEANING**

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

**END OF SECTION**

**Part 1        General**

**1.1        REFERENCE STANDARDS**

- .1    American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE)
- .2    National Fire Protection Association (NFPA)
  - .1        NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
  - .2        NFPA 90B, Standard for Installation of Warm Air Heating and Air-Conditioning Systems.
- .3    Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA)
  - .1        SMACNA HVAC Duct Construction Standards - Metal and Flexible.
  - .2        SMACNA IAQ Guideline for Occupied Buildings under Construction.
- .4    Underwriters' Laboratories (UL)
  - .1        UL 181, Standard for Factory-Made Air Ducts and Air Connectors.
- .5    Underwriters' Laboratories of Canada (ULC)
  - .1        CAN/ULC-S110, Standard Methods of Tests for Air Ducts.

**1.2        ACTION AND INFORMATIONAL SUBMITTALS**

- .1    Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2    Product Data:
  - .1        Submit manufacturer's instructions, printed product literature and data sheets for flexible ducts and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2        Indicate:
    - .1           Thermal properties.
    - .2           Friction loss.
    - .3           Acoustical loss.
    - .4           Leakage.
    - .5           Fire rating.
- .3    Test and Evaluation Reports:
  - .1        Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

### **1.3 DELIVERY, STORAGE AND HANDLING**

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

## **Part 2 Products**

### **2.1 GENERAL**

- .1 Factory fabricated to CAN/ULC-S110.
- .2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.
- .3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

### **2.1 METALLIC - UNINSULATED**

- .1 Type 1: spiral wound flexible aluminum, as indicated.
- .2 Performance:
  - .1 Factory tested to 1.0 kPa without leakage.
  - .2 Maximum relative pressure drop coefficient: 3.

### **2.2 METALLIC - INSULATED**

- .1 Type 2: spiral wound flexible aluminum with factory applied, 37mm thick flexible glass fibre thermal insulation with vapour barrier and vinyl or reinforced mylar/neoprene laminate jacket.
- .2 Performance:
  - .1 Factory tested to 1000 Pa without leakage.
  - .2 Maximum relative pressure drop coefficient: 3.
  - .3 Thermal loss/gain: 1.3 W/m<sup>2</sup>.°C. mean.

### 2.3 NON-METALLIC - UNINSULATED

- .1 Type 3: non-collapsible, coated mineral base fabric or aluminum foil mylar type, mechanically bonded to, and helically supported by, external steel wire.
- .2 Performance:
  - .1 Factory tested to 1000 Pa without leakage.
  - .2 Maximum relative pressure drop coefficient: 3.

### 2.4 NON-METALLIC - INSULATED

- .1 Type 4: non-collapsible, coated mineral base fabric or aluminum foil mylar type mechanically bonded to, and helically supported by, external steel wire with factory applied, 25 mm thick flexible glass fibre thermal insulation with vapour barrier and vinyl or reinforced mylar/neoprene laminate jacket.
- .2 Performance:
  - .1 Factory tested to 1000 Pa without leakage.
  - .2 Maximum relative pressure drop coefficient: 3.
  - .3 Thermal loss/gain: 1.3 W/m<sup>2</sup>.°C mean.

### 2.5 METALLIC ACOUSTIC INSULATED - MEDIUM PRESSURE

- .1 Type 5: Spiral wound, flexible perforated aluminum with factory applied 25 mm thick flexible glass fibre thermal insulation and sleeved by aluminum foil and mylar laminate vapour barrier.
- .2 Performance:
  - .1 Factory tested to 3 kPa without leakage.
  - .2 Maximum relative pressure drop coefficient: 3.
  - .3 Acoustical performance: Minimum attenuation (dB/m) to following table:

Frequency (Hz)					
Duct Diam:	125	250	500	1000	2000
100	0.6	3	12	27	0
150	1.2	3	12	22	27
200	2.0	5	12	19	20
300	2.4	5	12	16	15

### 2.6 METALLIC - ACOUSTIC INSULATED - HIGH PRESSURE

- .1 Type 6: Spiral wound, flexible perforated aluminum with factory applied 37 mm thick flexible glass fibre thermal insulation and encased in spiral wound flexible aluminum jacket, as indicated.

- .2 Performance:
- .1 Factory tested to 2.5 kPa without leakage.
  - .2 Maximum relative pressure drop coefficient: 3.
  - .3 Acoustical performance: Minimum attenuation (dB/m) to following table:

Frequency (Hz)					
Duct Diam:	125	250	500	1000	2000
100	0.6	3	12	27	0
150	1.2	3	12	22	27
200	2.0	5	12	19	20
300	2.4	5	12	16	15

## 2.7 NON-METALLIC - ACOUSTIC INSULATED

- .1 Type 7: Non-collapsible, coated mineral base perforated fabric type helically supported by and mechanically bonded to steel wire with factory applied flexible glass fibre acoustic insulation and encased in aluminum foil and mylar laminate vapour barrier.
- .2 Performance:
  - .1 Factory tested to 3 kPa without leakage.
  - .2 Maximum relative pressure drop coefficient: 3.
  - .3 Acoustical performance: Minimum attenuation (dB/m) to following table:

Frequency (Hz)					
Duct Diam:	125	250	500	1000	2000
100	0.6	3	12	27	0
150	1.2	3	12	22	27
200	2.0	5	12	19	20
300	2.4	5	12	16	15

**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 material 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                DUCT INSTALLATION**

- .1      Install in accordance with: SMACNA.

**3.3                CLEANING**

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

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)
  - .1 ANSI/AMCA Standard 99, Standards Handbook.
  - .2 ANSI/AMCA Standard 210/(ANSI/ASHRAE 51-07), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
  - .3 ANSI/AMCA Standard 300, Reverberant Room Method for Sound Testing of Fans.
  - .4 ANSI/AMCA Standard 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .2 The Master Painters Institute (MPI)
  - .1 Architectural Painting Specification Manual.
    - .1 MPI #18, Primer, Zinc Rich, Organic.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for HVAC fans and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Provide:
    - .1 Fan performance curves showing point of operation, kW/bhp and efficiency.
    - .2 Sound rating data at point of operation.
  - .2 Indicate:
    - .1 Motors, sheaves, bearings, shaft details
    - .2 Minimum performance achievable with as variable speed controllers.

**1.3 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra Materials:
  - .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
    - .1 Provide:
      - .1 Matched sets of belts.
      - .2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:
        - .1 Bearings and seals.
        - .2 Addresses of suppliers.

- .3 List of specialized tools necessary for adjusting, repairing or replacing.

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

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

### **Part 2 Products**

#### **2.1 SYSTEM DESCRIPTION**

- .1 Refer to Equipment schedule on drawings.

#### **2.2 FANS GENERAL**

- .1 Motors:
  - .1 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment supplemented as specified herein.
  - .2 For use with variable speed controllers.
- .2 Factory primed before assembly in colour standard to manufacturer.
- .3 Scroll casing drains: as indicated.
- .4 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .5 Vibration isolation: to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- .6 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

#### **2.3 DIRECT DRIVEN BACKWARD INCLINED CENTRIFUGAL INLINE FANS**

- .1 General Description:
  - .1 Ducted inline fan
  - .2 Normal operating temperature up to 130 Fahrenheit (54.4 Celsius)
  - .3 Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number



- .2 Wheel:
  - .1 Non-overloading, backward inclined centrifugal wheel
  - .2 Constructed of aluminum
  - .3 Statically and dynamically balanced in accordance to AMCA Standard 204-05
  - .4 The wheel cone and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency
  - .5 Single thickness blades are securely riveted or welded to a heavy gauge back plate and wheel cone.
- .3 Motors:
  - .1 Electronically Commutated Motor
    - .1 Motor enclosures: Open type
    - .2 Motor to be a DC electronic commutation type motor (ECM) specifically designed for fan applications. AC induction type motors are not acceptable. Examples of unacceptable motors are: Shaded Pole, Permanent Split Capacitor (PSC), Split Phase, Capacitor Start and 3 phase induction type motors.
    - .3 Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase.
    - .4 Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor
    - .5 Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal.
    - .6 Motor shall be a minimum of 85% efficient at all speeds.
- .4 Housing/Cabinet Construction
  - .1 Construction material: Galvanized
  - .2 Square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars
  - .3 Housing and bearing supports shall be constructed of heavy gauge bolted and welded steel construction to prevent vibration and to rigidly support the shaft and bearing assembly.
- .5 Housing Supports and Drive Frame:
  - .1 Housing supports are constructed of structural steel with formed flanges
  - .2 Drive frame is welded steel which supports the motor
- .6 Disconnect Switches:
  - .1 NEMA rated: 4
  - .2 Positive electrical shut-off
  - .3 Wired from fan motor to junction box
- .7 Duct Collars:
  - .1 Square design to provide a large discharge area
  - .2 Inlet and discharge collars provide easy duct connection

- .3 Provide Flexible connection to ductwork.
- .8 Access Panel:
  - .1 Two-sided access panels, permit easy access to all internal components
  - .2 Located perpendicular to the motor mounting panel
- .9 Options/Accessories:
  - .1 Isolation:
    - .1 Housed Spring sized to match the weight of each fan
  - .2 Motor Cover:
    - .1 Constructed of galvanized steel
    - .2 Covers motor and drives for safety
    - .3 Standard on unit specified with UL
  - .3 Wiring Pigtail:
    - .1 Direct hook-up to the power supply

## **2.4 CEILING FAN – AIR CIRCULATOR**

- .1 General Description:
  - .1 Ceiling mounted variable speed, reversible air circulation fan.
- .2 Blades
  - .1 Painted steel blades (3) with curved ends. White
  - .2 1200 mm blade diameter
  - .3 400 mm downrod
- .3 Motors and controls:
  - .1 Thermally protected PSC type variable speed with permanently lubricated bearings.
  - .2 Wall mounted remote controller capable of controlling up to 4 fans with forward and reverse switch and variable speed operation.

## **2.5 DIRECT DRIVE ROOF UPBLAST CENTRIFUGAL EXHAUST FANS**

- .1 General Description:
  - .1 Discharge air directly away from the mounting surface
  - .2 Roof mounted applications
  - .3 Maximum continuous operating temperature 200 Celsius.
  - .4 Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number.
- .2 Wheel:
  - .1 Material type: aluminum
  - .2 Non-overloading, backward inclined centrifugal
  - .3 Statically and dynamically balanced in accordance to AMCA Standard 204-05
  - .4 The wheel cone and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency.

- .3 Motors:
  - .1 Electronically Commutated Motor
    - .1 Motor enclosures: Open type
    - .2 Motor to be a DC electronic commutation type motor (ECM) specifically designed for fan applications. AC induction type motors are not acceptable. Examples of unacceptable motors are: Shaded Pole, Permanent Split Capacitor (PSC), Split Phase, Capacitor Start and 3 phase induction type motors.
    - .3 Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase.
    - .4 Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor
    - .5 Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal.
    - .6 Motor shall be a minimum of 85% efficient at all speeds.
- .4 Housing:
  - .1 Constructed of heavy gauge aluminum includes exterior housing, curb cap, windband, and motor compartment housing. Galvanized material is not acceptable.
  - .2 Housing shall have a rigid internal support structure. Windband to be one piece uniquely spun aluminum construction and maintain original material thickness throughout the housing.
  - .3 Windband to include an integral rolled bead for strength.
  - .4 Curb cap base to be fully welded to windband to ensure a leak proof construction. Tack welding, bolting, and caulking are not acceptable.
  - .5 Curb cap to have integral deep spun inlet venturi and pre-punched mounting holes to ensure correct attachment to curb.
  - .6 Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators.
  - .7 Breather tube shall be 10 square inches in size for fresh air motor cooling, and designed to allow wiring to be run through it.
  - .8 Motor Cover:
    - .1 Constructed of aluminum
  - .9 Vibration Isolation:
    - .1 Double studded true isolators
    - .2 No metal to metal contact
    - .3 Sized to match the weight of each fan
- .5 Disconnect Switches:
  - .1 NEMA rated: 4X
  - .2 Positive electrical shut-off
  - .3 Wired from fan motor to junction box installed within motor compartment

- .6 Drain Trough:
  - .1 Allows for one-point drainage of water, grease, and other residues
- .7 Dampers:
  - .1 Type: Insulated Motorized
  - .2 Prevents outside air from entering back into the building when fan is off per NECB.

## **2.6 DIRECT DRIVE SIDEWALL MOUNTED PROPELLER**

- .1 General Description:
  - .1 Sidewall mounted applications
  - .2 Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number
- .2 Wheel:
  - .1 Propeller shall be aluminum blade riveted to steel hub
  - .2 A standard square key and set screw or tapered bushing shall lock the propeller to the motor shaft
  - .3 Statically and dynamically balanced in accordance with AMCA Standard 204-05
  - .4 The propeller and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency
- .3 Motors:
  - .1 Electronically Commutated Motor
    - .1 Motor enclosures: Open type
    - .2 Motor to be a DC electronic commutation type motor (ECM) specifically designed for fan applications. AC induction type motors are not acceptable. Examples of unacceptable motors are: Shaded Pole, Permanent Split Capacitor (PSC), Split Phase, Capacitor Start and 3 phase induction type motors.
    - .3 Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase.
    - .4 Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor
    - .5 Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal.
    - .6 Motor shall be a minimum of 85% efficient at all speeds.
- .4 Drive Frame:
  - .1 Drive frame assemblies and fan panels shall be galvanized steel
  - .2 Drive frame shall have welded wire or formed channels and fan panels shall have pre-punched mounting holes, formed flanges and a deep formed one piece inlet venturi

- .5 Disconnect Switches:
  - .1 NEMA rated: 4X
  - .2 Positive electrical shut-off
  - .3 Wired from fan motor to junction box
- .6 Options/Accessories:
  - .1 Dampers:
    - .1 Type: Insulated Motorized
    - .2 Prevents outside air from entering back into the building when fan is off per NECB.
  - .2 Wall Housing:
    - .1 Mounting arrangement: Flush Interior
    - .2 Constructed of galvanized steel with heavy gauge mounting flanges and pre-punched mounting holes
  - .3 Wall Collar:
    - .1 Constructed of galvanized steel with heavy gauge mounting flanges and pre-punched mounting holes
  - .4 Weatherhood:
    - .1 Shall shield wall opening and dampers from rain and snow with a lockable hinged connection to allow access to fan.
    - .2 Material type: Galvanized
    - .3 Turndown Angle: 90 degrees
    - .4 Screen: Birdscreen
    - .5 Finishes: Permatector

## **2.7 Centrifugal Fume Exhaust with Integral Stack**

- .1 General:
  - .1 Single Width Centrifugal Fume Exhaust with Integral Stack.
  - .2 Fans selected shall be capable of accommodating static pressure and flow variations of +/-15% of scheduled values.
  - .3 Each fan shall be belt drive in AMCA arrangement 10.
  - .4 Fans are to be equipped with lifting lugs.
  - .5 When properly anchored to the roof structure, the standard fan / stack assembly shall withstand wind loads of up to 1 kPa equivalent to 41m/s windspeed, without the need for guy wires or additional structural support.
- .2 Fan Housing and Integral Stack:
  - .1 Fan housing is to be aerodynamically designed with high-efficiency inlet, engineered to reduce incoming air turbulence.
  - .2 Fan shall be of airtight construction with the scroll panel material formed and embedded into the side panels.
  - .3 Housing and bearing support shall be constructed of galvanized material and bolted framework.

- .4 Housing shall include discharge stack of same material as fan housing to increase the overall discharge height of the unit. Minimum overall unit height with stack to be 7 feet (2.1m) from the roof deck.
  - .5 Stack material to be a minimum of 18 gauge. Stack to match outlet dimensions of the fan and shall not add additional static pressure drop to the exhaust fan. Stack discharge shall have tapered design increasing exit velocity and not adding additional static pressure drop to the exhaust fan.
  - .6 No discharge rain caps or flapper caps are permitted as to interfere with exhaust airflow.
  - .7 Drain port shall be located at lowest part of scroll housing to prevent moisture build-up in the interior of fan.
  - .8 An OSHA compliant weatherhood shall be included to completely cover the motor pulley and belt(s).
- .3 Fan Wheel:
- .1 The fan wheel shall be of the non-overloading single width backward inclined centrifugal type. Wheels shall be statically and dynamically balanced to balance grade G6.3 per ANSI S2.19.
  - .2 Fan wheel shall be manufactured of single thickness blades securely riveted or welded to a heavy gauge back plate and wheel cone.
  - .3 The wheel and fan inlet shall be carefully matched and shall have precise running tolerances for maximum performance and operating efficiency.
- .4 Fan Motors and Drive:
- .1 Motors shall meet or exceed EISA (Energy Independence and Security Act) efficiencies. Motors to be NEMA T-frame, 1800 or 3600 RPM, Open Drip Proof (ODP) with a 1.15 service factor.
  - .2 Drive belts and sheaves shall be sized for 150% of the fan operating brake horsepower, and shall be readily and easily accessible for service, if required.
  - .3 Fan shaft to be turned and polished steel that is sized so the first critical speed is at least 25% over the maximum operating speed for each pressure class.
  - .4 Fan shaft bearings shall be Air Handling Quality, bearings shall be heavy-duty grease lubricated, self-aligning or roller pillow block type.
  - .5 Air Handling Quality bearings to be designed with low swivel torque to allow the outer race of the bearing to pivot or swivel within the cast pillow block. Bearings shall be 100% tested for noise and vibration by the manufacturer. Bearings shall be 100% tested to insure the inner race diameter is within tolerance to prevent vibration.
  - .6 Bearings shall be selected for a basic rating fatigue life (L-10) of 80,000 hours at maximum operating speed for each pressure class.
  - .7 Bearings shall have Zerk fittings to allow for lubrication.

**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 material 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                FAN INSTALLATION**

- .1      Install fans as indicated, complete with resilient mountings specified in Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment, flexible electrical leads and flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.
- .2      Provide sheaves and belts required for final air balance.
- .3      Bearings and extension tubes to be easily accessible.
- .4      Access doors and access panels to be easily accessible.

**3.3                ANCHOR BOLTS AND TEMPLATES**

- .1      Size anchor bolts to withstand seismic acceleration and velocity forces.

**3.4                CLEANING**

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

**END OF SECTION**

**Part 1            General**

**1.1            RELATED REQUIREMENTS**

- .1    Section 01 33 00 - Submittal Procedures.
- .2    Section 01 45 00 - Quality Control.
- .3    Section 01 74 21 - Construction/Demolition Waste Submittal and Disposal.
- .4    Section 01 78 00 - Closeout Submittals.

**1.2            REFERENCES**

- .1    American National Standards Institute/Air Movement and Control Association (ANSI/AMCA):
  - .1    ANSI/AMCA Standard 210 (ANSI/ASHRAE 51), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .2    American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
  - .1    AHSRAE 130, Methods of Testing for Rating Ducted Air Terminal Units.
- .3    Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1    Material Safety Data Sheets (MSDS).
- .4    International Organization of Standardization (ISO):
  - .1    ISO 3741, Acoustics-Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Methods for Reverberation Rooms.
- .5    National Fire Protection Association (NFPA):
  - .1    NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .6    Underwriter's Laboratories (UL):
  - .1    UL 181, Factory-Made Air Ducts and Air Connectors.

**1.3            PERFORMANCE REQUIREMENTS**

- .1    Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from certified ADC (Air Diffusion Council) testing agency signifying adherence to codes and standards.

**1.4            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 air terminal units and include product characteristics, performance criteria, physical size, finish and limitations.



- .2 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Alberta, Canada.
  - .2 Indicate the following:
    - .1 Capacity.
    - .2 Pressure drop.
    - .3 Noise rating.
    - .4 Leakage.
    - .5 Dimensions.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Test and Evaluation Reports:
  - .1 Test data: to ANSI/AMCA Standard 210:
    - .1 Submit published test data on DIN (Direct Internal Noise), in accordance with ISO 3741 made by independent testing agency for 0, 2.5 and 6 m/s branch velocity or inlet velocity.
    - .2 Sound power level with minimum inlet pressure of 0.25, 0.5, 1, 1.5 kPa in accordance with ISO 3741 for 2<sup>nd</sup> through 7<sup>th</sup> octave band, also made by independent testing agency.
    - .3 Pressure loss through silencer shall not exceed 60% of inlet velocity pressure maximum.
- .7 Sustainable Design Submittals:
  - .1 Construction Waste Management:
    - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

## **1.5 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for air terminal units for incorporation into manual.

## **1.6 QUALITY ASSURANCE**

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

## **1.7 DELIVERY, STORAGE AND HANDLING**

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

## **Part 2 Products**

### **2.1 SYSTEM DESCRIPTION**

- .1 Performance Requirements:
  - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from certified ADC (Air Diffusion Council) testing agency signifying adherence to codes and standards.

### **2.2 TERMINAL BOX - VARIABLE VOLUME BOXES**

- .1 Pressure independent factory reset to air flow between minimum and maximum air volume.
- .2 Sizes, capacities and differential pressures: as indicated in schedule.
- .3 Sound ratings of assembly not to exceed 35 NC at 750 Pa.
- .4 Complete with:
  - .1 Operator and controller: as specified under Section 25 30 02 - EMCS: Field Control Devices.
  - .2 Sound attenuator at discharge of unit.
  - .3 Reheat coil mounted integral with casing as indicated.
- .5 Adjustable reset start point.
- .6 Operator to be factory mounted and calibrated:
  - .1 Gauge taps for balancing with standard pressure gauge.
  - .2 Controller to have adjustable flow settings.

- .7 Casing: constructed of 0.75 mm thick galvanized steel, internally lined with 25 mm, 0.7 kg density fibrous glass, to UL181 and ANSI/NFPA 90A. Mount control components inside protective metal shroud.
- .8 Damper: galvanized steel with peripheral gasket and self-lubricating bearings. Air leakage past closed damper not to exceed 2% of nominal rating at 750 Pa inlet static pressure, in accordance with Air Diffusion Council test procedure.
- .9 Terminal Boxes shall meet or exceed that performance requirements, features and options indicated on drawings.
- .10 Hydronic reheat coils shall have a maximum of 29kPa fluid pressure drop.

### **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 air terminal units' installation in accordance with manufacturer's written instructions.
  - .1 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .2 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 in accordance with manufacturers recommendations.
- .2 Support independently of ductwork.
- .3 Install with at least 1000 mm of flexible inlet ducting and minimum of four duct diameters of straight inlet duct, same size as inlet.
- .4 Locate controls, dampers and access panels for easy access.

#### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning:
- .2 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:
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

**Part 1        General**

**1.1           ACTION AND INFORMATIONAL SUBMITTALS**

- .1       Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2       Product Data:
  - .1       Submit manufacturer's instructions, printed product literature and data sheets for diffusers, registers and grilles and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2       Indicate following:
    - .1       Capacity.
    - .2       Throw and terminal velocity.
    - .3       Noise criteria.
    - .4       Pressure drop.
    - .5       Neck velocity.
    - .6       Security features

**1.2           MAINTENANCE MATERIAL SUBMITTALS**

- .1       Extra Materials:
  - .1       Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
  - .2       Include:
    - .1       Keys for volume control adjustment.
    - .2       Keys for air flow pattern adjustment.

**1.3           DELIVERY, STORAGE AND HANDLING**

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

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**Part 2            Products**

**2.1            GENERAL**

- .1    To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.
- .2    Frames:
  - .1      Full perimeter gaskets.
  - .2      Plaster frames and as specified
  - .3      Concealed fasteners.
- .3    Concealed manual volume control damper operators.
- .4    Colour: standard.

**2.2            MANUFACTURED UNITS**

- .1    Grilles, registers and diffusers of same generic type, products of one manufacturer.

**2.3            SUPPLY GRILLES AND REGISTERS**

- .1    Refer to Equipment schedule on drawings.

**2.4            RETURN AND EXHAUST GRILLES AND REGISTERS**

- .1    Refer to Equipment schedule on drawings.

**2.5            DIFFUSERS**

- .1    Refer to Equipment schedule on drawings.

**2.6            MAXIMUM SECURITY FEATURES**

- .1    Grilles and diffusers with Maximum security requirements shall:
  - .1      Not be removable from the cell block.
  - .2      Structural quality steel bars not less than 12 mm diameter on 137 mm centers (2 bars of radius 6 mm plus a 125-mm gap = 137 mm), except that where the opening is between an inmate area and a security corridor the bars shall be of Tool Resistant Homogenous Steel.
  - .3      Maximum bar length without cross bars not to exceed 610 mm and all bars shall be welded together where they intersect.
  - .4      Bars to be welded to a flat steel frame secured to masonry/concrete. Acceptable method: bolts set a minimum of 50 mm into expansion shields. Bolt spacing not exceeding 400 mm on centers. No less than 4 bolts per grille

**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 material 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 in accordance with manufacturers instructions.
- .2      Bolt grilles, registers and diffusers, in place, in gymnasium and similar game rooms.

**3.3                CLEANING**

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

**END OF SECTION**

**Part 1        General**

**1.1        REFERENCE STANDARDS**

- .1    ASTM International
  - .1        ASTM E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .2    National Fire Protection Association (NFPA)
  - .1        NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .3    National Research Council Canada (NRC)
  - .1        National Building Code of Canada (NBC).
- .4    Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
- .5    Society of Automotive Engineers (SAE)

**1.2        ACTION AND INFORMATIONAL SUBMITTALS**

- .1    Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2    Product Data:
  - .1        Submit manufacturer's instructions, printed product literature and data sheets for louvres, intakes and vents and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2        Indicate following:
    - .1            Pressure drop.
    - .2            Face area.
    - .3            Free area.
- .3    Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4    Test Reports: submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E90.

**1.3        DELIVERY, STORAGE AND HANDLING**

- .1    Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2    Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3    Storage and Handling Requirements:
  - .1        Store materials off ground in a dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2        Store and protect materials from nicks, scratches, and blemishes.

- .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and/or recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **Part 2 Products**

### **2.1 SYSTEM DESCRIPTION**

- .1 Refer to Equipment schedule on drawings.

### **2.2 GRAVITY ROOF OUTSIDE AIR INTAKES AND RELIEF VENTS**

- .1 Factory manufactured aluminum hinged at curb line.
  - .1 Complete with integral birdscreen of 2.7 mm diam 12 mm mesh aluminum wire.
  - .2 Vertical or horizontal backdraft dampers on four faces.
  - .3 Maximum throat velocity: 3.3 m/s intake.
  - .4 Maximum loss through unit: 15 Pa exhaust static pressure.
  - .5 Maximum velocity through damper area: 1.5 m/s.
  - .6 Shape: as indicated.

### **2.3 GOOSENECK HOODS**

- .1 Thickness: to SMACNA.
  - .1 Kitchen: to ANSI/NFPA 96.
  - .2 Elsewhere: to SMACNA.
- .2 Fabrication: to SMACNA.
  - .1 Kitchen: to ANSI/NFPA 96.
  - .2 Elsewhere: to SMACNA.
- .3 Joints: to SMACNA or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint shall be considered to be a class A seal.
- .4 Supports: as indicated.
- .5 Complete with integral birdscreen of 2.7 mm diameter aluminum wire. Use 12 mm mesh on exhaust and intake.
- .6 Horizontal backdraft dampers.

### **2.4 FIXED LOUVRES - ALUMINUM**

- .1 Construction: welded with exposed joints ground flush and smooth.
- .2 Material: extruded aluminum alloy 6063-T5.
- .3 Blade: drainable, stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1500 mm.
- .4 Frame, head, sill and jamb: 150 mm deep one piece extruded aluminum, minimum 3 mm thick with approved caulking slot, integral to unit.



- .5 Mullions: at 1500 mm maximum centres.
- .6 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.
- .7 Screen: 12 mm on exhaust and intake mesh, 2.0 mm diameter wire aluminum or galvanized birdscreen on inside face of louvres in formed U-frame.
- .8 Finish: factory applied enamel. Colour: to Departmental Representative's approval.

### **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 material 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 In accordance with manufacturer's and SMACNA recommendations.
- .2 Reinforce and brace as indicated.
- .3 Anchor securely into opening. Seal with caulking to ensure weather tightness.

#### **3.3 CLEANING**

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

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
- .2 Underwriters' Laboratories of Canada (ULC)

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for chimneys and stacks and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Indicate following:
    - .1 Methods of sealing sections.
    - .2 Methods of expansion.
    - .3 Details of thimbles.
    - .4 Bases/Foundations.
    - .5 Supports.
    - .6 Guy details.
    - .7 Rain caps.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

**1.3 QUALITY ASSURANCE**

- .1 Regulatory Requirements: work to be performed in compliance with applicable Provincial/Territorial regulations.
- .2 Certifications:
  - .1 Catalogued or published ratings: obtained from tests carried out by independent testing agency or manufacturer signifying adherence to codes and standards.

**1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground in a dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

- .2 Store and protect materials from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and/or recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **Part 2 Products**

### **2.1 TYPE B GAS VENT**

- .1 ULC labelled, 288 degrees C rating maximum, atmospheric gas vent only.
- .2 Sectional, prefabricated, double wall with 13 mm air space. Aluminum inner wall. Galvanized steel outer wall. Mated fittings and couplings.

### **2.2 ACCESSORIES**

- .1 Cleanouts: bolted, gasketed type, full size of breeching, as indicated.
- .2 Hangers and supports: in accordance with recommendations SMACNA.
- .3 Rain cap.
- .4 Expansion sleeves with heat resistant caulking, held in place as indicated.

## **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 material installation in accordance with manufacturer's written instructions.
  - .1 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

### **3.2 INSTALLATION - GENERAL**

- .1 Follow manufacturer's and SMACNA installation recommendations for shop fabricated components.
- .2 Suspend breeching at 1.5 m centres and at each joint.
- .3 Support chimneys at bottom, roof and intermediate levels as indicated.
- .4 Install thimbles where penetrating roof, floor, ceiling and where breeching enters masonry chimney. Pack annular space with heat resistant caulking.
- .5 Install flashings on chimneys penetrating roofs, as indicated.
- .6 Install rain caps and cleanouts, as indicated.

**3.3 CLEANING**

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

**END OF SECTION**

**Part 1            General**

**1.1            REFERENCE STANDARDS**

- .1 American Boiler Manufacturers Association (ABMA)
- .2 ASME
  - .1 ASME Boiler and Pressure Vessel Code (BPVC), Section VII.
- .3 CSA Group
  - .1 CAN1-3.1-77, Industrial and Commercial Gas-Fired Package Boilers.
  - .2 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.
  - .3 CSA B139, Installation Code for Oil Burning Equipment.
  - .4 CSA B140.7, Oil Burning Equipment: Steam and Hot-Water Boilers.
  - .5 CSA B149.1, Natural Gas and Propane Installation Code.
  - .6 ANSI Z21.13-/CSA 4.9, Gas-Fired Low-Pressure Steam and Hot Water Boilers.
- .4 Electrical and Electronic Manufacturers Association of Canada (EEMAC)

**1.2            ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for heating boilers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Indicate on drawings:
    - .1 General arrangement showing terminal points, instrumentation test connections.
    - .2 Clearances for operation, maintenance, servicing, tube cleaning, tube replacement.
    - .3 Foundations with loadings, anchor bolt arrangements.
    - .4 Piping hook-ups.
    - .5 Equipment electrical drawings.
    - .6 Burners and controls.
    - .7 All miscellaneous equipment.
    - .8 Flame safety control system.
    - .9 Breeching and stack configuration.
  - .2 Engineering data to include:
    - .1 Boiler efficiency at 25%, 50%, 75%, 100%, of design capacity.
    - .2 Radiant heat loss at 100% design capacity.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for heating boilers for incorporation into manual.

### **1.4 QUALITY ASSURANCE**

- .1 Regulatory Requirements: work to be performed in compliance with applicable Provincial /Territorial regulations.

### **1.5 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra materials:
  - .1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
    - .1 Special tools for burners, access opening, handholes and Operation and Maintenance.
    - .2 Spare parts for 1 year of operation.
    - .3 Spare gaskets.
    - .4 Spare gauge glass inserts.
    - .5 Probes and sealants for electronic indication.
    - .6 Spare burner tips.
    - .7 Spare burner gun.
    - .8 Safety valve test gauge.

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

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

## **Part 2 Products**

### **2.1 Supplier Requirements**

- .1 Supplier Service and Support
  - .1 The supplier must have existing factory trained sales force locally available for applications assistance and to answer maintenance questions.

- .2 The Supplier is to provide a 24 hour, seven (7) day a week, assistance call line for maintenance and troubleshooting requirements with the equipment operation.
- .3 Supplier is to be capable of providing factory trained on-site technical support of the within a four (4) hour time period from notification.
- .2 Supplier Spare Parts Availability
  - .1 The supplier is to have a distributor organization, which locally stocks standard parts, modification kits, and spare parts.
  - .2 Components not regularly stocked are to be capable of being provided to the site in less than 36 hours.
- .3 Supplier Organization
  - .1 The supplier must have been in operation within the local Edmonton area for at least 5 years with product installed within the local area.
  - .2 The local supplier must have at least 5 years of representation history of the equipment brand.
  - .3 The supplier must have factory trained service representatives within the local Edmonton area. The factory representatives must be trained in the maintenance and troubleshooting of the equipment as specified herein.
  - .4 The factory representative is to be conversant in the requirements of the specific equipment.
- .4 Supplier Maintenance and Training Schools
  - .1 Supplier must offer maintenance and training in North America on the equipment supplied.
  - .2 Training programs are to be offered by the supplier on a yearly cycle (minimum).

## 2.2 GENERAL

- .1 Boiler shall be natural gas fired, fully condensing, and fire tube design. The boiler shall be factory-fabricated, factory-assembled, and factory-tested, fire-tube condensing boiler with heat exchanger sealed pressure tight, built on a steel base; including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls.
- .2 Heat Exchanger: The heater exchanger shall bear the ASME "H" stamp for 160 psi working pressure and shall be National Board listed. The heat exchanger shall be constructed of a fully welded 316L stainless steel and of fire tube design. The heat exchanger shall be designed for a single-pass water flow to limit the water side pressure drop. Cast iron, aluminum, or condensing copper tube boilers will not be accepted.
- .3 Efficiency: Boilers shall have an AHRI certified minimum thermal efficiency of 97 percent.
- .4 Condensate Collection Basin: Fully welded 316L stainless steel and shall include a stainless steel combustion analyzer test port.
- .5 Pressure Vessel: The pressure vessel shall be in accordance with ASME Section IV pressure vessel code. The pressure vessel shall be designed for a single-pass water flow to limit the water side pressure drop. The pressure vessel shall contain a volume of water no less than 60L.

- .6 Burner: Natural gas, forced draft single burner premix design. The burner shall be high temperature stainless steel with a woven Fecralloy outer covering to provide modulating firing rates. The burner shall be capable of the stated gas train turndown without loss of combustion efficiency.
- .7 Blower: Boiler shall be equipped with a pulse width modulating blower system to precisely control the fuel/air mixture to provide modulating boiler firing rates for maximum efficiency. The burner firing sequence of operation shall include pre-purge, firing, modulation, and post-purge operation.
- .8 Gas Train: The boiler shall be supplied with a negative pressure regulation gas train and shall be capable of the following minimum turndowns:
- .9 Ignition: Spark ignition with 100 percent main-valve shutoff with electronic flame supervision.
- .10 High Altitude: Boiler shall operate at altitudes up to 1372 m above sea level without additional parts or adjustments. High altitude operation shall be certified at a minimum of 1372 m above sea level by a third party organization.
- .11 Casing:
  - .1 Jacket: Heavy gauge primed and painted steel jacket with snap-in closures.
  - .2 Control Compartment Enclosures: NEMA 250, Type 1A.
  - .3 Combustion-Air Connections: Inlet and vent duct collars.
- .12 Characteristics and Capacities:
  - .1 Heating Medium: Hot water.
  - .2 Design Water Pressure Rating: 160 psi working pressure.
  - .3 Safety Relief Valve Setting: 50 psig
  - .4 Minimum Water Flow Rate at max output of not more than 1.25 L/s. and 0.26 L/s at minimum fire.
- .13 Start-up, instruction, on-site performance tests: 3 days per boiler.
- .14 Trial usage:
  - .1 Departmental Representative may use boilers for test purposes prior to acceptance and commencement of warranty period.
  - .2 Supply labour, materials and instruments required for tests.
- .15 Temporary use by contractor:
  - .1 Contractor may use boilers only after written approval from Departmental Representative.
  - .2 Monitor and record performance continuously. Keep log of maintenance activities carried out.
  - .3 Refurbish to as-new condition before final inspection and acceptance.

## 2.3 AUXILIARIES

- .1 Provide auxiliaries for each boiler and to meet ASME requirements.
- .2 Hot water boilers:
  - .1 Relief valves: ASME rated, set at 345 kPa. to release entire boiler capacity.



- .2 Pressure gauge: 90 mm diameter complete with shut-off clock.
- .3 Thermometer: 115 mm diameter range 10 to 150 degrees C.
- .4 Low water cut-off: with visual and audible alarms.
- .5 Auxiliary low water cut-off: with separate cold water connection to boiler.
- .6 Isolating gate valves: on supply and return connections.
- .7 Drain valve: NPS 2.
- .8 Stack thermometer: range 65 to 400 degrees C.
- .9 Outdoor controller: to reset operating temperature controller.
- .3 Condensate Neutralization Kit: Factory supplied condensate trap with condensate trip sensor, high capacity condensate receiver prefilled with appropriate medium.

## 2.4 CONTROLS

- .1 Boiler controls shall feature a standard, factory installed multi-color graphic LCD screen display with navigation dial and includes the following standard features:
  - .1 Boiler shall have the ability to communicate remotely using Ethernet connection.
  - .2 Variable Speed Boiler Pump Control: Boiler may be programmed to send a 0-10V DC output signal to an ECM or VFD boiler pump to maintain a designed temperature rise across the heat exchanger. The boiler shall be able to operate in this mode with a minimum temperature rise of 11°C (20°F) and a maximum temperature rise of 33.4°C (60°F).
  - .3 Password Security: Boiler shall have a different password security code for the User and the Installer to access adjustable parameters.
  - .4 Outdoor air reset: Boiler shall calculate the set point using a field installed, factory supplied outdoor sensor and an adjustable reset curve.
  - .5 Pump exercise: Boiler shall energize any pump it controls for an adjustable time if the associated pump has been off for a time period of 24 hours.
  - .6 Four pump control: Boiler shall have the ability to control the boiler pump, a system pump, a domestic hot water pump, and a domestic hot water recirculation pump.
  - .7 Ramp delay: Boiler may be programmed to limit the firing rate based on six limits steps and six time intervals.
  - .8 Boost function: Boiler may be programmed to automatically increase the set point a fixed number of degrees (adjustable by installer) if the setpoint has been continuously active for a set period of time (time adjustable by installer). This process will continue until the space heating demand ends.
  - .9 Domestic hot water priority: Boiler shall make the domestic hot water call for heat a priority over any space heating call and adjust the boiler setpoint to the domestic hot water boiler setpoint.
  - .10 Domestic hot water modulation limiting: Boiler may be programmed to limit the maximum domestic hot water firing rate to match the input rating of the indirect tank coil.
  - .11 Domestic hot water night setback: Boiler may be programmed to reduce the domestic hot water tank set point during a certain time of the day.
  - .12 PC port connection: Boiler shall have a PC port allowing the connection of PC boiler software.

- .13 Time clock: Boiler shall have an internal time clock with the ability to time and date stamp lock-out codes and maintain records of runtime.
- .14 Maintenance reminder: Boiler shall have the ability to display a yellow colored, customizable maintenance notification screen. All notifications are adjustable by the installer based upon months of installation, hours of operation, and number of boiler cycles.
- .15 English Error codes: Boiler shall have a user interface that displays a red error screen with fault codes that are displayed in English and include a date and time stamp for ease of servicing.
- .16 Anti-cycling control: Boiler shall have the ability to set a time delay after a heating demand is satisfied allowing the boiler to block a new call for heat. The boiler will display an anti-cycling blocking on the screen until the time has elapsed or the water temperature drops below the anti-cycling differential parameter. The anti-cycling control parameter is adjustable by the installer.
- .17 Space Heating Night setback: Boiler may be programmed to reduce the space heating temperature set point during a certain time of the day.
- .18 Freeze protection: Boiler shall turn on the boiler and system pumps when the boiler water temperature falls below 45 degrees. When the boiler water temperature falls below 37 degrees the boiler will automatically turn on. Boiler and pumps will turn off when the boiler water temperature rises above 43 degrees.
- .19 Isolation valve control: Boiler shall have the ability to control a 2-way motorized control valve. Boiler shall also be able to force a fixed number of valves to always be energized regardless of the number of boilers that are firing.
- .20 BMS integration with 0-10V DC input: The Control shall allow an option to Enable and control set point temperature or control firing rate by sending the boiler a 0-10V input signal.
- .21 Data logging: Boiler shall have non-volatile data logging memory including last 10 lockouts, space heat run hours, domestic hot water run hours and ignition attempts. All data should be visible on the boiler screen.
- .2 The boiler shall have a built-in Cascade controller to sequence and rotate lead boiler to ensure equal runtime while maintaining modulation of up to 8 boilers of different inputs without utilization of an external controller. The factory installed, internal cascade controller shall include:
  - .1 Lead lag: The Control module shall allow only one boiler to fire at the beginning of a call for heat. Once the lead boiler is in full fire and the control calculates that additional heat is required it will call on an additional boiler as needed.
  - .2 Efficiency optimization: The Control module shall allow multiple boilers to simultaneously fire at minimum firing rate in lieu of Lead/Lag.
  - .3 Front end loading: The Control module shall allow the cascading and functional control of several non-condensing products alongside this boiler.
- .3 Boiler operating controls shall include the following devices and features:
  - .1 Set-Point Adjust: Set points shall be fully adjustable by the installer.
  - .2 Sequence of Operation: Factory installed controller to modulate burner firing rate to maintain system water temperature in response to call for heat.

- .4 Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation and include:
  - .1 High Temperature Limit: Automatic and manual reset stops burner if operating conditions rise above maximum boiler design temperature. Limit switch to be manually reset on the control interface.
  - .2 Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be manually reset on the control interface.
  - .3 Blocked Inlet Safety Switch: Manual-reset pressure switch field mounted on boiler combustion-air inlet.
  - .4 High and Low Gas Pressure Switches: Pressure switches shall prevent burner operation on low or high gas pressure. Pressure switches to be manually reset on the control interface.
  - .5 Blocked Drain Switch: Blocked drain switch shall prevent burner operation when tripped. Switch to be manually reset on the control interface.
  - .6 Low air pressure switch: Pressure switches shall prevent burner operation on low air pressure. Switch to be manually reset on the control interface.
- .5 Building Automation System Interface:
  - .1 Boiler shall have the ability to receive a 0-10V system from a building management system and control by the following:
    - .1 0-10V DC input to control Modulation or Setpoint
    - .2 0-10V DC input from Variable speed Boiler pump
    - .3 0-10V DC output signal to a Variable speed system pump
    - .4 0-10V DC input Enable/Disable signal
  - .2 Factory installed gateway interface to enable BACnet MSTP building automation system to monitor, control, and display boiler status and alarms.

## **2.5 ELECTRICAL POWER**

- .1 Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.
- .2 Single-Point Field Power Connection: Factory-installed and factory-wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.
- .3 Electrical Characteristics:
  - .1 See Drawings

## **2.6 VENTING**

- .1 Exhaust flue must be Category IV approved stainless steel sealed vent material from one of the approved manufacturers listed in the Installation and Operation manual. Boilers exhaust vent length must be able to extend to 30.5 equivalent metres.
- .2 Intake piping must be of approved material as listed in the Installation and Operations manual. Boilers intake pipe length must be able to extend to 30.5 equivalent metres.
- .3 Boiler venting and intake piping configuration shall be installed per one of the approved venting methods shown in the Installation and Operation manual.

- .4 Boilers using common venting must only include like models and the optional common vent damper. Contact the factory for common vent sizing.
- .5 Boiler shall come standard with a flue sensor to monitor and display flue gas temperature on factory provided LCD display.
- .6 Refer to manufacturer's Installation and Operations manual for detailed venting instructions and approved manufacturers.

## **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 material 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 MANUFACTURER'S INSTRUCTIONS**

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

### **3.3 INSTALLATION**

- .1 Install in accordance with ASME Boiler and Pressure Vessels Code, regulations of Province having jurisdiction, except where specified otherwise, and manufacturers recommendations.
- .2 Make required piping connections to inlets and outlets recommended by boiler manufacturer.
- .3 Maintain clearances as indicated or if not indicated, as recommended by manufacturer for operation, servicing and maintenance without disruption of operation of any other equipment/system.
- .4 Mount unit level using specified vibration isolation in Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- .5 Pipe hot water relief valves full size to nearest drain.
- .6 Natural gas fired installations: in accordance with CSA B149.1.

### **3.4 MOUNTINGS AND ACCESSORIES**

- .1 Safety valves and relief valves:
  - .1 Run separate discharge from each valve.
  - .2 Terminate discharge pipe as indicated.

- .3 Run drain pipe from each valve outlet and drip pan elbow to above nearest drain.
- .2 Blowdown valves:
  - .1 Run discharge to terminate as indicated.

### **3.5 FIELD QUALITY CONTROL**

- .1 Commissioning:
  - .1 Manufacturer to:
    - .1 Certify installation.
    - .2 Start up and commission installation.
    - .3 Carry out on-site performance verification tests.
    - .4 Demonstrate operation and maintenance.
  - .2 Provide Departmental Representative at least 24 hours notice prior to inspections, tests, and demonstrations. Submit written report of inspections and test results.

### **3.6 CLEANING**

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

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 CSA Group
  - .1 CSA C22.2 No.46-M1988(R2011), Electric Air-Heaters.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for duct heaters/coils and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit product data and include:
    - .1 Element support details.
    - .2 Heater: total kW rating, voltage, phase.
    - .3 Number of stages.
    - .4 Rating of stage: rating, voltage, phase.
    - .5 Heater element watt/density and maximum sheath temperature.
    - .6 Maximum discharge temperature.
    - .7 Unit support.
    - .8 Clearance from combustible materials.
    - .9 Internal components wiring diagrams.
    - .10 Minimum operating airflow.
    - .11 Pressure drop operating / minimum airflow.

**1.3 DELIVERY, STORAGE AND HANDLING**

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

**Part 2            Products**

**2.1            ELECTRIC DUCT HEATERS**

- .1    Duct heaters: flange type.
- .2    Elements:
  - .1    Helical coils of nickel chrome alloy resistance wire.
  - .2    Finned tubular.
  - .3    Incoloy sheathed.
- .1    Terminal box:
  - .1    NEMA 1 general purpose enclosure.
  - .2    Hinged, latching cover.
  - .3    Multiple concentric knockouts to accept field wiring.
  - .4    Terminal blocks to accommodate field wiring.
  - .5    All internal wiring to be complete with 105°C rated insulation.
- .2    Staging:
  - .1    Staged heaters: balanced line current at each stage.
  - .2    Each stage: uniform face distribution.
- .3    Controls:
  - .1    Factory mounted and wired in control box. Use terminal blocks for power and control wiring to BMS and sail switch.
  - .2    Remote mounted as indicated with terminal strips in heater terminal box for power and control wiring.
  - .3    High temperature cutout and air proving switch.
  - .4    Controls to include:
    - .1    Magnetic contactors.
    - .2    Manual and automatic reset high limit.
    - .3    Control transformers.
    - .4    Solid state relays.
    - .5    Door interlocked disconnect switch (non-fused).
    - .6    HRC load fuses.
    - .7    Heater to be controlled by 0 – 10 VDC or 4-20mA remote control signal from the building automation system supplied and installed by the EMCS Contractor.
  - .5    Performance: see schedule.
  - .6    Provide heater complete with protective screens on inlet/outlet.
- .4    Main isolation disconnect switch.

**2.2            HYDRONIC COILS**

- .1    Capacity: as indicated on schedule.

- .2 Ratings: all coils shall meet or exceed all capacities specified on the mechanical schedule for the project.
- .3 Construction:
  - .1 Hot water coils:
    - .1 Tubes: 0.508 mm thick copper
    - .2 Fins: 0.1905 mm aluminum.
    - .3 Headers: headers shall be constructed from UNS 12200 seamless copper conforming to ASTM B75 and ASTM B251.
    - .4 Pressure tests: 1.7 MPa.

### **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 material 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 Make power and control connections to CSA C22.2 No.46.
- .2 When wireway is used, remove knock-outs and insert insulating bushing between units.
- .3 Install grounding wire to maintain ground integrity between heating, blank, and auxiliary sections.
- .4 Install thermostats in locations indicated.
- .5 Make power and control connections.
- .6 Provide each coil unit with shut-off valve on supply and lockshield balancing valve on return piping.
- .7 Provide each unit at high points with easily accessible manual air vent. If not easily accessible, extend vent to exterior surface of cabinet for each servicing.
- .8 Copper tube elements to be joined by sweat solder joints using 95-5 solder for working pressure of 345 kPa (50 psi) and less, and silver brazing for higher pressures.

#### **3.3 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Ensure heaters and controls operate correctly.



**3.4 COMMISSIONING**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical and Section 01 91 13 - General Commissioning (Cx) Requirements.
- .2 Ensure that heaters and thermostatic controls operate correctly.
- .3 Provide reports in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.

**3.5 CLEANING**

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

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 ASTM International
  - .1 ASTM A48/A48M Standard Specification for Grey Iron Castings.
  - .2 ASTM A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - .3 ASTM A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - .4 ASTM B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.
  - .5 ASTM C67, Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
  - .6 ASTM D520, Standard Specification for Zinc Dust Pigment.
- .2 CSA Group
  - .1 CSA B52, Mechanical Refrigeration Code.
  - .2 CAN/CSA-Z809, Sustainable Forest Management.
- .3 Canada Federal Halocarbon Regulations, 2003
- .4 Canadian Correctional Service Canada
  - .1 Internal Service Directive 318-4 – Environmental Management of Halocarbons
- .5 Environment Canada (EC)
  - .1 Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems. (2015)
- .6 National Electrical Manufacturers Association (NEMA)
  - .1 NEMA MG 1, Motors and Generators.
- .7 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102.2, Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies.

**1.1 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for cooling units and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Include information as follows:
    - .1 Replacement data for motor element, thermostat and switch.
    - .2 Mounting methods.

- .3 kW rating.
- .4 Cabinet material thicknesses.
- .5 Cabinet surface temperature.
- .6 Thermostat, transformer, controls where integral.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Complete the forms noted within CSC ISD 318-4.
- .5 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .6 Manufacturer's Field Reports: Submit manufacturer's field reports specified.

## **1.2 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Submit the form for Halocarbon tracking per the CSC ISD 318-4.
- .3 Operation and Maintenance Data: submit operation and maintenance data for cooling units for incorporation into manual.

## **1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect cooling units from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 PERFORMANCE REQUIREMENTS**

- .1 Refer to drawings.

### **2.2 AIR COOLED CONDENSERS**

- .1 Air cooled: free standing, coated steel unit construction, corrosion protected.
- .2 Capacity: to heat rejection capacity to meet indoor unit capacity at 35°C.

- .3 General
  - .1 Weatherproofed steel mounting/lifting rails
  - .2 Hermetic scroll compressors
  - .3 Microchannel condenser coils
  - .4 Fans and motors
  - .5 Standard operating range 0°F-125°F (min. 0°F with low ambient accessory)
  - .6 Nitrogen holding charge
  - .7 Certified and rated in accordance with AHRI and DOE standards
  - .8 Certified to UL 1995
- .4 Casing
  - .1 Zinc coated, heavy gauge, galvanized steel
  - .2 Weather resistant baked enamel finish
  - .3 Meets ASTM B117, 672 hour salt spray test
  - .4 Removable single side maintenance access panels
  - .5 Lifting handles in maintenance access panels
  - .6 Unit base provisions for forklift and/or crane lifting
- .5 Single Compressor
  - .1 Single refrigeration circuit with integral subcooling circuit
  - .2 2-stage direct drive hermetic scroll compressor
  - .3 Suction gas-cooled motor w/  $\pm 10\%$  voltage utilization range of unit nameplate voltage
  - .4 Crankcase heater
  - .5 Internal temperature and current sensitive motor overloads
  - .6 No compressor suction and/or discharge valves (reduced vibration/sound)
  - .7 Factory installed liquid line filter drier
  - .8 Phase loss/reverse rotation monitor
  - .9 Liquid line service valve (with gauge port)
  - .10 Suction line service valve (with gauge port)
  - .11 External high pressure cutout device
  - .12 External low pressure cutout device
  - .13 Evaporator defrost control
  - .14 Loss of charge protection (discharge temperature limit)
- .6 Dual Compressor
  - .1 Two (2) separate and independent refrigerant circuits
  - .2 Each refrigeration circuit equipped with integral subcooling circuit
  - .3 Two (2) direct drive hermetic scroll compressor
  - .4 Suction gas-cooled motors w/  $\pm 10\%$  voltage utilization range of unit nameplate voltage
  - .5 Crankcase Heaters

- .6 Internal temperature and current sensitive motor overloads
- .7 Factory installed liquid line filter driers
- .8 Phase loss/reverse rotation monitor
- .9 Liquid line service valves (with gauge port)
- .10 Suction line service valves (with gauge port)
- .11 No compressor suction and/or discharge valves (reduced vibration/sound)
- .12 External high pressure cutout devices
- .13 External low pressure cutout devices
- .14 Evaporator defrost control
- .15 Loss of charge protection (discharge temperature limit)
- .7 Condenser Fan
  - .1 660 mm propeller fan(s)
  - .2 Direct drive
  - .3 Statically and dynamically balanced
- .8 Condenser Motor(s)
  - .1 Permanently lubricated totally enclosed or open construction
  - .2 Built-in current and thermal overloads
  - .3 Ball or sleeve bearing type
- .9 Controls
  - .1 Factory installed microprocessor
  - .2 Completely internally wired
  - .3 Numbered and colored wires
  - .4 Contactor pressure lugs or terminal block
  - .5 Unit external mounting location for disconnect device
  - .6 Single point power entry
- .10 BACnet Communication Interface
  - .1 Communicates directly with a generic open protocol BACnet MS/TP Network building automation system control
- .11 Low Ambient (Fan ON/OFF)
  - .1 Provides unit cooling operation to outdoor ambient of 0°F
  - .2 Liquid line temperature controls condenser fan operation
  - .3 1 kit per condenser fan required
- .12 Hail Guards
  - .1 Condenser coil protection from hail, vandals, etc.
  - .2 Perforated, painted galvanized steel
  - .3 Factory or field installed

**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 material 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                GENERAL**

- .1      Mount on structural supports and vibration isolators as indicated and to manufacturer's recommendations.
- .2      Ensure clearance for servicing and maintenance as recommended by manufacturer.
- .3      Manufacturers field service representative to approve installation, to supervise start up and to instruct operators.
- .4      Complete and submit the form for Halocarbon tracking per the CSC ISD 318-4.

**3.3                ADJUSTING**

- .1      Lubricate bearings with oil or grease as recommended by manufacturer.
- .2      Tighten belts to manufacturer's specified tension.

**3.4                CLEANING**

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

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 American National Standards Institute/Air-Conditioning, Heating and Refrigeration Institute (ANSI/AHRI)
  - .1 ANSI/AHRI 430, Performance Rating of Central Station Air-Handling Units.
- .2 American National Standards Institute/American Society of Heating, Refrigeration and Air Condition Engineers/Illuminating Engineering Society (ANSI/ASHRAE/IES)
  - .1 ANSI/ASHRAE 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
  - .2 ANSI/ASHRAE/IES 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .3 Green Seal (GS)
  - .1 GS-11, Standard for Paints and Coatings.
  - .2 GS-36, Standard for Adhesives for Commercial Use.
- .4 Master Painters Institute (MPI)
  - .1 Architectural Painting Specification Manual - [current edition].
    - .1 MPI #18.
- .5 South Coast Air Quality Management District (SCAQMD)
  - .1 SCAQMD Rule 1113, Architectural Coatings.
  - .2 SCAQMD Rule 1168, Adhesives and Sealants.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data shall include dimensions, weights, capacities, certifications, component performance, electrical characteristics, casing construction details, wiring interconnections, gauges and finishes of materials.
- .3 Provide all technical information relevant to the product being provided, including but not limited to all the information shown in the schedules of this specification. It is the responsibility of the supplier to highlight any variances that his equipment has with the requirements of this specification whether or not pre-approval has been obtained. Provide the information in the same measurement units as indicated elsewhere in this specification.
- .4 Provide fan curves (not fan tables), with specified operating points clearly plotted.
- .5 Provide coil selection worksheets, clearly showing proper consideration for altitude, air density, and glycol corrections. Indicate coil tube fin and casing construction.
- .6 Provide filter information, including initial APD, final APD, dust spot efficiency, final dust holding capacity, filter media description, filter frame details, and filter removal details.

- .7 Submit sound power levels for both air handling unit inlet, outlet and radiated at rated capacity. If unit exceeds sound power levels at scheduled conditions, manufacturer must provide sound attenuators and meet specified BHP.
- .8 Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.
- .9 Submit manufacturer's recommended installation instructions.
- .10 Omission of any of the above information will cause shop drawings to be immediately returned without review.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for air handling equipment for incorporation into manual.
- .3 Include following: performance data as noted in equipment schedules.

### **1.4 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Provide 1 spare set of filters.
- .3 Provide list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.
- .4 Spare filters: in addition to filters installed immediately prior to acceptance by Departmental Representative, supply 1 complete set of filters for each filter unit or filter bank.
- .5 Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

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

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



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**Part 2 Products**

**2.1 Supplier Requirements**

- .1 Supplier Service and Support
  - .1 The supplier must have existing factory trained sales force locally available for applications assistance and to answer maintenance questions.
  - .2 The Supplier is to provide a 24 hour, seven (7) day a week, assistance call line for maintenance and troubleshooting requirements with the equipment operation.
  - .3 Supplier is to be capable of providing factory trained on-site technical support of the within a four (4) hour time period from notification.
- .2 Supplier Spare Parts Availability
  - .1 The supplier is to have a distributor organization, which locally stocks standard parts, modification kits, and spare parts.
  - .2 Components not regularly stocked are to be capable of being provided to the site in less than 36 hours.
- .3 Supplier Organization
  - .1 The supplier must have been in operation within the local Edmonton area for at least 5 years with product installed within the local area.
  - .2 The local supplier must have at least 5 years of representation history of the equipment brand.
  - .3 The supplier must have factory trained service representatives within the local Edmonton area. The factory representatives must be trained in the maintenance and troubleshooting of the equipment as specified herein.
  - .4 The factory representative is to be conversant in the requirements of the specific equipment.
- .4 Supplier Maintenance and Training Schools
  - .1 Supplier must offer maintenance and training in North America on the equipment supplied.
  - .2 Training programs are to be offered by the supplier on a yearly cycle (minimum).

**2.1 CASINGS**

- .1 Casing shall be constructed of 16-gauge galvanized steel reinforced 51mm thick acoustic thermal panels and braced for rigidity.
  - .1 Inspection doors: provide access for maintenance of internal parts.
  - .2 Insulation: provide 51mm thick, 1.36 kg density fiberglass. Provide neoprene coated with mylar liner to seal insulation. Insulation shall meet flame spread rating of less than 25 and a smoke developed rating of less than 50 when measured in accordance with ASTM E84. All insulation edges shall be joined on 203 mm centers using zinc plated TEK screws or metal clinches. All insulation edges shall be protected with metal lagging. Insulation systems using stickpins or adhesives are not acceptable.

- .3 Sealing: All permanently joined flanged panel surfaces shall be sealed with an individual strip of 3.2 mm x 9.5 mm tape sealer. Wall and roof seams shall be turned inward to provide a clean flush exterior finish. All panel seams shall be sealed during assembly to produce an airtight unit.
- .4 Unit shall be finished painted with two components, etch bond primer and finish painted with alkyd enamel, as selected by Department Representative. All uncoated steel shall be painted with grey enamel. All metal surfaces shall be pre-painted with vinyl wash primer to ensure paint bonds to metal.
- .2 Line casing with perforated 22 gauge galvanized steel liner.
- .3 All walls shall be 51 mm thick.
- .4 All roof panels shall be 51 mm thick.

## **2.2 ACOUSTIC LINER**

- .1 Ensure that expanded polystyrene and polyurethane insulation materials were not produced with ozone depleting substances.
- .2 Test methods and facilities used to establish sound transmission loss values shall conform explicitly with the ASTM designation E90-85 and E413-73. Sound Transmission Loss DB ASTM E-90 & E413-73, STC 40.
- .3 Test methods and facilities used to establish sound absorption values shall conform explicitly with the requirements of the ASTM Standard Test Method for Sound Absorption Coefficients by the Reverberation Method: ASTM C423-84A and E795-83. Sound Absorption ASTM C423-84A & E795-83. STC-40.

## **2.3 DRAIN PANS**

- .1 Construction: stainless steel, rounded corners.
- .2 Insulation: external foam type, minimum 13 mm thick.
- .3 Drain connection: in bottom at low point.
- .4 Installation: slope without sag minimum 1% to ensure no standing water at any time or at any point.
- .5 Dimensions: minimum 75 mm from upstream face of coil to 150 mm beyond downstream face of coil or eliminator and to include return bends and headers.

## **2.4 FANS**

- .1 All fans shall be tested in accordance with AMCA Standards 210-70 and 310 Test Codes for Air Moving Devices. Backward inclined fans shall bear the AMCA sticker for both air and sound performance.
- .2 Fan housing shall be constructed of steel, adequately braced with structural steel for rigidity.
- .3 Fan shafts are to solid, ground and polished, carbon steel, SAE 1045 material, machined to close tolerances, keyed to the fan wheel. Coat the fan shaft with a rust inhibitor after machining. Hollow shafts will not be acceptable.

- .4 Fan bearings shall be in self aligning pillow block, grease lubricated, extra heavy duty anti-friction ball or spherical roller type, selected for an L10 200,000 hour life at design operating conditions. Bearings are to be mounted on the fan structural bracing. Provide extended lubrication line to permit lubrication for both bearings to be performed from the access door side of the air handling unit.
- .5 Provide adjustable inlet vanes and linkage where indicated in the schedules. Inlet vanes are to be designed and manufactured by the fan manufacturer, and all fan performance data is to be corrected to allow for inlet vane losses. Vane and linkage bearings are to be bronze type.
- .6 Fan and motor are to be mounted on an all welded, structural steel, prime coated, internal isolation base with springs selected to provide 99% isolation efficiency from the building structure. Isolator deflection shall be 2". The outlet of the fan shall be separated from the unit casing by means of a factory installed flexible fabric connection. The internally mounted motor shall be provided on a slide rail base to allow proper adjustment of belt tension.
- .7 Provide an OSHA approved fully enclosed metal belt guard having side of galvanized steel and expanded metal face. Belt guard shall be sized to allow either sheave to be increased by two sizes.
- .8 Fans shall have inlet OSHA approved inlet screens.

## **2.5 VIBRATION ISOLATION**

- .1 Flexible connections at inlet and outlet of fan: to Section 23 33 00 - Air Duct Accessories.
- .2 An integral all welded epoxy coated steel vibration isolation base shall be provided for the fan and motor.
- .3 Isolators shall be free standing with sound deadening pads and leveling bolts.
- .4 Spring diameter to compressed operating height ratio shall be 1 to 1.
- .5 Spring deflection shall be a minimum of 25.4mm.
- .6 Isolators shall have seismic restraints designed to meet IBC 2006 requirements. Manufacturer shall provide seismic calculations upon request.
- .7 Fan systems which are provided without integral fan vibration isolation as specified shall include complete vibration isolation around the entire perimeter of the unit and under all splits to the level of the vibration isolation specified above. Flexible mounted ductwork and piping shall also be provided in conjunction with the perimeter vibration isolation to ensure the complete unit is isolated from the adjacent systems.
- .8 Air handling units which are provided with external vibration isolation shall include a finite element analysis to demonstrate the specified level of vibration isolation has been met. The analysis shall also determine if any natural frequencies occur in the system over the entire operating range of the AHU. A detailed report shall be submitted with the quote to ensure the proposed system meets specifications.

## **2.6 FILTER BOX**

- .1 Material to match casing complete with V type filter arrangement using disposable type filters. Provide access to filter through hinged door.
- .2 Filters:
  - .1 50 mm, pleated filter, average efficiency minimum Efficiency Reporting Value (MERV) value 8 filtration media to ANSI/ASHRAE 52.2, to be used upstream of coil section of air handling unit.
- .3 Filters containing urea formaldehyde or fiberglass are not acceptable.
- .4 Galvanized mounting racks to suit specified filter type.
- .5 Limit filter velocity based on face area to less than 2.5 m/s.
- .6 Provide one Dwyer 2000 magnehelic filter gauge for each bank of filters, including for each position of pre-filter. Flush mount gauge on the exterior of the unit.
- .7 Provide blank off plates around filters.

## **2.7 MIXING BOX**

- .1 Dampers for mixing boxes: Section 23 33 15- Dampers - Operating.
- .2 Material to match casing and produce uniformly mixed air temperature within plus or minus 5 degrees C of design across face of outlet.
- .3 Dampers for mixing boxes:
  - .1 Aluminum airfoil frames and blades shall be a minimum of 12 gauge extruded aluminum. Blades shall be of a single unit airfoil design 6" wide.
  - .2 Frames shall be extruded aluminum channel with grooved inserts for vinyl seals. Standard frames: 2" x 4" x 5/8" on linkage side, 1" x 4" x 1" on the other 3 sides.
  - .3 Pivot rods shall be 7/8" hexagon extruded aluminum interlocking into blade section. Bearings shall be of a double sealed type with a Celcon inner bearing on a rod within a Polycarbonate outer bearing inserted into frame so that the outer bearing cannot rotate.
  - .4 Bearing shall be designed so that there is not metal-to-metal or metal-to-bearing riding surfaces. Interconnecting linkage shall have a separate Celcon bearing to eliminate friction in linkage.
  - .5 Blade linkage hardware shall be installed in frame out of air-stream. All hardware shall be on non-corrosive, reinforced material of cadmium plated steel.
  - .6 Damper seals shall be designed for minimum air leakage by means of overlapping seals.

## **2.8 COILS**

- .1 Capacity: as indicated on schedule.
- .2 Ratings: all coils shall meet or exceed all capacities specified on the mechanical schedule for the project. All coil performance shall be certified by the manufacturer in accordance with ARI Standard 410.

- .3 Construction:
  - .1 Casings: 16 gauge thick galvanized sheet steel.
    - .1 Supports of galvanized steel channel.
  - .2 Hot water coils:
    - .1 Tubes: 0.508 mm thick copper
    - .2 Fins: 0.1905 mm aluminum.
    - .3 Headers: headers shall be constructed from UNS 12200 seamless copper conforming to ASTM B75 and ASTM B251.
    - .4 Pressure tests: 1.7 MPa.

### **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 material 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 Provide appropriate protection apparatus.
- .2 Install units in accordance with manufacturer's instructions and as indicated.
- .3 Ensure adequate clearance for servicing and maintenance.

#### **3.3 FANS**

- .1 Install fan sheaves required for final air balance.
- .2 Install flexible connections at fan inlet and fan outlets.
- .3 Install vibration isolators.

#### **3.4 DRIP PANS**

- .1 Install deep seal P-traps and trap seal primer on drip lines.
  - .1 Depth of water seal to be 1.5 times static pressure at this point.

#### **3.5 CLEANING**

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

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

**END OF SECTION**

Approved: 2013-12-31

**Part 1            General**

**1.1            REFERENCE STANDARDS**

- .1 American Gas Association (AGA)
- .2 American National Standards Institute/Air-Conditioning, Heating and Refrigeration Institute (ANSI/AHRI)
  - .1 ANSI/AHRI 210/240-[08], Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
  - .2 ANSI/AHRI 270-[08], Sound Rating of Outdoor Unitary Equipment.
- .3 CSA Group
  - .1 CSA B52-[05], Mechanical Refrigeration Code.
  - .2 CSA C22.1-[12], Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
- .4 National Fire Protection Association (NFPA)
  - .1 NFPA 90A-[12], Standard for the Installation of Air Conditioning and Ventilating Systems.
- .5 Underwriters Laboratories (UL)
  - .1 UL 1995-[11], Standard for Heating and Cooling Equipment.

**1.2            ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for outdoor HVAC equipment and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Drawings to indicate project layout and dimensions; indicate:
    - .1 Equipment, piping, and connections, together with valves, strainers, control assemblies, thermostatic controls, auxiliaries and hardware, and recommended ancillaries which are mounted, wired and piped ready for final connection to building system, its size and recommended bypass connections.
    - .2 Piping, valves, fitting shipped loose showing final location in assembly.
    - .3 Control equipment shipped loose, showing final location in assembly.
    - .4 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, mounting curb details, sizes and location of mounting bolt holes; include mass distribution drawings showing point loads.

- .5 Detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices of ancillaries, accessories, controllers.
- .6 Pump and fan performance curves.
- .7 Details of vibration isolation.
- .8 Estimate of sound levels to be expected across individual octave bands in dB referred to A rating.
- .9 Type of refrigerant used.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .6 Manufacturer's Field Reports:
  - .1 Submit manufacturer's field reports specified.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for outdoor HVAC equipment for incorporation into manual.
  - .1 Indicate: brief description of unit, indexed, with details of function, operation, control, and service for components.
  - .2 Provide for units, manufacturer's name, type, year, number of units, and capacity.

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

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

### **1.5 WARRANTY**

- .1 For Work of this Section 23 74 00 - Packaged Outdoor HVAC Equipment, 12-month warranty period is extended to 60 months.



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**Part 2            Products**

**2.1            GENERAL**

- .1    Roof mounted, self-contained single zone, indirect fired unit with gas burner and DX refrigeration and bear label of CSA, CGA, and ULC.
- .2    Units to be complete with of cabinet and frame, supply fan, heat exchanger, burner with integral induced draft fan, heater control, air filter, refrigerant cooling coil, compressor, condenser coil and fans, motorized outside air damper, return damper, gravity exhaust damper.
- .3    Conform to ANSI/ARI 210/240, rating for unit larger than 40 kW nominal.
- .4    Units shall be Energy Star Certified and meet ASHRAE 90.1 minimum efficiency requirements.
- .5    Refer to Equipment schedule on drawings.

**2.2            Supplier Requirements**

- .1    Supplier Service and Support
  - .1    The supplier must have existing factory trained sales force locally available for applications assistance and to answer maintenance questions.
  - .2    The Supplier is to provide a 24 hour, seven (7) day a week, assistance call line for maintenance and troubleshooting requirements with the equipment operation.
  - .3    Supplier is to be capable of providing factory trained on-site technical support of the within a four (4) hour time period from notification.
- .2    Supplier Spare Parts Availability
  - .1    The supplier is to have a distributor organization, which locally stocks standard parts, modification kits, and spare parts.
  - .2    Components not regularly stocked are to be capable of being provided to the site in less than 36 hours.
- .3    Supplier Organization
  - .1    The supplier must have been in operation within the local Edmonton area for at least 5 years with product installed within the local area.
  - .2    The local supplier must have at least 5 years of representation history of the equipment brand.
  - .3    The supplier must have factory trained service representatives within the local Edmonton area. The factory representatives must be trained in the maintenance and troubleshooting of the equipment as specified herein.
  - .4    The factory representative is to be conversant in the requirements of the specific equipment.
- .4    Supplier Maintenance and Training Schools
  - .1    Supplier must offer maintenance and training in North America on the equipment supplied.
  - .2    Training programs are to be offered by the supplier on a yearly cycle (minimum).

## **2.3 CABINET**

- .1 Cabinets: weatherproofing tested and certified to AGA rain test standards and soundproofing tested to AHRI 270.
- .2 Framing and supports: 2 mm thick welded steel, galvanized after manufacture, with lifting lugs.
- .3 Outer casing: weathertight 1.0 mm thick galvanized steel with baked enamel finish, complete with flashing.
- .4 Access: gasketed hinged doors or panels with quick locking door handle type fasteners.
- .5 Insulation: neoprene coated glass fibre on surfaces where conditioned air is handled, 50 mm thick, 32 kg/m<sup>3</sup> density.

## **2.4 FANS**

- .1 Centrifugal, forward curved impellers, statically and dynamically balanced. V-belt drive with adjustable variable pitch motor pulley, fan and motor integrally mounted on isolation base, separated from unit casing with flexible connections and spring isolators. Vibration isolators: 95% efficiency.

## **2.5 AIR FILTERS**

- .1 50 mm thick, MERV 8. standard to unit manufacture.

## **2.6 HEAT EXCHANGERS AND BURNERS**

- .1 Gas fired, multiple flue passes welded stainless steel construction.
  - .1 Gas burner: factory mounted, wired and fire tested complete with operating and safety controls.
  - .2 Induced draft type.
  - .3 Spark ignited pilot with pilot flame safety shut-off.
- .2 Gas fired, multiple flue passes welded stainless steel construction.

## **2.7 REFRIGERATION**

- .1 Conform to CSA B52 and UL 465 requirements.
- .2 Compressor/Condenser Section:
  - .1 Hermetic compressors, vibration isolated with flexible suction and discharge connections, oil sight glass, oil pressure switch, crankcase heater, and with control to liquid line solenoid valve.
  - .2 Fans: propeller type with single piece spun venturi outlets and zinc plated guards. Motors shall be sequenced for head pressure control.
  - .3 Electrical system shall have operating controls, oil and refrigerant pressure protection, motor overload protection, weatherproof electrical wiring with weatherproof, rain tight disconnect.
  - .4 Include refrigerant piping with sight glass, filter and valves.
  - .5 Condenser: staggered copper tube aluminum fin coil assembly.

- .6 Capacity reduction: cylinder unloading. Provide fan control and flooding for head control for low ambient operation down to 14 degrees C ambient temperature.
- .3 Evaporator:
  - .1 Rated to ANSI/ARI 210/240.
  - .2 Thermostatic expansion valve, with adjustable super heat and external equalizer.
  - .3 Coil: NPS5/8 od staggered seamless copper tubes expanded into aluminum fins and insulated condensation pan.
  - .4 Cooling coil condensate drain pans: designed to avoid standing water, to be easily cleaned or removable for cleaning. Drain connection to have deep seal trap and be complete with trap seal primer.
- .4 Refrigerant: Shall be Type R410A

## **2.8 CONTROLS**

- .1 In addition to combustion safety controls, provide smoke sensors in return to NFPA standards, low limit on supply and freeze protection on steam and water coils.
- .2 Control Panels:
  - .1 Provide local panels of unitized cabinet type for each system under automatic control. Mount relays and controllers with control point adjustment in cabinet and temperature indicators, pressure gauges, pilot lights, pushbuttons and switches flush on cabinet panel face.
  - .2 Panel shall be general purpose utility enclosures having an enamelled finish face panel and CSA approval for line voltage applications.
  - .3 Mount panels adjacent to associated equipment or as shown on the drawings on vibration free walls or free standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved lamicoid nameplates on cabinet face.
  - .4 All wiring and tubing within the control panel shall be either run in tray or placed neatly and securely fastened.
  - .5 All wiring within control panels shall be terminated at a terminal strip and shall be numbered with heat shrink markers.
  - .6 The use of "Easy On" self-adhesive markers is not acceptable.
  - .7 Provide control wiring to remote control panels provided by others.
- .3 Single Zone Cooling Control:
  - .1 Room thermostat to activate cooling relay in control circuit cycling compressor. Provide safeties and pressure controls. Condenser fans to operate in sequence.
  - .2 As back pressure is reduced, hot gas bypass opens to maintain set back pressure.
  - .3 When call for cooling is satisfied, relay is de-energized closing liquid line solenoid valve. On two compressor units provide separate circuits to evaporator and condenser and manual double pole double throw switch for lead-lag unit choice.

- .4 Mixed Air Single Zone Unit:
  - .1 Automatic outside and return air dampers for fixed outside air quantity.
  - .2 Motorized outside, return and automatic power exhaust gravity relief dampers with spring return damper operator and control package to automatically vary outside air quantity. Outside air and exhaust air dampers, normally closed.
  - .3 Tight fitting opposed blade dampers with neoprene or suitable gaskets, bronze or synthetic bushings and 1% maximum leakage.
  - .4 Damper operation: 24V, spring return motor with gear train sealed in oil, and heater for operation under minus 18 degrees C.
  - .5 Mixed air controls: maintain 13 degrees C indicated mixed air temperature, lock out compressor below 14 degrees C ambient, restart 17 degrees C, revert dampers to provide 15% fresh air above 21 degrees C adjustable for RTU-1.
- .5 Single Zone Heat-Cool Unit:
  - .1 Low voltage, adjustable room thermostat controls burner operation, compressor and supply fan shall maintain room temperature setting.
  - .2 Thermostat: include system selector switch day-night, heat-cool-off, and fan control switch (on-auto).
- .6 Night mode: unit cycles as unit heater with 100% recirculation on winter or summer cycles unit off.

## **2.9 MAKE-UP AIR Controls**

- .1 Provide terminals for connection to BMS system for activation schedule, temperature control and monitoring.
- .2 Provide factory controls for 2 speed operation with interlocks, and heating modulation for supply air set point provided by BMS.
- .3 Provide remote readout panel for Make Up Air Units each unit containing:
  - .1 Signal lights indicating system status, heating system failure, and dirty filters.
  - .2 Check switches proving signal light operation.
  - .3 System on-off-Auto switch.

## **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 material 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 as per manufacturers' instructions on roof curbs as indicated.
- .2 Manufacturer to certify installation, supervise start-up and commission unit.
- .3 Run drain line from cooling coil condensate drain pan to discharge over roof drain.

### **3.3 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Services:
  - .1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its products, and submit written reports, in acceptable format, to verify compliance of work with Contract.
  - .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 at stages listed:
    - .1 Refer to Commissioning Specifications.
      - .1 Start up of unit.
      - .2 Functional Testing
- .2 Obtain reports within 4 days of review and submit immediately to Departmental Representative.
- .3 Performance Verification:
  - .1 General:
    - .1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems, supplemented as specified herein.
  - .2 Rooftop Air Handling Units:
    - .1 Set zone mixing dampers for full cooling, except that where diversity factor forms part of design set that percentage of zone dampers to full heating.
    - .2 Set outside air and return air dampers for minimum outside air.
    - .3 Set face and bypass dampers so face dampers are fully open and bypass dampers are fully closed.
    - .4 Check for smooth, vibration less correct rotation of supply fan impeller.
    - .5 Measure supply fan capacity.
    - .6 Adjust impeller speed as necessary and repeat measurement of fan capacity.
    - .7 Measure pressure drop each component of air handling unit.
    - .8 Set outside air and return air dampers for the percentage of outside air required by design and repeat measurements of fan capacity.
    - .9 Reduce differences between fan capacity at minimum and maximum outside air less than 5%.
    - .10 Set face and bypass dampers to full bypass and repeat measurement of fan capacity.

- .11 Reduce difference between fan capacity with F&BPD fully closed to bypass and fully open to bypass to less than 5%.
- .12 Reduce difference between fan capacity at full cooling and fan capacity at full heating to less than 5%.
- .13 OAD: verify for proper stroking, interlock with RAD.
- .14 Measure DBT, WBT of SA, RA, EA.
- .15 Measure air cooled condenser discharge DBT.
- .16 Measure flow rates (minimum and maximum) of SA, RA, EA, relief air.
- .17 Simulate maximum cooling load and measure refrigerant hot gas and suction temperatures and pressures.
- .18 Use smoke test to verify no short-circuiting of EA, relief air to outside air intake or to condenser intake.
- .19 Simulate maximum heating load and:
  - .1 Verify temperature rise across heat exchanger.
  - .2 Perform flue gas analysis. Adjust for peak efficiency.
  - .3 Verify combustion air flow to heat exchanger.
  - .4 Simulate minimum heating load and repeat measurements.
- .20 Measure radiated and discharge sound power levels under maximum heating demand and under maximum cooling demand with compressors running.
- .21 Verify operating control strategies, including:
  - .1 Heat exchanger operating and high limit.
  - .2 Early morning warm-up cycle.
  - .3 Freeze protection.
  - .4 Economizer cycle operation, temperature of change-over.
  - .5 Alarms.
  - .6 Voltage drop across thermostat wiring.
  - .7 Operation of remote panel including pilot lights, failure modes.
- .22 Set zone mixing dampers for full heating and repeat measurements.
- .23 Measure leakage past zone mixing dampers by taking temperature measurements. Reduce leakage to less than 5%.
- .24 Measure return fan capacity.
- .25 Adjust impeller speed as necessary and repeat measurement of return fan capacity.
- .26 Check capacity of heating unit.
- .27 Refer to other sections of these specifications for PV procedures for other components.
- .3 Start-Up:
  - .1 General: in accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
- .4 Verify accessibility, serviceability of components including motorized dampers, filters coils, fans, motors, operators, humidifiers, sensors, electrical disconnects.
- .5 Verify accessibility, clean ability, drainage of drain pans for coils, humidifiers.

- .4 Commissioning Reports:
  - .1 In accordance with Section 01 91 13 - General Commissioning (Cx)  
Requirements: reports supplemented as specified herein. Include:
    - .1 Report forms as specified Section 01 91 13 - General Commissioning (Cx) Requirements: Report Forms and Schematics.

### **3.4 DEMONSTRATION**

- .1 Training: in accordance with Section 01 91 13 - General Commissioning (Cx)  
Requirements: Training of O&M Personnel, supplemented as specified.

### **3.5 CLEANING**

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

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 American National Standards Institute/American Society of Heating, Refrigeration and Air-Conditioning Engineers (ANSI/ASHRAE)
  - .1 ANSI/ASHRAE 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particulate Size.
  - .2 ANSI/ASHRAE 127, Method of Testing for Rating Computer and Data Processing Room Unitary Air-Conditioners.
- .2 ASTM International
  - .1 ASTM C547, Specification for Mineral Fiber Pipe Insulation.
- .3 CSA International
  - .1 CSA B52, Mechanical Refrigeration Code.
  - .2 CAN/CSA-C656, Performance Standard for Single Package Central Air-Conditioners and Heat Pumps.
- .4 Canada Federal Halocarbon Regulations, 2003
- .5 Canadian Correctional Service Canada
  - .1 Internal Service Directive 318-4 – Environmental Management of Halocarbons
- .6 Environment Canada (EC)
  - .1 Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems. (2015).

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for air conditioning components and accessories and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Indicate on drawings:
    - .1 Major components and accessories including sound power levels of units.
    - .2 Type of refrigerant used.
- .4 Complete the forms noted within CSC ISD 318-4.
- .5 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.



- .6 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Submit the form for Halocarbon tracking per the CSC ISD 318-4.
- .3 Operation and Maintenance Data: submit operation and maintenance data for air conditioning components for incorporation into manual.

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

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect air conditioning components from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

### **1.5 WARRANTY**

- .1 For computer room air conditioning system, the 12 months' warranty period is extended to 60 months.

## **Part 2 Products**

### **2.1 Supplier Requirements**

- .1 Supplier Service and Support
  - .1 The supplier must have existing factory trained sales force locally available for applications assistance and to answer maintenance questions.
  - .2 The Supplier is to provide a 24 hour, seven (7) day a week, assistance call line for maintenance and troubleshooting requirements with the equipment operation.
  - .3 Supplier is to be capable of providing factory trained on-site technical support of the within a four (4) hour time period from notification.
- .2 Supplier Spare Parts Availability
  - .1 The supplier is to have a distributor organization, which locally stocks standard parts, modification kits, and spare parts.
  - .2 Components not regularly stocked are to be capable of being provided to the site in less than 36 hours.

- .3 Supplier Organization
  - .1 The supplier must have been in operation within the local Edmonton area for at least 5 years with product installed within the local area.
  - .2 The local supplier must have at least 5 years of representation history of the equipment brand.
  - .3 The supplier must have factory trained service representatives within the local Edmonton area. The factory representatives must be trained in the maintenance and troubleshooting of the equipment as specified herein.
  - .4 The factory representative is to be conversant in the requirements of the specific equipment.
- .4 Supplier Maintenance and Training Schools
  - .1 Supplier must offer maintenance and training in North America on the equipment supplied.
  - .2 Training programs are to be offered by the supplier on a yearly cycle (minimum).

## 2.2 DESCRIPTION

- .1 Single refrigeration circuit shall include a liquid line filter drier, a refrigerant sight glass with moisture indicator, an expansion valve, pressure safety switches, and a liquid line solenoid valve. The indoor evaporator refrigerant piping shall be filled with a nitrogen holding charge and spun shut. Field relief of the Schrader valve shall indicate a leak-free system.
- .2 The direct-expansion, tilted-slab cooling coil shall be constructed of copper tubes and hydrophilic-coated aluminum fins. The hydrophilic coating shall significantly improve the speed of condensate drainage from the fins and shall provide superior water carryover resistance. One stainless steel condensate drain pan shall be provided.
- .3 The system shall be designed for use with R-410A refrigerant.
- .4 Refer to Equipment schedule on drawings.

## 2.3 CABINET

- .1 Cabinet to house: compressors, cooling coil, reheat coil, fans, filters, humidifier, unit environmental control system, motor starters or contactors.
- .2 Include adequate access to components for servicing.
- .3 Cabinet Construction: The exterior panels shall be 20-gauge steel and powder-coated with RAL 7021 black color paint to protect against corrosion. The exterior panels shall be insulated with 1/2" to 1" (12.7 to 25.4 mm), 1-1/2 lb. (0.68 kg) insulation. Front and side panels shall have captive, quarter-turn fasteners. The cabinet shall be designed so that all components are serviceable and removable using the front and right sides of the unit.
- .4 Locking Disconnect Switch: A locking-type fused disconnect switch shall be mounted in the electrical panel and shall be capable of disrupting the flow of power to the unit. The locking type shall consist of a main unit switch operational from outside the unit. The

electric panel compartment shall be accessible only with the switch in the Off position. The locking disconnect shall be lockable in support of lockout/tagout safety programs.

- .5 Short-Circuit Current Rating (SCCR): The electrical panel shall provide at least 65,000A SCCR. Short-circuit current rating (SCCR) is the maximum short-circuit current a component or assembly can safely withstand when protected by a specific overcurrent protective device(s) or for a specified time.

## **2.4 COMPRESSORS**

- .1 Digital Scroll Compressor: The compressor shall be an R-410A scroll-type with variable capacity operation from 20-100%, commonly known as a digital scroll. The compressor solenoid valve shall unload the digital scroll compressor to provide variable capacity operation. The compressor shall have a suction gas cooled motor, EPDM Rubber vibration isolators, internal thermal overloads, automatic reset high pressure switch with lockout after three failure occurrences, rota-lock service valves, low pressure transducer, and crankcase heater. The compressor shall be removable and serviceable from the front of the unit. The crankcase heater and a discharge check valve shall be provided for additional system protection from refrigerant migration during Off cycles.

## **2.5 COOLING COIL**

- .1 Direct expansion: with separate refrigerant circuit for each compressor.
- .2 Tilted slab constructed of copper tubes and hydrophilic coated aluminum fins with hydrophilic coating to provide water carryover resistance.
- .3 Stainless steel condensate drain pans.
- .4 Cooling coil condensate drain pans: designed to avoid standing water, easily cleaned or removable for cleaning.

## **2.6 FANS**

- .1 The unit shall be equipped with one plug fan: integral direct driven fan with backward-curved blades and electronically commutated DC motor; commonly referred to as EC fan. The fan speed shall be variable and automatically regulated by the controller through all modes of operation. The fan shall have a dedicated motor, fault monitoring circuitry, and speed controller, which shall provide a level of redundancy. The impeller shall be made of aluminum and dynamically balanced. The EC fan shall be located within the unit. The EC fan shall also provide greater energy savings than forward curved centrifugal fan and variable speed drives.
- .2 Upflow Supply with Front Air Return: The supply air shall exit from the top of the cabinet. The return air shall be through the front factory installed grilles. The EC fan shall be factory mounted in the upper portion of the unit. The fan shall be located to pull air through the filters and cooling coil to ensure even air distribution and maximum coil performance.

## **2.7 FILTERS**

- .1 Filters: 100 mm pleated, disposable type: MERV 11.
- .2 Mounting: in corrosion resistant racks with service access.
- .3 Filter Clog Alarm.

## **2.8 HUMIDIFIER**

- .1 Steam generator type: plastic disposable reservoir-boiler, latticed electrode heating elements complete with steam distributor, supply and drain valves, and electronic controls.
- .2 Capacity: 2.27 kg/h.
- .3 Water level control, overflow and drain, strainer and automatic flush, CSA or ULC approved.

## **2.9 CONDENSER**

- .1 Air cooled: free standing, Aluminum unit construction, corrosion protected.
  - .1 Structural support members, including coil support frame, motor, and drive support, are galvanized steel for strength and corrosion resistance.
  - .2 363mm Aluminum legs with rigging holes for hoisting the unit into position.
  - .3 Circuited to provide separate refrigerant circuit for each compressor/evaporator combination.
  - .4 Microchannel Aluminum fins, mechanically bonded to copper tubes, tested to 3.1 MPa.
  - .5 Propeller type fans – Variable speed EC.
  - .6 Electrical and control components housed in weather-tight access panels with electrical disconnect switch and control cable for control interconnection and designed for year-round operation.
  - .7 Capacity: to heat rejection capacity to meet indoor unit capacity at 35°C.
  - .8 Head pressure control complete with heated receiver tank, for low outdoor ambient of -34°C operation. Low ambient kit with 150W heater.

## **2.10 REFRIGERANT PIPING, VALVES, FITTINGS AND ACCESSORIES WITHIN UNIT**

- .1 To CSA B52.
- .2 Include for each refrigerant circuit:
  - .1 Thermal expansion valve, external equalizing type.
  - .2 Combination filter-dryer.
  - .3 Solenoid valves.
  - .4 Liquid sight glass with moisture indicator.
  - .5 Suction line insulation: flexible elastomeric unicellular to ASTM C547, 12 mm minimum thickness.

## **2.11 ENVIRONMENTAL CONTROLS**

- .1 Electronic control system.
- .2 Front mounted color, touch screen user interface (200 mm diagonal min).
- .3 Panel to include following:
  - .1 Manual operation and adjustment:
    - .1 On-Off air conditioning system control.
    - .2 Temperature set point, indicator and sensitivity adjustment controller.
    - .3 Room humidity set point, indicator and sensitivity adjustment controller.
    - .4 Alarm silencing switch for each alarm point.
    - .5 Password access.
  - .2 Operational: Alarms:
    - .1 Loss of air flow.
    - .2 High room temperature.
    - .3 Low room temperature.
    - .4 High humidity.
    - .5 Low humidity.
    - .6 Change filter.
  - .3 Operational: Visual display:
    - .1 Cooling each stage.
    - .2 Capacity
    - .3 Humidification.
    - .4 Change filter.
  - .4 Outputs:
    - .1 Remote shutdown relay.
    - .2 Common alarm contact.
    - .3 Capacity.
    - .4 Humidification.
    - .5 Change filter.
  - .5 Additional Controls:
    - .1 Humidifier/reheat lockout contact (24 volt) for emergency operation.
    - .2 Gateway card for Ethernet connectivity for connection to a BACnet BMS system.

## **2.12 REFRIGERANT CHARGE**

- .1 Charge refrigerant system at factory, seal and test.
- .2 Holding charge of refrigerant applied at factory.

**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 material 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 GENERAL**

- .1 Install as indicated, to manufacturer's recommendations, and to EPS 1/RA/2.
- .2 Manufacturer to certify installation.
- .3 Run drain line from cooling coil condensate drain pan to terminate over nearest floor drain.
- .4 Complete and submit the form for Halocarbon tracking per the CSC ISD 318-4.

**3.3 EQUIPMENT PREPARATION**

- .1 Provide services of manufacturer's field engineer to set and adjust equipment for operation as specified.

**3.4 CLEANING**

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

**3.5 PROTECTION**

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

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 American National Standards Institute/American Society of Heating, Refrigeration and Air-Conditioning Engineers (ANSI/ASHRAE)
  - .1 ANSI/ASHRAE 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particulate Size.
  - .2 ANSI/ASHRAE 127, Method of Testing for Rating Computer and Data Processing Room Unitary Air-Conditioners.
- .2 CSA International
  - .1 CSA B52-Mechanical Refrigeration Code.
  - .2 CAN/CSA-C656, Performance Standard for Single Package Central Air-Conditioners and Heat Pumps.
- .3 Canada Federal Halocarbon Regulations, 2003
- .4 Canadian Correctional Service Canada
  - .1 Internal Service Directive 318-4 – Environmental Management of Halocarbons
- .5 Environment Canada (EC)
  - .1 Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems. (2015)

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for cooling units and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Include information as follows:
    - .1 Replacement data for motor element, thermostat and switch.
    - .2 Mounting methods.
    - .3 kW rating.
    - .4 Cabinet material thicknesses.
    - .5 Cabinet surface temperature.
    - .6 Thermostat, transformer, controls where integral.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Complete the forms noted within CSC ISD 318-4.
- .5 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

- .6 Manufacturer's Field Reports: Submit manufacturer's field reports specified.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .1 Submit the form for Halocarbon tracking per the CSC ISD 318-4.
- .2 Operation and Maintenance Data: submit operation and maintenance data for cooling units for incorporation into manual.

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

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect cooling units from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 EQUIPMENT**

- .1 Refer to Equipment schedule on drawings.

### **2.2 COOLING UNITS:**

- .1 Indoor Unit General Configuration:
  - .1 Adjustable outlet vanes.
  - .2 Cross finned aluminum and copper tube.
  - .3 Sirocco type fans. Direct drive.
- .2 Controls:
  - .1 Wall mounted microprocessor controller with:
    - .1 Status display with operating mode indication.
    - .2 Central control override.
    - .3 7-day programmable schedule.
    - .4 Fans speed selection and indication.
    - .5 Dirty Filter Alarm.
    - .6 Self-diagnostics.
    - .7 Common Alarm output for BMS monitoring.
    - .8 Auxiliary connection to a BACnet BMS system.
- .3 Washable air filters arranged for easy removal.



- .4 Unit capacity as follows:
  - .1 Total cooling: based on D.B. 27°C, W.B. 19°C
  - .2 Capacity control: 25% to 100%.
  - .3 Electrical characteristics: 208/1/60.

## **2.3 CONDENSER**

- .1 Air cooled: free standing, coated steel unit construction, corrosion protected.
  - .1 Circuited to provide separate refrigerant circuit for each compressor/evaporator combination.
  - .2 Compressor: Inverter-Driven variable speed hermetic scroll.
  - .3 Cross fin copper tubes.
  - .4 Propeller type fans. Direct drive, DC control.
  - .5 Refrigerant Type: R410A.
  - .6 Electrical and control components housed in weather-tight access panels with electrical disconnect switch and control cable for control interconnection and designed for year round operation.
  - .7 Internal vibration isolation.
  - .8 Capacity: to heat rejection capacity of based on 35°C DB.
  - .9 Factory installed low ambient system for operation in outdoor temperature of -40°C.

## **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 material 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 in accordance with manufacturer's written instructions.
- .2 Make power and control connections.
- .3 Ensure positive contact between condenser frame and exterior louvre to prevent cross-ventilation of supply and discharge air.

### **3.3 FIELD QUALITY CONTROL**

- .1 Site Tests/Inspection:
  - .1 Perform tests in accordance Section 26 05 00 - Common Work Results for Electrical.
  - .2 Set controls and operate each unit.
  - .3 Take readings and record:
    - .1 Current.
    - .2 Air velocity at discharge.
    - .3 Discharge air temperature.
- .2 Manufacturer's Field Services:
  - .1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its products, and submit written reports, in acceptable format, to verify compliance of work with Contract.
  - .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 at stages listed:
    - .1 After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.
    - .2 Twice during progress of work at 25% and 60% complete.
    - .3 Upon completion of work, after cleaning is carried out.
- .3 Complete and submit the form for Halocarbon tracking per the CSC ISD 318-4.
- .4 Obtain reports within 3 days of review and submit immediately to Departmental Representative.

### **3.4 CLEANING**

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

**END OF SECTION**

**Part 1            General**

**1.1            REFERENCES**

- .1    CSA International
  - .1    CSA C22.2 No.46, Electric Air-Heaters.
- .2    Underwriters' Laboratories (UL)
  - .1    UL 1042, Standard for Electric Baseboard Heating Equipment.

**1.2            ACTION AND INFORMATIONAL SUBMITTALS**

- .1    Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2    Product Data:
  - .1    Submit manufacturer's instructions, printed product literature and data sheets for convectors and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2    Submit product data sheets for baseboard convectors, including:
    - .1    Product characteristics.
    - .2    Performance criteria.
    - .3    Mounting methods.
    - .4    Physical size.
    - .5    kW rating, voltage, phase.
    - .6    Cabinet material thicknesses.
    - .7    Limitations.
    - .8    Colour and finish.
- .3    Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence, cleaning procedures.

**1.3            CLOSEOUT SUBMITTALS**

- .1    Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2    Operation and Maintenance Data: submit operation and maintenance data for convectors for incorporation into manual.

**1.4            DELIVERY, STORAGE AND HANDLING**

- .1    Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2    Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
  - .1 Store materials off ground in a dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect materials from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and/or recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **Part 2 Products**

### **2.1 UNIT HEATERS**

- .1 Horizontal Unit Heaters: to UL 2021.
- .2 Casing: 1.2mm (18-gauge) steel with threaded connections for hanger rods.
- .3 Coils: Seamless copper tubing, 0.6 mm (24 gauge.) minimum wall thickness, silver brazed to steel headers, and with evenly spaced aluminum fins mechanically bonded to tubing.
- .4 Fan: Direct drive propeller type, statically and dynamically balanced. Horizontal models complete with sleeve bearings and fan guard. Vertical model complete with grease lubricated ball bearings.
- .5 Air Outlet: Adjustable pattern diffuser on projection models and four-way louvers on horizontal throw models.

### **2.2 RADIANT CEILING PANELS**

- .1 Panels shall be constructed of extruded 2.92 mm (12 gauge) thick aluminium. 16 mm O.D copper tubing shall be formed into an oval shape and mechanically bonded to the face plate with heat conductive paste, do not fasten tubing to non-radiant sections. Provide V-Grooved, finish on face plate. Cover back of panel with 25 mm (1") 340 gram (0.75 lb) density glass fibre insulation.
- .2 Non-active Radiant Panels shall be identical in appearance, constructed of 0.6 mm 26-gauge steel face plate. Install same insulation as noted in previous subsection.
- .3 Panel widths are minimum acceptable. Panels shall run continuous from wall-to-wall unless detailed otherwise. Non active panels shall be of same material and finish as active portion.
- .4 Test data to be based on a panel installed in ceiling with 21°C (70°F) ambient air temperature and 19.5°C (67°F) AUST (average unheated surface temperature), with natural convection. Certified test data shall clearly indicate AUST.
- .5 Finish: Panels shall be finished with Manufacturer's standard white color.

**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 material 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 baseboard convactor heaters, blank sections and controls.
- .2    When wireway is used, remove knock-outs and insert insulating bushing between units.
- .3    Install grounding wire to maintain ground integrity between heating, blank, and auxiliary sections.
- .4    Install thermostats in locations indicated.
- .5    Make power and control connections.
- .6    Provide each terminal heat transfer unit with shut-off valve on supply and Lockshield balancing valve on return piping.
- .7    Provide each unit at high points with easily accessible manual air vent. If not easily accessible, extend vent to exterior surface of cabinet for each servicing.
- .8    Copper tube elements to be joined by sweat solder joints using 95-5 solder for working pressure of 345 kPa (50 psi) and less, and silver brazing for higher pressures.

**3.3            RADIANT CEILING PANELS**

- .1    Grade piping to allow for air elimination. Radiant ceiling panels are to be installed with extreme care and caution so as not to soil the panel face. Panel supplier is to provide adequate instructions to all contractors involved of proper installation procedures.
- .2    Do not install finished ceiling surface panels and/or sound absorbing element until all glazing has been completed and all exterior openings are closed in.
- .3    All heating system piping shall be thoroughly cleaned, flushed, drained and refilled before radiant panels are connected to the system.
- .4    Submit complete (scale) drawings showing layouts, interconnections and circuiting details for areas where radiant panels are indicated. These drawings shall be coordinated with and interference shall be cleared with other trades. Shop drawings shall indicate locations of supply and return hook-ups in addition to interconnection details for each zone.
- .5    Radiant panels shall run continuous from wall-to-wall and shall be field trimmed to length, ensuring adequate expansion allowance while maintaining panel end coverage by

architectural mouldings. Inactive filler panels will be permitted only where indicated on drawings.

- .6 Interconnecting of radiant panels by the mechanical contractor shall consist of 12.7 mm (½") OD (9.5 mm (3/8") nominal) Type "L", soft copper tubing or other devices as recommended by the manufacturer (i.e., 360 deg. interconnecting loops and 180 deg. return U-bends). Multiple panels shall be circuited to ensure serpentine flow over complete length of zone. Individual serpentine panels coils connected in series are unacceptable for multiple-panel zones, except where noted otherwise in mechanical drawings.
- .7 Ensure ceiling openings and wall mouldings are installed to suit panel installation.

### **3.4 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Ensure heaters and controls operate correctly.

### **3.5 COMMISSIONING**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical and Section 01 91 13 - General Commissioning (Cx) Requirements.
- .2 Ensure that heaters and thermostatic controls operate correctly.
- .3 Provide reports in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.

### **3.6 CLEANING**

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

### **3.7 PROTECTION**

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

**END OF SECTION**

## **Part 1            General**

### **1.1            DEFINITIONS**

- .1 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.
- .2 AEL: ratio between total test period less any system downtime accumulated within that period and test period.
- .3 Downtime: results whenever EMCS is unable to fulfill required functions due to malfunction of equipment defined under responsibility of EMCS contractor. Downtime is measured by duration, in time, between time that Contractor is notified of failure and time system is restored to proper operating condition. Downtime not to include following:
  - .1 Outage of main power supply in excess of back-up power sources, provided that:
    - .1 Automatic initiation of back-up was accomplished.
    - .2 Automatic shut-down and re-start of components was as specified.
  - .2 Failure of communications link, provided that:
    - .1 Controller automatically and correctly operated in stand-alone mode.
    - .2 Failure was not due to failure of any specified EMCS equipment.
  - .3 Functional failure resulting from individual sensor inputs or output devices, provided that:
    - .1 System recorded said fault.
    - .2 Equipment defaulted to fail-safe mode.
    - .3 AEL of total of all input sensors and output devices is at least [99]% during test period.

### **1.2            DESIGN REQUIREMENTS**

- .1 Confirm with Departmental Representative that Design Criteria and Design Intents are still applicable.
- .2 Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intents.

### **1.3            ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Final Report: submit report to Departmental Representative.
  - .1 Include measurements, final settings and certified test results.
  - .2 Bear signature of commissioning technician and supervisor
  - .3 Report format to be approved by Departmental Representative before commissioning is started.
  - .4 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit

to Departmental Representative in accordance with Section 01 78 00 - Closeout Submittals.

- .5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

#### **1.4 CLOSEOUT SUBMITTALS**

- .1 Provide documentation, O&M Manuals, and training of O&M personnel for review of Departmental Representative before interim acceptance in accordance with Section 01 78 00 - Closeout Submittals.

#### **1.5 COMMISSIONING**

- .1 Do commissioning in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.
- .2 Carry out commissioning under direction of Departmental Representative and in presence of Departmental Representative and PSPC Commissioning Manager.
- .3 Inform, and obtain approval from, Departmental Representative in writing at least 14 days prior to commissioning or each test. Indicate:
  - .1 Location and part of system to be tested or commissioned.
  - .2 Testing/commissioning procedures, anticipated results.
  - .3 Names of testing/commissioning personnel.
- .4 Correct deficiencies, re-test in presence of Departmental Representative until satisfactory performance is obtained.
- .5 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.
- .6 Load system with project software.
- .7 Perform tests as required.

#### **1.6 COMPLETION OF COMMISSIONING**

- .1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by Departmental Representative and PSPC Commissioning Manager.

#### **1.7 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION**

- .1 Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation.

### **Part 2 Products**

#### **2.1 EQUIPMENT**

- .1 Provide sufficient instrumentation to verify and commission the installed system. Provide two-way radios.



- .2 Instrumentation accuracy tolerances: higher order of magnitude than equipment or system being tested.
- .3 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 2 months prior to tests.
- .4 Locations to be approved, readily accessible and readable.
- .5 Application: to conform to normal industry standards.

### **Part 3 Execution**

#### **3.1 PROCEDURES**

- .1 Test each system independently and then in unison with other related systems.
- .2 Commission each system using procedures prescribed by the Departmental Representative.
- .3 Commission integrated systems using procedures prescribed by Departmental Representative.
- .4 Debug system software.
- .5 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.
- .6 Test full scale emergency evacuation and life safety procedures including operation and integrity of smoke management systems under normal and emergency power conditions as applicable.

#### **3.2 FIELD QUALITY CONTROL**

- .1 Pre-Installation Testing.
  - .1 General: consists of field tests of equipment just prior to installation.
  - .2 Testing may be on site or at Contractor's premises as approved by Departmental Representative.
  - .3 Configure major components to be tested in same architecture as designed system. Include BECC equipment and 2 sets of Building Controller's including MCUs, LCUs, and TCUs.
  - .4 Equip each Building Controller with sensor and controlled device of each type (AI, AO, DI, DO).
  - .5 Additional instruments to include:
    - .1 DP transmitters.
    - .2 VAV supply duct SP transmitters.
    - .3 DP switches used for dirty filter indication and fan status.
  - .6 In addition to test equipment, provide inclined manometer, digital micro-manometer, milli-amp meter, to hold steady at any setting and with direct output to milli-amp meter at source.
  - .7 After setting, test zero and span in 10% increments through entire range while both increasing and decreasing pressure.

- 
- .8 Departmental Representative 0.5 to mark instruments tracking within % in both directions as "approved for installation".
  - .9 Transmitters above 0.5% error will be rejected.
  - .10 DP switches to open and close within 2% of set point.
  - .2 Completion Testing.
    - .1 General: test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.
    - .2 Include following activities:
      - .1 Test and calibrate field hardware including stand-alone capability of each controller.
      - .2 Verify each A-to-D convertor.
      - .3 Test and calibrate each AI using calibrated digital instruments.
      - .4 Test each DI to ensure proper settings and switching contacts.
      - .5 Test each DO to ensure proper operation and lag time.
      - .6 Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.
      - .7 Test operating software.
      - .8 Test application software and provide samples of logs and commands.
      - .9 Verify each CDL including energy optimization programs.
      - .10 Debug software.
      - .11 Blow out flow measuring and static pressure stations with high pressure air at 700 kPa.
      - .12 Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. Include space on commissioning technician and Departmental Representative. This document will be used in final start-up testing.
    - .3 Final Start-up Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of Departmental Representative Commissioning Co-ordinator and provide:
      - .1 2 technical personnel capable of re-calibrating field hardware and modifying software.
      - .2 Detailed daily schedule showing items to be tested and personnel available.
      - .3 Departmental Representative's acceptance signature to be on executive and applications programs.
      - .4 Commissioning to commence during final start-up testing.
      - .5 O M personnel to assist in commissioning procedures as part of training.
      - .6 Commissioning to be supervised by qualified supervisory personnel and Departmental Representative.
      - .7 Commission systems considered as life safety systems before affected parts of the facility are occupied.
      - .8 Operate systems as long as necessary to commission entire project.

- .9 Monitor progress and keep detailed records of activities and results.
- .4 Final Operational Testing: to demonstrate that EMCS functions in accordance with contract requirements.
  - .1 Prior to beginning of 30day test demonstrate that operating parameters (set points, alarm limits, operating control software, sequences of operation, trends, graphics and CDLs) have been implemented to ensure proper operation and operator notification in event of off-normal operation.
    - .1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.
  - .2 Test to last at least 30consecutive 24 hour days.
  - .3 Tests to include:
    - .1 Demonstration of correct operation of monitored and controlled points.
    - .2 Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.
  - .4 System will be accepted when:
    - .1 EMCS equipment operates to meet overall performance requirements. Downtime as defined in this Section must not exceed allowable time calculated for this site.
    - .2 Requirements of Contract have been met.
  - .5 In event of failure to attain specified AEL during test period, extend test period on day-to-day basis until specified AEL is attained for test period.
  - .6 Correct defects when they occur and before resuming tests.
- .5 Commissioning Co-ordinator and/or Departmental Representative to verify reported results.

### **3.3 ADJUSTING**

- .1 Final adjusting: upon completion of commissioning as reviewed by Departmental Representative, set and lock devices in final position and permanently mark settings.

### **3.4 COOPERATION WITH COMMISSIONING TEAM**

- .1 The Mechanical Contractor to complete commissioning activities as per Section 01 91 13. In addition, advise the Commissioning Authority of dates for the commissioning schedule when mechanical systems will be ready for commissioning reviews.
- .2 Cooperate with the Commissioning Team as follows:
  - .1 Inform Commissioning Team in advance of controls start-up.
  - .2 Coordinate with TAB to establish setpoints and balancing values.
  - .3 Coordinate site visits during warranty period.

- .3 In-Contract Test:
  - .1 Include functional testing of each system noted within the Summary of work. The Commissioning Team will witness selected in-contract tests. Provide documentation confirming of test and sign-off acceptance of each test.
- .4 Allow for work necessary to assist Commissioning Team in completion of the commissioning process. The Controls Contractor shall fill a point to point and start-up check sheets. Format of one checks sheet will be provided by the Commissioning Team.
- .5 Demonstrate all equipment and system operation and fail modes for all elements of mechanical work as defined by the project documents, and in accordance with the commissioning authorities' direction.

### **3.5 DEMONSTRATION**

- .1 Demonstrate to Departmental Representative operation of systems including sequence of operations in regular and emergency modes, under normal and emergency conditions, start-up, shutdown interlocks and lockouts in accordance with Section 01 79 00 - Demonstration and Training.

**END OF SECTION**

**Part 1            General**

**1.1            DEFINITIONS**

- .1        CDL - Control Description Logic.
- .2        For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

**1.2            ACTION AND INFORMATIONAL SUBMITTALS**

- .1        Submittals in accordance with Section 01 33 00 - Submittal Procedures, supplemented and modified by requirements of this Section.
- .2        Submit training proposal complete with hour-by-hour schedule including brief overview of content of each segment to Departmental Representative 30 days prior to anticipated date of beginning of training.
  - .1        List name of trainer, and type of visual and audio aids to be used.
  - .2        Show co-ordinated interface with other EMCS mechanical and electrical training programs.
- .3        Submit reports within two weeks after completion of Phase 1 and Phase 2 training program that training has been satisfactorily completed.

**1.3            QUALITY ASSURANCE**

- .1        Provide competent instructors thoroughly familiar with aspects of EMCS installed in facility.
- .2        Departmental Representative reserves right to approve instructors.

**1.4            INSTRUCTIONS**

- .1        Provide instruction to designated personnel in adjustment, operation, maintenance and pertinent safety requirements of EMCS installed.
- .2        Training to be project-specific.

**1.5            TIME FOR TRAINING**

- .1        Number of days of instruction to be as specified in section 01 91 41 COMMISSIONING (CX) TRAINING.

**1.6            TRAINING MATERIALS**

- .1        Provide equipment, visual and audio aids, and materials for classroom training.
- .2        Supply manual for each trainee, describing in detail data included in each training program.
  - .1        Review contents of manual in detail to explain aspects of operation and maintenance (O&M).

## **1.7 TRAINING PROGRAM**

- .1 Specific System Training shall occur in sequence with overall project schedule and phased turnover as specified in section 01 91 41 Commissioning (Cx) Training.
- .2 Overall controls final training shall be in 2 phases over 6-month period.
- .3 Phase 1: 1 day program to begin before 30-day test period at time mutually agreeable to Contractor, Departmental Representative and PSPC Commissioning Manager.
  - .1 Train O&M personnel in functional operations and procedures to be employed for system operation.
  - .2 Supplement with on-the-job training during 30-day test period.
  - .3 Include overview of system architecture, communications, operation of computer and peripherals, report generation.
  - .4 Include detailed training on operator interface functions for control of mechanical systems, CDLs for each system, and elementary preventive maintenance.
- .4 Phase 2: Three-day program to begin 8 weeks after acceptance for operators, equipment maintenance personnel and programmers.
  - .1 Provide multiple instructors on pre-arranged schedule. Include at least following:
    - .1 Operator training: provide operating personnel, maintenance personnel and programmers with condensed version of Phase 1 training.
    - .2 Equipment maintenance training: provide personnel with 1 day training within a 5-day period in maintenance of EMCS equipment, including general equipment layout, trouble shooting and preventive maintenance of EMCS components, maintenance and calibration of sensors and controls.
    - .3 Programmers: provide personnel with 1 day training within 5-day period in following subjects in approximate percentages of total course shown:
      - .1 Software and architecture: 5%.
      - .2 Application programs: 10%.
      - .3 Display and interpret summaries. 10%.
      - .4 Controller programming: 40%.
      - .5 Trouble shooting and debugging: 10%.
      - .6 Define trend logs. 15%.
      - .7 Schedule and print reports. 10%.

## **1.8 ADDITIONAL TRAINING**

- .1 List courses offered by name, duration and approximate cost per person per week. Note courses recommended for training supervisory personnel.

## **1.9 MONITORING OF TRAINING**

- .1 Departmental Representative to monitor training program and may modify schedule and content.

**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        REFERENCES**

- .1 American National Standards Institute (ANSI):
  - .1 ANSI/ISA 5.5, Graphic Symbols for Process Displays.
- .2 American National Standards Institute (ANSI)/ Institute of Electrical and Electronics Engineers (IEEE):
  - .1 ANSI/IEEE 260.1, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).
- .3 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):
  - .1 ASHRAE STD 135, BACNET - Data Communication Protocol for Building Automation and Control Network.
- .4 Canadian Standards Association (CSA International):
  - .1 CAN/CSA-Z234.1, Canadian Metric Practice Guide.
- .5 Consumer Electronics Association (CEA):
  - .1 CEA-709.1-B, Control Network Protocol Specification.
- .6 Department of Justice Canada (Jus):
  - .1 Canadian Environmental Assessment Act (CEAA).
  - .2 Canadian Environmental Protection Act (CEPA).
- .7 Electrical and Electronic Manufacturers Association (EEMAC):
  - .1 EEMAC 2Y-1, Light Gray Colour for Indoor Switch Gear.
- .8 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
  - .1 Material Safety Data Sheets (MSDS).
- .9 Transport Canada (TC):
  - .1 Transportation of Dangerous Goods Act (TDGA).
- .10 Public Works and Government Services Canada (PWGSC):
  - .1 PWGSC MD 250005: Energy Monitoring and Control Systems (EMCS) Design Guidelines.

### **1.2        ABBREVIATIONS AND ACRONYMS**

- .1 Acronyms used in EMCS:
  - .1 AEL - Average Effectiveness Level
  - .2 AI - Analog Input
  - .3 AIT - Agreement on International Trade
  - .4 AO - Analog Output
  - .5 BACnet - Building Automation and Control Network.
  - .6 BC(s) - Building Controller(s).



- .7 BECC - Building Environmental Control Centre.
- .8 CAD - Computer Aided Design.
- .9 CDL - Control Description Logic.
- .10 CDS - Control Design Schematic.
- .11 COSV - Change of State or Value.
- .12 CPU - Central Processing Unit.
- .13 DI - Digital Input.
- .14 DO - Digital Output.
- .15 DP - Differential Pressure.
- .16 ECU - Equipment Control Unit.
- .17 EMCS - Energy Monitoring and Control System.
- .18 HVAC - Heating, Ventilation, Air Conditioning.
- .19 IDE - Interface Device Equipment.
- .20 I/O - Input/Output.
- .21 ISA - Industry Standard Architecture.
- .22 LAN - Local Area Network.
- .23 LCU - Local Control Unit.
- .24 MCU - Master Control Unit.
- .25 NAFTA - North American Free Trade Agreement.
- .26 NC - Normally Closed.
- .27 NO - Normally Open.
- .28 OS - Operating System.
- .29 O&M - Operation and Maintenance.
- .30 OWS - Operator Work Station.
- .31 PC - Personal Computer.
- .32 PCI - Peripheral Control Interface.
- .33 PCMCIA - Personal Computer Micro-Card Interface Adapter.
- .34 PID - Proportional, Integral and Derivative.
- .35 RAM - Random Access Memory.
- .36 SP - Static Pressure.
- .37 ROM - Read Only Memory.
- .38 TCU - Terminal Control Unit.
- .39 USB - Universal Serial Bus.
- .40 UPS - Uninterruptible Power Supply.
- .41 VAV - Variable Air Volume.

### 1.3 DEFINITIONS

- .1 Point: may be logical or physical.
  - .1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDLs.
  - .2 Physical points: inputs or outputs which have hardware wired to controllers which are measuring physical properties, or providing status conditions of contacts or relays which provide interaction with related equipment (stop, start) and valve or damper actuators.
- .2 Point Name: composed of two parts, point identifier and point expansion:
  - .1 Point identifier: comprised of three descriptors, "area" descriptor, "system" descriptor and "point" descriptor, for which database to provide 25-character field for each point identifier. "System" is system that point is located on:
    - .1 Area descriptor: building or part of building where point is located.
    - .2 System descriptor: system that point is located on.
    - .3 Point descriptor: physical or logical point description. For point identifier "area", "system" and "point" will be shortforms or acronyms. Database must provide 25character field for each point identifier.
  - .2 Point expansion: comprised of three fields, one for each descriptor. Expanded form of shortform or acronym used in "area", "system" and "point" descriptors is placed into appropriate point expansion field. Database must provide 32-character field for each point expansion.
  - .3 Bilingual systems to include additional point identifier expansion fields of equal capacity for each point name for second language:
    - .1 System to support use of numbers and readable characters including blanks, periods or underscores to enhance user readability for each of the above strings.
- .3 Point Object Type: points fall into following object types:
  - .1 AI (analog input).
  - .2 AO (analog output).
  - .3 DI (digital input).
  - .4 DO (digital output).
  - .5 Pulse inputs.
- .4 Symbols and engineering unit abbreviations utilized in displays: to ANSI/ISA S5.5.
  - .1 Printouts: to ANSI/IEEE 260.1.
  - .2 Refer also to Section 25 05 54 - EMCS: Identification.

### 1.4 SYSTEM DESCRIPTION

- .1 Refer to schematics for general intent.

- .2 Work covered by sections referred to above consists of fully operational EMCS, including, but not limited to, following:
  - .1 Building Controllers.
  - .2 Control devices as listed in I/O point summary tables.
  - .3 OWS(s).
  - .4 Data communications equipment necessary to effect EMCS data transmission system.
  - .5 Field control devices.
  - .6 Software/Hardware complete with full documentation.
  - .7 Complete operating and maintenance manuals.
  - .8 Training of personnel.
  - .9 Acceptance tests, technical support during commissioning, full documentation.
  - .10 Wiring interface co-ordination of equipment supplied by others.
  - .11 Miscellaneous work as specified in these sections and as indicated.
- .3 Design Requirements:
  - .1 Design and provide conduit and wiring linking elements of system.
  - .2 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed by Departmental Representative prior to installation.
  - .3 Location of controllers as reviewed by Departmental Representative prior to installation.
  - .4 Provide utility power and emergency power to EMCS as indicated.
  - .5 Metric references: in accordance with CAN/CSA Z234.1.
- .4 Language Operating Requirements:
  - .1 Provide English operator selectable access codes.
  - .2 Use non-linguistic symbols for displays on graphic terminals wherever possible. Other information to be in English.
  - .3 Operating system executive: provide primary hardware-to-software interface specified as part of hardware purchase with associated documentation to be in English.
  - .4 System manager software: include in English system definition point database, additions, deletions or modifications, control loop statements, use of high level programming languages, report generator utility and other OS utilities used for maintaining optimal operating efficiency.
  - .5 Include, in English:
    - .1 Input and output commands and messages from operator-initiated functions and field related changes and alarms as defined in CDL's or assigned limits (i.e. commands relating to day-to-day operating functions and not related to system modifications, additions, or logic re-definitions).
    - .2 Graphic "display" functions, point commands to turn systems on or off, manually override automatic control of specified hardware points. To be in English at specified OWS. Point name expansions in English.

- .3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.
- .5 The network design to be a fully distributed network, with each primary system having its own locally mounted dedicated controller. Any failure in the network shall **not** in any way affect the control of these primary systems. Connecting hardware points from one system to more than one controller is not acceptable. Any points associated with a system are to be connected to one dedicated controller. Each dedicated controller to have a locally mounted control and display device to allow the operator to view and adjust any point on the controller.
- .6 All wiring associated with the EMCS communication network as well as all control wiring and conduit associated with the EMCS at 50 volts or less. Wire and conduit above 50 volts by Electrical Division.
- .7 BACNet compliance: full compliance to the BACNet standard (ANSA/ASHRAE) 135, BACNet – A Data Communication Protocol for Building Automation and Control Networks is mandatory. Down to the field device level, the EMCS system must meet BACNet standards for system architecture and administration, and use open communication protocols and user friendly programming and graphics. Install the EMCS installed to communicate at the supervisory layer to the WAN using the BACNet TCP/IP protocol implemented on Ethernet.
- .8 The EMCS system for this facility to be accessible by designated personnel via the WAN for monitoring and programming purposes. The EMCS contractor to provide all the required hardware, software, gateways, etc. needed to permit connection of the EMCS to the WAN. This shall include all hardware, software, programming, start-up and commissioning required. The contractor to supply and install all the required hardware and software on the WAN file server to allow for this remote operation monitoring and programming to take place. The contractor to supply and install all the required hardware and software on the operator workstation(s) located in the facilities management department. In addition, a remote access directly to the system shall be provided.

## **1.5 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Make submittals in accordance with Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process and Section 01 33 00 - Submittal Procedures.
- .2 Co-ordinate submittal requirements and provide submittals required by Section 01 47 15 - Sustainable Requirements: Construction.
- .3 Submit for review:
  - .1 Equipment list and systems manufacturers within twenty (20) working days after award of contract.
  - .2 List existing control hardware to be re-used included in pricing, along with unit price for replacement hardware.
- .4 Quality Control:
  - .1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.
  - .2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.

- .3 Submit proof of compliance to specified standards with shop drawings and product data in accordance with Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process. Label or listing of specified organization is acceptable evidence.
- .4 In lieu of such evidence, submit certificate from testing organization, approved by Departmental Representative, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.
- .5 For materials whose compliance with organizational standards/ codes/ specifications is not regulated by organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.
- .6 Permits and fees: in accordance with general conditions of contract.
- .7 Submit certificate of acceptance from authority having jurisdiction to Departmental Representative.
- .8 Existing devices intended for re-use: submit test report.

## **1.6 QUALITY ASSURANCE**

- .1 Have local office within 50 km of project staffed by trained personnel capable of providing instruction, routine maintenance and emergency service on systems,
- .2 Provide record of successful previous installations submitting tender showing a minimum of 7 years experience with similar installations utilizing computer-based systems.
- .3 Have access to local supplies of essential parts and provide 7 year guarantee of availability of spare parts after obsolescence.
- .4 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.
- .5 Health and Safety: Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

## **1.7 DELIVERY, STORAGE AND HANDLING**

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

## **1.8 EXISTING- CONTROL COMPONENTS**

- .1 Utilize existing control wiring and piping where possible.
- .2 Re-use field control devices that are usable in their original configuration provided that they conform to applicable codes, standards specifications:
  - .1 Do not modify original design of existing devices without written permission from Departmental Representative.
  - .2 Provide for new, properly designed device where re-usability of components is uncertain.
- .3 Inspect and test existing devices intended for re-use within 30 days of award of contract, and prior to installation of new devices:
  - .1 Furnish test report within 40 days of award of contract listing each component to be re-used and indicating whether it is in good order or requires repair by Departmental Representative.
  - .2 Failure to produce test report will constitute acceptance of existing devices by contractor.
- .4 Non-functioning items:
  - .1 Provide with report specification sheets or written functional requirements to support findings.
  - .2 Departmental Representative will repair or replace existing items judged defective yet deemed necessary for EMCS.
- .5 Submit written request for permission to disconnect controls and to obtain equipment downtime before proceeding with Work.
- .6 Assume responsibility for controls to be incorporated into EMCS after written receipt of approval from Departmental Representative:
  - .1 Be responsible for items repaired or replaced by Departmental Representative.
  - .2 Be responsible for repair costs due to negligence or abuse of equipment.
  - .3 Responsibility for existing devices terminates upon final acceptance of EMCS or applicable portions of EMCS as approved by Departmental Representative.
- .7 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed.

## **Part 2 Products**

### **2.1 EQUIPMENT**

- .1 Existing control system is a Johnson Controls Metasys BACNet MSTP.
- .2 All new components shall have communication capability utilizing BACNet Protocol and shall be BACNet BTL listed.
- .3 Panel to be NEMA rated to suit environmental requirements.
- .4 Panels to have hinged doors equipped with standard keyed-alike cabinet locks, keyed to same key.

- .5 Wiring within panels to be contained within properly sized rigid PVC slotted wall wire duct. All wiring within the wire duct to be concealed with a non-slip cover.
- .6 Terminations for the connection of power wiring, communication wiring and field mounted devices to be at properly identified terminal blocks mounted within the control panel.
- .7 All control panels to be provided with an internally mounted 120-volt duplex power receptacle.
- .8 All control panels to be identified with permanently mounted Lamacoid tags to identify the control panel and the systems served by the control panel. Submit schedule of labels with shop drawing submission.
- .9 Provide low voltage transformers in panels or elsewhere as required.
- .10 Provide adaptors between metric and imperial components.

## **2.2 ADAPTORS**

- .1 Provide adaptors between metric and imperial components.

## **Part 3 Execution**

### **3.1 MANUFACTURER'S RECOMMENDATIONS**

- .1 Installation: to manufacturer's recommendations.

### **3.2 PAINTING**

- .1 Painting: in accordance with Section 09 91 23 - Interior Painting, supplemented as follows:
  - .1 Clean and touch up marred or scratched surfaces of factory finished equipment to match original finish.
  - .2 Restore to new condition, finished surfaces too extensively damaged to be primed and touched up to make good.
  - .3 Clean and prime exposed hangers, racks, fastenings, and other support components.
  - .4 Paint unfinished equipment installed indoors to EEMAC 2Y-1.

### **3.3 COOPERATION WITH COMMISSIONING TEAM**

- .1 The Controls Contractor is to complete commissioning activities as per Section 01 91 13 - General Commissioning (Cx) Requirements. In addition, advise the Commissioning Authority of dates for the commissioning schedule when mechanical systems will be ready for commissioning reviews.
- .2 Cooperate with the Commissioning Team as follows:
  - .1 Inform Commissioning Team in advance of degreasing and flushing of heating system, hydrostatic and air tests.
  - .2 Allow Commissioning Team free access to the site during construction phase.
  - .3 Coordinate site visits during warranty period.

- .3 Allow for work necessary to assist Commissioning Team in completion of the commissioning process. Fill a complete system of check sheets. Format of one checks sheet will be provided by the Commissioning Team.
- .4 Demonstrate all equipment and system operation and fail modes for all sequences as defined by the project documents, and in accordance with the commissioning authorities' direction.

**END OF SECTION**



**Part 1 General**

**1.1 REFERENCES**

- .1 Public Works and Government Services Canada (PWGSC)
  - .1 PWGSC MD 250005-2009: Energy Monitoring and Control Systems (EMCS) Design Guidelines.

**1.2 DEFINITIONS**

- .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

**1.3 DESIGN REQUIREMENTS**

- .1 Preliminary Design Review: to contain following contractor and systems information.
  - .1 Location of local office.
  - .2 Description and location of installing and servicing technical staff.
  - .3 Location and qualifications of programming design and programming support staff.
  - .4 List of spare parts.
  - .5 Location of spare parts stock.
  - .6 Names of sub-contractors and site-specific key personnel.
  - .7 Sketch of site-specific system architecture.
  - .8 Specification sheets for each item including memory provided, programming language, speed, type of data transmission.
  - .9 Descriptive brochures.
  - .10 Sample CDL and graphics (systems schematics).
  - .11 Response time for each type of command and report.
  - .12 Item-by-item statement of compliance.
  - .13 Proof of demonstrated ability of system to communicate utilizing BACNet and existing controls system.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures and coordinate with requirements in this Section.
- .2 Submit preliminary design document within 28 working days contract award, for review by Departmental Representative.
- .3 Shop Drawings to consist of 1 soft copy of design documents, shop drawings, product data and software.
- .4 Hard copy to be completely indexed and coordinated package to assure compliance with contract requirements and arranged in same sequence as specification and cross-referenced to specification section and paragraph number.

- .5 Soft copy to be in AutoCAD - latest version and Microsoft Word latest version format, structured using menu format for easy loading and retrieval on OWS.

## **1.5 PRELIMINARY SHOP DRAWING REVIEW**

## **1.6 PRELIMINARY SHOP DRAWING REVIEW**

- .1 Submit preliminary shop drawings within 30 working days of award of contract and include following:
  - .1 Specification sheets for each new item. To include manufacturer's descriptive literature, manufacturer's installation recommendations, specifications, drawings, diagrams, performance and characteristic curves, catalogue cuts, manufacturer's name, trade name, catalogue or model number, nameplate data, size, layout, dimensions, capacity, other data to establish compliance.
  - .2 Detailed system architecture showing all points associated with each (new & existing) controller including, signal levels, pressures where new EMCS ties into existing control equipment.
  - .3 Spare point capacity of each controller by number and type.
  - .4 Controller locations.
  - .5 Auxiliary control cabinet locations.
  - .6 Single line diagrams showing cable routings, conduit sizes, spare conduit capacity between control centre, field controllers and systems being controlled.
  - .7 Valves: complete schedule listing including following information: designation, service, manufacturer, model, point ID, design flow rate, design pressure drop, required Cv, Valve size, actual Cv, spring range, pilot range, required torque, actual torque and close off pressure (required and actual).
  - .8 Dampers: sketches showing module assembly, interconnecting hardware, operator locations, operator spring range, pilot range, required torque, actual torque.
  - .9 Flow measuring stations: complete schedule listing designation, service, point ID, manufacturer, model, size, velocity at design flow rate, manufacturer, model and range of velocity transmitter.

## **1.7 DETAILED SHOP DRAWING REVIEW**

- .1 Submit detailed shop drawings within 60 working days after award of contract and before start of installation and include following:
  - .1 Corrected and updated versions (hard copy only) of submissions made during preliminary review.
  - .2 Wiring diagrams.
  - .3 Piping diagrams and hook-ups.
  - .4 Interface wiring diagrams showing termination connections and signal levels for equipment to be supplied by others.
  - .5 Provide a tabulated complete hardware and software points list, with description and point type.

- .6 Shop drawings for each input/output point, sensors, transmitters, showing information associated with each particular point including:
  - .1 Sensing element type and location.
  - .2 Transmitter type and range.
  - .3 Associated field wiring schematics, schedules and terminations.
  - .4 Complete Point Name Lists.
  - .5 Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.
  - .6 Software and programming details associated with each point.
  - .7 Manufacturer's recommended installation instructions and procedures.
  - .8 Input and output signal levels or pressures where new system ties into existing control equipment.
- .7 Control schematics, narrative description, CDL's fully showing and describing automatic and manual procedure required to achieve proper operation of project, including under complete failure of EMCS.
- .8 Graphic system schematic displays of air water systems with point identifiers and textual description of system, and typical floor plans as specified.
- .9 Complete system CDL's including companion English language explanations on same sheet but with different font and italics. CDL's to contain specified energy optimization programs.
- .10 Listing and example of specified reports.
- .11 Listing of time of day schedules.
- .12 Mark up to-scale construction drawing to detail control room showing location of equipment and operator work space.
- .13 Type and size of memory with statement of spare memory capacity.
- .14 Full description of software programs provided.
- .15 Sample of "Operating Instructions Manual" to be used for training purposes.
- .16 Outline of proposed start-up and verification procedures. Refer to Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

## **1.8 QUALITY ASSURANCE**

- .1 Preliminary Design Review Meeting: Convene meeting within 45 working days of award of contract to:
  - .1 Undertake functional review of preliminary design documents, resolve inconsistencies.
  - .2 Resolve conflicts between contract document requirements and actual items (e.g.: points list inconsistencies).
  - .3 Review interface requirements of materials supplied by others.
  - .4 Review "Sequence of Operations".
- .2 Contractor's programmer to attend meeting.
- .3 Departmental Representative retains right to revise sequence or subsequent CDL prior to software finalization without cost to Departmental Representative.

**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        REFERENCES**

- .1        Public Works and Government Services Canada (PWGSC)
  - .1        PWGSC MD 250005-2009: Energy Monitoring and Control Systems (EMCS) Design Guidelines.

**1.2        DEFINITIONS**

- .1        BECC - Building Environmental Control Centre.
- .2        OWS - Operator Work Station.
- .3        For additional acronyms and definitions, refer to Section 25 05 01 - EMCS: General Requirements.

**1.3        ACTION AND INFORMATIONAL SUBMITTALS**

- .1        Submittals in accordance with Section 01 78 00 - Closeout Procedures, supplemented and modified by requirements of this Section.
- .2        Submit Record Documents, As-built drawings and Operation and Maintenance Manual to Departmental Representative in English.
- .3        Provide soft copies and hard copies in hard-back, 50 mm 3 ring, D-ring binders:
  - .1        Binders to be 2/3 maximum full.
  - .2        Provide index to full volume in each binder.
  - .3        Identify contents of each manual on cover and spine.
  - .4        Provide Table of Contents in each manual.
  - .5        Assemble each manual to conform to Table of Contents with tab sheets placed before instructions covering subject.

**1.4        AS-BUILTS**

- .1        Provide 1 copy of detailed shop drawings generated in Section 25 05 02 - EMCS: Submittals and Review Process and include:
  - .1        Changes to contract documents as well as addenda and contract extras.
  - .2        Changes to interface wiring.
  - .3        Routing of conduit, wiring and control air lines associated with EMCS installation.
  - .4        Locations of obscure devices to be indicated on drawings.
  - .5        Listing of alarm messages.
  - .6        Panel/circuit breaker number for sources of normal/emergency power.
  - .7        Names, addresses, telephone numbers of each sub-contractor having installed equipment, local representative for each item of equipment, each system.

- .8 Test procedures and reports: provide records of start-up procedures, test procedures, checkout tests and final commissioning reports as specified in Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.
- .9 Basic system design and full documentation on system configuration.
- .2 Submit for final review by Departmental Representative.
- .3 Provide before acceptance 1 soft copy incorporating changes made during final review.

## **1.5 O M MANUALS**

- .1 Custom design O M Manuals (both hard and soft copy) to contain material pertinent to this project only, and to provide full and complete coverage of subjects referred to in this Section.
- .2 Provide 2 complete sets of hard and soft copies prior to system or equipment tests
- .3 Include complete coverage in concise language, readily understood by operating personnel using common terminology of functional and operational requirements of system. Do not presume knowledge of computers, electronics or in-depth control theory.
- .4 Functional description to include:
  - .1 Functional description of theory of operation.
  - .2 Design philosophy.
  - .3 Specific functions of design philosophy and system.
  - .4 Full details of data communications, including data types and formats, data processing and disposition data link components, interfaces and operator tests or self-test of data link integrity.
  - .5 Explicit description of hardware and software functions, interfaces and requirements for components in functions and operating modes.
  - .6 Description of person-machine interactions required to supplement system description, known or established constraints on system operation, operating procedures currently implemented or planned for implementation in automatic mode.
- .5 System operation to include:
  - .1 Complete step-by-step procedures for operation of system including required actions at each OWS.
  - .2 Operation of computer peripherals, input and output formats.
  - .3 Emergency, alarm and failure recovery.
  - .4 Step-by-step instructions for start-up, back-up equipment operation, execution of systems functions and operating modes, including key strokes for each command so that operator need only refer to these pages for keystroke entries required to call up display or to input command.
- .6 Software to include:
  - .1 Documentation of theory, design, interface requirements, functions, including test and verification procedures.
  - .2 Detailed descriptions of program requirements and capabilities.

- .3 Data necessary to permit modification, relocation, reprogramming and to permit new and existing software modules to respond to changing system functional requirements without disrupting normal operation.
- .4 Software modules, fully annotated source code listings, error free object code files ready for loading via peripheral device
- .5 Complete program cross reference plus linking requirements, data exchange requirements, necessary subroutine lists, data file requirements, other information necessary for proper loading, integration, interfacing, program execution.
- .6 Software for each Controller and single section referencing Controller common parameters and functions.
- .7 Maintenance: document maintenance procedures including inspection, periodic preventive maintenance, fault diagnosis, repair or replacement of defective components, including calibration, maintenance, repair of sensors, transmitters, transducers, controller and interface firmware's, plus diagnostics and repair/replacement of system hardware.
- .8 System configuration document:
  - .1 Provisions and procedures for planning, implementing and recording hardware and software modifications required during operating lifetime of system.
  - .2 Information to ensure co-ordination of hardware and software changes, data link or message format/content changes, sensor or control changes in event that system modifications are required.
- .9 Programmer control panel documentation: provide where panels are independently interfaced with BECC, including interfacing schematics, signal identification, timing diagrams, fully commented source listing of applicable driver/handler.

**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           REFERENCES**

- .1 Canadian Standards Association (CSA International):
  - .1 CSA C22.1, The Canadian Electrical Code, Part I (19<sup>th</sup> Edition), Safety Standard for Electrical Installations.
- .2 Public Works and Government Services Canada (PWGSC):
  - .1 PWGSC MD 250005-2009: Energy Monitoring and Control Systems (EMCS) Design Guidelines.

### **1.2           DEFINITIONS**

- .1 For acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

### **1.3           SYSTEM DESCRIPTION**

- .1 Language Operating Requirements: provide identification for control items in English.

### **1.4           ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures and Section 25 05 02 – EMCS: Submittals and Review Process supplemented and modified by requirements of this Section.
- .2 Submit to Departmental Representative for approval samples of nameplates, identification tags and list of proposed wording.

## **Part 2           Products**

### **2.1           NAMEPLATES FOR PANELS**

- .1 Identify by Plastic laminate, 3 mm thick Melamine, matt white finish, black core, square corners, lettering accurately aligned and engraved into core.
- .2 Sizes: 25 x 67 mm minimum.
- .3 Lettering: minimum 7 mm high, black.
- .4 Inscriptions: machine engraved to identify function.

### **2.2           NAMEPLATES FOR FIELD DEVICES**

- .1 Identify by plastic encased cards attached by plastic tie.
- .2 Sizes: 50 x 100 mm minimum.
- .3 Lettering: minimum 5 mm high produced from laser printer in black.
- .4 Data to include: point name and point address, make, model number.
- .5 Companion cabinet: identify interior components using plastic enclosed cards with point name and point address.



**2.3 NAMEPLATES FOR ROOM SENSORS**

- .1 Identify by stick-on labels, using point identifier.
- .2 Location: as directed by Departmental Representative.
- .3 Letter size: to suit, clearly legible.

**2.4 WARNING SIGNS**

- .1 Equipment including motors, starters under remote automatic control: supply and install orange coloured signs warning of automatic starting under control of EMCS.
- .2 Sign to read: "Caution: This equipment is under automatic remote control of EMCS", as reviewed by Departmental Representative.

**2.5 WIRING**

- .1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.
- .2 Colour coding: to CSA C22.1. Use colour coded wiring in communications cables, matched throughout system.
- .3 Power wiring: identify circuit breaker panel/circuit breaker number inside each EMCS panel.

**2.6 PNEUMATIC TUBING**

- .1 Numbered tape markings on tubing to provide uninterrupted tracing capability.

**2.7 CONDUIT**

- .1 Colour code EMCS conduit.
- .2 Pre-paint box covers and conduit fittings.
- .3 Coding: use fluorescent orange paint and confirm colour with Departmental Representative during "Preliminary Design Review".

**Part 3 Execution**

**3.1 NAMEPLATES AND LABELS**

- .1 Ensure that manufacturer's nameplates, CSA labels and identification nameplates are visible and legible at all times.

**3.2 EXISTING PANELS**

- .1 Correct existing nameplates and legends to reflect changes made during Work.

**END OF SECTION**

**Part 1        General**

**1.1        REFERENCE STANDARDS**

**1.1        REFERENCES**

- .1 American National Standards Institute (ANSI)
  - .1 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressures Fittings.
  - .2 ANSI C2, National Electrical Safety Code.
  - .3 ANSI/NFPA 70, National Electrical Code.
- .2 CSA Group
  - .1 CSA C22.1, Canadian electrical code
  - .2 CSA C22.2 No. 45.1, Electrical Rigid Metal Conduit.
  - .3 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .4 CSA C22.2 No. 83, Electrical Metallic Tubing.
  - .5 CAN/CSA-C22.3 No. 1, Overhead Systems.

**1.2        SYSTEM DESCRIPTION**

- .1 Electrical:
  - .1 Provide power wiring from existing emergency power panels to EMCS field panels. Circuits to be for exclusive use of EMCS equipment. Panel breakers to be identified on panel legends tagged and locks applied to breaker switches.
  - .2 Hard wiring between field control devices and EMCS field panels.
  - .3 Communication wiring between EMCS field panels and OWS's including main control centre BECC.
  - .4 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
  - .5 Trace existing control wiring installation and provide updated wiring schematics including additions and/or deletions to control circuits for approval by Departmental Representative before commencing work.
- .2 Pneumatic: Pneumatic tubing, valves and fittings for field control devices.
- .3 Mechanical:
  - .1 Pipe Taps Required for EMCS equipment will be supplied and installed by Division 23.
  - .2 Wells and Control Valves Shall Be Supplied by EMCS Contractor and Installed by Division 23.
  - .3 Installation of air flow stations, dampers, and other devices requiring sheet metal trades to be mounted by Division 23. Costs to be carried by designated trade.
- .4 Air Terminal Units:

- .1 Air flow probe for vav boxes to be supplied and installed under Section 23 36 00 - Air Terminal Units. Air flow dp sensor, actuator and associated vav controls to be supplied and installed by EMCS contractor. Tubing from air probe to dp sensor as well as installation and adjustment of air flow sensors and actuators to be the responsibility of EMCS contractor. Coordinate air flow adjustments with balancing trade.
- .5 Structural: Special steelwork as required for installation of work.

### **1.3 PERSONNEL QUALIFICATIONS**

- .1 Qualified supervisory personnel to:
  - .1 Continuously direct and monitor all work.
  - .2 Attend site meetings.

### **1.4 EXISTING CONDITIONS**

- .1 Cutting and Patching: refer to Section 01 73 00 - Execution supplemented as specified herein.
- .2 Repair all surfaces damaged during execution of work.
- .3 Turn over to Departmental Representative existing materials removed from work not identified for re-use.

## **Part 2 Products**

### **2.1 SPECIAL SUPPORTS**

- .1 Structural grade steel, primed and painted after construction and before installation.

### **2.2 WIRING**

- .1 As per requirements of Division 26.
- .2 For 70V and above copper conductor with chemically cross-linked thermosetting polyethylene insulation rated RW90 and 600V. Colour code to CSA 22.1.
- .3 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. All other cases use FT4 wiring.
- .4 Sizes:
  - .1 120V Power supply: to match or exceed breaker, size #12 minimum.
  - .2 Wiring for safeties/interlocks for starters, motor control centres, to be stranded, #14 minimum.
  - .3 Field wiring to digital device: #18AWG or 20AWG stranded twisted pair.
  - .4 Analog input and output: shielded #18 minimum solid copper or #20 minimum stranded twisted pair. Wiring must be continuous without joints.
  - .5 More than 4 conductors: #22 minimum solid copper.
- .5 Terminations: Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

## **2.3 CONDUIT**

- .1 As per requirements of Division 26.
- .2 Electrical metallic tubing to CSA C22.2 No. 83. Flexible and liquid tight flexible metal conduit to CSA C22.2 No. 56. Rigid steel threaded conduit to CSA C22.2 No. 45.1.
- .3 Junction and pull boxes: welded steel:
  - .1 Surface mounting cast FS: screw-on flat covers.
  - .2 Flush mounting: covers with 25 mm minimum extension all round.
- .4 Cabinets: sheet steel, for surface mounting, with hinged door, latch lock, 2 keys, complete with perforated metal mounting backboard. Panels to be keyed alike for similar functions and or entire contract as approved.
- .5 Outlet boxes: 100 mm minimum, square.
- .6 Conduit boxes, fittings:
  - .1 Bushings and connectors: with nylon insulated throats.
  - .2 With push pennies to prevent entry of foreign materials.
- .7 Fittings for rigid conduit:
  - .1 Couplings and fittings: threaded type steel.
  - .2 Double locknuts and insulated bushings: use on sheet metal boxes.
  - .3 Use factory "ells" where 90-degree bends required for 25 mm and larger conduits.
- .8 Fittings for thin wall conduit:
  - .1 Connectors and couplings: steel, set screw type.

## **2.4 WIRING DEVICES, COVER PLATES**

- .1 Conform to CSA.
- .2 Receptacles:
  - .1 Duplex: CSA type 5-15R.
  - .2 Single: CSA type 5-15R.
  - .3 Cover plates and blank plates: finish to match other plates in area.

## **2.5 STARTERS, CONTROL DEVICES**

- .1 Across-the-line magnetic starters:
  - .1 Enclosures: CSA Type 1, except where otherwise specified.
  - .2 Size, type and rating: to suit motors.
- .2 Starter diagrams:
  - .1 Provide copy of wiring and schematic diagrams - mount one copy in each starter with additional copies for operation and maintenance manual.
- .3 Auxiliary Control Devices:

- .1 Control transformers: 60 Hz, primary voltage to suit supply, 120 V single phase secondary, VA rating to suit load plus 20% margin.
- .2 Auxiliary contacts: one "Normally Open" and one "Normally Closed" spare auxiliary contact in addition to maintained auxiliary contacts as indicated.
- .3 Hand-Off-Automatic switch: heavy duty type, knob lever operator.
- .4 Double voltage relays: with barrier to separate relay contacts from operating magnet. Operating coil voltage and contact rating as indicated.

## **2.6 SUPPORTS FOR CONDUIT, FASTENINGS, EQUIPMENT**

- .1 Solid masonry, tile and plastic surfaces: lead anchors or nylon shields:
  - .1 Hollow masonry walls, suspended drywall ceilings: toggle bolts.
- .2 Exposed conduits or cables:
  - .1 50 mm diameter and smaller: one-hole steel straps.
  - .2 Larger than 50 mm diameter: two-hole steel straps.
- .3 Suspended support systems:
  - .1 Individual cable or conduit runs: support with 6 mm diameter threaded rods and support clips.
  - .2 Two or more suspended cables or conduits: support channels supported by 6 mm diameter threaded rod hangers.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.

### **3.2 DEMOLITION**

- .1 Remove all abandoned control wiring back to conduit.
- .2 Remove all abandoned exposed conduit back to concealed space. Cap and label abandoned conduit.
- .3 Remove all accessible abandoned pneumatic tubing.

### **3.3 MECHANICAL PIPING**

- .1 Install piping straight, parallel and close to building structure with required grades for drainage and venting.
- .2 Ream ends of pipes before assembly.
- .3 Copper tubing not to come into contact with dissimilar metal.
- .4 Use non-corrosive lubricant or Teflon tape on male screwed threads.
- .5 Clean ends of pipes, tubing and recesses of fittings to be brazed or soldered. Assemble joints without binding.

- .6 Install di-electric couplings where dissimilar metals joined.
- .7 Sleeves:
  - .1 Installation:
    - .1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.
    - .2 Other floors: terminate 25 mm above finished floor.
    - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint.
  - .2 Caulking:
    - .1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.
    - .2 Elsewhere: provide space for fire stopping by Section 07 84 00 - Fire Stopping. Maintain fire rating integrity.
    - .3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.
    - .4 Ensure no contact between copper pipe or tube and sleeve.
- .8 Pressure tests:
  - .1 Test all piping systems modified under this contract by means of visual inspection of each connection.
  - .2 Isolate equipment, components, not designed to withstand test pressure.
- .9 Introduce system pressure carefully into new piping.

### **3.4 SUPPORTS**

- .1 Install special supports as required and as indicated.

### **3.5 PNEUMATIC CONTROL SYSTEMS**

- .1 Demolition:
  - .1 Existing Pneumatic components shall be removed upon replacement with electronic component.

### **3.6 ELECTRICAL GENERAL**

- .1 Do complete installation in accordance with requirements of:
  - .1 Division 26, this specification.
  - .2 CSA 22.1 Canadian Electrical Code.
  - .3 ANSI/NFPA 70.
  - .4 ANSI C2.
- .2 Fully enclose or properly guard electrical wiring, terminal blocks, high voltage (above 70 V) contacts and mark to prevent accidental injury.
- .3 Do underground installation to CAN/CSA-C22.3 No.7, except where otherwise specified.
- .4 Conform to manufacturer's recommendations for storage, handling and installation.

- .5 Check factory connections and joints. Tighten where necessary to ensure continuity.
- .6 Install electrical equipment between 1000 and 2000 mm above finished floor wherever possible and adjacent to related equipment.
- .7 Protect exposed live equipment such as panel, mains, outlet wiring during construction for personnel safety.
- .8 Shield and mark live parts "LIVE 120 VOLTS" or other appropriate voltage.
- .9 Install conduits, and sleeves prior to pouring of concrete.
- .10 Holes through exterior wall and roofs: flash and make weatherproof.
- .11 Make necessary arrangements for cutting of chases, drilling holes and other structural work required to install electrical conduit, cable, pull boxes, outlet boxes.
- .12 Install cables, conduits and fittings which are to be embedded or plastered over, neatly and closely to building structure to minimize furring.

### **3.7 CONDUIT SYSTEM**

- .1 Communication wiring in exposed areas shall be installed in conduit. Provide complete conduit system to link Building Controllers to BECC. Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems. Maximum conduit fill not to exceed 40%. Design drawings do not show conduit layout.
- .2 Communication wiring in ceiling spaces shall be supported above ceilings and shall be plenum rated.
- .3 Install conduits parallel or perpendicular to building lines, to conserve headroom and to minimize interference.
- .4 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Obtain approval from Departmental Representative before starting such work. Provide complete conduit system to link field panels and devices with main control centre. Conduit size to match conductors plus future expansion capabilities as specified.
- .5 Locate conduits at least 150 mm from parallel steam or hot water pipes and at least 50 mm at crossovers.
- .6 Bend conduit so that diameter is reduced by less than 1/10th original diameter.
- .7 Field thread on rigid conduit to be of sufficient length to draw conduits up tight.
- .8 Limit conduit length between pull boxes to less than 30 m.
- .9 Use conduit outlet boxes for conduit up to 32 mm diameter and pull boxes for larger sizes.
- .10 Fastenings and supports for conduits, cables, and equipment:
  - .1 Provide metal brackets, frames, hangers, clamps and related types of support structures as indicated and as required to support cable and conduit runs.
  - .2 Provide adequate support for raceways and cables, sloped vertically to equipment.

- .3 Use supports or equipment installed by other trades for conduit, cable and raceway supports only after written approval from Departmental Representative.
- .11 Install polypropylene fish cord in empty conduits for future use.
- .12 Where conduits become blocked, remove and replace blocked sections.
- .13 Pass conduits through structural members only after receipt of Departmental Representative's written approval.
- .14 Conduits may be run in flanged portion of structural steel.
- .15 Group conduits wherever possible on suspended or surface channels.
- .16 Pull boxes:
  - .1 Install in inconspicuous but accessible locations.
  - .2 Support boxes independently of connecting conduits.
  - .3 Fill boxes with paper or foam to prevent entry of construction material.
  - .4 Provide correct size of openings. Reducing washers not permitted.
  - .5 Mark location of pull boxes on record drawings.
  - .6 Identify AC power junction boxes, by panel and circuit breaker.
- .17 Install terminal blocks or strips indicated in cabinets to Section 26
- .18 Install bonding conductor for 120 volt and above in conduit.

### **3.8 WIRING**

- .1 Install multiple wiring in ducts simultaneously.
- .2 Do not pull spliced wiring inside conduits or ducts.
- .3 Use CSA certified lubricants of type compatible with insulation to reduce pulling tension.
- .4 Tests: use only qualified personnel. Demonstrate that:
  - .1 Circuits are continuous, free from shorts, unspecified grounds.
  - .2 Resistance to ground of all circuits is greater than 50 Megohms.
- .5 Provide Departmental Representative with test results showing locations, circuits, results of tests.
- .6 Remove insulation carefully from ends of conductors and install to manufacturer's recommendations. Accommodate all strands in lugs. Where insulation is stripped in excess, neatly tape so that only lug remains exposed.
- .7 Wiring in main junction boxes and pull boxes to terminate on terminal blocks only, clearly and permanently identified. Junctions or splices not permitted for sensing or control signal covering wiring.
- .8 Do not allow wiring to come into direct physical contact with compression screw.
- .9 Install ALL strands of conductor in lugs of components. Strip insulation only to extent necessary for installation.



### **3.9 WIRING DEVICES, COVER PLATES**

- .1 Receptacles:
  - .1 Install vertically in gang type outlet box when more than one receptacle is required in one location.
- .2 Cover plates:
  - .1 Install suitable common cover plate where wiring devices are grouped.
  - .2 Use flush type cover plates only on flush type outlet boxes.

### **3.10 STARTERS, CONTROL DEVICES**

- .1 Install and make power and control connections as indicated.
- .2 Install correct over-current devices.
- .3 Identify each wire, terminal for external connections with permanent number marking identical to diagram.
- .4 Performance Verification:
  - .1 Operate switches and controls to verify functioning.
  - .2 Perform start and stop sequences of contactors and relays.
  - .3 Check that interlock sequences, with other separate related starters, equipment and auxiliary control devices, operate as specified.

### **3.11 GROUNDING**

- .1 Install complete, permanent, continuous grounding system for equipment, including conductors, connectors and accessories.
- .2 Install separate grounding conductors in conduit within building.
- .3 Install ground wire in all PVC ducts and in tunnel conduit systems.
- .4 Tests: perform ground continuity and resistance tests, using approved method appropriate to site conditions.

### **3.12 TESTS**

- .1 General:
  - .1 Perform following tests in addition to tests specified Section 25 08 20 - EMCS: Warranty and Maintenance.
  - .2 Give 14 days' written notice of intention to test.
  - .3 Conduct in presence of Departmental Representatives and authority having jurisdiction.
  - .4 Conceal work only after tests satisfactorily completed.
  - .5 Report results of tests to Departmental Representative in writing.

- .6 Preliminary tests:
  - .1 Conduct as directed to verify compliance with specified requirements.
  - .2 Make needed changes, adjustments, replacements.
  - .3 Insulation resistance tests:
    - .1 Megger all circuits, feeders, equipment for 120 - 600V with 1000V instrument. Resistance to ground to be more than required by Code before energizing.
    - .2 Test insulation between conductors and ground, efficiency of grounding system to satisfaction of Departmental Representative and authority having jurisdiction.

### **3.13 IDENTIFICATION**

- .1 Refer to Section 25 05 54 - EMCS: Identification.

**END OF SECTION**

**Part 1            General**

**1.1            DEFINITIONS**

- .1      BC(s) - Building Controller(s).
- .2      OWS - Operator Work Station.
- .3      For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

**1.2            ACTION AND INFORMATIONAL SUBMITTALS**

- .1      Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2      Submit detailed preventative maintenance schedule for system components to Departmental Representative.
- .3      Submit detailed inspection reports to Departmental Representative.
- .4      Submit dated, maintenance task lists to Departmental Representative and include the following sensor and output point detail, as proof of system verification:
  - .1          Point name and location.
  - .2          Device type and range.
  - .3          Measured value.
  - .4          System displayed value.
  - .5          Calibration detail
  - .6          Indication if adjustment required,
  - .7          Other action taken or recommended.
- .5      Submit network analysis report showing results with detailed recommendations to correct problems found.
- .6      Records and logs: in accordance with Section 01 78 00 - Closeout Submittals.
  - .1          Maintain records and logs of each maintenance task on site.
  - .2          Organize cumulative records for each major component and for entire EMCS chronologically.
  - .3          Submit records to Departmental Representative, after inspection indicating that planned and systematic maintenance have been accomplished.
- .7      Revise and submit to Departmental Representative in accordance with Section 01 78 00 - Closeout Submittals "As-built drawings" documentation and commissioning reports to reflect changes, adjustments and modifications to EMCS made during warranty period.

**1.3            MAINTENANCE SERVICE DURING WARRANTY PERIOD**

- .1      Provide services, materials, and equipment to maintain EMCS for specified warranty period. Provide detailed preventative maintenance schedule for system components as described in Submittal article.

- .2 Emergency Service Calls:
  - .1 Initiate service calls when EMCS is not functioning correctly.
  - .2 Qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost.
  - .3 Furnish Departmental Representative with telephone number where service personnel may be reached at any time.
  - .4 Service personnel to be on site ready to service EMCS within 2 hours after receiving request for service.
  - .5 Perform Work continuously until EMCS restored to reliable operating condition.
- .3 Operation: foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of EMCS based on original design conditions and as recommended by manufacturer.
- .4 Work requests: record each service call request, when received separately on approved form and include:
  - .1 Serial number identifying component involved.
  - .2 Location, date and time call received.
  - .3 Nature of trouble.
  - .4 Names of personnel assigned.
  - .5 Instructions of work to be done.
  - .6 Amount and nature of materials used.
  - .7 Time and date work started.
  - .8 Time and date of completion.
- .5 Provide system modifications in writing.
  - .1 No system modification, including operating parameters and control settings, to be made without prior written approval of Departmental Representative.

#### **1.4 SERVICE CONTRACTS**

- .1 Provide in-depth technical expertise and assistance to Departmental Representative and Commissioning Manager in preparation and implementation of service contracts and in-house preventive maintenance procedures.
- .2 Service Contracts to include:
  - .1 Annual verification of field points for operation and calibration.
  - .2 4 visits per year.
  - .3 4 responses to emergency calls during day, per year.
  - .4 2 responses to emergency calls during silent hours per year.
  - .1 Silent hours defined as 1630 h – 0730 h and on weekends and statutory holidays.
  - .2 Complete inventory of installed system.

**Part 2            Products**

**2.1            NOT USED**

- .1    Not Used.

**Part 3            Execution**

**3.1            FIELD QUALITY CONTROL**

- .1    Perform as minimum (3) three minor inspections and one major inspection (more often if required by manufacturer) per year. Provide detailed written report to Departmental Representative as described in Submittal article.
- .2    Perform inspections during regular working hours, 0800 to 1630 h, Monday through Friday, excluding statutory holidays.
- .3    Following inspections are minimum requirements and should not be interpreted to mean satisfactory performance:
  - .1    Perform calibrations using test equipment having traceable, certifiable accuracy at minimum 50% greater than accuracy of system displaying or logging value.
  - .2    Check and calibrate random sample of 10% field input/output devices in accordance with Canada Labour Code - Part I and CSA Z204.
  - .3    Provide dated, maintenance task lists, as described in Submittal article, as proof of execution of complete system verification.
- .4    Minor inspections to include, but not limited to:
  - .1    Perform visual, operational checks to BC's, peripheral equipment, interface equipment and other panels.
  - .2    Check equipment cooling fans as required.
  - .3    Visually check for mechanical faults, air leaks and proper pressure settings on pneumatic components.
  - .4    Review system performance with Departmental Representative to discuss suggested or required changes.
- .5    Major inspections to include, but not limited to:
  - .1    Minor inspection.
  - .2    Clean OWS(s) peripheral equipment, BC(s), interface and other panels, micro-processor interior and exterior surfaces.
  - .3    Check signal, voltage and system isolation of BC(s), peripherals, interface and other panels.
  - .4    Verify calibration/accuracy of each input and output device and recalibrate or replace as required.
  - .5    Provide mechanical adjustments, and necessary maintenance on printers.
  - .6    Run system software diagnostics as required.

- .7 Install software and firmware enhancements to ensure components are operating at most current revision for maximum capability and reliability.
  - .1 Perform network analysis and provide report as described in Submittal article.
- .6 Rectify deficiencies revealed by maintenance inspections and environmental checks.
- .7 Continue system debugging and optimization.
- .8 Testing/verification of occupancy and seasonal-sensitive systems to take place during four (4) consecutive seasons, after facility has been accepted, taken over and fully occupied.
  - .1 Test weather-sensitive systems twice: first at near winter design conditions and secondly under near summer design conditions.

**END OF SECTION**

**Part 1        General**

**1.1        REFERENCE STANDARDS**

- .1 Canadian Standards Association (CSA International).
  - .1 CSA T529, Telecommunications Cabling Systems in Commercial Buildings (Adopted ANSI/TIA/EIA-568-A with modifications.
  - .2 CSA T530, Commercial Building Standard for Telecommunications Pathways and Spaces (Adopted ANSI/TIA/EIA – 569-A with modifications.
- .2 Institute of Electrical and Electronics Engineers (IEEE)/Standard for Information Technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements:
  - .1 IEEE Std 802.3TM, Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.
- .3 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA):
  - .1 TIA/EIA-568, Commercial Building Telecommunications Cabling Standards Set, Part 1 General Requirements, Part 2 Balanced Twisted- Pair Cabling Components, Part 3 Optical Fiber Cabling Components Standard.
  - .2 TIA/EIA-569-A, Commercial Building Standard for Telecommunications Pathways and Spaces.
- .4 Treasury Board Information Technology Standard (TBITS):
  - .1 TBITS 6.9, Profile for the Telecommunications Wiring System in Government Owned and Leased Buildings-Technical Specifications.

**1.2        DEFINITIONS**

- .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS - General Requirements.

**1.3        SYSTEM DESCRIPTION**

- .1 Data communication network to link Operator Workstations and Master Control Units (MCU) in accordance with CSA T529, TIA/EIA-568, CSA T530 and TIA/EIA-569-A:
  - .1 Provide reliable and secure connectivity of adequate performance between different sections segments of network.
  - .2 Allow for future expansion of network, with selection of networking technology and communication protocols.
- .2 Data communication network to include, but not limited to:
  - .1 EMCS-LAN.
  - .2 Modems.
  - .3 Network interface cards.
  - .4 Network management hardware and software.
  - .5 Network components necessary for complete network.

## **1.4 DESIGN REQUIREMENTS**

- .1 EMCS Local Area Network (EMCS-LAN):
  - .1 High Speed, high performance, local area network over MS/TP with MCUs and OWSs communicate with each other directly on peer to peer basis in accordance with IEEE 802.3/Ethernet Standard.
  - .2 EMCS-LAN to be: BACnet Protocol.
  - .3 Each EMCS-LAN to be capable of supporting at least 50 devices.
  - .4 Support of combination of MCUs and OWSs directly connected to EMCS-LAN.
  - .5 High speed data transfer rates for alarm reporting, quick report generation from multiple controllers, upload/download information between network devices. Bit rate to be 10 Megabits per second minimum.
  - .6 Detection and accommodation of single or multiple failures of either OWSs, MCUs or network media. Operational equipment to continue to perform designated functions effectively in event of single or multiple failures.
  - .7 Commonly available, multiple sourced, networking components and protocols to allow system to co-exist with other networking applications including office automation.
- .2 Dynamic Data Access:
  - .1 LAN to provide capabilities for OWSs, either network resident or connected remotely to access point status and application report data or execute control functions for other devices via LAN.
  - .2 Access to data to be based upon logical identification of building equipment.
- .3 Network Medium:
  - .1 Network medium: twisted cable, shielded twisted cable, or fibre optic cable compatible with network protocol to be used within buildings. Fibre optic cable to be used between buildings.

## **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            DEFINITIONS**

- .1      Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.
- .2      Secondary OWS: serves as backup to primary OWS, is storage and retrieval facility of soft copy of as-built contractor supplied data as described in Section 25 05 03 - EMCS: Project Record Documents.
- .3      Portable OWS: used as remote dial-up OWS with same capabilities as primary OWS including graphic display.
- .4      Remote Auxiliary OWS: performs identical user interface functions as primary OWS.

**1.2            OWS SYSTEM DESCRIPTION**

- .1      Consists of commercially available personal computer in current production, with sufficient memory and processor capacity to perform functions specified.

**1.3            ACTION AND INFORMATIONAL SUBMITTALS**

- .1      Make submittals in accordance with Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

**1.4            ENVIRONMENTAL CONDITIONS**

- .1      OWS to operate in conditions of 10 degrees C to 32 degrees C and 20% to 90% non-condensing RH.

**1.5            MAINTENANCE**

- .1      Provide maintenance in accordance with Section 25 05 03 - EMCS: Project Record Documents.

**Part 2           Products**

**2.1            OWS HARDWARE**

- .1      PC system to include:
  - .1      Processor to be Intel i5 micro-processor, operating at clock speed of 2.2 GHz minimum, capable of supporting software necessary to perform functions specified in this section. System backplane bus (1066 Megahertz) to support PCI boards.
  - .2      Internal clock:
    - .1      Uninterruptible clock having accuracy of plus or minus 5 seconds/month, capable of deriving year/month/day/ hour/minute/second.
    - .2      Rechargeable batteries to provide minimum 48 h clock operation in event of power failure.

- .3 Asynchronous interfaces for connection to listed peripheral devices including LAN and remote devices.
- .2 Power supply unit to accept 120 V 60 Hz source and include line surge and low voltage protection for processor and its peripherals.
- .3 Include UPS to provide 30 minutes' minimum operation of PC, CRT and communication and peripheral devices. This shall apply to fixed (non-portable) OWS and peripherals.

## 2.2 OWS PC COMPONENTS

- .1 OWS shall meet the minimum requirements of the upgraded controls systems and software.
- .2 Minimum Components:
  - .1 Processor: Intel™ i5.
  - .2 Operating System: Genuine Windows 10.
  - .3 Monitors: 24" Widescreen flat panel.
  - .4 Memory: 8 GB Dual Channel DDR3 SDRAM – 2 DIMMs.
  - .5 Hard Drives: 2 X 2 Tb Serial ATA 3 Gb/s Hard Drive (7200 RPM) w/DataBurst Cache™.
  - .6 CD or DVD Drive: 8x DVD+/-RW Drive.
  - .7 Video Cards: Integrated.
  - .8 Sound Cards: Integrated.
  - .9 Network Card: Integrated Ethernet.
  - .10 Office Productivity Software (Pre-Installed): Microsoft® Office – Includes MS WORD 2010, MS EXCEL 2010.
  - .11 Keyboard: USB Keyboard.
  - .12 Mouse: Optical USB Mouse.
  - .13 Hardware Support Services: 2 Year Next Business Day Onsite/In Home Service and Tech Support.
  - .14 Power Protection: 5-Outlet Desktop Surge Protector.
  - .15 Ports, Slots and Chassis:
    - .1 Externally Accessible:
      - .1 Video: HDMI and DVI/Display Port.
      - .2 USB: 8 Ports (2 Front, 6 Back) + 1 Internal, with minimum of four (4) 3.0 ports.
      - .3 Audio: Audio – Six back-panel connectors for line-in, line-out, microphone, rear surround, side surround, SPDIF interface in rear, two front-panel connectors for headphones/microphone, integrated 7.1 channel sound.
      - .4 Additional Jacks: 1 front headphone jack and 1 front / 1 back microphone jack.
      - .5 Network: Integrated Ethernet.
      - .6 Integrated 10/100/1000 Gigabit network interface.

- .2 Expansion Slots.
  - .1 Half-height PCIe x 1.
  - .2 Half-height PCIe x 16 (Graphics).
- .3 Power Supply
  - .1 DC Power Supply sized for specified system.
    - .1 Voltage: 200 to 240 V and 100 to 120 V at 50/60 Hz.
    - .2 Backup battery: 3-V CR2032 lithium coin cell.
- .4 Chassis:
  - .1 3.5" Bays: 2 bays (one external; one internal).
  - .2 5.25 Bays: 1 Slimline bays.
  - .3 Memory DIMM slots: 4 available.
  - .4 Dimensions and Weight:
    - .1 H: 31.5 cm (12.5").
    - .2 W: 9.4 cm (3.7").
    - .3 D: 36.5 cm (14.5").
    - .4 Weight: 7.7 kg (16.4 lbs).

## **2.3 OPERATING SYSTEM (OS) OR EXECUTIVE**

- .1 OS to support complement of hardware terminals and software programs specified.
- .2 OS to be true multitasking operating environment.
  - .1 MS DOS or PC DOS based software platforms not permitted.
- .3 OWS Software to operate in a "Windows" based operating environment. Software to be Windows 10.

## **2.4 OWS CONTROL SOFTWARE**

- .1 OWS is not to form part of real-time control functions either directly or indirectly or as part of communication link. Real-time control functions to reside in MCUs, LCUs, and TCUs with peer to peer communication occurring at MCU to MCU device level.
- .2 Time Synchronization Module.
  - .1 System to provide Time Synchronization of real-time clocks in controllers.
  - .2 System to perform this feature on regular scheduled basis and on operator request.
- .3 User Display Interface Module.
  - .1 OWS software to support "Point Names" as defined in Section 25 05 01 - EMCS: General Requirements.
  - .2 Upon operator's request in either text, graphic or table mode, system to present condition of single point, system, area, or connected points on system to OWS. Display analog values digitally to 1 place of decimal with negative sign as required. Update displayed analog values and status when new values received. Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm. For systems supporting

COSV, refresh rate of screen data not to exceed 5 seconds from time of field change and system is to execute supervisory background scan every 20 seconds to verify point data value. For other systems refresh rate not to exceed 5 seconds for points displayed. Initial display of new system graphic display (with up to 30 active points), including presentation of associated dynamic data not to exceed 8 seconds.

- .4 General Event Log Module: to record system activities occurring at OWS or elsewhere in system including:
  - .1 Operator Log-in from user interface device.
  - .2 Communication messages: errors, failures and recovery.
  - .3 Event notifications and alarms by category.
  - .4 Record of operator initiated commands.
- .5 General Event Log:
  - .1 Hold minimum of 6 months information and be readily accessible to operator.
  - .2 Able to be archived as necessary to prevent loss of information.
- .6 Operator Control Software Module: to support entry of information into system from keyboard and mouse, disk, or from another network device. Display of information to user; dynamic displays, textual displays, and graphic displays to display logging and trending of system information and following tasks:
  - .1 Automatic logging of digital alarms and change of status messages.
  - .2 Automatic logging of analog alarms.
  - .3 System changes: alarm limits, set-points, alarm lockouts.
  - .4 Display specific point values, states as selected.
  - .5 Provide reports as requested and on scheduled basis when required.
  - .6 Display graphics as requested, and on alarm receptions (user's option).
  - .7 Display list of points within system.
  - .8 Display list of systems within building.
  - .9 Direct output of information to selected peripheral device.
  - .10 On-line changes:
    - .1 Alarm limits.
    - .2 Setpoints.
    - .3 Deadbands.
    - .4 Control and change of state changes.
    - .5 Time, day, month, year.
    - .6 Control loop configuration changes for controller-based CDLs.
    - .7 Control loop tuning changes.
    - .8 Schedule changes.
    - .9 Changes, additions, or deletions, of points, graphics, for installed and future systems.
  - .11 According to assigned user privileges (password definition) following functions are to be supported:

- .1 Permit operator to terminate automatic (logic based) control and set value of field point to operator selected value. These values or settings to remain in effect until returned to automatic (logic based) control by operator.
    - .2 Requests for status, analog values, graphic displays, logs and controls to be through user interface screens.
  - .12 Software and tools utilized to generate, modify and configure building controllers to be installed and operational on the OWS.
- .7 Dial-up host Module for off site OWSs.
  - .1 Operators at dial-up OWS to be able to perform control functions, report functions, data base generation and modification functions as described for OWS's connected via LAN. Provide routines to automatically answer calls and either file or display information sent from remote panels.
  - .2 Operator to be able to access remote buildings by selection of facility by its logical name. Dial-up module to maintain user-definable cross-reference of buildings and associated telephone numbers without manual dialing.
  - .3 Local OWS may serve as dial-up host for remotely connecting OWSs, remote controllers or networks. Alarms and data file transfers handled via dial-up transactions must not interfere with local LAN activity. LAN activity not to prevent work-station from handling incoming calls.
- .8 Message Handling Module - and Error Messages: to provide message handling for following conditions:
  - .1 Message and alarm buffering to prevent loss of information.
  - .2 Error detection correction and retransmission to guarantee data integrity.
  - .3 Informative messages to operator for data error occurrences, errors in keyboard entry, failure of equipment to respond to requests or commands and failure of communications between EMCS devices.
  - .4 Default device definition to be implemented to ensure alarms are reported as quickly as possible in event of faulty designated OWS.
- .9 Access Control Module.
  - .1 Minimum 5 levels of password access protection to limit control, display, or data base manipulation capabilities. Following is preferred format of progression of password levels:
    - .1 Guest: no password data access and display only.
    - .2 Operator Level: full operational commands including automatic override.
    - .3 Technician: data base modifications.
    - .4 Programmer: data base generation.
    - .5 Highest Level: system administration - password assignment addition, modification.
  - .2 User-definable, automatic log-off timers from 1 to 60 min. to prevent operators leaving devices on-line inadvertently. Default setting = 3 minutes.

- .10 Trend Data Module: includes historical data collection utility, trend data utility, control loop plot utility. Each utility to permit operator to add trend point, delete trend point, set scan rate.
  - .1 Historical data collection utility: collect concurrently operator selected real or calculated point values at operator selectable rate 30-480 minutes. Samples to include for each time interval (time-stamped), minimum present value, maximum present value, and average present value for point selected. Rate to be individually selectable for each point. Data collection to be continuous operation, stored in temporary storage until removed from historical data list by operator. Temporary storage to have at least 12-month capacity.
  - .2 Trend data utility: continuously collect point object data variables for variables from building controllers as selected by operator, including at minimum; present value of following point object types - DI, DO, AI, AO set points value, calculated values. Trend data utility to have capacity to trend concurrently points at operator-selectable rate of 05 seconds to 3600 seconds, individually selectable for selected value, or use of COSV detection. Collected trend data to be stored on minimum 96 hours basis in temporary storage until removed from trend data list by operator. Option to archive data before overwriting to be available.
  - .3 Control loop plot utility: for AO Points provide for concurrent plotting of Measured value input - present value, present value of output, and AO setpoint. Operator selectable sampling interval to be selectable between 1 second to 20 seconds. Plotting utility to scroll to left as plot reaches right side of display window. Systems not supporting control loop plot as separate function must provide predefined groups of values. Each group to include values for one control loop display.
  - .4 Trend data Module to include display of historical or trend data to OWS screen in X Y plot presentation. Plot utility to display minimum of 6 historical points or 6 trend points concurrently or 1 Control Loop Plot. For display output of real time trend data, display to automatically index to left when window becomes full. Provide plotting capabilities to display collected data based on range of selected value for (Y) component against time/date stamp of collected data for (X) component.
  - .5 Provide separate reports for each trend utility. Provide operator feature to specify report type, by point name and for output device. Reports to include time, day, month, year, report title, and operator's initials. Implement reports using report module. Ensure trend data is exportable to third party spreadsheet or database applications for PCs.
- .11 Report Module: reports for energy management programs, function totalization, analog/pulse totalization and event totalization features available at MCU level. Refer also to Section 25 30 01- EMCS: Building Controllers.
  - .1 Reports to include time, day, month, year, report title, operator's initials.
  - .2 Software to provide capability to:
    - .1 Generate and format reports for graphical and numerical display from real time and stored data.
    - .2 Print and store reports as selected by operator.
    - .3 Select and assign points used in such reports.

- .4 Sort output by area, system, as minimum.
  - .3 Periodic/automatic report:
    - .1 Generate specified report(s) automatically including options of start time and date, interval between reports (hourly, daily, weekly, monthly), output device. Software to permit modifying periodic/automatic reporting profile at any time.
    - .2 Reports to include:
      - .1 Power demand and duty cycle summary: see application program for same.
      - .2 Disabled "Locked-out" point summary: include point name, whether disabled by system or by operator.
      - .3 Run time summary: summary of accumulated running time of selected equipment. Include point name, run time to date, alarm limit setting. Run time to accumulate until reset individually by operator.
      - .4 Summary of run time alarms: include point name, run time to date, alarm limit.
      - .5 Summary of start/stop schedules: include start/stop times and days, point name.
      - .6 Motor status summary.
  - .4 Report types:
    - .1 Dynamic reports: system to printout or display of point object data value requested by operator. System to indicate status at time of request, when displayed, updated at operator selected time interval. Provide option for operator selection of report type, by point name, and/or output device. Ensure reports are available for following point value combinations:
    - .2 Points in accessible from this OWS (total connected for this location), multiple "areas".
    - .3 Area (points and systems in Area).
    - .4 Area, system (points in system).
    - .5 System (points by system type).
    - .6 System point (points by system and point object type).
    - .7 Area point (points by system and point object type).
    - .8 Point (points by point object type).
  - .5 Summary report: printout or display of point object data value selected by operator. Report header to indicate status at time of request. Ensure reports are available on same basis as dynamic reports. Provide option as to report type, point name, output device.
  - .6 Include preformatted reports as listed in Event/Alarm Module.
- .12 Graphics Display Module: graphics software utility to permit user to create, modify, delete, file, and recall graphics required by Section 25 90 01 - EMCS: Site Requirements, Applications and Systems Sequences of Operation.

- .1 Provide capacity for 100% expansion of system graphics. Graphic interface to provide user with multiple layered diagrams for site, building in plan view, floor furniture plan view and building systems, overlaid with dynamic data appropriately placed and permitting direct operator interaction. Graphic interface to permit operator to start and stop equipment, change set points, modify alarm limits, override system functions and points from graphic system displays by use of mouse or similar pointing device.
- .2 Display specific system graphics: provide for manual and/or automatic activation (on occurrence of an alarm). Include capability to call up and cancel display of graphic picture.
- .3 Library of pre-engineered screens and symbols depicting standard air handling components (fans, coils, filters, dampers, VAV), complete mechanical system components (chillers, boilers, pumps), electrical symbols.
- .4 Graphic development, creation, modification package to use mouse and drawing utility to permit user to:
  - .1 Modify portion of graphic picture/schematic background.
  - .2 Delete graphic picture.
  - .3 Call up and cancel display of graphic picture.
  - .4 Define symbols.
  - .5 Position and size symbols.
  - .6 Define background screens.
  - .7 Define connecting lines, curves.
  - .8 Locate, orient, size descriptive text.
  - .9 Define, display colours of elements.
  - .10 Establish co-relation between symbols or text and associated system points or other graphic displays.
- .5 User to be able to build graphic displays showing on-line point data from multiple MCU panels. Graphic displays to represent logical grouping of system points or calculated data based upon building function, mechanical system, building layout, other logical grouping of points which aids operator in analysis of facility operation. Data to be refreshed on screen as "changed data" without redrawing of entire screen or row on screen.
- .6 Dynamic data (temperature, humidity, flow, status) to be shown in actual schematic locations, to be automatically updated to show current values without operator intervention.
- .7 Windowing environment to allow user to view several graphics simultaneously to permit analysis of building operation, system performance, display of graphic associated with alarm to be viewed without interrupting work in progress. If interface is unable to display several different types of display at same time, provide at minimum 2 OWSs.
- .8 Utilize graphics package to generate system schematic diagrams as required in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation, and as directed by Departmental Representative. In addition, provide graphics for schematic depicted on mechanical plan flow diagrams, point lists and system graphics. Provide graphic for floor depicting



- room sensors and control devices located in their actual location. For floor graphic include secondary diagram to show TCU-VAV box actuator and, flow sensor. Diagram to be single line schematic of ductwork as well as associated heating coil or radiation valve. Departmental Representative to provide CAD floor layouts. Provide display of TCU-VAVs in table form, include following values as minimum; space temp, setpoint, mode, actual flow, min flow setpoint, max flow setpoint, cooling signal value, and heating signal value. Organize table by rooms and floor groupings.
- .9 Provide complete directory of system graphics, including other pertinent system information. Utilize mouse or pointing device to "point and click" to activate selected graphic.
  - .10 Provide unique sequence of operation graphic or pop-up window for each graphic that is depicted on OWS. Provide access to sequence of operation graphic by link button on each system graphic. Provide translation of sequence of operation, a concise explanation of systems operation, from control descriptive logic into plain and/or English language.
  - .13 Event/Alarm Module: displays in window alarms as received and stored in General Event Log.
    - .1 Classify alarms as "critical", "cautionary", "maintenance". Alarms and alarm classifications to be designated by personnel requiring password level.
    - .2 Presentation of alarms to include features identified under applicable report definitions of Report Module paragraph.
    - .3 Alarm reports.
      - .1 Summary of points in critical, cautionary or maintenance alarm. Include at least point name, alarm type, current value, limit exceeded.
      - .2 Analog alarm limit summary: include point name, alarm limits, deviation limits.
      - .3 Summary of alarm messages: include associated point name, alarm description.
    - .4 Software to notify operator of each occurrence of alarm conditions. Each point to have its own secondary alarm message.
    - .5 EMCS to notify operator of occurrence of alarms originating at field device within following time periods of detection:
      - .1 Critical - 5 seconds.
      - .2 Cautionary - 10 seconds.
      - .3 Maintenance - 10 seconds.
    - .6 Display alarm messages in English.
    - .7 Primary alarm message to include as minimum: point identifier, alarm classification, time of occurrence, type of alarm. Provide for initial message to be automatically presented to operator whenever associated alarm is reported. Assignment of secondary messages to point to be operator-editable function. Provide secondary messages giving further information (telephone lists, maintenance functions) on per point basis.
    - .8 System reaction to alarms: provide alarm annunciation by dedicated window (activated to foreground on receipt of new alarm or event) of OWS with visual

and audible hardware indication. Acknowledgement of alarm to change visual indicator from flashing to steady state and to silence audible device. Acknowledgment of alarm to be time, date and operator stamped and stored in General Event Log. Steady state visual indicator to remain until alarm condition is corrected but must not impede reporting of new alarm conditions. Notification of alarm not to impede notification of subsequent alarms or function of Controller's/CDL. Do not allow random occurrence of alarms to cause loss of alarm or over-burden system. Do not allow acknowledgement of one alarm as acknowledgement of other alarms.

- .9 Controller network alarms: system supervision of controllers and communications lines to provide following alarms as minimum:
  - .1 Controller not responding - where possible delineate between controller and communication line failure.
  - .2 Controller responding - return to normal.
  - .3 Controller communications bad - high error rate or loss of communication.
  - .4 Controller communications normal - return to normal.
- .10 Digital alarm status to be interrogated every 2 seconds as minimum or be direct interrupting non-polling type (COV). Annunciate each non-expected status with alarm message.
- .14 Archiving and Restoration Module.
  - .1 Primary OWS to include services to store back-up copies of controller databases. Perform complete backup of OWS software and data files at time of system installation and at time of final acceptance. Provide backup copies before and after Controller's revisions or major modifications.
  - .2 Provide continuous integrity supervision of controller data bases. When controller encounters database integrity problems with its data base, system to notify operator of need to download copy data base to restore proper operation.
  - .3 Ensure data base back-up and downloading occurs over LAN without specialized operator technical knowledge. Provide operator with ability to manually download entire controller data base, or parts thereof as required.
- .15 CDL Generator and Modifier Module.
  - .1 CDL Generator module to permit generation and modification of CDLs.
  - .2 Provide standard reference modules for text based systems module that will permit modification to suit site specific applications. Module to include cut, paste, search and compare utilities to permit easy CDL modification and verification.
  - .3 Provide full library of symbols used by manufacturer for system product installed accessible to operators for systems using graphical environment for creation of CDLs Module to include graphic tools required to generate and create new object code for downloading to building controllers.
  - .4 Module to permit testing of code before downloading to building controllers.

**Part 3          Execution**

**3.1            INSTALLATION REQUIREMENTS**

- .1      Provide necessary power as required from local 120V emergency power branch circuit panels for OWSs and peripheral equipment.
  - .1          Install tamper locks on breakers of circuit panels.
  - .2          Refer to UPS requirements stated under OWS Hardware in PART 2.

**END OF SECTION**

**Part 1        General**

**1.1        REFERENCES**

- .1 American Society of Heating, Refrigeration, and Air-Conditioning Engineers, Inc. (ASHRAE):
  - .1 ASHRAE, Applications Handbook, SI Edition.
  - .2 ASHRAE Standard 135 – BAC net – A Data Communications Protocol for Building Automation and Control Networks.
  - .3 ASHRAE Standard 135.1 Method of Test Conformance to BAC net.
- .2 Canadian Standards Association (CSA):
  - .1 C22.2 No.205, Signal Equipment.
- .3 Institute of Electrical and Electronics Engineers (IEEE):
  - .1 IEEE C37.90.1, Surge Withstand Capabilities Test for Protective Relays and Relays Systems.
- .4 Public Works and Government Services Canada (PWGSC)/Real Property Branch/Architectural and Engineering Services:
  - .1 PWGSC MD 250005-2009: Energy Monitoring and Control Systems (EMCS) Design Guidelines.

**1.2        DEFINITIONS**

- .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

**1.3        DESCRIPTION**

- .1 General: Network of controllers comprising of MCU(s), LCU(s), ECU(s) or TCU(s) to be provided as indicated in System Architecture Diagram to support building systems and associated sequence(s) of operations as detailed in these specifications.
  - .1 Provide sufficient controllers to meet intents and requirements of this section.
  - .2 Controller quantity, and point contents to be approved by Departmental Representative at time of preliminary design review.
- .2 Controllers: stand-alone intelligent Control Units.
  - .1 Incorporate programmable microprocessor, non-volatile program memory, RAM, power supplies, as required to perform specified functions.
  - .2 Incorporate communication interface ports for communication to LANs to exchange information with other Controllers.
  - .3 Capable of interfacing with operator interface device.
  - .4 Execute its logic and control using primary inputs and outputs connected directly to its onboard input/output field terminations or slave devices, and without need to interact with other controller. Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).
    - .1 Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).

- .3 Interface to include provisions for use of dial-up modem for interconnection with remote modem.
  - .1 Dial-up communications to use 56 Kbit modems and voice grade telephone lines.
  - .2 Each stand-alone panel may have its own modem or group of stand-alone panels may share modem.

#### **1.4 DESIGN REQUIREMENTS**

- .1 To include:
  - .1 Scanning of AI and DI connected inputs for detection of change of value and processing detection of alarm conditions.
  - .2 Perform On-Off digital control of connected points, including resulting required states generated through programmable logic output.
  - .3 Perform Analog control using programmable logic, (including PID) with adjustable dead bands and deviation alarms.
  - .4 Control of systems as described in sequence of operations.
  - .5 Execution of optimization routines as listed in this section.
- .2 Total spare capacity for MCUs and LCUs: at least 25 % of each point type distributed throughout the MCUs and LCUs.
- .3 Field Termination and Interface Devices:
  - .1 To: CSA C22.2 No.205.
  - .2 Electronically interface sensors and control devices to processor unit.
  - .3 Include, but not be limited to, following:
    - .1 Programmed firmware or logic circuits to meet functional and technical requirements.
    - .2 Power supplies for operation of logics devices and associated field equipment.
    - .3 Lockable wall cabinet.
    - .4 Required communications equipment and wiring (if remote units).
    - .5 Leave controlled system in "fail-safe" mode in event of loss of communication with, or failure of, processor unit.
    - .6 Input Output interface to accept as minimum AI, AO, DI, DO functions as specified.
    - .7 Wiring terminations: use conveniently located screw type or spade lug terminals.
  - .4 AI interface equipment to:
    - .1 Convert analog signals to digital format with 10 bit analog-to-digital resolution.
    - .2 Provide for following input signal types and ranges:
      - .1 4-20 mA;
      - .2 0 - 10 V DC; and
      - .3 100/1000 ohm RTD input.
    - .3 Meet IEEE C37.90.1 surge withstand capability.
    - .4 Have common mode signal rejection greater than 60 dB to 60 Hz.

- .5 Where required, dropping resistors to be certified precision devices which complement accuracy of sensor and transmitter range specified.
- .5 AO interface equipment:
  - .1 Convert digital data from controller processor to acceptable analog output signals using 8 bit digital-to-analog resolution.
  - .2 Provide for following output signal types and ranges:
    - .1 4 - 20 mA.
    - .2 0 - 10 V DC.
  - .3 Meet IEEE C37.90.1 surge withstand capability.
- .6 DI interface equipment:
  - .1 Able to reliably detect contact change of sensed field contact and transmit condition to controller.
  - .2 Meet IEEE C37.90.1 surge withstand capability.
  - .3 Accept pulsed inputs up to 2 kHz.
- .7 DO interface equipment:
  - .1 Respond to controller processor output, switch respective outputs. Each DO hardware to be capable of switching up to 0.5 amps at 24 V AC.
  - .2 Switch up to 5 amps at 220 V AC using optional interface relay.
- .4 Controllers and associated hardware and software: operate in conditions of 0°C to 44°C and 20% to 90% non-condensing RH.
- .5 Controllers (MCU, LCU): mount in wall mounted cabinet with hinged, keyed-alike locked door:
  - .1 Provide for conduit entrance from top, bottom or sides of panel.
  - .2 ECUs and TCUs to be mounted in equipment enclosures or separate enclosures.
  - .3 Mounting details as approved by Departmental Representative for ceiling mounting.
- .6 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.
- .7 Provide surge and low voltage protection for interconnecting wiring connections.

## **1.5 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
  - .1 Submit product data sheets for each product item proposed for this project.

## **1.6 MAINTENANCE**

- .1 Provide manufacturers recommended maintenance procedures for insertion in Section 25 05 03 - EMCS: Project Record Documents.

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**Part 2            Products**

**2.1            MASTER CONTROL UNIT (MCU)**

- .1      General: primary function of MCU is to provide co-ordination and supervision of subordinate devices in execution of optimization routines such as demand limiting or enthalpy control.
- .2      Include high speed communication LAN Port for Peer to Peer communications with OWS(s) and other MCU level devices.
  - .1          MCU must support Proprietary Protocol BACnet.
- .3      MCU local I/O capacity as follows:
  - .1          MCU I/O points as allocated in I/O Summary Table referenced in MD250005.
  - .2          LCUs may be added to support system functions.
- .4      Central Processing Unit (CPU).
  - .1          Processor to consist of minimum 16-bit microprocessor capable of supporting software to meet specified requirements.
  - .2          CPU idle time to be more than 30% when system configured to maximum input and output with worst case program use.
  - .3          Minimum addressable memory to be at manufacturer's discretion but to support at least performance and technical specifications to include but not limited to:
    - .1              Non-volatile EEPROM to contain operating system, executive, application, sub-routine, other configurations definition software. Tape media not acceptable.
    - .2              Battery backed (72-hour minimum capacity) RAM (to reduce the need to reload operating data in event of power failure) to contain CDLs, application parameters, operating data or software that is required to be modifiable from operational standpoint such as schedules, setpoints, alarm limits, PID constants and CDL and hence modifiable on-line through operator panel or remote operator's interface. RAM to be downline loadable from OWS.
  - .4          Include uninterruptible clock accurate to plus or minus 5 secs/month, capable of deriving year/month/day/hour/minute/second, with rechargeable batteries for minimum 72-hour operation in event of power failure.
- .5      Local Operator Terminal (OT): Provide OT for each MCU unless otherwise specified in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.
  - .1          Mount access/display panel in MCU or in suitable enclosure beside MCU as approved by Departmental Representative.
  - .2          Support operator's terminal for local command entry, instantaneous and historical data display, programs, additions and modifications.
  - .3          Display simultaneously minimum of 16 point identifiers to allow operator to view single screen dynamic displays depicting entire mechanical systems. Point identifiers to be in English French.

- .4 Functions to include, but not be limited to, following:
  - .1 Start and stop points.
  - .2 Modify setpoints.
  - .3 Modify PID loop parameters.
  - .4 Override PID control.
  - .5 Change time/date.
  - .6 Add/modify/start/stop weekly scheduling.
  - .7 Add/modify setpoint weekly scheduling.
  - .8 Enter temporary override schedules.
  - .9 Define holiday schedules.
  - .10 View analog limits.
  - .11 Enter/modify analog warning limits.
  - .12 Enter/modify analog alarm limits.
  - .13 Enter/modify analog differentials.
- .5 Provide access to real and calculated points in controller to which it is connected or to other controller in network. This capability not to be restricted to subset of predefined "global points" but to provide totally open exchange of data between OT and other controller in network.
- .6 Operator access to OTs: same as OWS user password and password changes to automatically be downloaded to controllers on network.
- .7 Provide prompting to eliminate need for user to remember command format or point names. Prompting to be consistent with user's password clearance and types of points displayed to eliminate possibility of operator error.
- .8 Identity of real or calculated points to be consistent with network devices. Use same point identifier as at OWS's for access of points at OT to eliminate cross-reference or look-up tables.

## **2.2 LOCAL CONTROL UNIT (LCU)**

- .1 Provide multiple control functions for typical built-up and package HVAC systems, hydronic systems and electrical systems.
- .2 Minimum of 16 I/O points of which minimum be 4 AOs, 4 AIs, 4 DIs, 4 DOs.
- .3 Points integral to one Building System to be resident on only one controller.
- .4 Microprocessor capable of supporting necessary software and hardware to meet specified requirements as listed in previous MCU article with following additions:
  - .1 Include minimum 2 interface ports for connection of local computer terminal.
  - .2 Design so that shorts, opens or grounds on input or output will not interfere with other input or output signals.
  - .3 Physically separate line voltage (70V and over) circuits from DC logic circuits to permit maintenance on either circuit with minimum hazards to technician and equipment.
  - .4 Include power supplies for operation of LCU and associated field equipment.
  - .5 In event of loss of communications with, or failure of, MCU, LCU to continue to perform control. Controllers that use defaults or fail to open or close positions not acceptable.



- .6 Provide conveniently located screw type or spade lug terminals for field wiring.
- .7 LCU to have 25 % spare input and 25 % output point capacity without addition of cards, terminals, etc.

## **2.3 TERMINAL/EQUIPMENT CONTROL UNIT (TCU/ECU)**

- .1 Microprocessor capable of supporting necessary software and hardware to meet TCU/ECU functional specifications.
  - .1 TCU/ECU definition to be consistent with those defined in ASHRAE HVAC Applications Handbook Section 45.
- .2 Controller to communicate directly with EMCS through EMCS LAN and provide access from EMCS OWS for setting occupied and unoccupied space temperature setpoints, flow setpoints, and associated alarm values, permit reading of sensor values, field control values (% open) and transmit alarm conditions to EMCS OWS.
- .3 VAV Terminal Controller.
  - .1 Microprocessor based controller with integral flow transducer, including software routines to execute PID algorithms, calculate airflow for integral flow transducer and measure temperatures as per I/O Summary required inputs. Sequence of operation to ASHRAE HVAC Applications Handbook.
  - .2 Controller to support point definition; in accordance with Section 25 05 01 - EMCS: General Requirements.
  - .3 Controller to operate independent of network in case of communication failure.
  - .4 Controller to include damper actuator and terminations for input and output sensors and devices.

## **2.4 SOFTWARE**

- .1 General.
  - .1 Include as minimum: operating system executive, communications, application programs, operator interface, and systems sequence of operation - CDL's.
  - .2 Include "firmware" or instructions which are programmed into ROM, EPROM, EEPROM or other non-volatile memory.
  - .3 Include initial programming of Controllers, for entire system.
- .2 Program and data storage.
  - .1 Store executive programs and site configuration data in ROM, EEPROM or other non-volatile memory.
  - .2 Maintain CDL and operating data including setpoints, operating constants, alarm limits in battery-backed RAM or EEPROM for display and modification by operator.
- .3 Programming languages.
  - .1 Program Control Description Logic software (CDL) using English like or graphical, high level, general control language.
  - .2 Structure software in modular fashion to permit simple restructuring of program modules if future software additions or modifications are required. GO TO constructs not allowed unless approved by Departmental Representative.

- .4 Operator Terminal interface.
  - .1 Operating and control functions include:
    - .1 Multi-level password access protection to allow user/manager to limit workstation control.
    - .2 Alarm management: processing and messages.
    - .3 Operator commands.
    - .4 Reports.
    - .5 Displays.
    - .6 Point identification.
- .5 Pseudo or calculated points.
  - .1 Software to provide access to value or status in controller or other networked controller in order to define and calculate pseudo point. When current pseudo point value is derived, normal alarm checks must be performed or value used to totalize.
  - .2 Inputs and outputs for process: include data from controllers to permit development of network-wide control strategies. Processes also to permit operator to use results of one process as input to number of other processes (e.g. cascading).
- .6 Control Description Logic (CDL):
  - .1 Capable of generating on-line project-specific CDLs which are software based, programmed into RAM or EEPROM and backed up to OWS. Departmental Representative must have access to these algorithms for modification or to be able to create new ones and to integrate these into CDLs on BC(s) from OWS.
  - .2 Write CDL in high level language that allows algorithms and interlocking programs to be written simply and clearly. Use parameters entered into system (e.g. setpoints) to determine operation of algorithm. Operator to be able to alter operating parameters on-line from OWS and BC(s) to tune control loops.
  - .3 Perform changes to CDL on-line.
  - .4 Control logic to have access to values or status of points available to controller including global or common values, allowing cascading or inter-locking control.
  - .5 Energy optimization routines including enthalpy control, supply temperature reset, to be LCU or MCU resident functions and form part of CDL.
  - .6 MCU to be able to perform following pre-tested control algorithms:
    - .1 Two position control.
    - .2 Proportional Integral and Derivative (PID) control.
  - .7 Control software to provide ability to define time between successive starts for each piece of equipment to reduce cycling of motors.
  - .8 Provide protection against excessive electrical-demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.
  - .9 Power Fail Restart: upon detection of power failure system to verify availability of Emergency Power as determined by emergency power transfer switches and analyze controlled equipment to determine its appropriate status under Emergency power conditions and start or stop equipment as defined by

I/O Summary. Upon resumption of normal power as determined by emergency power transfer switches, MCU to analyze status of controlled equipment, compare with normal occupancy scheduling, turn equipment on or off as necessary to resume normal operation.

- .7 Event and Alarm management: use management by exception concept for Alarm Reporting. This is system wide requirement. This approach will insure that only principal alarms are reported to OWS. Events which occur as direct result of primary event to be suppressed by system and only events which fail to occur to be reported. Such event sequence to be identified in I/O Summary and sequence of operation. Examples of above are, operational temperature alarms limits which are exceeded when main air handler is stopped, or General Fire condition shuts air handlers down, only Fire alarm status shall be reported. Exception is, when air handler which is supposed to stop or start fails to do so under event condition.
- .8 Energy management programs: include specific summarizing reports, with date stamp indicating sensor details which activated and or terminated feature.
  - .1 MCU in coordination with subordinate LCU, TCU, ECU to provide for the following energy management routines:
    - .1 Time of day scheduling.
    - .2 Calendar based scheduling.
    - .3 Holiday scheduling.
    - .4 Temporary schedule overrides.
    - .5 Optimal start/stop.
    - .6 Night setback control.
    - .7 Enthalpy (economizer) switchover.
    - .8 Peak demand limiting.
    - .9 Temperature compensated load rolling.
    - .10 Fan speed/flow rate control.
    - .11 Cold deck reset.
    - .12 Hot deck reset.
    - .13 Hot water reset.
    - .14 Chilled water reset.
    - .15 Condenser water reset.
    - .16 Chiller sequencing.
    - .17 Night purge.
  - .2 Programs to be executed automatically without need for operator intervention and be flexible enough to allow customization.
  - .3 Apply programs to equipment and systems as specified or requested by the Departmental Representative.
- .9 Function/Event Totalization: features to provide predefined reports which show daily, weekly, and monthly accumulating totals and which include high rate (time stamped) and low rate (time stamped) and accumulation to date for month.
  - .1 MCUs to accumulate and store automatically run-time for binary input and output points.

- .2 MCU to automatically sample, calculate and store consumption totals on daily, weekly or monthly basis for user-selected analog or binary pulse input-type points.
- .3 MCU to automatically count events (number of times pump is cycled off and on) daily, weekly or monthly basis.
- .4 Totalization routine to have sampling resolution of 1 min or less for analog inputs.
- .5 Totalization to provide calculations and storage of accumulations up to 99,999.9 units (e.g., kWh, litres, tonnes, etc.).
- .6 Store event totalization records with minimum of 9,999,999 events before reset.
- .7 User to be able to define warning limit and generate user-specified messages when limit reached.

## **2.5 LEVELS OF ADDRESS**

- .1 Upon operator's request, EMCS to present status of any single 'point', 'system' or point group, entire 'area', or entire network on printer or OWS as selected by operator.
  - .1 Display analog values digitally to 1 place of decimals with negative sign as required.
  - .2 Update displayed analog values and status when new values received.
  - .3 Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm.
  - .4 Updates to be change-of-value (COV) driven or if polled not exceeding 2 second intervals.

## **2.6 POINT NAME SUPPORT**

- .1 Controllers (MCU, LCU) to support PSPC point naming convention as defined in Section 25 05 01 - EMCS: General Requirements.

## **Part 3 Execution**

### **3.1 LOCATION**

- .1 Location of Controllers to be approved by Departmental Representative.

### **3.2 INSTALLATION**

- .1 Install Controllers in secure locking enclosures as indicated or as directed by Departmental Representative.
- .2 Provide necessary power from local 120V branch circuit panel for equipment.
- .3 Install tamper locks on breakers of circuit breaker panel.
- .4 Use uninterruptible Power Supply (UPS) and emergency power when equipment must operate in emergency and co-ordinating mode.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 American National Standards Institute (ANSI).
  - .1 ANSI C12.7, Requirements for Watthour Meter Sockets.
  - .2 ANSI/IEEE C57.13, Standard Requirements for Instrument Transformers.
- .2 American Society for Testing and Materials International, (ASTM).
  - .1 ASTM B148, Standard Specification for Aluminum-Bronze Sand Castings.
- .3 National Electrical Manufacturer's Association (NEMA).
  - .1 NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
- .4 Air Movement and Control Association, Inc. (AMCA).
  - .1 AMCA Standard 500-D, Laboratory Method of Testing Dampers For Rating.
- .5 Canadian Standards Association (CSA International).
  - .1 CSA-C22.1, Canadian Electrical Code, Part 1 (19th Edition), Safety Standard for Electrical Installations.

**1.2 DEFINITIONS**

- .1 Acronyms and Definitions: refer to Section 25 05 01 - EMCS: General Requirements.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 25 05 02 - EMCS: Submittals and Review Process.
- .2 Pre-Installation Tests.
  - .1 Submit samples at random from equipment shipped, as requested by Departmental Representative, for testing before installation. Replace devices not meeting specified performance and accuracy.
- .3 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation instructions for specified equipment and devices.

**1.4 EXISTING CONDITIONS**

- .1 Cutting and Patching: in accordance with Section 01 73 00 - Execution Requirements supplemented as specified herein.
- .2 Repair surfaces damaged during execution of Work.
- .3 Turn over to Departmental Representative existing materials removed from Work not identified for re-use.

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**Part 2        Products**

**2.1        GENERAL**

- .1        Control devices of each category to be of same type and manufacturer.
- .2        External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof, vibration-proof, heat resistant assembly.
- .3        Operating conditions: 0 - 32°C with 10% - 90% RH (non-condensing) unless otherwise specified.
- .4        Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .5        Transmitters to be unaffected by external transmitters (eg. walkie talkies).
- .6        Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
- .7        Outdoor installations: use weatherproof construction in CSA 4X enclosures.
- .8        Devices to be installed in user occupied space must not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.
- .9        Range: including temperature, humidity, and pressure, as indicated in I/O summary in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

**2.2        TEMPERATURE SENSORS**

- .1        General: except for room sensors to be resistance or thermocouple type to following requirements:
  - .1        Thermocouples: limit to temperature range of 200°C and over.
  - .2        Thermistors 10 K ohm,  $\pm 0.2^\circ\text{C}$  accuracy, less than 0.1°C drift over 10-year span. Power supply 5 V dc, 10-35 Vdc, 24 Vac.
  - .3        RTD's: 1000 ohm at 0°C ( $\pm 0.2$  ohms) platinum element with strain minimizing construction, 3 integral anchored leadwires. Coefficient of resistivity: 0.00385 ohms/ohmEC.
  - .4        Immersion wells: NPS 3/4, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length 100 mm as indicated.
  - .5        Sensing element: hermetically sealed.
  - .6        Stem and tip construction: copper or type 304 stainless steel.
  - .7        Time constant response: less than 3 seconds to temperature change of 10°C.
  - .8        Immersion wells: 20mm, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length as required.
- .2        Room temperature sensors and display wall modules.
  - .1        Temperature sensing and display wall module.
    - .1        LCD display to show space temperature and temperature setpoint.
    - .2        Buttons for occupant selection of temperature setpoint and occupied/unoccupied mode.

- .3 Onboard passive infrared (PIR) occupancy sensor.
- .4 For wired sensors provide jack connection for plugging in laptop personal computer for access to zone bus.
- .5 Integral thermistor sensing element 10,000 ohm at 24 degrees.
- .6 Accuracy 0.6°C over range of 13 to 29°C.
- .7 Stability 0.02°C drift per year.
- .8 Separate mounting base for ease of installation.
- .2 Room temperature sensors.
  - .1 Wall mounting, in slotted type covers having brushed stainless steel finish, with guard.
  - .2 Element 10-50mm long RTD with ceramic tube or equivalent protection or thermistor, 10,000 ohm, accuracy of plus or minus 0.2 degrees C.
- .3 Duct temperature sensors:
  - .1 General purpose duct type: suitable for insertion into ducts at various orientations, insertion length as required.
  - .2 Averaging duct type: incorporates numerous sensors inside assembly which are averaged to provide one reading. Minimum continuous filament with minimum immersion length 6000 mm. Bend probe at field installation time to 100 mm radius at any point along probe without degradation of performance.
- .4 Outdoor air temperature sensors:
  - .1 Outside air type: complete with probe length 100 - 150 mm long, non-corroding shield to minimize solar and wind effects, threaded fitting for mating to 13 mm conduit, weatherproof construction in CSA 4X enclosure.

## **2.3 TEMPERATURE TRANSMITTERS**

- .1 Requirements:
  - .1 Input circuit: to accept 3-lead, 100 ohm at 0°C, platinum resistance detector type sensors.
  - .2 Power supply: 575 ohms at 24 V DC into load of 575 ohms. Power supply effect less than 0.01°C per volt change.
  - .3 Output signal: 4 - 20 mA into 500 ohm maximum load.
  - .4 Input and output short circuit and open circuit protection.
  - .5 Output variation: less than 0.2% of full scale for supply voltage variation of  $\pm 10\%$ .
  - .6 Combined non-linearity, repeatability, hysteresis effects: not to exceed  $\pm 0.5\%$  of full scale output.
  - .7 Maximum current to 100 ohm RTD sensor: not to exceed 22.5 mA.
  - .8 Integral zero and span adjustments.
  - .9 Temperature effects: not to exceed  $\pm 1.0\%$  of full scale/ 50°C.
  - .10 Long term output drift: not to exceed 0.25% of full scale/6 months.

- .11 Transmitter ranges: Select narrowest range to suit application from following:
  - .1  $-5^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$ ,  $\pm 0.5^{\circ}\text{C}$ .
  - .2 0 to  $100^{\circ}\text{C}$ ,  $\pm 0.5^{\circ}\text{C}$ .
  - .3 0 to  $50^{\circ}\text{C}$ ,  $\pm 0.25^{\circ}\text{C}$ .
  - .4 0 to  $25^{\circ}\text{C}$ ,  $\pm 0.1^{\circ}\text{C}$ .
  - .5 10 to  $35^{\circ}\text{C}$ ,  $\pm 0.25^{\circ}\text{C}$ .

## 2.4 HUMIDITY SENSORS

- .1 Room and Duct Requirements:
  - .1 Range: 5% - 95% RH minimum.
  - .2 Operating temperature range: 0 -  $60^{\circ}\text{C}$ .
  - .3 Absolute accuracy:
    - .1 Duct sensors:  $\pm 5\%$ .
    - .2 Room sensors:  $\pm 2\%$ .
  - .4 Sheath: stainless steel with integral shroud for specified operation in air streams of up to 10 m/s.
  - .5 Maintenance: by simple field method such as washing with solvent or mild detergent solution so as to remove anticipated airborne contaminants.
  - .6 Maximum sensor non-linearity:  $\pm 0.5\%$  RH with defined curves.
  - .7 Room sensors: wall mounted as indicated.
  - .8 Duct mounted sensors: locate so that sensing element is between  $\frac{1}{3}$  and  $\frac{2}{3}$  distance across any duct dimension.
  - .9 Sensors to be unaffected by external transmitters such as walkie-talkies. Demonstrate to Departmental's Representative.
  - .10 Power supply: 18-35 Vdc, 18-32 Vac with temperature sensor.
- .2 Outdoor Humidity Requirements:
  - .1 Range: 5% - 95% RH minimum.
  - .2 Operating temperature range:  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .
  - .3 Absolute accuracy:  $\pm 2\%$ .
  - .4 Temperature coefficient:  $\pm 0.03\% \text{RH}/^{\circ}\text{C}$  over 0 to  $50^{\circ}\text{C}$ .
  - .5 Must be unaffected by condensation or 100% saturation.
  - .6 No routine maintenance or calibration is required.

## 2.5 HUMIDITY TRANSMITTERS

- .1 Requirements:
  - .1 Input signal: from 1000 ohm RTD.
  - .2 Output signal: 4 - 20 mA into 1000 ohm maximum load, 0-5 Vdc, 0-10 Vdc.
  - .3 Input and output short circuit and open circuit protection.
  - .4 Output accuracy: not to exceed 0.1% of full span.
  - .5 Output linearity error:  $\pm 1.0\%$  maximum of full scale output.
  - .6 Integral zero and span adjustment.



- .7 Temperature range: 0-70°C, -40°C to 85°C for outside air.
- .8 Long term output drift: not to exceed 0.25% of full scale output/6 months.

## **2.6 PRESSURE TRANSDUCERS**

- .1 Requirements:
  - .1 Range: as indicated in I/O summaries.
    - .1 Pressure sensing elements: bourdon tube, bellows or diaphragm type.
    - .2 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
  - .2 Output signal: 4 - 20 mA, 0-5V, 0-10V.
  - .3 Output variations:  $\pm 1\%$  full scale for supply voltage variations of  $\pm 10\%$ .
  - .4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed  $\pm 1\%$  of full scale output over entire range.
  - .5 Integral zero and span adjustment.
  - .6 Temperature effects: not to exceed  $\pm 1.5\%$  full scale/50°C.
  - .7 Over-pressure input protection to at least twice rated input pressure.
  - .8 Output short circuit and open circuit protection.
  - .9 Pressure ranges: see I/O Summaries.
  - .10 Accuracy:  $\pm 1\%$  of full scale.
  - .11 LCD Display.

## **2.7 DIFFERENTIAL PRESSURE TRANSMITTERS**

- .1 Requirements:
  - .1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
  - .2 Output signal: 4 - 20 mA, 0-5V, 0-10V.
  - .3 Output variations:  $\pm 1\%$  full scale for supply voltage variations of  $\pm 10\%$ .
  - .4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed  $\pm 1\%$  of full scale output over entire range.
  - .5 Integral zero and span adjustment.
  - .6 Temperature effects: not to exceed  $\pm 1.5\%$  full scale/50°C.
  - .7 Over-pressure input protection to at least twice rated input pressure.
  - .8 Output short circuit and open circuit protection.
  - .9 The unit to have NPT connections. The enclosure shall be an integral part of the unit.
  - .10 LCD Display.

## **2.8 STATIC PRESSURE SENSORS**

- .1 Requirements:
  - .1 Multipoint element with self-averaging manifold:
    - .1 Maximum pressure loss: 160 Pa at 10 m/s. (Air stream manifold).

- .2 Accuracy:  $\pm 1\%$  of actual duct static pressure.

## **2.9 STATIC PRESSURE TRANSMITTERS**

### **.1 Requirements:**

- .1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.
- .2 Calibrated span: not to exceed 150% of duct static pressure at maximum flow.
- .3 Accuracy: 0.4% of span.
- .4 Repeatability: within 0.5% of output.
- .5 Linearity: within 1.5% of span.
- .6 Deadband or hysteresis: 0.1% of span.
- .7 External exposed zero and span adjustment.
- .8 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit

## **2.10 VELOCITY PRESSURE SENSORS**

### **.1 Requirements:**

- .1 Multipoint static and total pressure sensing element with self-averaging manifold with integral air equalizer and straightener section.
- .2 Maximum pressure loss: 37 Pa at 1000 m/s.
- .3 Accuracy:  $\pm 1\%$  of actual duct velocity.

## **2.11 VELOCITY PRESSURE TRANSMITTERS**

### **.1 Requirements:**

- .1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.
- .2 Calibrated span: not to exceed 25% of duct velocity pressure at maximum flow.
- .3 Accuracy: 0.4% of span.
- .4 Repeatability: within 0.1% of output.
- .5 Linearity: within 0.5% of span.
- .6 Deadband or hysteresis: 0.1% of span.
- .7 External exposed zero and span adjustment.
- .8 The unit to have a NPT  $\frac{1}{2}$  conduit connection. The enclosure shall be an integral part of the unit.

## **2.12 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES**

### **.1 Requirements:**

- .1 Range: as indicated in I/O summaries.
  - .1 Pressure sensing elements: bourdon tube, bellows or diaphragm type.
- .2 Adjustable setpoint and differential.
- .3 Switch: snap action type, rated at 120V, 15 amps AC or 24 V DC.

- .4 Sensor assembly: to operate automatically and reset automatically when conditions return to normal. Over-pressure input protection to at least twice rated input pressure.
- .5 Accuracy: within 2% repetitive switching.
- .6 Provide sensor pressure and accuracy ratings:
  - .1 Hot water: 860 kPa.
  - .2 High temperature water: 2700 kPa. Range: 0-2700 kPa. Accuracy:  $\pm 25$  kPa.
  - .3 For fan operation: Range: 0 to 3000 Pa. Adjustable differential: 10 to 300 Pa.
- .7 Provide sensors with isolation valve and snubber between sensor and pressure source on liquid service.
- .8 Sensors on steam and high temperature hot water service: provide pigtail syphon.

## **2.13 TEMPERATURE SWITCHES**

- .1 Requirements:
  - .1 Temperature sensor: liquid, vapour or bimetallic type. Operate automatically. Reset automatically, except as follows:
    - .1 Freeze protection: manual reset. Optional if software does not auto restart.
    - .2 Fire detection: manual reset. Optional if software does not auto restart.
    - .3 Duct Heater: high limit manual reset in addition to automatic reset.
  - .2 Adjustable setpoint and differential.
  - .3 Accuracy:  $\pm 1^{\circ}\text{C}$ .
  - .4 Snap action rating: 120V, 15 amps or 24V DC as required. Switch to be DPST for hardwire and EMCS connections.
  - .5 Type as follows:
    - .1 Room: for wall mounting on standard electrical box with or without protective guard as indicated.
    - .2 Duct, general purpose: insertion length = 460 mm.
    - .3 Thermowell: stainless steel, with compression fitting for NPS 3/4 thermowell. Immersion length: 100 mm.
    - .4 Freeze detection: continuous element with 6000 mm insertion length, duct mounting, to detect coldest temperature in any 300 mm length.
    - .5 Strap-on: with helical screw stainless steel clamp.

## **2.14 TANK LEVEL SWITCHES**

- .1 Requirements:
  - .1 Indicate high/low water level and to alarm.
  - .2 For mounting on top of tank.
  - .3 Maximum operating temperature:  $120^{\circ}\text{C}$ .
  - .4 Mechanical switch or snap action contacts rated 15 amp at 120 V.

- .5 Adjustable setpoint and differential.

## **2.15 SOLENOID CONTROL AIR VALVES**

- .1 Coil: 120V AC or 24V DC, as indicated.
- .2 Complete with manual over-ride.
- .3 Shall have the capacity to pass .07 l/s air at 104 kPa differential.

## **2.16 AIR PRESSURE GAUGES**

- .1 Diameter: 38 mm minimum.
- .2 Range: zero to two times operating pressure of measured pressure media or nearest standard range.
- .3 Requirements:
  - .1 Double voltage, DPDT, plug-in type with termination base.
  - .2 Coils: rated for 120V AC or 24V DC. Other voltage: provide transformer.
  - .3 Contacts: rated at 5 amps at 120 V AC.
  - .4 Relay to have visual status indication.

## **2.17 SOLID STATE RELAYS**

- .1 General:
  - .1 Relays to be socket or rail mounted.
  - .2 Relays to have LED Indicator
  - .3 Input and output Barrier Strips to accept 14 to 28 AWG wire.
  - .4 Operating temperature range to be -20°C to 70°C.
  - .5 Relays to be CSA Certified.
  - .6 Input/Output Isolation Voltage to be 4000 VAC at 25°C for 1 second maximum duration.
  - .7 Operational frequency range, 45 to 65 HZ.
- .2 Input:
  - .1 Control voltage, 3 to 32 VDC.
  - .2 Drop out voltage, 1.2 VDC.
  - .3 Maximum input current to match AO (Analog Output) board.
- .3 Output.
  - .1 AC or DC Output Model to suit application.

## **2.18 CURRENT TRANSDUCERS**

- .1 Requirements:
- .2 Purpose: combined sensor/transducer, to measure line current and produce proportional signal in one of following ranges:
  - .1 4-20 mA DC.
  - .2 0-1 volt DC.
  - .3 0-10 volts DC.
  - .4 0-20 volts DC.
- .3 Frequency insensitive from 10 - 80 hz.
- .4 Accuracy to 0.5% full scale.
- .5 Zero and span adjustments. Field adjustable range to suit motor applications.
- .6 Adjustable mounting bracket to allow for secure/safe mounting inside MCC.

## **2.19 CURRENT SENSING RELAYS**

- .1 Requirements:
  - .1 Suitable to detect belt loss or motor failure.
  - .2 Trip point adjustment, output status LED.
  - .3 Split core for easy mounting.
  - .4 Induced sensor power.
  - .5 Relay contacts: capable of handling 0.5 amps at 30 VAC / DC. Output to be NO solid state.
  - .6 Suitable for single or 3 phase monitoring. For 3-Phase applications: provide for discrimination between phases.
  - .7 Adjustable latch level.

## **2.20 CONTROL DAMPERS**

- .1 Construction: blades, 152 mm wide, 1219 mm long, maximum. Modular maximum size, 1219 mm wide x 2438 mm high. Multiple sections to have stiffening mullions and jack shafts.
- .2 Materials
  - .1 Frame: 2.3 mm minimum thickness galvanized steel.
  - .2 Blades: galvanized steel with two sheets 0.5 mm thick or otherwise reinforced to ensure specified low leakage when fully closed.
  - .3 Bearings: oil impregnated sintered bronze. Provide thrust bearings for vertical blades.
  - .4 Linkage and shafts: zinc plated steel.
  - .5 Seals: replaceable neoprene or stainless steel spring on sides, top, bottom of frame, along all blade edges and blade ends.

- .3 Performance: minimum damper leakage meets or exceed AMCA Standard 500-D ratings.
  - .1 Size/Capacity: refer to damper schedule
  - .2 25 L/s/m<sup>2</sup> maximum allowable leakage against 1000 Pa static pressure for outdoor air and exhaust air applications.
  - .3 Temperature range: -40°C to +100°C.
- .4 Arrangements: dampers mixing warm and cold air to be parallel blade, mounted at right angles to each other, with blades opening to mix air stream.
- .5 Jack shafts:
  - .1 25 mm diameter solid shaft, constructed of corrosion resistant metal complete with required number of pillow block bearings to support jack shaft and operate dampers throughout their range.
  - .2 Include corrosion resistant connecting hardware to accommodate connection to damper actuating device.
  - .3 Install using manufacturers installation guidelines.
  - .4 Use same manufacturer as damper sections.

## **2.21 ELECTRONIC CONTROL DAMPER ACTUATORS**

- .1 Requirements:
  - .1 Direct mount proportional type as indicated.
  - .2 Spring return for "fail-safe" in Normally Open or Normally Closed position as indicated.
  - .3 Operator: size to control dampers against maximum pressure and dynamic closing/opening pressure, whichever is greater.
  - .4 Power requirements: 5 VA maximum at 24 V AC.
  - .5 Operating range: 0 - 10 V DC or 4 - 20 mA DC.
  - .6 For VAV box applications floating control type actuators may be used.
  - .7 Damper actuator to drive damper from full open to full closed in less than 120 seconds.

## **2.22 CONTROL VALVES**

- .1 Body: globe style, characterized ball.
  - .1 Flow characteristic as indicated on control valve schedule: linear, equal percentage, quick opening.
  - .2 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.
  - .3 Normally open, normally closed, as indicated.
  - .4 Two and three port, as indicated.
  - .5 Leakage rate ANSI class IV, 0.01% of full open valve capacity.
  - .6 Packing easily replaceable.
  - .7 Stem, stainless steel.
  - .8 Plug and seat, stainless steel, brass, bronze.
  - .9 Disc, replaceable, material to suit application.

- .10 NPS 2 and under:
  - .1 Screwed National Pipe Thread (NPT) tapered female connections.
  - .2 Valves to ANSI Class 250, valves to bear ANSI mark.
  - .3 Range-ability 50:1 minimum.
- .11 NPS 2 and larger:
  - .1 Flanged connections.
  - .2 Valves to ANSI Class 150 or 250 as indicated, valves to bear ANSI mark.
  - .3 Range-ability 100:1 minimum.
- .2 Butterfly Valves NPS 2 and larger:
  - .1 Body: for chilled water ANSI Class 150 cast iron installed in locations as indicated. For steam and heating water ANSI Class 150 carbon steel.
  - .2 End connections to suit flanges that are ANSI Class 150.
  - .3 Extended stem neck to provide adequate clearance for flanges and insulation.
  - .4 Pressure limit: bubble tight sealing to 170 kilopascals.
  - .5 Disc/vane: 316 stainless steel, aluminum bronze to ASTM B148.
  - .6 Seat: for service on chilled water PTFE (polytetrafluoroethylene), EPDM (ethylene propylene diene monomer). For service on steam and heating water PTFE, RTFE (reinforced PTFE).
  - .7 Stem: 316 stainless steel.
  - .8 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.
  - .9 Flow characteristic linear.
  - .10 Maximum flow requirement as indicated on control valve schedule.
  - .11 Maximum pressure drop as indicated on control valve schedule: pressure drop not to exceed one half of inlet pressure.
  - .12 Normally open; Normally closed, as indicated.
  - .13 Valves are to be provided complete with mounting plate for installation of actuators.

## **2.23 ELECTRONIC / ELECTRIC VALVE ACTUATORS**

- .1 Requirements:
  - .1 Construction: steel, cast iron, aluminum.
  - .2 Control voltage: 0-5, 0-10, 2-10V DC, or 4-20 mA.
  - .3 Positioning time: to suit application, 90 sec maximum.
  - .4 Fail to normal position as indicated.
  - .5 Scale or dial indication of actual control valve position.
  - .6 Size actuator to meet requirements and performance of control valve specifications.
  - .7 For interior and perimeter terminal heating and cooling applications floating control actuators are acceptable.
  - .8 Minimum shut-off pressure: refer to control valve schedule.

## **2.24 WATTHOUR METERS AND CURRENT TRANSFORMERS**

- .1 Requirements:
  - .1 Include three phases, test and terminal blocks for watthour meter connections and connections to FID for monitoring of current. Provide three potentiometer transformers for 600 V 4 wire systems for watthour meter use. Accuracy:  $\pm$  0.25% of full scale. For chiller applications: To have instantaneous indicator with analog or digital display.
  - .2 Watthour meter sockets: to ANSI C12.7.
  - .3 Potential and current transformers: to ANSI/IEEE C57.13.
  - .4 Potential transformers: provide two primary fuses.
  - .5 Demand meters: configure to measure demand at 15 minute intervals.

## **2.25 SURFACE WATER DETECTORS**

- .1 Requirements:
  - .1 Provide alarm on presence of water on floor.
  - .2 Expendable cartridge sensor.
  - .3 Internal waterproof switch.
  - .4 One set of dry contacts 2 amps at 24 V.
  - .5 Unaffected by moisture in air.
  - .6 Self-powered.

## **2.26 PANELS**

- .1 Either free-standing or wall mounted enameled steel cabinets with hinged and key-locked front door.
- .2 To be modular multiple panels as required to handle requirements with additional space to accommodate future capacity as required by Department's Representative without adding additional cabinets.
- .3 Panels to be lockable with same key.

## **2.27 WIRING**

- .1 In accordance with Division 26.
- .2 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.
- .3 Wiring must be continuous without joints.
- .4 Sizes:
  - .1 Field wiring to digital device: #18AWG or 20AWG stranded twisted pair.
  - .2 Analog input and output: shielded #18 minimum solid copper or #20 minimum stranded twisted pair.



**Part 3            Execution**

**3.1                INSTALLATION**

- .1      Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
- .2      Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.
- .3      Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.
- .4      Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.
- .5      Firestopping: provide space for firestopping in accordance with Section 07 84 00 - Firestopping. Maintain fire rating integrity.
- .6      Electrical:
  - .1          Complete installation in accordance with Section 26 05 00 - Common Work Results for Electrical.
  - .2          Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
  - .3          Refer to electrical control schematics included as part of control design schematics on drawings and in Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation. Trace existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review by Departmental Representative before beginning Work.
  - .4          Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.
  - .5          Install communication wiring in conduit.
    - .1              Provide complete conduit system to link Building Controllers, field panels and OWS(s).
    - .2              Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.
    - .3              Maximum conduit fill not to exceed 40%.
    - .4              Design drawings do not show conduit layout.
  - .6          Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Departmental Representative to review before starting Work. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.
- .7      VAV Terminal Units: supply, install and adjust as required.
  - .1          Air probe, actuator and associated vav controls.
  - .2          Tubing from air probe to dp sensor as well as installation and adjustment of air flow sensors and actuators.

- .3 Co-ordinate air flow adjustments with balancing trade.

### **3.2 TEMPERATURE AND HUMIDITY SENSORS**

- .1 Stabilize to ensure minimum field adjustments or calibrations.
- .2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.
- .3 Outdoor installation:
  - .1 Protect from solar radiation and wind effects by non-corroding shields.
  - .2 Install in NEMA 4 enclosures.
- .4 Duct installations:
  - .1 Do not mount in dead air space.
  - .2 Locate within sensor vibration and velocity limits.
  - .3 Securely mount extended surface sensor used to sense average temperature.
  - .4 Thermally isolate elements from brackets and supports to respond to air temperature only.
  - .5 Support sensor element separately from coils, filter racks.
- .5 Averaging duct type temperature sensors.
  - .1 Install averaging element horizontally across the ductwork starting 300 mm from top of ductwork. Each additional horizontal run to be no more than 300 mm from one above it. Continue until complete cross sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.
  - .2 Wire multiple sensors in series for low temperature protection applications.
  - .3 Wire multiple sensors separately for temperature measurement.
  - .4 Use software averaging algorithm to derive overall average for control purposes.
- .6 Thermowells: install for piping installations.
  - .1 Locate well in elbow where pipe diameter is less than well insertion length.
  - .2 Thermowell to restrict flow by less than 30%.
  - .3 Use thermal conducting paste inside wells.
- .7 Room Temperature Sensors:
  - .1 Room Temperature sensors for non-inmate areas shall include temperature display and user adjustable set points.
  - .2 Room Temperature sensors for inmate areas shall be concealed behind a tamper proof plate or enclosure as approved by CSC.

### **3.3 PANELS**

- .1 Arrange for conduit and tubing entry from top, bottom or either side.
- .2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.
- .3 Identify wiring and conduit clearly.

**3.4 MAGNEHELIC PRESSURE INDICATORS**

- .1 Install adjacent to fan system static pressure sensor and duct system velocity pressure sensor as reviewed by Departmental Representative.
- .2 Locations: as indicated.

**3.5 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES AND SENSORS**

- .1 Install isolation valve and snubber on sensors between sensor and pressure source where code allows.
  - .1 Protect sensing elements on steam and high temperature hot water service with pigtail syphon between valve and sensor.

**3.6 I/P TRANSDUCERS**

- .1 Install air pressure gauge on outlet.

**3.7 AIR PRESSURE GAUGES**

- .1 Install pressure gauges on pneumatic devices, I/P, pilot positioners, motor operators, switches, relays, valves, damper operators, valve actuators.
- .2 Install pressure gauge on output of auxiliary cabinet pneumatic devices.

**3.8 IDENTIFICATION**

- .1 Identify field devices in accordance with Section 25 05 54 - EMCS: Identification.

**3.9 AIR FLOW MEASURING STATIONS**

- .1 Protect air flow measuring assembly until cleaning of ducts is completed.

**3.10 TESTING AND COMMISSIONING**

- .1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

**END OF SECTION**

**Part 1            General**

**1.1            REFERENCES**

- .1    Public Works and Government Services Canada (PWGSC):
  - .1       MD250005-2009, Energy Monitoring and Control Systems (EMCS) Design Guidelines.

**1.2            SEQUENCING**

- .1    Present sequencing of operations for systems, in accordance with MD250005-2009, Energy Monitoring and Control Systems (EMCS) Design Guidelines.

**1.3            ABBREVIATIONS**

- .1    SA – Supply Air
- .2    RA – Return Air
- .3    MA – Mixed Air
- .4    EA – Exhaust Air
- .5    OA – Outdoor Air
- .6    SAT - Supply Air Temperature
- .7    RAT – Return Air Temperature
- .8    MAT – Mixed Air Temperature
- .9    OAT – Outdoor Air Temperature
- .10   HWS – Heating Water Supply
- .11   HWR – Heating Water Return

**Part 2           Products**

**2.1           NOT USED**

- .1    Not Used.

**Part 3           Execution**

**3.1           SYSTEM PROTOCOL**

- .1    The existing controls system is a Metasys MS/TP system.
- .2    All new control items shall be on a BACnet MS/TP system parallel to the existing.
- .3    Replace existing server with new

### 3.2 GRAPHICS LIST

- .1 Update all equipment tags to reflect tags indicated on the drawing:
- .2 Provide updated graphics to reflect the updated system.

### 3.3 POINT LIST

- .1 Existing points noted in bold italics

Description	Type	Alarm	Comments
<b>AH-4E/F, 7G/H, 10°C/D, 13A/B (Multi-zone) (8 Units one per cell block)</b>			
<b>Return Air Damper Actuators</b>	AO		
<b>Return Air Temperature Sensor</b>	AI		
<b>Return Air Humidity Sensor</b>	AI		
<b>Return Air Filter Pressure Differential Sensor</b>	AI		New
<b>Return Air Coil Valve Actuator</b>	AO		New
<b>Outdoor Air Damper Actuator</b>	AO		
<b>Outdoor Air Temperature Sensor</b>	AI		
<b>Mixed Air Temperature Sensor</b>	AI		
<b>Filter Pressure Differential Sensor</b>	AI		
<b>Supply Fan Start/Stop</b>	DO		
<b>Supply Fan Status</b>	DI		
<b>Mixed air Humidity Sensor</b>	AI		
<b>Hot Deck Coil Valve Actuator</b>	AO		
<b>Hot Deck SAT sensor</b>	AI		
<b>Loop HWS Temp sensor</b>	AI		New
<b>Loop HWR Temp sensor</b>	AI		New
<b>Cold Deck Temperature Sensor</b>	AI		New
<b>AH Heating Coil Pump Start/Stop</b>	DO		
<b>AH Heating Coil Pump Status</b>	DI		New
<b>AH Heating Coil Pump Mixing valve</b>	DO		New
<b>Steam Humidification Valve Actuator</b>	AO		Delete
<b>Low Temperature alarm</b>	DI		Interlocked to stop unit
<b>ZONE Mixing Damper</b>	AO		Type of 4 per unit
<b>ZONE SA Temperature Sensor</b>	AI		Type of 4 per unit
<b>Zone Temperature Sensor</b>	AI		4 existing plus <b>2 new</b> in end cells
<b>Cell Block Fire Alarm Status</b>	DI		Zone Alarm/Smoke detection by fire alarm contractor
<b>Upper RA Smoke Damper Status</b>	DI		
<b>Lower RA Smoke Damper Status</b>	DI		
<b>Upper Range Exhaust Fan Status</b>	DI		

Description	Type	Alarm	Comments
Lower Range Exhaust Fan Status	DI		
DELCO "STOP"	DI		
<b>AS-1 (Multi-Zone) Segregation</b>			
Return Fan Status	DI		Delete
Return Air Damper Actuators	AO		New
Return Air Temperature Sensor	AI		Existing
Return Air Humidity Sensor	AI		Existing
Outdoor Air Damper Actuator	AO		Existing
Outdoor Air Temperature Sensor	AI		New
Mixed Air Temperature Sensor	AI		Existing
Filter Pressure Differential Sensor	AI		Existing
Steam Humidification Valve Actuator	AO		Delete
Supply Fan Start/Stop	DO		Existing
Supply Fan Status	DI		Existing
Mixed Air Humidity Sensor	AI		Existing
Heating Coil Valve Actuator	AO		Existing
Heating Coil HWR Temp sensor	AI		New
Heating Coil Pump Start/Stop	DO		Existing
Heating Coil Pump Status	DI		Existing
Hot Deck Temperature Sensor	AI		Existing
Low Temperature alarm	DI		Existing - Interlocked to stop unit
Zone Mixing Damper (Typ 8)	AO		Existing
Zone SA Temperature Sensor (Typ 8)	AI		Existing
Zone Temperature Sensor (Typ 8)	AI		Existing
Cell Block Fire Alarm Status	DI		Existing
Electric Reheat Coil	AO		Control of end cell reheat coils based on cell temperature. Refer to drawing for locations.
<b>AH-1</b>			
Return Air Damper Actuators	AO		New
Return Air Temperature Sensor	AI		New
Return Air Damper End Switch	DI		New
Outdoor Air Damper Actuator	AO		Delete
Outdoor Air Temperature Sensor	AI		Global
Isolation Damper Actuator	AO		New
Filter Pressure Differential Sensor	AI		New

Description	Type	Alarm	Comments
Mixed Air Temperature Sensor	AI		Delete
Bypass Mixing Damper	AO		Delete
Supply Fan Start/Stop	DO		Existing
Supply Fan Status	DI		Existing
Heating Coil Valve Actuator	AO		Existing
Heating Coil Pump Start/Stop	DO		New
Heating Coil Pump Status	DI		New
Heating Coil HWR Temp Sensor	AI		New
Heating Coil Air Temp Sensor	AI		Delete
Supply Temperature Sensor	AI		Existing
Freezing Temperature Stat	DI		Existing
<b>AH-2</b>			
Return Air Damper Actuators	AO		Existing
Return Air Temperature Sensor	AI		Existing
Outdoor Air Damper Actuator	AO		New
Outdoor Air Temperature Sensor	AI		Global
Filter Pressure Differential Sensor	AI		New
Mixed Air Temperature Sensor	AI		Existing
Bypass Mixing Damper	AO		Delete
Supply Fan Start/Stop	DO		Existing
Supply Fan Status	DI		Existing
Heating Coil Valve Actuator	AO		Existing
Heating Coil Pump Start/Stop	DO		Existing
Heating Coil Pump Status	DI		Existing
Heating Coil HWR Temp Sensor	AI		New
Heating Coil Air Temp Sensor	AI		Delete
Supply Temperature Sensor	AI		Existing
Freezing Temperature Stat	DI		Existing
<b>AH-3B, 5, 8, 11, 14, 18, 23, 27, 29, 30, 103 &amp; AS-2</b>			
Return Air Damper Actuators	AO		
Return Air Temperature Sensor	AI		
Return Air Humidity Sensor	AI		
Outdoor Air Damper Actuator	AO		New for 23, 27, 29, 30, 103
Outdoor Air Temperature Sensor	AI		New for 1, 2, 3B, 5, 8, 11, 14, 18, 23, 27, 29, 30, 103, AS-2

Description	Type	Alarm	Comments
Mixed Air Temperature Sensor	AI		
Filter Pressure Differential Sensor	AI		New for 1, 2, 3B
Supply Fan Start/Stop	DO		
Supply Fan Status	DI		
Heating Coil Valve Actuator	AO		
Heating Coil Pump Start/Stop	DO		New for 5, 8, 11, 14
Heating Coil Pump Status	DI		New for 5, 8, 11, 14
Heating Coil Air Temp sensor	AI		Delete from 1, 2, 3B, 5, 8, 11, 14, 18, 23, 29, 30,
Heating Coil HWR Temp	AI		New for 1, 2, 3B, 5, 8, 11, 14, 18, 23, 27, 29, 30, 103 & AS-2
Bypass Mixing Damper	AO		Delete from 1, 2, 3B, 5, 8, 11, 14, 18, 23, 27, 29, 30
Steam Humidification Valve Actuator	AO		Delete from 1, 2, 3B, 5, 8, 11, 14, 18, 23, 27
Supply Temperature Sensor	AI		
Supply Humidity Sensor	AI		Delete from 1, 2, 3B, 5, 8, 11, 14, 18, 23, 27
Zone Temperature Sensor	AI		
Supply air Low Temperature alarm	DI		Interlocked to stop unit
<b>AH-6, 9, 12, 15 (Free cooling fan)</b>			
Return Air Damper Actuators	AO		
Outdoor Air Damper Actuator	AO		
Filter Pressure Differential Sensor	AI		
Mixed Air Temperature Sensor	AI		
Supply Fan Start/Stop	DO		
Supply Fan Status	DI		
Supply Temperature Sensor	AI		
Zone Temperature Sensor	AI		
Supply air Low Temperature alarm	DI		Interlocked to stop unit
<b>AH-16 (VAV)</b>			
Return Air Damper Actuators	AO		
Return Air Temperature Sensor	AI		
Return Air Humidity Sensor	AI		
Outdoor Air Damper Actuator	AO		
Outdoor Air Temperature Sensor	AI		Global
Mixed Air Temperature Sensor	AI		
Filter Pressure Differential Sensor	AI		



Description	Type	Alarm	Comments
Supply Fan Start/Stop	DO		
Supply Fan speed	AO		New
Supply Fan Status	DI		
Supply Air Pressure Sensor	AI		Duct mounted sensor located in ceiling space of Administration office.
Supply Air Flow Station	AI		
Heating Coil Valve Actuator	AO		New
Heating Coil Pump Start/Stop	DO		New
Heating Coil Pump Status	DI		New
Heating Coil HWR Temp	AI		New
Cooling Start/Stop	DO		
Cooling Status	DI		
Steam Humidification Valve Actuator	AO		Delete
Supply Temperature Sensor	AI		
Supply Humidity Sensor	AI		Delete
Supply air Low Temperature alarm	DI		
<b>AH-26, 28, 32, 101</b>			
Return Air Damper Actuators	AO		(linked to OA on 101)
Return Air Temperature Sensor	AI		
Return Air Humidity Sensor	AI		Delete from 26
Outdoor Air Damper Actuator	AO		(linked to MA on 26,28)
Outdoor Air Temperature Sensor	AI		New for 28, 32, 101
Mixed Air Temperature Sensor	AI		
Mixed Air Low Temperature Alarm	DI		Delete from 26
Steam Humidification Valve Actuator	AO		Delete from 26
Filter Pressure Differential Sensor	AI		
Supply Fan Start/Stop	DO		
Supply Fan Status	DI		
Heating Coil Valve Actuator	AO		New for 26
Heating Coil Pump Start/Stop	DO		New for 26
Heating Coil Pump Status	DI		New for 26
Heating Coil HWR Temp	AI		New for 26, 28, 32, 101
Cooling Start/Stop	DO		New for 26, 28, 32, 101
Cooling Status	DI		New for 26, 28, 32, 101
Supply Temperature Sensor	AI		
Supply Humidity Sensor	AI		Delete from 26
Zone Temperature Sensor	AI		32 only
Supply air Low Temperature alarm	DI		
<b>AH-3°C (Gas fired make up air) (all new)</b>			
Outdoor Air Temperature Sensor	AI		Global
Filter Pressure Differential Sensor	AI		
AH Start/Stop	DO		

Description	Type	Alarm	Comments
<b>AH Status</b>	DI		
<b>Supply fan speed</b>	DO		Command to AH for fan speed.
<b>F-13(Hood exhausts)</b>	DI		Fan status.
<b>EF-218 General exhaust (50%)</b>	DO		Hard wired interlock with low speed.
<b>EF-218 Status</b>	DI		Fan Status
<b>Air Handler Common Alar,</b>	DI		From factory controller.
<b>Supply Temperature Sensor</b>	AI		
<b>Supply Set Point</b>	AO		
<b>Supply air Low Temperature alarm</b>	DI		
<b>Supply air damper</b>	DO		Wired interlock with air handler
<b>VAV – Terminal</b>			
<b>Zone Temperature Sensor</b>	AI		
Damper Position	AO		
Air Flow	AI		
Supply air temp	AI	Hi/Low	
Reheat Valve	AO		
· Locations as indicated on drawings			
<b>Heating Water System</b>			
<b>End of Line differential pressure</b>	AI		New (Location in West Mechanical Room) Add to graphic for monitoring
<b>Zone valves</b>	AO		(Cabinet, ceiling radiant, unit heaters, duct reheat coils)
<b>Zone Temperature Sensors</b>	AI		
<b>S &amp; D Boiler System</b>			
<b>Boiler 1 Enable</b>	DO		
<b>Boiler 1 Status</b>	AI		Via BACnet
<b>Pump 1 Control (Speed)</b>	AO		
<b>Pump 1 Status</b>	DI		
<b>Boiler 1 HWS temperature sensor</b>	AI		
<b>Common HWR temperature sensor</b>	AI		
<b>Boiler 1 Enable</b>	DO		
<b>Boiler 2 Status</b>	AI		Via BACnet
<b>Pump 2 Control (Speed)</b>	AO		
<b>Pump 2 Status</b>	DI		
<b>Boiler 2 HWS temperature sensor</b>	AI		
<b>Outdoor air temperature sensor</b>	AI		
<b>Common HWS Set Point</b>	AI		
<b>Terminal Differential Pressure sensor</b>	AI		
<b>Pressure bypass valve actuator</b>	AO		
<b>System Static Pressure</b>	AI		
Boiler system points Via BACnet to Boiler Controller for monitoring. Include:			
<ul style="list-style-type: none"> <li>· Boiler status</li> <li>· Firing rate</li> <li>· Common alarm</li> </ul>			

Description	Type	Alarm	Comments
<b>Branch Booster Pumps (Serving systems P-214B, 216B, 217A, 218A, 220A, 223, 225B, 227B, 228A, 229A)</b>			
Booster Pump Start/Stop	DO		
Booster Pump 2 Status	DI		
<b>Room Temperature Sensors and Heating Terminals</b>			
Room Temperature Sensor	AI		
Room Temperature Set point	AI		
Occupancy Sensor	DI		
Occupancy Override	DI		
Heating Terminal Valve	AO		
Locations as indicated on drawings			
<b>Server Room Cooling</b>			
Room Temperature Sensor	AI	Hi/Low	
CRAC Status	DI		Via BACNet Connection
CRAC Rack Temperature	AI		Via BACNet Connection
CRAC Rack Temperature Set point	AI		Via BACNet Connection
CRAC Humidity	AI		Via BACNet Connection
CRAC Dirty Filter	DI		Via BACNet Connection
CRAC Common Alarm	DI		Via BACNet Connection
Air Conditioner (AC) On/off	DO		Via BACNet Connection
AC Dirty Filter	DI		Via BACNet Connection
AC Set-point	AI		Via BACNet Connection
AC Alarm	DI		Via BACNet Connection
<b>West Mechanical Room</b>			
Temperature Sensor	AI		
West Mechanical Room intake Louvre 1	DO		
West Mechanical Room intake Louvre 2	DO		
West Mechanical Room intake Louvre 3	DO		
Fan 82 Status	DI		
Fan 82 Enable	DO		
Fan 83 Status	DI		
Fan 83 Enable	DO		

### 3.4 CONTROL SEQUENCES

- .1 Program EMCS software to achieve the following sequences of operation.
- .2 Existing sequences on existing controls system shall remain unless noted in the following sections.

### 3.5 AH-4E/F, 7G/H, 10°C/D, 13A/B Cell Living Air Handler Units -Multi-zone

- .1 General
  - .1 The 4 existing units serving the 8 cell blocks are being replaced with 8 units, one for each cell block. The Number of zones have not changed. The smoke control system is modified and a reheat coil is being added to the end cell zone along with a concealed room temperature sensor.
  - .2 This system provides heating and ventilation to the Cell Block living units.

- .3 The system includes:
  - .1 A mixed air constant volume multi-zone air handler as per air handler schematic shown on drawings.
  - .2 Heating loop pump
  - .3 Two (upper and lower) end of range exhaust fans for smoke removal with interlocked dampers.
  - .4 Return Air Smoke control dampers.
- .4 The air handler runs continuously all year long in
  - .1 Normal - Occupied/ Unoccupied mode or
  - .2 Smoke/Fire Alarm mode.
- .2 Stopped mode
  - .1 When the system is stopped the supply fan is deenergized and the OA damper and RA damper are closed.
  - .2 Multizone dampers will stay in the last position.
  - .3 The heating coil circulating pump is off
  - .4 The mixing valve for the heating coil circuit is deenergized open
  - .5 The control valves for the heating coils are deenergized open
- .3 Start-Up mode
  - .1 The air handler will be activated via BMS. Upon activation, the R/A damper shall open fully and the supply fan will only start when the R/A damper is fully open in full recirculation mode.
  - .2 The heating coil circulating pump will be activated when the OA temperature falls below 20°C (adj.)
- .4 Normal Operation
  - .1 Once the supply fan status indicates operation it will operate continuously.
  - .2 After 1 minute (adjustable) the unit will go into occupied mode and the RA and OA damper (mixing dampers) will ramp open to minimum OA position over a 5 min period (adjustable). The minimum OA damper position shall be established in coordination with the air balancer. When the operator switched the unit in to unoccupied mode the mixing dampers will go to full recirculation.
  - .3 The MA is the air to the cold deck. The RA reheat coil will modulate to maintain a cold deck temperature set point of 17.C (Adjustable)
  - .4 The unit will go into free-cool mode when the cold deck temperature is higher than the cold deck set point for more than 3 mins (adjustable) and when there is no call for heat. Free cool shall be locked out when the OAT is below 14°C (adj.). In free-cool mode the RA reheat coil will be closed and the mixing dampers will modulate to maintain cold set point. If the OAT is higher than RAT the mixing dampers will go back to minimum position.
  - .5 The hot deck coil will modulate to maintain a hot deck supply temperature based on an adjustable linear OAT reset of:

OAT	Hot Deck Setpoint
-30°C	40°C
22 C	28°C

- .6 The Air handler heating pump will energize upon call for heat from any of the zone temperature sensors and or when the OAT is less than 19°C (Adjustable)
- .7 Zone control: Each multizone damper will modulate to maintain the corresponding zone temperature set point.
- .5 Alarm Modes
  - .1 A freeze stat located up stream of the hot deck coil shall shut down the unit if the temperature falls below 3°C. A manual reset will be required.
  - .2 Low Air Temperature Alarm: If the Cold Deck temperature is below 10°C (Adj) or the hot deck SA temperature is below 10°C (Adj) then the MA dampers will reduce the OA flow to half of the balanced minimum OA value and initiate a low temperature alarm. When the alarm is cleared, the unit will return to normal operation. If the MA temperature falls below 3°C then the air handling unit will go into stopped mode.
  - .3 Filter Alarm: When the pressure differential across the filter exceeds 180 Pa (adj.) an filter alarm signal is sent to the BMS.
- .6 DELCO Controls Modes
  - .1 The DELCO control system will be revised to have the following states per cell block:
    - .1 Cell Block Ventilation Stop
    - .2 Upper Range Purge.
    - .3 Lower Range Purge
  - .2 The DELCO shall provide contacts/relays for these states for connection by controls contractor.
  - .3 The STOP status shall be interlocked with both upper and lower RA smoke control dampers and close on STOP status. The STOP status shall prompt the associated Air handler to go in to “Stopped” mode by BMS. When the Stop mode is deactivated, the Smoke Dampers shall open and the air handler will reactivate.
  - .4 The Range Purge state shall be interlocked with the associated Range Exhaust and Smoke Damper. Upon activation, the range Smoke damper will close and the Range Exhaust shall energize when the exhaust damper is fully open. The air handler will continue to operate normally. The purge fan status will be monitored by the BMS.
  - .5 Purge mode shall be activated by a signal from the DELCO Alarm system. Once activated the DELCO Alarm mode will end, the air handling unit will be signaled to start operating in normal mode and the end of run exhaust fans shall be energized via direct interlock with the Delco System, while the return fire/smoke dampers in each level of the cell block shall remain closed via a direct interlock

with the DELCO alarm system. A stop purge signal from the DELCO alarm system shall stop the end of run exhaust fans and open the fire/smoke dampers in the return air openings. The air handling unit shall remain in normal operating mode.

- .7 Smoke control refer to schematic shown on drawings and the following.
  - .1 The return air openings from each level of the cell block is equipped with a combination smoke and fire damper with smoke detection. Upon detection of smoke in these ducts the damper shall close and the fire alarm will activate.
  - .2 A fire alarm for the cell block zone shall shut down the air handler via interlock relay to the starter. The system will reactivate in start-up up mode when the fire alarm is cleared.

### **3.6 AS-1 Cell Living Air Handler Units**

- .1 General
  - .1 This system provides heating and ventilation to the Cell Block living units.
  - .2 The system includes:
    - .1 A mixed air constant volume multi-zone air handler as per air handler schematic shown on drawings.
    - .2 Heating loop pump
    - .3 Two (upper and lower) end of range exhaust fans for smoke removal with interlocked dampers.
    - .4 Return Air Smoke control dampers.
  - .3 The air handler runs continuously all year long in
    - .1 Normal - Occupied/ Unoccupied mode or
    - .2 Smoke/Fire Alarm mode.
- .2 Stopped mode
  - .1 When the system is stopped the supply fan is deenergized and the OA damper and RA damper are closed.
  - .2 Multizone dampers will stay in the last position.
  - .3 The heating coil circulating pump is off
  - .4 The mixing valve for the heating coil circuit is deenergized open
  - .5 The control valves for the heating coils are deenergized open
- .3 Start-Up mode
  - .1 The air handler will be activated via BMS. Upon activation, the R/A damper shall open fully and the supply fan will only start when the R/A damper is fully open in full recirculation mode.
  - .2 The heating coil circulating pump will be activated when the OA temperature falls below 18°C (adj.)

.4 Normal Operation

- .1 Once the supply fan status indicates operation it will operate continuously.
- .2 After 1 minute (adjustable) the unit will go into occupied mode and the RA and OA damper (mixing dampers) will ramp open to minimum OA position over a 5 min period (adjustable). The minimum OA damper position shall be established in coordination with the air balancer. When the operator switched the unit in to unoccupied mode the mixing dampers will go to full recirculation.
- .3 The MA is the air to the cold deck. The RA reheat coil will modulate to maintain a cold deck temperature set point of 17.C (Adjustable)
- .4 The unit will go into free-cool mode when the cold deck temperature is higher than the cold deck set point for more than 3 mins (adjustable) and when there is no call for heat. Free cool shall be locked out when the OAT is below 14°C (adj.). In free-cool mode the RA reheat coil will be closed and the mixing dampers will modulate to maintain cold set point. If the OAT is higher than RAT the mixing dampers will go back to minimum position.
- .5 The hot deck coil will modulate to maintain a hot deck supply temperature based on an adjustable linear OAT reset of:

OAT	Hot Deck Setpoint
-30°C	40°C
22 C	25°C

- .6 The Air handler heating pump will energize upon call for heat from any of the zone temperature sensors and or when the OAT is less than 19°C (Adjustable)
- .7 Zone control: Each multizone damper will modulate to maintain the corresponding zone temperature set point.

.5 Alarm Modes

- .1 A freeze stat located up stream of the hot deck coil shall shut down the unit if the temperature falls below 3°C. A manual reset will be required.
- .2 Low Air Temperature Alarm: If the Cold Deck temperature is below 10°C (Adj) or the hot deck SA temperature is below 10°C (Adj) then the MA dampers will reduce the OA flow to half of the balanced minimum OA value and initiate a low temperature alarm. When the alarm is cleared, the unit will return to normal operation. If the MA temperature falls below 3°C then the air handling unit will go into stopped mode.
- .3 Filter Alarm: When the pressure differential across the filter exceeds 180 Pa (adj.) an filter alarm signal is sent to the BMS.

.6 Purge Mode

- .1 The existing smoke controls system shall be maintained.

.7 Fire Alarm:

- .1 Reconnect fire alarm shutdown to supply fan.

**3.7 AH-1 (Boiler Room)**

.1 General

- .1 This system provides tempered combustion air, heating and free cooling ventilation.

- .2 The system includes:

- .1 Constant volume air handler as per air handler schematic shown on drawings. Heating coil.
  - .2 Heating coil pump
  - .3 Relief damper (existing)

- .3 The air handler runs all year long in:

- .1 Normal – heating / cooling mode or
  - .2 Smoke/Fire Alarm mode.

.2 Stopped mode

- .1 When the system is stopped the supply, fan is deenergized and shut off damper is closed and return damper is opened fully for recirculation.
- .2 The heating coil circulating pump is off
- .3 The mixing valve for the heating coil circuit is deenergized

.3 Start-Up mode

- .1 The air handler will be activated manually via BMS based on combustion equipment status. Upon activation, isolation damper will open and the unit will begin monitoring the room temperature.
- .2 The R/A damper shall remain deenergized in the open position.
- .3 The heating coil circulating pump will be activated when the OA temperature falls below 18°C (adj.)

.4 Normal Operation

- .1 Once activated the unit will continuously monitor the room temperature to maintain the room cooling and heating set points by cycling the fan and modulating the heating coil or return damper as indicated below.
- .2 The RA damper will remain open even when there is no call for heating or cooling to allow combustion air into the space. The room temperature sensor shall be located near the RA intake to sense any cold combustion air coming into the space when the fan is off.
- .3 When the room temperature falls below the heating set point 18°C (adj.) the supply fan will energize and the heating valve will modulate to provide the SA temperature set-point as provided by outdoor reset table. Once the room temperature rises above the heating set point for more than 5 minutes (adj.) the fan will stop.



OAT	SA Set-point
-30°C	30°C
15 C	18°C

- .4 When the room temperature rises above the cooling set point 25°C (adj.) and the outdoor air temperature is less than the cooling set point, the supply fan will operate at full speed and the RA damper will be close to 50% to allow more OA into the space. The RA damper shall energized closed / fail open and it shall have a mechanical end stop that prevents the RA damper from fully closing more than 50%. The additional OA will be relieved through the rooms existing relief damper which shall be balanced to minimize any room pressurization. Once the room temperature falls below the cooling set point for more than 1 min (adj.) the RA damper will fully open and after 5 minutes (adj.) the fan will stop.
- .5 Alarm Modes
  - .1 The Low Temp Alarm shall stop the SA fan and close the isolation damper when the SA temp drops below 4°C or the coil return water temp drops below 5°C.
  - .2 A freeze stat located down stream of the heating coil shall shut down the unit and close the isolation damper through interlocks when the supply temperature falls below 3°C. A manual reset will be required.
  - .3 The Fire Alarm shall stop the S/A fan, and close the isolation damper through hard wired interlock to the alarm system
  - .4 Filter Alarm: When the pressure differential across the filter exceeds 180 Pa (adj.) an filter alarm signal is sent to the BMS.

### 3.8 AH-2 (Laundry Room)

- .1 General
  - .1 This system provides tempered make-up air, heating and free cooling ventilation.
  - .2 The system includes:
    - .1 Constant volume air handler as per air handler schematic shown on drawings. Heating coil.
    - .2 Heating coil pump
    - .3 Relief damper (existing)
  - .3 The air handler runs all year long in:
    - .1 Normal – heating / cooling mode or
    - .2 Smoke/Fire Alarm mode.
- .2 Stopped mode
  - .1 When the system is stopped the supply, fan is deenergized, the OA damper is closed and return damper is opened fully for recirculation.

- .2 The heating coil circulating pump is off
- .3 The mixing valve for the heating coil circuit is deenergized
- .3 Start-Up mode
  - .1 The air handler will be activated manually via BMS, upon activation the unit will begin monitoring the room temperature.
  - .2 The OA damper shall open
  - .3 The RA damper shall remain deenergized in the open position.
  - .4 The heating coil circulating pump will be activated when the OA temperature falls below 18°C (adj.).
- .4 Normal Operation
  - .1 Once activated the unit will maintain the room cooling and heating set points by modulating the heating coil or return damper as indicated below. The OA and RA damper will remain open even when there is no call for heating or cooling to allow make-up air into the space.
  - .2 When the room temperature falls below the heating set point 20°C (adj.) the heating valve will modulate to provide the SA temperature set-point based on the outdoor reset table below.

OAT	SA Set-point
-30°C	35°C
15°C	18°C

- .3 When the room temperature rises above the cooling set point 25°C (adj.) and the outdoor air temperature is less than the cooling set point, the RA damper will modulate to achieve a cooling SA set-point of 18°C (adj.). The additional OA will be relieved through the existing relief damper which shall be balanced to minimize any room pressurization.
- .5 Alarm Modes
  - .1 The Low Temp Alarm shall stop the SA fan and close the isolation damper when the SA temp drops below 4°C or the coil return water temp drops below 5°C.
  - .2 A freeze stat shall shut down the unit and close the isolation damper through interlocks when the supply temperature falls below 3°C. A manual reset will be required.
  - .3 The Fire Alarm shall stop the S/A fan, and close the isolation damper through hard wired interlock to the alarm system
  - .4 Filter Alarm: When the pressure differential across the filter exceeds 180 Pa (adj.) an filter alarm signal is sent to the BMS.

### 3.9 AH-5, 8, 11, 14

#### .1 General

- .1 This system provides tempered ventilation.
- .2 The system includes:
  - .1 A mixed air constant volume air handler as per air handler schematic shown on drawings.
  - .2 Heating coil pump
- .3 The air handler runs continuously all year long in:
  - .1 Normal - Occupied/ Unoccupied mode or
  - .2 Smoke/Fire Alarm mode.

#### .2 Stopped mode

- .1 When the system is stopped the supply fan is deenergized and the OA damper is closed and return damper is opened fully for recirculation.
- .2 The heating coil circulating pump is off
- .3 The mixing valve for the heating coil circuit is deenergized

#### .3 Start-Up mode

- .1 The air handler will be activated manually via BMS. Upon activation, the supply fan will only start when the R/A damper is fully open in full recirculation mode.
- .2 The heating coil circulating pump will be activated when the OA temperature falls below 18°C (adj.)

#### .4 Normal Operation

- .1 Once the supply fan status indicates operation it will operate continuously.
- .2 After 1 minute (adjustable) the unit will go into occupied mode and the RA and OA damper (mixing dampers) will gradually open to minimum OA position over a 1 min period (adjustable). The minimum OA damper position shall be established in coordination with the air balancer. When the operator switched the unit in to unoccupied mode the mixing dampers will go to full recirculation.
- .3 The unit will go into free-cool mode when the MA temperature is higher than the SA set point for more than 3 mins (adjustable) and when there is no call for heat. Free cool shall be locked out when the OAT is below 14°C (adj.). In free-cool mode the mixing dampers will modulate to maintain SA set point. If the OAT is higher than RAT the mixing dampers will go back to minimum position.
- .4 The SA heating coil valve will modulate to maintain SA temperature based on an adjustable linear OAT reset of:

OAT	SA Set-point
-30°C	25°C
22 C	22°C

.5 Alarm Modes

- .1 The Low Temp Alarm shall stop the SA fan and close the isolation damper when the SA temp drops below 4°C or the coil return water temp drops below 5°C.
- .2 A freeze stat shall shut down the unit and close the isolation damper through interlocks when the supply temperature falls below 3°C. A manual reset will be required.
- .3 The Fire Alarm shall stop the S/A fan, and close the isolation damper through hard wired interlock to the alarm system
- .4 Filter Alarm: When the pressure differential across the filter exceeds 180 Pa (adj.) an filter alarm signal is sent to the BMS.

**3.10 AH-2, 3B, 18, 23, 27, 29, 30, 103 & AS-2**

.1 General

- .1 This system provides tempered ventilation
- .2 The system includes:
  - .1 A mixed air constant volume air handler as per air handler schematic shown on drawings.
  - .2 Heating coil pump
- .3 The air handler runs on an occupancy schedule:
  - .1 Normal - Occupied/ Unoccupied mode or
  - .2 Smoke/Fire Alarm mode.

.2 Stopped mode

- .1 When the system is stopped the supply fan is deenergized and the OA damper is closed and return damper is opened fully for recirculation.
- .2 The heating coil circulating pump is off
- .3 The mixing valve for the heating coil circuit is deenergized

.3 Start-Up mode

- .1 The air handler will be activated via BMS schedule or manually. Upon activation, the supply fan will only start when the R/A damper is fully open in full recirculation mode.
- .2 The heating coil circulating pump will be activated when the OA temperature falls below 18°C (adj.)

.4 Normal Operation

- .1 Once the supply fan status indicates operation it will operate continuously until stopped by BMS schedule or manually.
- .2 After 1 minute (adjustable) the unit will go into occupied mode and the RA and OA damper (mixing dampers) will gradually open to minimum OA position over a 1 min period (adjustable). The minimum OA damper position shall be established in coordination with the air balancer. When the operator switches the unit in to unoccupied mode the mixing dampers will go to full recirculation.

- .3 The SA heating coil valve will modulate to maintain SA temperature based on an adjustable linear OAT reset of:

OAT	SA Set-point
-30°C	28°C
22 C	22°C

- .4 The unit will go into free-cool mode when the MA temperature is higher than the SA set point for more than 3 mins (adjustable) and when there is no call for heat. Free cool shall be locked out when the OAT is below 14°C (adj.). In free-cool mode the mixing dampers will modulate to maintain SA set point. If the OAT is higher than RAT the mixing dampers will go back to minimum position.

.5 Alarm Modes

- .1 The Low Temp Alarm shall stop the SA fan and close the isolation damper when the SA temp drops below 4°C or the coil return water temp drops below 5°C.
- .2 A freeze stat shall shut down the unit and close the isolation damper through interlocks when the supply temperature falls below 3°C. A manual reset will be required.
- .3 The Fire Alarm shall stop the S/A fan, and close the isolation damper through hard wired interlock to the alarm system
- .4 Filter Alarm: When the pressure differential across the filter exceeds 180 Pa (adj.) an filter alarm signal is sent to the BMS.

**3.11 AH-28 & 32**

.1 General

- .1 This system provides tempered ventilation and cooling
- .2 The system includes:
- .1 A mixed air constant volume air handler as per air handler schematic shown on drawings.
  - .2 Heating coil pump
  - .3 DX Cooling coil and condensing unit
- .3 The air handler runs continuously all year long in:
- .1 Normal - Occupied/ Unoccupied mode or
  - .2 Smoke/Fire Alarm mode.

.2 Stopped mode

- .1 When the system is stopped the supply fan is deenergized and the OA damper is closed and return damper is opened fully for recirculation.
- .2 The heating coil circulating pump is off
- .3 The mixing valve for the heating coil circuit is deenergized

- .4 DX cooling system is deenergized
- .3 Start-Up mode
  - .1 The air handler will be activated via BMS or manually. Upon activation, the supply fan will only start when the R/A damper is fully open in full recirculation mode.
  - .2 The heating coil circulating pump will be activated when the OA temperature falls below 18°C (adj.)
- .4 Normal Operation
  - .1 Once the supply fan status indicates operation it will operate continuously.
  - .2 After 1 minute (adjustable) the unit will go into occupied mode and the RA and OA damper (mixing dampers) will gradually open to minimum OA position over a 1 min period (adjustable). The minimum OA damper position shall be established in coordination with the air balancer. When the operator switches the unit in to unoccupied mode the mixing dampers will go to full recirculation.
  - .3 The unit will go into free-cool mode when the MAT is higher than the SA set point for more than 3 mins (adjustable) and when there is no call for heat. Free cool shall be locked out when the OAT is below 14°C (adj.). In free-cool mode the mixing dampers will modulate to maintain SA set point. If the OAT is higher than RAT the mixing dampers will go back to minimum position.
  - .4 The system will be in cooling mode when the space temperature is above the cooling set point. In cooling mode the heating valve shall close and the DX cooling system shall energize and shall cycle and stage to maintain space temperature set point.
  - .5 The SA heating coil valve will modulate to maintain SA temperature based on an adjustable linear OAT reset of:

OAT	SA Set-point
-30°C	25°C
20 C	22°C

- .5 Alarm Modes
  - .1 The Low Temp Alarm shall stop the SA fan and close the OA damper when the SA temp drops below 4°C or the coil water return temp drops below 4°C.
  - .2 The Fire Alarm shall stop the S/A fan through hard wired interlock to the alarm system. The BMS shall d-energize DX cooling system, stop the coil circulation pump and close the O/A damper.
  - .3 Filter Alarm: When the pressure differential across the filter exceeds 180 Pa (adj.) an filter alarm signal is sent to the BMS.

### 3.12 AH-26 & 101

- .1 General
  - .1 This system provides tempered ventilation with mechanical cooling
  - .2 The system includes:
    - .1 A mixed air constant volume air handler as per air handler schematic shown on drawings.
    - .2 Heating coil pump
    - .3 DX Cooling coil and condensing unit
  - .3 The air handler runs on an occupancy schedule:
    - .1 Normal - Occupied/ Unoccupied mode or
    - .2 Manual – Override or
    - .3 Smoke/Fire Alarm mode.
- .2 Stopped mode
  - .1 When the system is stopped the supply fan is deenergized and the OA damper is closed and return damper is opened fully for recirculation.
  - .2 The heating coil circulating pump is off
  - .3 The mixing valve for the heating coil circuit is deenergized
  - .4 DX cooling system is deenergized
- .3 Start-Up mode
  - .1 The air handler will be activated via BMS schedule or manually. Upon activation, the supply fan will only start when the R/A damper is fully open in full recirculation mode.
  - .2 The heating coil circulating pump will be activated when the OA temperature falls below 18°C (adj.)
- .4 Normal Operation
  - .1 Once the supply fan status indicates operation it will operate continuously until stopped by BMS schedule or manually.
  - .2 After 1 minute (adjustable) the unit will go into occupied mode and the RA and OA damper (mixing dampers) will gradually open to minimum OA position over a 1 min period (adjustable). The minimum OA damper position shall be established in coordination with the air balancer. When the operator switches the unit in to unoccupied mode the mixing dampers will go to full recirculation.
  - .3 The unit will go into free-cool mode when the MAT is higher than the SA set point for more than 3 mins (adjustable) and when there is no call for heat. Free cool shall be locked out when the OAT is below 14°C (adj.). In free-cool mode the mixing dampers will modulate to maintain SA set point. If the OAT is higher than RAT the mixing dampers will go back to minimum position.
  - .4 The system will be in cooling mode when the space temperature is above the cooling set point. In cooling mode the heating valve shall close and the DX cooling system shall energize and shall cycle and stage to maintain space temperature set point.

- .5 The SA heating coil valve will modulate to maintain SA temperature based on an adjustable linear OAT reset of:

OAT	SA Set-point
-30°C	25°C
20 C	22°C

.5 Alarm Modes

- .1 The Low Temp Alarm shall stop the SA fan and close the OA damper when the SA temp drops below 4°C or the coil water return temp drops below 4°C.
- .2 The Fire Alarm shall stop the S/A fan through hard wired interlock to the alarm system. The BMS shall d-energize DX cooling system, stop the coil circulation pump and close the O/A damper.
- .3 Filter Alarm: When the pressure differential across the filter exceeds 180 Pa (adj.) an filter alarm signal is sent to the BMS.

**3.13 AH-6, 9, 12 & 15**

.1 General

- .1 This system provides tempered ventilation and free cooling
- .2 The system includes:
- .1 A mixed air constant volume air handler as per air handler schematic shown on drawings.
- .3 The air handler runs continuously all year long in:
- .1 Normal - Occupied/ Unoccupied mode or
- .2 Smoke/Fire Alarm mode.

.2 Stopped mode

- .1 When the system is stopped the supply fan is deenergized and the OA damper is closed and return damper is opened fully for recirculation.

.3 Start-Up mode

- .1 The air handler will be activated manually via BMS. Upon activation, the supply fan will only start when the RA damper is fully open in full recirculation mode.

.4 Normal Operation

- .1 Once the supply fan status indicates operation it will operate continuously.
- .2 After 1 minute (adjustable) the unit will go into occupied mode and the RA and OA damper (mixing dampers) will gradually open to minimum OA position. The minimum OA damper position shall be established in coordination with the air balancer. When the operator switched the unit in to unoccupied mode the mixing dampers will go to full recirculation.



- .3 The RA damper and OA damper shall modulate to maintain a space temperature set point. A minimum supply air limit shall prevent the mixing damper from supplying air less than 10°C (adj.). If the OAT is higher than the space temperature setpoint the mixing dampers will go back to minimum position.
- .5 Alarm Modes
  - .1 The Low SA Temp Alarm shall close the OA damper and go into full recirculation when the SA temp drops below 4°C. Once the SAT rises above the SA set point the Low temp alarm shall clear and the unit will go into Normal operation mode.
  - .2 The Fire Alarm shall stop the S/A fan through hard wired interlock to the alarm system. The BMS shall close the O/A damper.
  - .3 Filter Alarm: When the pressure differential across the filter exceeds 180 Pa (adj.) an filter alarm signal is sent to the BMS.

### **3.14 AH-16**

- .1 General
  - .1 This system provides ventilation air and variable flow cooling Air
  - .2 The system includes:
    - .1 A mixed air variable volume air handler with VFD on the supply fan
    - .2 as per air handler schematic shown on drawings.
    - .3 Heating coil pump
    - .4 DX Cooling coil and condensing unit
    - .5 Variable Air Volume terminals in each Zone
  - .3 The air handler runs on an occupancy schedule:
    - .1 Normal - Occupied/ Unoccupied mode or
    - .2 Manual – Override or
    - .3 Smoke/Fire Alarm mode.
- .2 Stopped mode
  - .1 When the system is stopped the supply fan is deenergized and the OA damper is closed and return damper is opened fully for recirculation.
  - .2 The heating coil circulating pump is off
  - .3 The mixing valve for the heating coil circuit is deenergized
  - .4 DX cooling system is deenergized
- .3 Start-Up mode
  - .1 The air handler will be activated via BMS schedule or manually. Upon activation, the supply fan will only start when the R/A damper is fully open in full recirculation mode.
  - .2 The heating coil circulating pump will be activated when the OA temperature falls below 16°C (adj.)
- .4 Normal Operation

- .1 Once the supply fan status indicates operation it will operate continuously until stopped by BMS schedule or manually.
- .2 After 1 minute (adjustable) the unit will go into occupied mode with the supply air fan operating at minimum air flow and the RA and OA damper (mixing dampers) will gradually open to minimum OA position over a 1 min period (adjustable). The minimum flow rate and minimum OA damper position shall be established in coordination with the air balancer and set based on minimum flow.
- .3 The VAV air terminals will have a minimum air flow set point to provide minimum ventilation to each zone. The VAV terminal shall open when the zone temperature exceeds the zone set point and modulate to maintain the temperature set point.
- .4 The supply air fan speed will modulate maintain a minimum supply duct static pressure as established with the air balancers for box max operation. The static set point shall be reset based on VAV flow requirements.
- .5 The OA and RA damper shall modulate to maintain OA flow rate set point. The OA flow rate shall be calculated by measuring the OAT RAT MAT and the SA flow rate
- .6 The unit will operate the DX cooling system to maintain the SA set point. If there is a call for cooling from any VAV air terminal and the MAT is higher than the SA set point. Once the DX system is operating system will cycle and stage the compressors to maintain the SA set point. The DX system will de-energize if no zones are calling for cooling.
- .7 The unit will go into economizer mode when the MAT is higher than the SA set point and the heating valve is closed and when there is a call for cooling. Economizer mode shall be locked out when the OAT is below 6°C (adj.). In Economizer mode the mixing dampers will modulate to maintain SA set point. If the OAT is higher than RAT the mixing dampers will go back to minimum position.
- .8 When in heating mode,  $MAT < SAT$ , the heating coil valve will modulate to maintain SAT set point.
- .9 The supply air set point shall be based on an outdoor reset:

OAT	SA Set-point
-30°C	20°C
0 C	18°C
28	13°C

.5 Alarm Modes

- .1 The Low SA Temp Alarm shall close the OA damper and go into full recirculation when the SA temp drops below 4°C. Once the SAT rises above the

SA set point the Low temp alarm shall clear and the unit will go into Normal operation mode.

- .2 The Fire Alarm shall stop the S/A fan through hard wired interlock to the alarm system. The BMS shall close the O/A damper.
- .3 Filter Alarm: When the pressure differential across the filter exceeds 180 Pa (adj.) an filter alarm signal is sent to the BMS.

### 3.15 AH-3°C

#### .1 General

- .1 This system provides tempered ventilation
- .2 The system includes:
  - .1 2 Speed gas indirect fired makeup air unit as per air handler schematic shown on drawings.
  - .2 A general roof exhaust fan c/w interlocked motorized damper
  - .3 A fume hood exhaust fan c/w interlocked motorized damper
  - .4 The air handler low speed setting shall be interlocked with the general exhaust fan EF-218.
  - .5 The air handler high speed setting shall be interlocked with the fume hood fan F-13.
- .3 The air handler runs on an occupancy schedule:
  - .1 Normal - Occupied/ Unoccupied mode or
  - .2 Smoke/Fire Alarm mode.

#### .2 Stopped mode

- .1 When the system is stopped the supply fan and burner section is deenergized and the OA damper is closed

#### .3 Start-Up mode

- .1 The air handler will be activated via BMS schedule or manually. Upon activation, the air handler controller and the interlocks with the exhaust fans will engage the fans speed.

#### .4 Normal Operation

- .1 Once the supply fan status indicates operation it will operate continuously until stopped by BMS schedule or manually.
- .2 The system will normal run low speed with the general exhaust fan.
- .3 Upon activation of the fume hood exhaust, through existing wall switch, the general exhaust fan will de-energize and the fume hood exhaust fan will energize.
- .4 The indirect natural gas burner will cycle and modulate to maintain SA temperature based on an adjustable linear OAT reset provided from the BMS.

OAT	SA Set-point
-----	--------------

-30°C	25°C
18°C	20°C

- .5 Alarm Modes
  - .1 The Low Temp Alarm shall stop the S/A fan and close the O/A damper when the S/A temp drops below 4°C.
  - .2 The Fire Alarm shall stop the S/A fan and close the O/A damper through hard wired interlock to the alarm system
  - .3 Filter Alarm: When the pressure differential across the filter exceeds 180 Pa (adj.) an filter alarm signal is sent to the BMS.

### 3.16 S&D Boiler system

- .1 General
  - .1 This system provides hydronic heating water to existing heating terminals and Air Handlers AS-1 and AS-2. The system is a primary flow condensing system.
  - .2 The system includes:
    - .1 Two High mass gas fired hydronic boilers with integral burner controls. Each sized for 100% of the heating load.
    - .2 Two System circulating pumps with VFD speed control. One for each boiler and each sized for 100% of the heating load.
  - .3 The boiler and pumps runs on:
    - .1 Normal – Signal from BMS
    - .2 Manual – Override or
    - .3 Smoke/Fire Alarm mode.
- .2 Stopped mode
  - .1 When the system is stopped, the boilers are deenergized as well as the system pumps and branch circulators.
- .3 Start-Up mode
  - .1 The BMS shall provide a start signal to the lead boiler controller.
  - .2 The BMS shall provide boiler start signal based on supply temperature reset.
  - .3 All boilers system circulators and branch pumps shall be overridden by the OAT. If the OAT is less than 15°C (adj) and the lowest zone temp sensor is more than 1°C below set point the lead boiler shall be enabled. If the OAT is less than 5°C (adj) the lead boiler and pump shall always be enabled
  - .4 The BMS shall provide boiler/pump staging control which shall alternate lead and stand-by statues monthly(adj).
  - .5 Once enabled the boiler controller shall first start the system circulators in minimum speed.
  - .6 The boiler shall be interlocked with its respective system circulator so that the boiler will not operate without flow.
  - .7 Once flow Is proven the boiler will go into normal operation

.4 Normal Operation

- .1 Once the heating system is enabled the lead boiler and system circulation pump shall modulate and cycle as required to maintain system set-points.
- .2 The lead system pump will operate by minimum speed and modulate its speed to maintain a constant pressure differential of [30kPa] (adj) between the supply and return at the terminal of the longest run. This shall be set in coordination with the hydronic balancer.
- .3 Minimum speed of the pumps shall be set to ensure the required minimum water flow rates for the boiler are met as coordinated by with the TAB (0.32L/s).
- .4 A modulating bypass valve shall provide HWS flow to AS-1 & 2 coil loops as the system zone valves close.
  - .1 The bypass valve shall close if the pump flow is over 1.1L/s (adj.)
  - .2 The bypass shall modulate to maintain a minimum return water temperature of no less more than 39°C (adj.) less than the supply water temperature.
- .5 The boilers integral controller will cycle and modulated the gas burner as required to maintain the HWS temperature set point provided be the BMS
- .6 The BMS shall provide HWS temperature based on outdoor reset (adj).

OAT	HWS Set-point
-30°C	93°C (200°F)
0°C	65.5°C (150°F)
18°C	38°C (100°F)

- .7 The BMS shall further reset the HWS temperature plus or minus 5°C (adj) per the average space heating demand.
- .8 When the lead boilers firing rate rises above 95% (adj) for more than 10min (adj) the standby boiler and pump shall go into Startup mode and run in parallel with the lead boiler at a minimum 48% (adj) flow rate. Once both boilers firing rate falls below 45%(adj) for more than 5min (adj) the standby boiler shall be disabled and after 5min (adj) the circulator shall be disabled.

.5 Alarm Modes

- .1 Upon failure of the lead boiler or associated system pump and alarm shall be generated at the BMS graphics and the Standby boiler and system pump shall become the lead.
- .2 A pressure sensor shall monitor the heating system pressure. If the pressure increases above 120kPa or decreases below 25kPa and alarm shall be generated at the BMS graphics
- .3 Provide general boiler alarm point on the BMS graphics to indicate common alarm from boiler system via BACnet connection to the boiler system.

**3.17 Hydronic heating system branch booster pump (P-214B, 216B, 217A, 218A, 220A, 223, 225B, 227B, 228A, 229A)**

- .1 General
  - .1 These systems boost the pressure to hydronic heating branches of specific areas on the central hydronic heating system. This provide the adequate heating water to these areas as required.
  - .2 The system includes:
    - .1 Constant volume hydronic booster pump
    - .2 Pressure bypass valve
  - .3 The boiler and pumps runs on:
    - .1 Normal – Signal from BMS
    - .2 Manual – Override or
    - .3 Alarm mode.
- .2 Stopped mode
  - .1 When the system is stopped, pump is deenergized
- .3 Start-Up mode
  - .1 The BMS shall provide a start signal to the pump
  - .2 The BMS shall provide pump start signal only if the boiler system is energized and OAT is less than 18°C (adj) or there is a call for heating from any of the control valves in the area being serviced.
- .4 Normal Operation
  - .1 Once the branch booster pump is enabled it will operate continuously.
  - .2 A differential pressure bypass valve open when differential pressure reaches the adjustment setting. Differential Pressure bypass valve shall be set in coordination with the TAB.
- .5 Alarm Modes
  - .1 Upon pump failure, an alarm signal will be sent to the BMS

**3.18 AH-48, 49, 50, 51**

- .1 Replace existing Pneumatic valves actuator(s) with new electric actuators and connect back to existing point.
- .2 The existing points and sequence remain unchanged.

**3.19 West Mechanical Room Ventilation**

- .1 Replace existing Pneumatic actuator(s) with new electric actuators and connect to BMS.
- .2 Added EF-82 and EF-83 to BMS

**3.20 Fan -1 (Administration ceiling)**

- .1 Fan F-1 is being replaced. Existing controls is to remain.

**3.21 HEATING WATER SYSTEM**

- .1 Replace existing Pneumatic actuator(s) with new electric actuators and connect back to existing point.
- .2 The existing points and sequence remain unchanged.

**3.22 Reheat coils**

- .1 Reheat coils shall modulate valve or electric heating coil to maintain room temperature set point of associated room temperature sensor.

**3.23 RTUs**

- .1 Reconnect existing points from replacement RTU(s) into EMCS.
  - .1 Refer to existing controls shop drawings.
- .2 The existing points and sequence remain unchanged.
- .3 RTU(s), points shall be shown on area graphics.

**3.24 SERVER ROOM COOLING**

- .1 The air conditioning systems provide cooling, humidification and dehumidification for the local space. Provide all the programming, graphics, alarming, etc. for the supervisory functions for these systems from the DDC system via the BACnet interface connection. In the event of a DDC system failure, the air conditioning systems shall continue to operate on their local controls using the last know good values for all setpoints.
- .2 The Controls Contractor shall supply and install all wiring, and install all control devices for the Split System Computer Room Air Conditioning Systems (supplied by others). See Mechanical specifications and drawings for locations and details.
- .3 All setpoints for temperature, humidity, scheduling, etc. shall be approved through the Shop Drawing process.
- .4 Provide a room temperature sensor for monitoring of Server Room temperature.
  - .1 High Temperature Alarm: 27°C.
  - .2 Low Temperature Alarm: 19°C.

**END OF SECTION**

**Part 1 General**

**1.1 GENERAL**

- .1 All 'reference specifications' indicated in Division 26 are to be distributed as part of the specification.
- .2 This Section covers items common to Sections of Division 26. This section supplements requirements of Division 01.
- .3 If this specification or the referenced drawings conflict in any way with the requirements of the applicable codes and/or standards, the more rigorous requirement shall prevail. Contractor shall be responsible for the compliance with applicable codes and/or standards.
- .4 The Contractor shall furnish all scaffolding, rigging, hoisting and services necessary for delivery, erection and installation of all equipment and apparatus required to be installed by the Contractor. All equipment shall be removed by the Contractor upon completion of the project.
- .5 The drawings depicting electric work are diagrammatic and show, in their approximate location, symbols representing electrical equipment and devices. The exact location of such equipment and devices shall be established in the field.
- .6 Contractor shall furnish and install all such work, piping, structural supports, electrical wiring and conduit and any other additional equipment for a complete operational system.
- .7 Unless specifically stated to the contrary, no measurement of an electrical drawing by scale shall be used as a dimension. Dimensions noted on the electrical drawings are subject, in each case, to measurements of adjacent or previously completed work and all such measurements necessary shall be taken before undertaking any work dependent upon them.
- .8 In the event of a conflict of quantities between the drawings and specifications Contractor shall base his bid on the greater quantity, cost or quality of the item in question, unless such conflict is resolved by an addendum.
- .9 Contractor must follow all requirements set by Corrections Canada and Public Works Canada.
- .10 All equipment in an inmate accessible area shall be tamper resistant.

**1.2 CODES AND STANDARDS**

- .1 Do complete installation in accordance with CSA C22.1 except where specified more stringently as identified on drawings specifications or by the authority having jurisdiction.
- .2 Do overhead and underground systems in accordance with CSA C22.3 No.1 where specified more stringently as identified on drawings specifications or by the authority having jurisdiction.



**1.3 REGULATORY REQUIREMENTS**

- .1 Furnish products listed and classified by CSA and/or a nationally accepted testing laboratory (NRTL) such as UL, ETL, etc. Products must be acceptable to authority having jurisdiction.

**1.4 DEFINITIONS**

- .1 Provide: Furnish, install and wire complete and ready for service.
- .2 Furnish: Responsible for purchasing item and also delivery to the jobsite.
- .3 Install: Responsible for moving and mounting equipment to the final location.
- .4 Wire: Responsible for final connections, ready for service.
- .5 Exposed: Exposed to view in any room, corridor or stairway.

**1.5 CARE, OPERATION AND START-UP**

- .1 Instruct operating personnel in the 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 with all aspects of its care and operation.
- .4 During the progress of the work the Contractor shall remove from the building site rubbish, dirt and other debris caused by performance of the work.

**1.6 VOLTAGE RATINGS**

- .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 CAN3-C235. Equipment to operate in extreme operating conditions established in CAN3-C235 without damage to equipment.

**1.7 PERMITS, FEES AND INSPECTION**

- .1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2 Pay associated fees and taxes as required to complete the work.
- .3 Departmental Representative will provide drawings and specifications required by Electrical Inspection Department and Supply Authority at no cost.
- .4 Notify Departmental Representative of changes required by Electrical Inspection Department prior to making changes.

- .5 Furnish Certificates of Acceptance from Electrical Inspection Department and Authorities Having Jurisdiction as required on completion of work to Departmental Representative.

## **1.8 MATERIALS AND EQUIPMENT**

- .1 Provide materials and equipment in accordance with Division 01.
- .2 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department.
- .3 Contractor to provide factory assembled control panels and component assemblies as necessary.
- .4 All items specified shall be the latest type or model produced by the manufacturer specified. If descriptive specification or model number is obsolete, substitute with current product with approval of Departmental Representative.

## **1.9 FINISHES**

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
  - .1 Paint outdoor electrical equipment "equipment green" finish to EEMAC Y1.
  - .2 Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 The Contractor shall clean all exposed ironwork, the interior and exterior of cabinets and pull boxes, etc., and remove all rubbish and debris resulting from the work.
- .4 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

## **1.10 LABELLING**

- .1 Labelling - Equipment
  - .1 Identify electrical equipment with nameplates and labels as follows:
    - .1 Nameplates:
      - .1 Lamicoid 3 mm thick plastic engraving sheet, white face, black core, mechanically attached with self-tapping screws.

Nameplate Sizes			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .2 Labels:

- .1 Embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.
- .4 Allow for average of twenty-five (25) letters per nameplate and label.
- .5 Identification to be English.
- .6 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .7 Identify equipment with Size 3 labels engraved "ASSET INVENTORY No. ". Number as and if directed by Departmental Representative.
- .8 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .9 Terminal cabinets and pull boxes: indicate system and voltage.
- .10 Transformers: indicate capacity, primary and secondary voltages.
- .2 Labelling – Wiring
  - .1 All power, instrumentation and control wires:
    - .1 Shall be provided with indelible permanent wire tags at each end of the wire.
    - .2 Shall use polyester or polyolefin heat-shrinkable sleeves.
    - .3 Marking shall be abrasion, ozone, ultraviolet, and solvent resistant.
    - .4 Numbering shall match control wiring diagrams
    - .5 Numbering shall match on both ends of phase conductors of feeders and branch circuit wiring.
  - .2 Maintain phase sequence and colour coding throughout.
  - .3 Colour code: to CSA C22.1.
  - .4 Use colour coded wires in communication cables, matched throughout system.
- .3 Labelling – Conduit and Cable
  - .1 Conductors to be labelled at each end by slip-on plastic tags Wieland type Z5 or Weidmuller type Z or by machine-printed heat-shrink labels. Use the conductor designations shown on the wiring drawings. Seal all conductor labels with clear heat-shrink covers.
  - .2 WRITE-ON LABELS ARE NOT ACCEPTABLE.
  - .3 Colour code conduits, boxes and metallic sheathed cables.
  - .4 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
  - .5 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

Wire Colours		
	Prime	Auxiliary Stripe
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
Telephone	Green	

Other Communication Systems	Green	Blue
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**1.11 LABELS - MANUFACTURER AND CSA**

- .1 Visible and legible, after equipment is installed.
- .2 All electrical equipment shall be approved by a nationally recognized testing laboratory such as the Canadian Standards Association.
- .3 New electrical equipment shall have potential electric shock and arc flash hazard labels as per CSA.

**1.12 WIRING TERMINATIONS**

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

**1.13 WARNING SIGNS**

- .1 As specified and to meet requirements of Electrical Inspection Department and Departmental Representative.
- .2 Decal signs, minimum size: 175 x 250 mm.

**1.14 LOCATION OF OUTLETS**

- .1 Locate outlets as shown on drawings and to CSA C22.1.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .4 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

**1.15 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.
- .3 Install electrical equipment at following heights unless indicated otherwise.
  - .1 Local switches: 1400 mm.
  - .2 Wall receptacles:
    - .1 General: 300 mm.
    - .2 Above top of continuous baseboard heater: 200 mm.
    - .3 Above top of counters or counter splash backs: 175 mm.
    - .4 In mechanical rooms: 1400 mm.
  - .3 Panelboards: as required by Code or as indicated.
  - .4 Telephone and interphone outlets: 300 mm.

- .5 Wall mounted telephone and interphone outlets: 1500 mm.

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

#### **1.17 CONDUIT AND CABLE INSTALLATION**

- .1 In-slab conduit is not to be used under any circumstances unless existing in-slab conduit is reused.
- .2 Arrange for holes through exterior walls and roof to be flashed and made weatherproof.
- .3 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: schedule 40 steel, sized for free passage of conduit, and protruding 50 mm.
- .4 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .5 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

#### **1.18 FIELD QUALITY CONTROL**

- .1 All electrical work to be carried out by qualified, licensed electricians or apprentices as per the conditions of the Provincial Act respecting manpower vocational training and qualification. Employees registered in a provincial apprentices' program shall be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks - the activities permitted shall be determined based on the level of training attained and the demonstration of ability to perform specific duties.
- .2 The work of this division to be carried out by a contractor who holds a valid Master Electrical contractor license as issued by the Province that the work is being constructed.
- .3 Conduct and pay for following tests:
  - .1 Power system including phasing, voltage, grounding and load balancing.
  - .2 Circuits originating from branch distribution panels.
  - .3 Lighting and its control.
  - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
  - .5 Systems: fire alarm system, communications.
- .4 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- .5 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 Megger 4160 V circuits, feeders and equipment with a 5000 V instrument.
- .4 Check resistance to ground before energizing.
- .6 Carry out tests in presence of Departmental Representative unless directed otherwise.
- .7 Provide instruments, meters, equipment, and personnel required to conduct tests during and at conclusion of project.
- .8 Submit test results for Departmental Representative's review.
- .9 Should it be found by the Departmental Representative that any equipment or any portion of the electrical system installed under this Contract fails to comply with the Contract Documents with respect to quality of workmanship or materials, such shall be replaced by the Contractor and all other work disturbed by correction of defects or imperfections shall also be corrected at the Contractor's expense.
- .10 The operation of the equipment and electrical systems does not constitute an acceptance of the work. The final review is to be made after the Contractor has adjusted his equipment and demonstrated that it fulfills the requirements of the drawings and the specifications.
- .11 Upon completion of the installation, the Contractor shall furnish certificates of approval from all authorities having jurisdiction. Demonstrate that all work is complete and in ideal operating condition, with raceway and conduit system properly grounded, all wiring free from grounds, shorts, and that the entire installation is free from any physical defects. In the presence of the Departmental Representative and the Municipality, the Contractor shall demonstrate the proper operation of all miscellaneous systems.

#### **1.19 CO-ORDINATION OF PROTECTIVE DEVICES**

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

#### **1.20 RECORD DRAWINGS**

- .1 The Contractor shall keep a detailed up to date record of the following items:
  - .1 Feeder conduit routing.
  - .2 Dimensions drawings indicating all conduits in the slab.
  - .3 Approximate junction box and branch conduit locations.
  - .4 Actual circuit numbers, the equipment, and devices are connected to.
- .2 Record drawings shall be maintained throughout the duration of the project. At the time of project completion, a complete set drawings reflecting pertinent information shall be completed and turned over to the Departmental Representative.

#### **Part 2 Products**

- .1 Not applicable.

#### **Part 3 Execution**

- .1 Not applicable.

**END OF SECTION**

# Edmonton Maximum Security Institiution - Radial Breaker Replacement MCC Shutdown Strategy

Date: 8/10/2017  
Description: Issued For Tender  
Rev: 0

Item	Initial Operating Mode	Tag #	Event	Expected Action	Test Methods	Comments
MCC'S LOCATED THROUGHOUT BUILDING						
SHUTDOWN/NEW WORK						
1	ON		lockout tag out radial #1 breaker in generator building switchgear	one bus duct is de-energized		contractor to test busduct breakers beforehand to determine which radial to turn off first.
2	OFF		lock out and tag out MCC busduct breaker #1 connected to radial #1.	breaker #1 locked out	Multimeter	Contractor to first replace busduct breaker that do not pass initial tests
3	ON		lock out and tag out MCC busduct breaker #2 connected to radial #2.	MCC is denergized.	Multimeter	coordinate with Owner before denergizing any MCC.
4	OFF		disconnect and protect cable feeding busduct breaker #1	MCC will only be fed from busduct breaker #2		Exposed cables need to be protected
5	OFF		energize busduct breaker #2	MCC will have power from radial #2	Multimeter	
6	OFF		Replace de-energized busduct breaker #1			
7	ON		lock out and tag out MCC busduct breaker #2 connected to radial #2.	MCC is denergized.	Multimeter	coordinate with Owner before denergizing any MCC.
8	OFF		connect existing cable to new busduct breaker #1	MCC fed from two sources		MCC will now have the option to be fed from busduct breaker #1 or busduct breaker #2
9	OFF		energize busduct breaker #2	MCC will have power	Multimeter	
10	ON		Verify busduct key interlock breakers work as designed	only one breaker can be turned on at a time		
11	ON		Verify downstream loads have power	equipment is fully functional	Multimeter	
12	-		Follow similar procedure to replace busduct breaker #2.			

NOTES:  
1.The following is a proposed shutdown plan to mitigate the need for a generator rental. It is the contractors responsibility to coordinate with the Owner and modify the proposed shutdown plan to suit the project as required.  
2.generic breaker tags are being used for clarity

**Part 1            General**

**1.1            GENERAL**

- .1    Description:
  - .1    This specification covers the field inspection, testing, checking out and adjustments, if necessary, of all electrical equipment and materials in the completed facility.
  - .2    All Start-up and Commissioning to conform to the requirements of Division 01.
- .2    General:
  - .1    Workmanship, methods, inspections, and materials used in erection and installation of the subject equipment to conform with accepted engineering practices, IEEE Standards, the Canadian Electrical Code and the Specifications for electrical work.
  - .2    Perform all wire checks, including factory wiring, setting up all test equipment and any other preliminary work in preparation for the electrical acceptance tests. Inspect all equipment to make sure it has been installed in accordance with the Manufacturer's recommendations.
  - .3    Each acceptance test shall be witnessed by the authorized Departmental Representative unless otherwise advised.
  - .4    Schedule all testing with Departmental Representative's approval and no testing shall be performed without Departmental Representative's approval.
  - .5    The testing shall be performed by and under the immediate supervision of the Contractor:
    - .1    Notify the Departmental Representative in writing at least seventy-two (72) hours prior to test establishing the time the test is to be performed.
  - .6    Field test (as outlined in the following paragraphs) all wire, cable and electrical equipment to assure proper installation, settling, connections, and functioning in accordance with this project's contract drawings, Specifications, and manufacturer's recommendations and perform any additional tests deemed necessary by Departmental Representative to determine that equipment, materials and systems meet the requirements of the project.
  - .7    Final acceptance will not only depend on equipment dependability, as determined by the subject tests; but will depend on complete operational tests on all equipment to show that the equipment will perform the functions for which it was designed and meet the requirements of the project and specifications.
  - .8    Manufacturers shall be notified and shall be permitted to witness high voltage or other tests performed on their equipment, if they so request.
  - .9    No equipment is to be energized without the approval of a designated Departmental Representative.
  - .10   The following precautions shall be observed prior to energizing any equipment:
    - .1    Make certain that all construction dirt and debris, conducting material, wire trimmings, and unused or dropped hardware have been removed. All electrical equipment shall be vacuum cleaned to dust free



- condensation (equipment shall be dried out, if necessary). The enclosures, door(s), etc., shall then be visually inspected for protective integrity.
- .2 Inspect and check all bolted bus connection and bus bracing for proper assembly.
  - .3 Operate the equipment manually and visually inspect the same for proper clearances of all moving items also making certain that proper lubrication is in evidence.
  - .11 Furnish all required testing equipment and safety devices including, but not limited to the following items:
    - .1 500 V, 1000 V, 5000V DC meggers, 0-10+ giga ohm scale.
    - .2 Portable telephone sets and 2-way radios, if required.
    - .3 Battery powered ringing sets.
    - .4 150-1000 V AC voltmeters, 0-500 A AC ammeters 1.5% accuracy.
    - .5 Volt-OHM-Milli-ammeters, Simpson or as approved.
    - .6 Micro-ohm meter 10A output.
    - .7 Phase rotation meters, 60 hertz.
    - .8 D.C. voltmeter 0-1000 V DC. DC ammeter to 10 Amps.
    - .9 Rubber gloves, rubber mats, goggles, insulated tools, and any other equipment necessary to ensure safe working condition.
    - .10 Signals and danger signs.
    - .11 Miscellaneous cable, switches, receptacles, plugs, etc., as required.

## 1.2 SAFETY

- .1 The purpose of electrical equipment testing and checking is to determine whether the device will work properly as intended for the specific job to which it is applied. The field testing of apparatus shall, as much as possible, duplicate actual operating conditions, e.g. control circuits energized. In many instances, this requires that the apparatus be in actual use. For safety, however, the testing of live equipment at power voltage shall be avoided whenever possible.
- .2 If temporary circuits must be maintained, accidental contact with other circuits and live parts on adjacent apparatus must be prevented. If at all possible, power to adjacent apparatus shall be disconnected prior to testing.
- .3 Equipment under test shall be isolated from remote control or feedback circuits to prevent accidental energization by others. If power must be maintained as part of the test, personnel shall be protected against electrical shock by rubber floor mats, rubber gloves, goggles, approved non-conducting safety hats, and insulated tools.
- .4 Bus runs that have been disconnected for test purposes shall be grounded to prevent feedback of test voltages. If these conductors cannot be grounded, the test area shall be roped off or otherwise protected from the accidental approach of unauthorized and unnecessary personnel while test is in progress.
- .5 Capacitive circuits and any device capable of storing electrical energy received from test voltages are a significant hazard. They shall be grounded during the test, or if they are

necessary and included in the circuitry, they shall be grounded after each application of test voltages.

### **1.3 PHASING AND SYNCHRONIZING**

- .1 All power cable and bus duct circuits shall be checked to verify that connections, in regard to phasing, are in accordance with the contract drawings.
- .2 All power cable circuits shall be checked to verify that all circuits that can be energized from two (2) or more sources are in phase.

### **1.4 WIRE AND CABLE**

- .1 All cable connections must pass visual inspection for workmanship and conformance with standard practice.
- .2 All wire and cable shall be tested for continuity.
- .3 All cables for 600 V AC circuits shall be megger tested with a 1000 V DC megger for one (1) minute. The insulation resistance level shall not be less than one hundred (100) megaohms, with the exception of circuit directly connected to existing equipment shall not be less than five (5) megaohms.
  - .1 During insulation tests all switchboards, panelboards, fuse holders, switches, and overcurrent devices to be in place (except devices with sensitive electronic components recommended by manufacturer not to be megger tested).
  - .2 Motors and transformers shall not be connected during megger tests.
- .4 Each phase shall be tested between conductor and ground and between phases.
- .5 For 600 V cables, the cable megger test shall be held until three (3) equal readings, each one (1) minute apart, are obtained.
- .6 Lighting circuits and all 120 V power services shall be tested only during construction for continuity and identification and shall pass operational tests to see that the circuits perform all functions for which they are designed.
- .7 120 VAC to 4160 VAC and control cable shall be checked by megger tests similar to those described for 600 V wire and cable (1.4.5). Control wiring shall be checked for proper connection in accordance with interconnection diagrams or tables and for tightness of terminal contacts and continuity through each "run" of control circuiting.
- .8 Complete and accurate records of all cable tests and inspection shall be made

### **1.5 MOTORS**

- .1 All motors large and small shall pass a minimum 100 megaohms reading at room temperature. Any machine not passing this test shall be dried and retested until it either passes or is found unsatisfactory.
- .2 Prior to testing, all rotating equipment shall be inspected for cleanliness, damage, moisture, proper lubrication, oil leaks and phase identification. Proper rotation shall be checked.
- .3 The test shall include the connected motor cables. Where magnetic contactors are used, contactor shall be blocked in closed position so that the section of conductor between

circuit breaker and magnetic contactor is included in test. Control circuit conductors shall be isolated.

- .4 Megger tests shall be applied between all phases tied together and ground. Megger tests shall be taken with motor winding temperatures at room temperature.
- .5 Megger test shall be held for one minute once the megger reading stabilises. Repeat tests to be performed at Departmental Representative's discretion.
- .6 Final acceptance of motors cannot be made until the equipment is energized during operational tests. Operational tests shall prove proper rotation and lubrication. The motor shall not have excessive vibration or unusual heating.
- .7 Motors above 100 hp to be fitted with insulated bearings (drive and non-drive ends).
- .8 Motors below 100 hp to be fitted with ground ring/brushes on the shaft.

## **1.6 BEARING CURRENT MEASUREMENT**

- .1 Shaft Voltage – measure the discharges per minute using a SKF discharge wand.
  - .1 Measure the shaft discharges at start up, commissioning and after the 30 day run in.
  - .2 Provide a report to the Departmental Representative after the 30 day run in period.
  - .3 Immediately report greater than five discharges per minute to the Departmental Representative.

## **1.7 CONTROLS**

- .1 Electrical controls, circuits and systems shall be tested by trial operation of control equipment after all wiring is completed to see that each interlock and control function operates in accordance with the contract drawings, specifications and the description of operation for the equipment. Where field conditions prevent actual equipment functioning during testing, the Contractor shall simulate the intended operating condition in the associated control circuits.
- .2 Locate the cause of any malfunction, within the contractor's scope of responsibility, and make the necessary wiring and/or equipment changes or corrections to obtain the particular systems intended operation as defined by the contract drawings. Costs of these necessary changes are included in the base bid. Such changes shall be included in the test report.
- .3 Control panels shall be operated through all design functions. This shall include remote operation of all equipment and actuation of alarms and indicating devices according to design requirements.
- .4 Complete operational tests shall be given to all relays and control devices to show that the equipment performs all design functions and meets design and procurement specifications.

## **1.8 TRANSFORMERS**

- .1 Locate, install and ground transformers in accordance with manufacturer's instructions.

- .2 Check transformers for dryness before putting it into service if it has been stored on site for any length of time.
- .3 Energize transformers and check secondary no-load voltage.
- .4 Adjust primary taps as necessary to produce rated secondary voltage at no-load.
- .5 Use torque wrench to adjust internal connections in accordance with manufacturers' recommended values.

## **1.9 GROUNDING**

- .1 Loop Impedance – test to demonstrate compliance to CEC 22.1 – Appendix B, 10-500.
  - .1 Use a Fluke 1653B Installation Tester W/Autotest.
  - .2 Use 2403368 NEMA 5-15 Plug 3 ea 4mm Banana.
- .2 Perform ground continuity and resistance tests meeting the approval of Departmental Representative and local authority having jurisdiction over installation.
  - .1 Use a Fluke 1653B Installation Tester W/Autotest.
- .3 Earth Impedance use Geo-Earth-Stake A604510350 Ground/Earth Earth Stake.
- .4 Perform ground impedance tests before energizing electrical system.
- .5 Perform loop impedance tests with electrical system energized.
- .6 Disconnect ground fault indicator during tests.

## **1.10 METERING**

- .1 Verify correct PT and CT ratio and that the connection conforms to manufacturer's recommendation.
- .2 Voltage, current, kW, pf, harmonics, etc., displayed on meter must be verified to Departmental Representative, to be representing actual system characteristics.

## **1.11 MISCELLANEOUS**

- .1 All other breakers, switches, and contactors shall be given complete operational tests to determine that all design functions are satisfactorily performed.
- .2 All switches (control, instrument, disconnect, safety, etc.) shall be inspected and tested as to cleanliness and operation. Contacts so requiring, shall be cleaned before operation.
- .3 Switches shall be checked for correct sequence of operation.
- .4 Fuses shall be inspected for correct rating.
- .5 Coordinate all testing of instruments for those devices.

## **1.12 PANELBOARDS**

- .1 Complete all field tests for panelboards as herein outlined.
- .2 Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads. Maintain proper phasing for multi-wire branch circuits.

- .3 Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.
- .4 Megger check of phase-to-phase and phase-to-ground insulation levels prior to connection of any load circuits.

### **1.13 CIRCUIT BREAKERS – LOW VOLTAGE**

- .1 Complete all field tests for low voltage circuit breakers as herein outlined.
- .2 Visual Inspection
  - .1 Circuit breaker shall be checked for proper mounting, conductor size and feeder designation.
  - .2 Operate circuit breaker to ensure smooth operation.
  - .3 Inspect case for cracks or other defects.
  - .4 Check tightness of connection with torque wrench in accordance with manufacturer's recommendations.
- .3 Electrical Test
  - .1 Measure contact resistance.
  - .2 Insulation resistance shall be determined phase to phase and phase to ground. Test voltage shall be 1000 VDC.
- .4 Test Results
  - .1 Contact resistance shall be compared to adjacent poles and similar breaker. Deviations of more than 50% shall be investigated and corrected.
  - .2 Insulation resistance shall not be less than 50 meg-ohms.

### **1.14 SURGE PROTECTION DEVICES**

- .1 Visual and Mechanical Inspection
  - .1 Inspect lightning surge arresters for physical damage, such as chipped or fractured porcelain.
  - .2 Verify proper mounting and clearances.
  - .3 Check external bolted joints shall be checked for tightness by calibrated torque wrench method.
  - .4 Check ground leads on each device for attachment to a ground bus or ground electrode.
  - .5 Check exhaust ports on expulsion type arresters for any obstructions.
- .2 Electrical Tests
  - .1 A ground continuity test shall be performed to the ground grid system.
  - .2 Varistor surge arresters: Perform tests as recommended by the manufacturer.

### **1.15 RECEPTACLES**

- .1 All field tests for receptacles as herein outlined shall be completed by the Electrical Contractor.

- .2 Verify that each receptacle device is energized.
- .3 Test each receptacle device for proper polarity.
- .4 Test each GFCI receptacle device for proper operation.

#### **1.16 MEDIUM VOLTAGE CABLE**

- .1 All field tests for medium voltage cable as herein outlined shall be completed by the Independent Testing Contractor.
- .2 Each conductor shall be individually hypot tested with other conductors grounded. Shields shall be grounded.
- .3 Terminations shall be properly corona suppressed by guard ring, field reduction sphere, or other suitable methods.
- .4 DC hypotential shall be applied in at least eight equal increments until maximum test voltage is reached. DC leakage current shall be recorded at each step after a constant stabilization time consistent with system charging current decay.
- .5 Graphic plot shall be made of leakage current versus voltage at each increment.
- .6 Test conductor shall be raised to a maximum test voltage and held for a total of 10 min. Readings of leakage current (Y axis) versus time (X axis) shall be recorded and plotted on 30 sec intervals for the first 2 min and every minute thereafter.
- .7 Conductor test potential shall be reduced to zero and grounds applied for at least 10 min.
- .8 Maximum test voltage shall not exceed the maximum test voltage recommended by the cable manufacturer.
- .9 Conductors shall be tested both before and after installation in raceway system.
- .10 Perform a shield continuity test by Ohm meter method. Ohmic value shall be recorded.

#### **1.17 DC HYPOTENTIAL TEST RESULTS**

- .1 Step voltage slope shall be reasonably linear.
- .2 Absorption slope shall be flat or negative. In no case shall slope exhibit positive characteristics.
- .3 Shield continuity test shall exhibit circuit continuity of shield and conductor.

#### **1.18 SWITCHGEAR, MCCS AND SWITCHBOARD ASSEMBLIES**

- .1 Complete all field tests for metal enclosed switchgear as herein outlined.
- .2 Visual and Mechanical Inspection
  - .1 Inspect for physical damage.
  - .2 Verify equipment is supplied and connected in accordance with design specifications.
  - .3 Inspect for proper alignment, anchorage, and grounding.
  - .4 Check tightness of accessible bolted bus joints by calibrated torque wrench method. Refer to manufacturer's instructions for proper foot pound levels.
  - .5 Doors, panels, and sections shall be inspected for paint, scratches and fit.

- .6 Physically test all key interlocking systems.
- .3 Electrical Tests
  - .1 Insulation Resistance Test: Measure insulation resistance of each bus section phase to phase and phase to ground.
  - .2 All electronic equipment shall be disconnected prior to testing.
  - .3 Testing shall proceed final connection and energization of feeders (i.e., prior to placing in service).
- .4 Test Results
  - .1 Values of insulation resistance less than rated kv + 1-in megohms shall be investigated and corrected.

#### **1.19 PAD MOUNTED DISTRIBUTION TRANSFORMERS**

- .1 Complete all field tests for pad mounted distribution transformers as herein outlined.
- .2 Visual and Mechanical Inspection
  - .1 Inspect for physical damage, cracked insulators, tightness of connections, and general mechanical and electrical conditions.
  - .2 Compare equipment nameplate data with design drawings report any discrepancies.
  - .3 Verify proper auxiliary device operation such as fans, sudden pressure device, indicators and tap changer.
  - .4 Check tightness of accessible bolted electrical connections by calibrated torque wrench method. Refer to manufacturer's instructions for proper foot pound levels.
  - .5 Check liquid level in tank for proper level.
  - .6 Perform specific inspections and mechanical tests as recommended by the manufacturer.
- .3 Electrical Tests
  - .1 Perform inspections and tests listed in NEMA ATS, Section 7.2. Include the following optional tests:
    - .1 Winding resistance tests for each winding at nominal and final tap setting.
    - .2 Individual excitation current tests on each phase.
    - .3 Insulating liquid specific gravity, water content, and total combustible gas.
    - .4 Operational test and adjustments on fan and pump controls and alarm functions.
    - .5 Percent oxygen test on nitrogen gas blanket.

#### **1.20 GROUND FAULT SYSTEMS**

- .1 Complete all field tests for ground fault systems as herein outlined.
- .2 Visual and Mechanical Inspection
  - .1 Inspect for physical damage and compliance with drawings and specifications.

- .3 Inspect Neutral main bonding connection to ensure:
  - .1 Zero sequence system is grounded upstream of sensor.
  - .2 Ground strap systems are grounded through sensing device.
  - .3 Ground connection is made ahead of neutral disconnect link.
  - .4 Inspect control power transformer to ensure adequate capacity for system.
  - .5 Proper operation and test sequence shall be recorded.
  - .6 Zero sequence system shall be inspected for symmetrical alignment of core balance transformers about current carrying conductors.
  - .7 Ground fault device circuit nameplate identification shall be verified by actuation observation.
  - .8 Pickup and time delay settings shall be set in accordance with settings developed through verification with Departmental Representative.
- .4 Electrical Tests
  - .1 System neutral insulation resistance shall be measured to ensure no shunt ground paths exist, neutral ground disconnect link shall be removed, neutral insulation resistance measured, and link replaced.
- .5 Test Parameters
  - .1 System neutral insulation shall be minimum of 100 ohms preferably 1 meg-ohm or larger.

**Part 2 Products**

- .1 Not applicable.

**Part 3 Execution**

**3.1 GENERAL FIELD TESTING REQUIREMENTS**

- .1 Complete the following testing requirements:
  - .1 Test work and equipment installed to ensure its proper and safe operation in accordance with intent of drawings and specifications.
  - .2 Check interlocking and automatic control sequences and test operation of safety and protective devices.
  - .3 Correct defects.
  - .4 Cooperate with electrical utility, suppliers', and manufacturer's representatives in order to achieve proper and intended operation of equipment.
  - .5 Test, adjust, and record operating voltages at each system level before energizing branch circuits.
- .2 Transformer taps must be adjusted to obtain as near as possible nominal system voltage.
- .3 Where transformer is under utility jurisdiction, obtain services of utility to correct voltage.
- .4 Replace devices and equipment damaged due to failure to comply with this requirement.
- .5 Balance load among feeders conductors at each panelboard, switchboard, or substation, and reconnect loads as may be necessary to obtain a reasonable balance of load on each



phase. Electrical unbalance shall not exceed 7½% between phases. If the Contractor feels that because of the nature of the load, a 7½% or less unbalance cannot be achieved, the Contractor shall submit written request to the Departmental Representative for approval.

### **3.2 TEST REPORTS**

- .1 During each of the aforementioned tests, maintain a comprehensive set (quantity of duplicates to be determined by Departmental Representative) of test reports defining the specific condition in which the apparatus is left, after it has been given approval for use in its intended service. The completed reports shall become the property of the Departmental Representative.
- .2 A checklist type report for each individual item of major electrical equipment should be headed with, but not limited to, the following identification data defining:
  - .1 Equipment Name.
  - .2 Item Tag Number.
  - .3 Manufacturer.
  - .4 Type of Class.
  - .5 Application.
  - .6 Plant Location.
  - .7 Voltage Rating.
  - .8 Date of Test.
  - .9 Ambient Conditions.
  - .10 Testers Signature.
- .3 Among the specific requirements of testing to determine the equipment's operational condition relative to that particular apparatus, all items shall be visually inspected and evaluated on the report as to its general condition both exterior and interior.
- .4 Unless otherwise directed by Departmental Representative, the forms used for testing shall be those that are available by the particular equipment's manufacturer and as per Division 1.

### **3.3 EQUIPMENT TO BE TESTED**

- .1 Building wire and cable.
- .2 Wiring devices.
- .3 Grounding.
- .4 Motors.
- .5 Feeders.
- .6 Motor controllers and control centers.
- .7 Dry type transformers.
- .8 Circuit breakers
- .9 Panelboards.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 CSA C22.2 No .0.3, Test Methods for Electrical Wires and Cables.
- .2 Additional section references:
  - .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 74 21 - Waste Management and Disposal.
  - .3 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

**1.2 PRODUCT DATA**

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

**1.3 WASTE MANAGEMENT AND DISPOSAL**

- .1 Only applicable when Section 01 74 21 – Construction/Demolition Waste Management and Disposal, is part of contract.
- .2 Separate and recycle waste materials in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .3 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
- .4 Fold up metal banding, flatten and place in designated area for recycling.

**Part 2 Products**

**2.1 BUILDING WIRES**

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 1000 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.
- .3 Copper conductors: size as indicated, with thermoplastic insulation type TWU or TWH, rated at 600 V.

**2.2 CONTROL CABLES**

- .1 Type LVT: 2 soft annealed copper conductors, sized as indicated, with thermoplastic insulation, outer covering of thermoplastic jacket, and armour of closely wound aluminum wire.
- .2 Low energy 300 V control cable: stranded annealed copper conductors sized as indicated, with PVC insulation type TW, TW -40°C or TWH polyethylene insulation with shielding of metallized tape with wire braid over all conductors and overall covering of PVC jackets.

- .3 600 V type: stranded conductors, sizes as indicated with PVC insulation type RW90 and overall covering of thermoplastic jacket with sheath of aluminum interlocked armour and jacket over sheath of PVC thermosetting compound.

## **2.3 FITTINGS**

- .1 In wet, damp location indoors or outdoors StarTeck compression fittings or equivalent shall be used.
- .2 For hazardous locations, a Class I hazardous location sealing fitting shall be added.

## **Part 3 Execution**

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

- .1 Install wiring as follows:
  - .1 In conduit systems in accordance with Section 26 05 34.

### **3.2 INSTALLATION OF CONTROL CABLES**

- .1 Install control cables in conduit.
- .2 Ground control cable shield.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE)
  - .1 ANSI/IEEE 837- IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.
- .2 CSA International
  - .1 CSA C22.2 Rule 10-500 including Appendix B.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for grounding equipment and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Sustainable Design Submittals:
  - .1 Construction Waste Management:
    - .1 Submit project Waste Reduction Workplan highlighting recycling and salvage requirements.
    - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.

**1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for grounding equipment for incorporation into manual.

**1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect wire and box connectors from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

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

## **Part 2 Products**

### **2.1 EQUIPMENT**

- .1 Clamps for grounding of conductor: size as indicated and as required to electrically conductive underground water pipe.
- .2 Copper conductor: minimum 6 m long for each concrete encased electrode, bare, stranded, tinned, soft annealed, size as indicated.
- .3 Grounding conductors: bare stranded copper, tinned, soft annealed, size as indicated.
- .4 Insulated grounding conductors: green, copper conductors, size as indicated.
- .5 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .6 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
  - .1 Grounding and bonding bushings.
  - .2 Protective type clamps.
  - .3 Bolted type conductor connectors.
  - .4 Thermit welded type conductor connectors.
  - .5 Bonding jumpers, straps.
  - .6 Pressure wire connectors.

## **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 grounding equipment installation in accordance with manufacturer's written instructions.
  - .1 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .2 Proceed with installation only after unacceptable conditions have been remedied.

### **3.2 INSTALLATION GENERAL**

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.

- .4 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .5 Soldered joints not permitted.
- .6 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .7 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .8 Connect building structural steel and metal siding to ground by welding copper to steel.
- .9 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .10 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.
- .11 Ground secondary service pedestals.

### **3.3 EQUIPMENT GROUNDING**

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting, cable trays.

### **3.4 GROUNDING BUS**

- .1 Install copper grounding bus mounted on insulated supports on wall of electrical room and communication equipment room.
- .2 Ground items of electrical equipment in electrical room and IT equipment in communication equipment room to ground bus with individual bare stranded copper connections size 1/0AWG.

### **3.5 COMMUNICATION SYSTEMS**

- .1 Install grounding connections for fire alarm as required by code.

### **3.6 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Perform loop impedance tests with electrical system energized.
- .5 Disconnect ground fault indicator during tests.

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

**END OF SECTION**



**Part 1            General****1.1                SHOP DRAWINGS AND PRODUCT DATA**

- .1        Submit shop drawings and product data to the Departmental Representative for approval.

**1.2                DEFINITIONS**

- .1        Junction Box: A box where conductors are spliced with or without terminal blocks, generally not scheduled on drawings or tagged in field. Junction Box can be used as a Pull Box for some cables.
- .2        Terminal Box: A box containing terminal blocks to connect conductors, generally scheduled on drawings and tagged in field as AJB, CJB, DJB and EJB for instrumentation and electrical circuits respectively.
- .3        Pull Box: A box used to ease the pulling of conductors. May be a through-pull or a T or X conduit connection, but no splicing of conductors is being done. Generally, not scheduled on drawings or tagged in field.
- .4        Panel: An enclosure containing electrical control components such as relays, controllers and the like or an enclosure with a large number of terminal blocks for the purpose of serving as a marshalling point for a number of branch circuits. Scheduled on drawings and tagged in field.
- .5        Splitter: An enclosure containing a splitter block or bus bars for the connection of a main circuit and several branch circuits.

**Part 2            Products****2.1                ACCEPTABLE MANUFACTURERS**

- .1        Catalogue numbers specified are for the purpose of illustrating features and to establish the grade of quality of the products specified in this section and are taken from one manufacturer's product line. Unless otherwise noted, products from other listed manufacturers that have identical features and characteristics are acceptable.
- .2        Acceptable manufacturers:
  - .1        Appleton.
  - .2        BEL.
  - .3        Hammond.
  - .4        Hoffman.
  - .5        Pursley.
  - .6        Or approved equal.
- .3        All equipment shall be CSA certified.

**2.2 SPLITTERS**

- .1 Compliance: CSA C22.2 - No. 76.
- .2 Sheet metal enclosure, welded corners and formed hinged gasketed cover suitable for locking in closed position.
- .3 Main and branch lugs or connection bars to match required size and number of connecting conductors as indicated.
- .4 At least three (3) spare terminals on each set of lugs in splitters.

**2.3 JUNCTION AND PULL BOXES**

- .1 For outlet and conduit boxes refer to Division 26.
- .2 Metal enclosure, NEMA Type 4 for process areas and NEMA Type 12 for electrical rooms.
- .3 Exterior pull boxes to be non-metallic and suitable for vehicle traffic. Open bottom, four sided with raceway openings and lid. Depth to be approximately 1000mm or by specific vendor.

**2.4 TERMINAL AND PULL BOXES**

- .1 Intended for surface mounting, except as otherwise shown or specified.
- .2 Weatherproof Style
  - .1 Metal enclosure, NEMA Type 4.
  - .2 Hinged door if any one (1) dimension exceeds 300 mm.
  - .3 Manufactured breather, designed to maintain weatherproof classification of enclosure.
  - .4 When used as terminal box, equipped with mounting pan and terminal strip.
- .3 Weather- and Corrosion-Proof
  - .1 Same features as for weather proof style, non-metallic, NEMA Type 4X enclosure.
  - .2 Quick-release latches.
- .4 Indoor Dry Location
  - .1 Welded steel or aluminum NEMA Type 12 enclosure.
  - .2 Hinged cover with quick-release latch or automotive handle, for enclosures which exceed 300 mm in width or height.

**2.5 PANELS**

- .1 Intended for surface mounting, except as otherwise shown or specified.
- .2 Single or double door construction with stainless steel full-length hinge.
- .3 Minimum standard: Formed and welded NEMA Type 12 construction, of minimum 1.8 mm thick sheet steel, with automotive door handle.
- .4 For process and outdoor areas: Formed and welded NEMA Type 4 construction of minimum 2 mm thick sheet aluminum, with stainless steel door clamps.

- .5 Full size equipment mounting pan of formed sheet metal.

## **2.6 EQUIPMENT MOUNTING HARDWARE**

- .1 Mounting straps, brackets and fastening hardware designed for the installation of terminal blocks.
- .2 Welded studs in sheet metal enclosures to avoid penetration of enclosure walls.
- .3 Raised cast bosses in cast metal enclosures, drilled and tapped, for hardware installation.

## **2.7 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Division 26.

## **Part 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 PANELS INSTALLATION**

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount panels with top not higher than 2 m above finished floor, coordinated with masonry, panelboards, fire hose cabinets and similar items.
- .3 Install terminal blocks as indicated using mounting straps and hardware designed for this purpose.
- .4 Only main pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit runs between pull boxes as specified in Division 26.
- .5 Minimum standard in Process Areas and below grade locations is NEMA Type 4.
- .6 Install a breather in locations of high humidity and changing temperature conditions; the downgrading to weatherproof of the enclosure will be acceptable.
- .7 Where boxes terminate conduits at interior walls below grade elevation, provide a drain hole in the bottom of the box suitable for accumulated moisture drainage

**END OF SECTION**

**Part 1            General**

**1.1            REFERENCES**

- .1        CSA 22.1, Canadian Electrical Code, Part 1.

**1.2            GENERAL**

- .1        Establish installation method based on area use; provide concealed installation in finished areas; embed or surface mount boxes on unfinished poured concrete walls as indicated.
- .2        Installation methods to be consistently followed in each area.

**Part 2           Products**

**2.1            OUTLET AND CONDUIT BOXES GENERAL**

- .1        Size boxes in accordance with CSA C22.1.
- .2        102 mm or larger outlet boxes as required for special devices.
- .3        Gang boxes where wiring devices are grouped.
- .4        Blank cover plates for boxes without wiring devices.
- .5        Combination boxes with barriers where outlets for more than one system are grouped.
- .6        Provide corrosion resistant boxes in corrosive areas.

**2.2            SHEET STEEL OUTLET BOXES**

- .1        Electro-galvanized steel single and multi-gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. Use 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .2        Use 102 mm square or octagonal outlet boxes for lighting fixture outlets.

**2.3            MASONRY BOXES**

- .1        Electro-galvanized steel masonry single gang boxes for devices flush mounted in exposed block walls.

**2.4            CONDUIT BOXES**

- .1        Cast FS Feraloy boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle.

**2.5            FITTINGS - GENERAL**

- .1        Bushing and connectors with nylon insulated throats.
- .2        Knock out fillers to prevent entry of debris.
- .3        Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
- .4        Double locknuts and insulated bushings on sheet-metal boxes.

**Part 3            Execution****3.1                INSTALLATION**

- .1       Support boxes independently of connecting conduits.
- .2       Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3       For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4       Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.
- .5       Identify systems for outlet boxes as required.

**END OF SECTION**

**Part 1            General**

**1.1            REFERENCES**

- .1 Canadian Standards Association (CSA International):
  - .1 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
  - .2 CSA C22.2 No. 45, Rigid Metal Conduit.
  - .3 CSA C22.2 No. 56 Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .4 CSA C22.2 No. 83, Electrical Metallic Tubing.
  - .5 CSA C22.2 No. 211.2, Rigid PVC (Unplasticized) Conduit.
  - .6 CAN/CSA C22.2 No. 227.3, Non-metallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).

**1.2            ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data: submit manufacturer's printed product literature, specifications and datasheets:
  - .1 Submit cable manufacturing data.
- .3 Quality assurance submittals:
  - .1 Test reports: submit certified test reports.
  - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .3 Instructions: submit manufacturer's installation instructions.

**1.3            WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

**Part 2            Products**

**2.1            CABLES AND REELS**

- .1 Provide cables on reels or coils:
  - .1 Mark or tag each cable and outside of each reel or coil, to indicate cable length, voltage rating, conductor size, and manufacturer's lot number and reel number.
- .2 Each coil or reel of cable to contain only one continuous cable without splices.
- .3 Identify cables for exclusively dc applications.

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## 2.2 CONDUITS

- .1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded.
- .2 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.
- .3 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .4 Rigid PVC conduit: to CSA C22.2 No. 211.2.
- .5 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.
- .6 Flexible PVC conduit: to CAN/CSA-C22.2 No. 227.3.
- .7 For hazardous location use, unless specified otherwise rigid metal conduit will be used. Galvanized rigid steel threaded conduit or threaded aluminum conduit.
- .8 For corrosive areas, unless specified otherwise use:
  - .1 Epoxy coated rigid metal conduit
  - .2 Rigid PVC conduit.
  - .3 Fibreglass reinforced plastic (FRP) upon Departmental Representative approval.
- .9 Use electrical metallic tubing (EMT) above 2.4 m or where not subject to mechanical damage. Aluminum above grade in non-corrosive environments and steel above or below grade with protective coating for corrosion.
- .10 Use rigid metal conduit and tamper proof screws for supports in locations that are inmate accessible.
- .11 Motor / Vibrating equipment connections:
  - .1 Use flexible metal conduit for connection in dry areas.
  - .2 Use liquid tight flexible metal conduit for connection in damp, wet or corrosive locations.
  - .3 Use explosion proof flexible connection for connections in zone classified areas.
  - .4 Flexible runs shall not exceed the maximum distance allowed by CEC Part 1.

## 2.3 CONDUIT FASTENINGS

- .1 One-hole steel straps to secure surface conduits 50 mm and smaller:
  - .1 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 on centre.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.

## 2.4 CONDUIT FITTINGS

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Factory "ells" where 90° bends are required for NPS 25 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT. Set-screws are not acceptable. Grounding must be maintained throughout the raceway.

## **2.5 FISH CORD**

- .1 Polypropylene.
- .2 For spare conduit, prior to closing conduit with end cap, fish cord:
  - .1 To be taped to inside of end cap.
  - .2 Or, taped near end of conduit such that it is accessible in the future.

## **2.6 MANUFACTURERS**

- .1 Schedule 40 PVC type
  - .1 IPEX, Scepter Series.
  - .2 Allied Tube and Conduit, Schedule 40 PVC.
  - .3 Carlon Plus 40® Series.
  - .4 Cantex, Forte-Duct® Conduit - UL Schedule 40.
- .2 Galvanized Rigid Metal Conduit
  - .1 Allied Electrical Group.
  - .2 Or approved equivalent.
- .3 Schedule 80 PVC type:
  - .1 IPEX, Super Duct Series.
  - .2 Carlon Plus 80® Series.
  - .3 Allied Tube and Conduit, Schedule 80 PVC.
  - .4 Cantex, Schedule 80.
- .4 EMT
  - .1 Allied Electrical Group.
  - .2 Republic Conduit.
  - .3 Tomas & Betts.
  - .4 Or approved equivalent.

## **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 datasheets.

### **3.2 INSTALLATION**

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.
- .3 Install conduit sealing fittings in hazardous areas. Fill with compound.



- .4 Minimum conduit size for lighting and power circuits: 19 mm.
- .5 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10<sup>th</sup> of its original diameter.
- .6 Mechanically bend steel conduit over 19 mm dia.
- .7 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .8 Provide grounding clamps on the unions where the length of non-threaded conduit exceeds the allowed distance in the CEC Part 1.
- .9 Install fish cord in empty conduits.
- .10 Run 2-NPS 25 mm spare conduits up to ceiling space and 2-NPS 25 mm spare conduits down to ceiling space from each flush panel. Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in flush concrete surface type box.
- .11 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .12 Dry conduits out before installing wire.

### **3.3 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 or surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

### **3.4 CONCEALED CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

### **3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
- .2 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.
- .4 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## **Part 1            General**

### **1.1            SECTION INCLUDES**

- .1      This section specifies the supply and installation of Dry Type Power Transformers.
- .2      Not to be applied to instrumentation / control transformers.

### **1.2            REFERENCES**

- .1      Canadian Standards Association (CSA International).
  - .1      CSA Standard C22.2, No. 47, Air Cooled Transformers (Dry Type).
  - .2      CSA C9, Dry-Type Transformers.
  - .3      CSA C802.2 Minimum Efficiency Values for Dry-Type Transformers.
- .2      Additional section references: Division 26.

### **1.3            SUBMITTALS FOR REVIEW**

- .1      Submit the following to the Departmental Representative for approval.
- .2      Shop drawings and product data which includes the following information:
  - .1      Dimensioned drawing showing enclosure, mounting devices, terminals, taps, internal and external component layout.
  - .2      Weight, dry / wet as applicable.
  - .3      Technical data:
    - .1      Type to be indicated as: dry, wet, laminated core, toroidal, autotransformer, polyphase, resonant, constant voltage, ferrite core, planar, isolation, etc.
    - .2      kVA rating.
    - .3      Primary and secondary voltages.
    - .4      Frequency.
    - .5      Single or three phase.
    - .6      Full load efficiency.
    - .7      Regulation at unity pf.
    - .8      BIL<sup>1</sup>
    - .9      Insulation class/type.
    - .10     Sound rating.
    - .11     Impedance.
    - .12     X/R Ratio.

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<sup>1</sup> Basic-Impulse Insulation Level

#### **1.4 SUBMITTALS FOR INFORMATION ONLY**

- .1 Submit the following to the Departmental Representative for approval:
  - .1 Operation and maintenance information for incorporation into manual.
    - .1 Mounting details of transformer.
  - .2 Operation and maintenance instructions to include:
    - .1 Tap changing.
    - .2 Recommended environmental conditions.
    - .3 Recommended periodic inspection and maintenance.
    - .4 Bushing replacement.

### **Part 2 Products**

#### **2.1 ACCEPTABLE MANUFACTURERS**

- .1 Unless otherwise approved by the Departmental Representative, transformers to be of one manufacture throughout.
- .2 Acceptable Manufacturers (in alphabetical order):
  - .1 Eaton
  - .2 Federal Pioneer.
  - .3 Hammond.
  - .4 Synergy Energy.
  - .5 Rex Manufacturers.
  - .6 Engineering approved alternates.

#### **2.2 DESIGN**

- .1 Dry-type, ANN<sup>2</sup>, ventilated NEMA 12 enclosure for transformers located indoors.
- .2 Minimum efficiency to be:
  - .1 97.6% for general purpose transformers.
- .3 Primary voltage: As indicated.
- .4 Secondary voltage: As indicated.
- .5 Lighting Transformers: As indicated.
- .6 Frequency: 60 Hz.
- .7 Windings: Copper only.
- .8 Primary taps above normal: 2-2½% full capacity.
- .9 Primary taps below normal: 2-2½% full capacity.
- .10 kVA size: As indicated.

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<sup>2</sup> Air cooled, natural circulation.

- .11 Impedance:
  - .1 3-4% max. up to 112.5 kVA.
- .12 Sound level:
  - .1 45 dB max. up to 45 kVA.
  - .2 Impulse level: 10 kV B.I.L.
- .13 Mounting fixture / frame to be complete with anti-vibration pads.

## **2.3 INSULATION**

- .1 Class H (220°C) insulation with maximum 130°C rise with continuous full load.

## **2.4 ENCLOSURE**

- .1 Fabricated from sheet steel.
- .2 Bolted removable panels for access to tap connections, enclosed terminals, fan brackets, fans, and other accessories.
- .3 Conductor entry:
  - .1 Knockouts.
  - .2 Potheads.
  - .3 Junction boxes.
  - .4 Bushings.
  - .5 Clamping rings.
  - .6 Entry for cable.
- .4 Designed for MCC, floor, or wall mounting as indicated.
- .5 Indoor, ventilated, self-cooled type. Temperature of exposed metal parts not to exceed 65°C rise.
- .6 Pad mounted type:
  - .1 Conductor entry through bottom for underground distribution, with separate high and low voltage compartments divided by full length metal barrier.
  - .2 Each compartment to have access door with concealed hinges.
  - .3 Secondary door to have 3-point latch, external operating handle, provision for padlocking and arranged so that secondary door must be open before access gained to primary compartment.
- .7 Open type: no enclosure, for installation in switchgear enclosure.

## **2.5 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Division 26.

**Part 3            Execution**

**3.1                INSTALLATION**

- .1 Unless indicated otherwise in drawings mount transformers within buildings as:
  - .1 75kVA or less on wall.
- .2 Ensure adequate clearance around transformers for ventilation.
  - .1 Orient vents away from wall, perpendicular to wall, to ensure good air cross flow.
- .3 Install transformers in level upright position.
- .4 Remove shipping supports only after transformer is installed.
- .5 Loosen isolation pad bolts until no compression is visible.
- .6 Make primary and secondary connections in accordance with wiring diagram.
- .7 Energize transformers after installation is complete.

**3.2                FIELD TESTING AND INSPECTION**

- .1 Conduct tests in accordance with Division 26 and in accordance with manufacturer's recommendation

**END OF SECTION**

**Part 1 General**

**1.1 SUBMITTALS**

- .1 Approval documents shall include drawings. Drawings shall contain overall panelboard dimensions, interior mounting dimensions, and wiring gutter dimensions. The location of the main, branches, and solid neutral shall be clearly shown. In addition, the drawing shall illustrate one line diagrams with applicable voltage systems.
- .2 Operations and Maintenance Manuals: Manufacturer shall provide installation instructions and NEMA Standards Publication PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

**Part 2 Products**

**2.1 PANELBOARDS**

- .1 Panelboard Manufactures:
  - .1 Eaton Pow-R-Line Series.
  - .2 Schneider Electric NF, NQ, NQOD.
  - .3 Siemens equivalents.
- .2 The 208/120 V lighting panel boards bus and breakers rated:
  - .1 For minimum 10,000 A (symmetrical) interrupting capacity.
  - .2 To match panel interrupting capacity or as shown on drawings.
- .3 The 347/600 V and 600 V panel boards bus and breakers rated:
  - .1 For minimum 22,000 A (symmetrical) interrupting capacity.
  - .2 To match panel interrupting capacity or as shown on drawings.
- .4 Panel boards: mains, number of circuits, and number and size of branch circuit breakers as indicated on schedules.

**2.2 CONSTRUCTION**

- .1 Interior
  - .1 Continuous main current ratings, as indicated on associated schedules and drawings, not to exceed 600 amperes maximum.
  - .2 Provide one (1) continuous bus bar per phase. Each bus bar shall have sequentially phased branch circuit connectors suitable for plug-on or bolt-on branch circuit breakers. The bussing shall be fully rated. Bussing shall be plated copper as standard construction. Bus bar plating shall run the entire length of the bus bar.
  - .3 All current-carrying parts shall be insulated from ground and phase-to-phase by high dielectric strength thermoplastic.

- .4 A solidly bonded copper equipment ground bar shall be provided.
  - .5 Split solid neutral shall be plated and located in the mains compartment up to 225 amperes so all incoming neutral cable may be of the same length. CSA Listed panelboards with 200% rated solid neutral shall be plated copper for non-linear load applications (200% Neutral only required when specified). Panelboards shall be marked for non-linear load applications.
  - .6 Interior trim shall be of dead-front construction to shield user from energized parts. Dead-front trim shall have filler plates covering unused mounting spaces.
  - .7 Nameplates shall contain system information and catalogue number or factory order number. Interior wiring diagram, neutral wiring diagram, CSA Listed label and short circuit current rating shall be displayed on the interior or in a booklet format.
  - .8 Interiors shall be field convertible for top or bottom incoming feed. Main circuit breakers in 100A interiors shall be horizontally mounted. Main circuit breakers over 100A shall be vertically mounted. Sub-feed circuit breakers shall be vertically mounted. Main lug interiors up to 400 amperes shall be field convertible to main breaker. Interior levelling provisions shall be provided for flush mounted applications.
  - .9 Interior phase bus shall be pre-drilled to accommodate field installable options (NQ only), i.e., Sub-Feed Lugs, Sub-Feed Breakers, Thru-Feed Lugs.
- .2 Main Circuit Breaker
- .1 Main circuit breakers shall have an over center, trip-free, toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have a permanent trip unit with thermal and magnetic trip elements in each pole. Each thermal element shall be true rms sensing and be factory calibrated to operate in a 40°C ambient environment. Thermal elements shall be ambient compensating above 40°C.
  - .2 Two- and three-pole circuit breakers shall have common tripping of all poles. Circuit breaker frame sizes above 100 amperes shall have a single magnetic trip adjustment located on the front of the circuit breaker that allows the user to simultaneously select the desired trip level of all poles. Circuit breakers shall have a push-to-trip button for maintenance and testing purposes.
  - .3 Breaker handle and faceplate shall indicate rated ampacity. Standard construction circuit breakers shall be rated for reverse connection without restrictive line or load markings.
  - .4 Circuit breaker escutcheon shall have international I/O markings, in addition to standard ON/OFF markings. Circuit breaker handle accessories shall provide provisions for locking handle in the ON or OFF position.
  - .5 Lugs shall be CSA Listed to accept solid or stranded copper conductors only. Lugs shall be suitable for 90° C rated wire, sized according to the 75°C temperature rating. Lug body shall be bolted in place; snap-in designs are not acceptable.
  - .6 The circuit breakers shall be CSA Listed for use with the following accessories: Shunt Trip, Under Voltage Trip, Ground Fault Shunt Trip, Auxiliary Switch, Alarm Switch, Mechanical Lug Kits, and Compression Lug Kits.

.3 Branch Circuit Breakers

- .1 Circuit breakers shall be CSA and UL Listed with amperage ratings, interrupting ratings, and number of poles as indicated on the associated schedules and drawings.
- .2 Moulded case branch circuit breakers shall have bolt-on type bus connectors.
- .3 Circuit breakers shall have an overcenter toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have thermal and magnetic trip elements in each pole. Two- and three-pole circuit breakers shall have common tripping of all poles.
- .4 There shall be two forms of visible trip indication. The breaker handle shall reside in a position between ON and OFF. In addition, there shall be a red VISI-TRIP® indicator appearing in the clear window of the circuit breaker housing.
- .5 The exposed faceplates of all branch circuit breakers shall be flush with one another.
- .6 Lugs shall accept solid or stranded copper conductors only. Lugs shall be suitable for 90° C rated wire. Branch circuit breakers rated 20 amperes and below shall be CSA Listed to accept 60°C rated wire.
- .7 Breakers shall be CSA Listed for use with the following factory installed accessories: Shunt Trip, Auxiliary Switch, and Alarm Switch.
- .8 Breakers feeding fire alarm panels shall be permanently painted red.

.4 Enclosures

- .1 Type 1 Boxes for dry areas, Type 4 in wet areas.
- .2 Boxes shall be galvanized steel constructed. Galvannealed steel will not be acceptable.
- .3 Boxes shall have removable endwalls with knockouts located on one end. Boxes shall have welded interior mounting studs. Interior mounting brackets are not required.
- .4 Box width shall be 26" wide maximum.
- .5 Front shall have ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel where panel is loose equipment. Front shall be sand color when connected to MCC or switchgear. Front shall be orange for UPS panels.
- .6 Fronts shall be 1-piece with door. Mounting shall be as indicated on associated schedules or drawings.
- .7 Panelboards shall have MONO-FLAT fronts with concealed door hinges and mounted with trim screws. Front shall not be removable with the door locked. Doors on front shall have rounded corners and edges shall be free of burrs.
- .8 Front shall have cylindrical tumbler type lock with catch and spring-loaded stainless steel door pull. All lock assemblies shall be keyed alike. Two (2) keys shall be provided with each lock. A clear plastic directory cardholder shall be mounted on the inside of door.



## **2.3 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Division 26.
- .2 Complete circuit directory with typewritten legend showing equipment tag for each circuit. Handwritten directory is not acceptable.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Locate panel boards as indicated and mount securely, plumb, and true and square, to adjoining surfaces.
- .2 Install surface mounted panel boards on plywood backboards. Where practical, group panel boards on common backboard. Install panelboards in accordance with manufacturer's written instructions, NEMA PB 1.1 and NEC standards
- .3 Mount panel boards to height specified in Division 26.
- .4 Connect loads to circuits and balance loads.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.
- .6 Inspect complete installation for physical damage, proper alignment, anchorage, and grounding.
- .7 Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads within 20% of each other. Maintain proper phasing for multi-wire branch circuits.
- .8 Check tightness of bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written specifications

**END OF SECTION**

**Part 1            General**

**1.1            SECTION INCLUDES**

- .1        Materials for moulded-case circuit breakers.

**1.2            REFERENCES**

- .1        Canadian Standards Association (CSA International).
  - .1        CSA-C22.2 No. 5-02, Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

**1.3            SUBMITTALS**

- .1        Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2        Include time-current characteristic curves for breakers with interrupting capacity of 22,000 A symmetrical (RMS) and over at system voltage.
- .3        Include arc flash characteristics and indicate on all panels and disconnect switches as to arch hazard and category levels.

**Part 2           Products**

**2.1            BREAKERS GENERAL**

- .1        Moulded-case circuit breakers to CSA C22.2 No. 5
- .2        Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.
- .3        Common-trip breakers: with single handle for multi-pole applications.
- .4        Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
  - .1        Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .5        Circuit breakers with interchangeable trips as indicated.
- .6        Circuit breakers to have minimum 22 kA symmetrical RMS interrupting capacity rating.

**2.2            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.

**2.3            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            BUSDUCT BREAKERS**

- .1        Existing bus duct is Square D, I-Line, 800A, 600V, 3 Phase, 4 W, 100% neutral aluminum feeder type.
- .2        New key interlock busduct breakers must be compatible with existing busduct. New busduct breakers replacing new must

**2.5            OPTIONAL FEATURES**

- .1        Include:
  - .1        Shunt trip.
  - .2        Auxiliary switch.
  - .3        Motor-operated mechanism c/w time delay unit.
  - .4        Under-voltage release.
  - .5        On-off locking device.
  - .6        Handle mechanism.

**Part 3           Execution**

**3.1            INSTALLATION**

- .1        Install circuit breakers as indicated.

**END OF SECTION**

**Part 1 General****1.1 REFERENCES**

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 74 21 – Waste Management and Disposal.
- .3 Section 26 05 00 – Common Work Results for Electrical.

**1.2 PRODUCT DATA**

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

**1.3 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Waste Management and Disposal.
- .2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
- .3 Fold up metal banding, flatten and place in designated area for recycling.

**Part 2 Products****2.1 DISCONNECT SWITCHES**

- .1 Non-fusible, disconnect switch in CSA Enclosure, size as indicated on drawings.
- .2 Provision for padlocking in on-off off switch position by three locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Quick-make, quick-break action.
- .5 ON-OFF switch position indication on switch enclosure cover.

**2.2 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00.
- .2 Indicate name of load controlled on size 4 nameplate.

**Part 3 Execution****3.1 INSTALLATION**

- .1 Install disconnect switches complete with fuses if applicable.

**END OF SECTION**

**Part 1            General**

**1.1            PRODUCT DATA**

- .1        Submit product data in accordance with Division 1.

**1.2            REFERENCES**

- .1        Section 26 05 00 - Common Work Results for Electrical.

**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 equipment and include product characteristics, performance criteria, physical size, finish and limitations.
- .3        Sustainable Design Submittals:
  - .1            Construction Waste Management:
    - .1                Submit project Waste Reduction Workplan highlighting recycling and salvage requirements.
    - .2                Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.

**1.4            CLOSEOUT SUBMITTALS**

- .1        Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2        Operation and Maintenance Data: submit operation and maintenance data for equipment for incorporation into manual.

**1.5            DELIVERY, STORAGE AND HANDLING**

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

**Part 2            Products**

**2.1               CONTACTORS**

- .1      Electrically held controlled by pilot devices as indicated and rated for type of load controlled.
- .2      Breaker combination contactor as indicated.
- .3      Complete with 2 normally OPEN and 2 normally CLOSED auxiliary contacts unless indicated otherwise.
- .4      Control transformer in contactor enclosure.

**2.2               EQUIPMENT IDENTIFICATION**

- .1      Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2      Size 4 nameplate indicating name of load controlled if installed outside an MCC.

**Part 3            Execution**

**3.1               INSTALLATION**

- .1      Install contactors and connect auxiliary control devices.

**END OF SECTION**

## **Part 1            General**

### **1.1            DESCRIPTION**

- .1      This section specifies starting equipment for single and three phase motors up to 600 V.
- .2      Where indicated on the drawings, supply and install starters and all necessary apparatus. Starters to be mounted in MCCs or in separate enclosures as shown. Wiring and accessories to be as per schematic diagrams.
- .3      Where starters have been provided by others, supply and install disconnects and wire to the terminals of the equipment.

### **1.2            REFERENCES**

- .1      Conform to the following reference standards in accordance with Division 1.
  - .1          NEMA
- .2      Additional References:
  - .1          Section 26 05 00 - Common Work Results for Electrical.
  - .2          Section 26 28 21 - Moulded Case Circuit Breakers.

### **1.3            SHOP DRAWINGS AND PRODUCT DATA**

- .1      Submit shop drawings and product data in accordance with Division 01.
- .2      Indicate:
  - .1          Mounting method and dimensions.
  - .2          Starter size and type.
  - .3          Layout of identified internal and front panel components.
  - .4          Enclosure types.
  - .5          Wiring diagram for each type and size of starter.
  - .6          Interconnection diagrams.

### **1.4            OPERATION & MAINTENANCE DATA**

- .1      Provide data for incorporation into maintenance manual specified in Section 26 05 00.
- .2      Include operation and maintenance data for each type and size of starter.

## **Part 2            Products**

### **2.1            MATERIALS**

- .1      Starters: NEMA E14-1:
  - .1          Half size starters not acceptable.
  - .2          Interrupting Capacity: to match MCC rating or panel feeding starter.
  - .3          Provide NEMA Type 12 enclosures in electrical rooms and control rooms.

- .4 All enclosures for mounting outside of electrical rooms and control rooms to be NEMA Type 4. In a corrosive environment, use non-metallic or stainless steel NEMA Type 4X enclosures.

## **2.2 MANUAL MOTOR STARTERS**

- .1 Single and three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
  - .1 Switching mechanism, quick make, and break.
  - .2 One (1) or three (3) overload heater(s), manual reset, trip indicating handle.
  - .3 Single-phase motors equipped with inherent temperature protection only require suitable H.P. rated disconnects.
- .2 Accessories:
  - .1 Key switch, pushbutton: Heavy duty, oil tight. Labeled as per Section 26 05 00.
  - .2 Indicating light: Heavy duty, oil tight, Labeled as per Section 26 05 00.
  - .3 Locking tab to permit padlocking in "ON" or "OFF" position.

## **2.3 FULL VOLTAGE NON-REVERSING MAGNETIC STARTERS**

- .1 Full voltage magnetic starters of size, type, rating, and enclosure type as indicated with components as follows:
  - .1 Contactor three-pole, solenoid operated, and rapid action type.
  - .2 Motor overload protective device in each phase, manually reset from outside enclosure.
  - .3 Adjustable solid-state overload devices ambient compensated type.
  - .4 Power and control interface terminals strips.
  - .5 Wiring and schematic diagram inside starter enclosure in visible location.
  - .6 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- .2 Accessories:
  - .1 Pushbuttons, selector switches: Heavy duty, oil tight, labeled as per Section 26 05 00.
  - .2 Indicating lights: Heavy duty, oil tight, labeled as per Section 26 05 00.
  - .3 Auxiliary contacts.
  - .4 Control Power Transformers.

## **2.4 COMBINATION TYPE STARTERS**

- .1 Combination type starters to include motor circuit protector with operating lever on outside of enclosure to control motor circuit protector, and provision for:
  - .1 Locking in "OFF" position with up to three (3) padlocks.
  - .2 Independent locking of enclosure door.
  - .3 Provision for preventing switching to "ON" position while enclosure door open and provision for preventing opening door when switched in "ON" position. Provide a defeat mechanism for starters in MCC.



- .4 Starters shall be minimum size NEMA 1. Control devices, terminals blocks, auxiliary contacts, etc., to be included as required to comply with control schematics.

## **2.5 CONTROL TRANSFORMERS**

- .1 Each control transformer to be rated 600-120 V, single phase, 2-wire, 60 Hz. Size the transformer for the load it feeds but not less than the minimum ratings as follows:
- .2 Provide each control transformer with time-delay, slow-blow secondary fuse rated to interrupt 10kA short circuit at 250 V AC. Provide two (2) primary fuses rated to interrupt 50kA at 600 V on all starters.
- .3 Fuse holder for secondary fuse shall be properly rated for control voltage. Fuse holders for primary fuses shall be dead front fuse clips with full barriers between fuses.

<b>Starter Size</b>	<b>Minimum Transformer Volt-Ampere Rating</b>
1	100
2	150
3	200
4	300

## **2.6 AUXILIARY CONTACTS**

- .1 Contactors to be equipped with auxiliary contacts, rated 10 A at 120 V AC. Unless otherwise specified on the drawings, each contactor to be equipped with one (1) spare normally open and one normally closed, field convertible, electrically isolated auxiliary contacts. Wire auxiliary contacts out to terminal blocks. Refer to drawings for actual quantities required.

## **2.7 TERMINAL BLOCKS**

- .1 Provide quick disconnect on terminal blocks to allow terminal block to be pulled without wiring disconnection.
- .2 Provide terminal blocks of screw type rated 600 V; 20 A for control wiring and 30 A for power wiring (starters size 3 and larger shall terminate the power leads directly to the contactor). Supply the number of terminal blocks shown on the drawings.
- .3 On starters Size 4 and larger, provide terminals for connection of the conductors for power factor correction capacitors between the contactor and overload relay as indicated on the drawings.
- .4 Provide terminal blocks with integral marking strips permanently marked with the conductor number as specified on the drawings.
- .5 Internal wiring to be connected on one (1) side of the terminal block; outgoing conductors to be connected to the other side.

## **2.8 AC CONTROL RELAYS**

- .1 Control relays for control and instrument panels shall be plug-in types with clear polycarbonate covers, 120 V AC, 60 Hz, unless otherwise indicated on the drawings.

- .2 Plug-in relays shall have a minimum contact rating of 10 A, mechanical life expectancy 10 million operations, operating temperatures -45°C to +50°C, dielectric strength 1500 VAC for one (1) minute.
- .3 The exact type of relay shall be determined from the number of contacts used as shown on each control diagram as indicated on the drawings. The minimum number of contacts to be DPDT. If more than three (3) contacts are shown, parallel relays shall be used.
- .4 All relays to provide indication of whether the relay is energized or not.
- .5 Acceptable products:
  - .1 Potter & Brumfield.
  - .2 Omron.
  - .3 Departmental Representative approved alternate.

## **2.9 ELAPSED TIME METERS**

- .1 Elapsed time meters shall be calibrated in hours, suitable for door mounting, non-resettable, 120 VAC.
- .2 Acceptable Manufacturers:
  - .1 Veeder-Root 7795 Series.
  - .2 Departmental Representative approved alternate.

## **2.10 OPERATOR CONTROL STATIONS**

- .1 Enclosure: NEMA Type 4 door mounted.

## **2.11 PUSHBUTTONS**

- .1 Operator flush type, as indicated. Black with 1-NO and 1-NC contacts rated at 10 A, AC, labels as indicated. Stop pushbuttons coloured red, provision for padlocking in depressed position.
- .2 Acceptable Manufacturers:
  - .1 Allen-Bradley, Bulletin 800T series.
  - .2 Departmental Representative approved alternate.

## **2.12 PUSHBUTTONS E-Stop**

- .1 Red coloured, two position latching (non-momentary), with twist to release to reset. Tamper resistant, front-of-panel mounting and non-removable operator head.
- .2 Compliant with global E-stop standards.
- .3 Acceptable Manufacturers:
  - .1 Allen-Bradley, Bulletin 800T series.
  - .2 Departmental Representative approved alternate.

## **2.13 SELECTOR SWITCHES**

- .1 Maintained two (2) position labeled as indicated, operators standard knob, contact arrangement as indicated, rated 120 V AC, 10 A.

- .2 Acceptable Manufacturers:
  - .1 Allen-Bradley, Bulletin 800T series.
  - .2 Departmental Representative approved alternate.

## **2.14 INDICATING LIGHTS**

- .1 LED type, push-to-test, and lens colour as indicated, supply voltage: 120 V AC, labels as indicated.
- .2 Acceptable Manufacturers:
  - .1 Allen-Bradley, Bulletin 800L series.
  - .2 Departmental Representative approved alternate.

## **2.15 FINISHES**

- .1 Apply finishes to enclosure in accordance with Section 26 05 00.

## **2.16 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00.

## **2.17 SPARE PARTS AND MAINTENANCE MATERIALS**

- .1 Provide maintenance materials in accordance with Division 1.
- .2 Provide listed spare parts:
  - .1 One (1) control transformer.
  - .2 Ten (10) of each size of fuse.
  - .3 Five (5) indicating lamp bulbs.
- .3 Provide a list of recommended spare parts, not specifically listed above, for each size and type of starter.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install starters, connect power, and control as indicated.
- .2 Ensure motor circuit protectors, breakers, and correct fuses and overload device elements are provided for equipment through confirmation of motor nameplate data.

### **3.2 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00.
- .2 Operate switches, contactors to verify correct functioning.
- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Check that sequence controls, interlocking with other separate related starters, equipment and control devices operate as indicated.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 Canadian Electrical Code C 22.1 and CSA C 22.2.
- .2 Alberta Fire Code.
- .3 Alberta Building Code.
- .4 ULC – Underwriters’ Laboratories of Canada, 524 and 537.
- .5 Additional section references:
  - .1 Section 01 33 00 - Submittal Procedures
  - .2 Division 01 – General Requirements
  - .3 Section 26 05 01 - Electrical General Requirements
  - .4 Section 26 05 02 - Electrical Field Inspection and Testing

**1.2 SECTION INCLUDES**

- .1 This performance specification provides the minimum requirements for the Fire Alarm System. The system shall include, but not be limited to all equipment, materials, labor, documentation and services necessary to furnish and install a complete, operational system to include but not limited to the following devices:
  - .1 Automatic fire detectors.
- .2 All Fire Alarm System equipment shall be arranged and programmed to provide a system for the early detection of fire, the notification of building occupants, the override of the HVAC system operation when required, and the activation of other auxiliary systems to inhibit the spread of smoke and fire, and to facilitate the safe evacuation of building occupants.
- .3 The System shall utilize independently addressed, smoke and heat detectors and input/output modules as described elsewhere in this specification.

**1.3 SYSTEM DESCRIPTION**

- .1 This system shall be an intelligent, addressable, selectable between strobe only and continuous sounding with strobe lights, ULC listed, electrically supervised system, fully installed, tested and left in first class operating conditions.
- .2 Interface the new system with the existing fire alarm wiring such that the trouble alarm function of the new system will be monitored by the main fire alarm panel using monitoring modules and isolation modules as required.
- .3 Provide and install new fire detection and alarm system consisting of:
  - .1 Duct smoke detection shall be provided as shown on the drawings.
  - .2 All wiring (conduit, outlets, wire, etc.) required to provide power to and interconnect all components listed above.

- .3 All wiring (conduit, outlets, wire, etc.) required to provide power to, and interconnect, devices supplied under other divisions, including:
  - .1 HVAC shutdown of air handling units through temperature control panels.
  - .2 Interface with the Building Automation System (BAS) where provided.
- .4 The provision of all submittals required by the Departmental Representative and local authorities, and the obtaining of all approvals there from.
- .4 All equipment shall be ULC listed compatible as a product of a single fire alarm system manufacturer.
- .5 Any devices interfacing with the existing fire alarm system equipment shall be ULC recognized as compatible.

#### **1.4 SYSTEM CONFIGURATION**

- .1 The system shall be configured such that system Initiating Device Circuits (IDC) shall not leave large areas of the building unprotected upon cable failure. The following rules must be maintained when wiring this system:
  - .1 The use of isolating modules across floors or in between process areas is required.
  - .2 The supply and return lines shall be routed in different conduits, so as to enhance system protection. A fault isolation module or equivalent device shall be installed where crossing multiple floors or zones.
- .2 Duct-type smoke detectors shall be installed at a location in the main supply air duct on the downstream side of the filter units; and at a location in the return air duct prior to exhausting from the building or prior to being diluted by outside fresh air.
- .3 Coordinate with mechanical contractor for intent of duct smoke detectors near dampers.

#### **1.5 DUCT SMOKE OPERATION-ALARM**

- .1 The alarm activation of any duct-type smoke detector shall automatically shut down the local air handling unit.
  - .1 Shut down interlock are to be directly operated by the duct-type smoke detector.

#### **1.6 SUBMITTALS**

- .1 Submit under provisions of Division 01 and Section 26 05 00 - Common Work Results for Electrical.
- .2 Product Data
  - .1 Supply data sheets with the printed logo or trademark of the manufacturer for all equipment. Indicated in the documentation will be the type, size, rating, style, and catalog number for all items proposed to meet the system performance detailed in this specification. The proposed equipment shall be subject to the approval of the Departmental Representative.

- .3 Shop Drawings
  - .1 A complete set of shop drawings shall be supplied. The shop drawings shall be reproduced electronically in digital format. This package shall include but not be limited to:
    - .1 Control panel wiring and interconnection schematics.
    - .2 Complete point to point wiring diagrams.
    - .3 Riser diagrams.
    - .4 Logic diagrams.
  - .2 Complete floor plan drawing locating all system devices and elevation of all equipment in the Fire Alarm System. Including showing the placement of each individual item of fire alarm equipment as well as raceway size and routing, junction boxes, and conductor size, quantity, and color in each raceway.
  - .3 Detailed system operational description. Any Specification differences and deviations shall be clearly noted and marked.
  - .4 Complete system bill of materials.
- .4 Shop Drawings:
  - .1 Submit under provisions of Division 01 and Section 26 05 00 - Common Work Results for Electrical.
  - .2 Complete shop drawings of all custom-fabricated or assembled products, including wiring diagrams.
  - .3 Drawings identifying all terminals and illustrating all device wiring connections.
  - .4 Bill of materials listing all components and devices.
  - .5 Product Data: Provide electrical characteristics and typical connection requirements.
  - .6 All and any information and data (such as drawings showing device locations and types, typical riser diagrams, typical wiring diagrams, approvals, test data, etc.)
- .5 Test Reports: Indicate satisfactory completion of required tests and inspections.  
Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of products.

## **1.7 OPERATION AND MAINTENANCE DATA**

- .1 Provide operation and maintenance manuals with the following:
  - .1 Nomenclature of all replaceable parts, part numbers, present costs, and name and address of nearest vendor of parts. Where manuals include manufacturer's catalogue pages, clearly indicate items included and delete it as not included in this installation.
  - .2 Copy of guarantees and warranties.
  - .3 Copy of approved show drawings with data concerning changes made during construction.
- .2 Upon approval of rough draft, submit three (3) final copies as to each such unit of equipment.

## **1.8 WARRANTY**

- .1 The contractor shall warranty all materials, installation and workmanship for one (1) year from date of acceptance, unless otherwise specified in Division 01 – General Requirements. A copy of the manufacturer's warranty shall be provided with close-out documentation and included with the operation and installation manuals.
- .2 The System Supplier shall maintain a service organization with adequate spare parts stock within 150 km of the installation. Any defects that render the system inoperative shall be repaired within 24 hours of the Departmental Representative notifying the contractor.

## **1.9 SPARE PARTS**

- .1 The Contractor shall supply the following spare parts:
  - .1 Automatic detection devices – 2% of the installed quantity of each type, rounding up to the nearest number of devices.
  - .2 Manual fire alarm stations – 2% of the installed quantity of each type, rounding up to the nearest number of devices.
  - .3 Glass rods or panels for break glass manual fire alarm stations – 10% of the installed quantity, but no less than two devices.
  - .4 Audible and visible devices – 1% of the installed quantity of each type, but no less than two (2) devices.
  - .5 Keys – A minimum of three (3) sets of keys shall be provided and appropriately identified.

## **1.10 TRAINING**

- .1 The System Supplier shall schedule and present a minimum of 4 hours of documented formalized instruction for the Departmental Representative, detailing the proper operation of the installed System.
- .2 The instruction shall be presented in an organized and professional manner by a person factory-trained in the operation and maintenance of the equipment and who is also thoroughly familiar with the installation.
- .3 The instruction shall cover the schedule of maintenance required by Alberta Building and Fire Codes and any additional maintenance recommended by the system manufacturer.
- .4 Instruction shall be made available to the Local Municipal Fire Department if required by the Local Authority Having Jurisdiction.

## **Part 2 Products**

### **2.1 MANUFACTURERS**

- .1 All new system components shall be the cataloged products of a single supplier. All products shall be listed by the manufacturer for their intended purpose.
- .2 All control panel assemblies and connected field appliances shall be both designed and manufactured by the same company, and shall be tested and cross-listed as to ensure that a fully functioning system is designed and installed. The system supplied under this specification shall be a microprocessor-based system. The system shall utilize

independently addressed, microprocessor-based smoke detectors, heat detectors, and modules as described in this specification.

- .3 The authorized representative of the manufacturer of the major equipment shall be responsible for the satisfactory installation of the complete system.
- .4 All control panel assemblies and connected field appliances shall be provided by the same system supplier, and shall be designed and tested to ensure that the system operates as specified. The system shall utilize independently addressed, microprocessor-based smoke detectors, heat detectors, as described in this specification.
- .5 All equipment and components shall be the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approval agency for use as part of a protected premises protective signaling (fire alarm) system. The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system.
- .6 The contractor shall provide, from the acceptable manufacturer's current product lines, equipment and components, which comply, with the requirements of these specifications. Equipment or components, which do not provide the performance and features, required by these specifications are not acceptable, regardless of manufacturer.
- .7 All equipment and components shall be installed in strict compliance with the manufacturer's recommendations.

## **2.2 INITIATING DEVICES**

- .1 Duct-type smoke detectors
  - .1 Each analog addressable smoke detector's sensitivity shall be capable of being programmed individually as: most sensitive, more sensitive, normal, less sensitive or least sensitive. In addition to the five sensitivity levels the detector shall provide a pre-alarm sensitivity setting, which shall be settable in 5% increments of the detector's alarm sensitivity value.
  - .2 An alternate alarm sensitivity level shall be provided for each detector, which can be set to any of the five (5) sensitivity settings manually or automatically using a time of day event. In addition to the five alternate sensitivity levels the detector shall provide an alternate pre-alarm sensitivity setting, which shall be settable in 5% increments of the detector's alternate alarm sensitivity value.
  - .3 The detector shall be able to differentiate between a long drift above the pre-alarm threshold and fast rise above the threshold.
  - .4 The detector's sensing element reference point shall automatically adjust, compensating for background environmental conditions such as dust, temperature, and pressure. Periodically, the sensing element real-time analog value shall be compared against its reference value. The detector shall provide a maintenance alert signal that 75% to 99% compensation has been used. The detector shall provide a dirty fault signal that 100% or greater compensation has been used.
  - .5 The system shall allow for changing of detector types for service replacement purposes without the need to reprogram the system. The replacement detector type shall automatically continue to operate with the same programmed sensitivity levels and functions as the detector it replaced. System shall display



an off-normal condition until the proper detector type has been installed or change in the application program profile has been made.

- .6 Provide smoke detector duct housing assemblies to mount an analog/addressable detector along with a standard, relay or isolator detector mounting base. The housing shall also protect the measuring chamber from damage and insects. The housing shall utilize an air exhaust tube and an air sampling inlet tube that extends into the duct air stream up to ten feet. Drilling templates and gaskets to facilitate locating and mounting the housing shall also be provided. The housing shall be finished in baked red enamel. Remote alarm LED indicators and remote test stations shall be provided.
- .7 Where smoke detectors are directly inserted into a low velocity ducts 3 ft (0.91 m) high x 3 ft (0.91 m) wide, ceiling plenums, or raised floors, provide factory supplied mounting plate assemblies to facilitate mounting the detectors. The mounting plate shall be code gauge steel with corrosion resistant red enamel finish. The detector mounting plate shall support an analog/addressable detector along with a standard, relay or isolator detector mounting base.
- .8 Acceptable Product: System Sensor Innovair Flex DNRA

## **2.3 FIRE ALARM WIRE AND CABLE**

- .1 Fire Alarm Power Branch Circuits: Building wire FT 4 rated, red insulation.
- .2 Run cable in conduit in exposed locations or where subject to damage as per CEC.
- .3 Exposed non-current carrying metal parts of electrical equipment including outlet boxes, conductor enclosures, raceway, and cabinets shall be bonded to ground in accordance with the Canadian Electrical Code.

## **Part 3 Execution**

### **3.1 SHOP DRAWINGS**

- .1 Contractor to provide vendor supplied battery calculations, interconnection drawings and logic diagrams for the propose fire alarm system prior to construction.

### **3.2 INSTALLATION**

- .1 Install products in accordance with manufacturer's instructions. Installation shall be supervised and tested by the manufacturer of the system equipment. The work shall be performed by skilled technicians, all of whom shall be properly trained and qualified for this work.
- .2 Initiating device circuits, including smoke and heat detectors, valve supervisory switches and manual pull stations shall be Class A wiring.
- .3 Notification appliance circuits shall be Class B wiring. All notification appliance circuits shall have a minimum circuit output rating of 1 amp at 24 VDC. The notification circuits shall be power limited. Non-power limited circuits are not acceptable.
- .4 Minimum size wiring for individual devices is as follows:
  - .1 Bells and/or horns - 2#14
  - .2 Strobes - 2 #14.
  - .3 Signalling line or initiating device circuit wiring - 2 #18 twisted shielded.

- .4 Remote annunciator/graphic devices - 2 #18 twisted shielded for data transmission and 2 #14 for power.
- .5 Conductors within equipment enclosures shall be carefully cabled and laced. Individual conductors shall be tagged with E-Z code markers indicating circuit number and type. Markers shall be used on all conductors at each outlet or pull box and at each equipment enclosure.
- .6 Outlet pull and junction boxes shall be painted red on the exterior and shall be installed in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes, and Cabinets.
- .7 Locate all duct detectors associated with main air handling units (supply and return ducts) in the locations shown on the drawings.
- .8 All duct detectors in association with fire/smoke dampers shall be located upstream of these dampers as per ULC 524.
- .9 T-tapped connections will not be allowed on any supervised or SLC circuits. Connections shall be made directly to and from device terminal screws of fire alarm devices. Screw terminals shall have rising plates to terminate more than one wire or each wire shall be terminated to individual screws or each wire shall terminate in a ring lug.
- .10 Cabling serving any supervised and SLC circuits shall not be spliced in any boxes. Cabling shall be continuous between field devices, "splice-free".
- .11 Breakers supplying fire alarm equipment shall be painted red.

### **3.3 FIELD QUALITY CONTROL**

- .1 Field inspection and testing will be performed under provisions of Section 26 05 00 – Common Work Results for Electrical and 01 45 00 – Quality Control.
- .2 Verify installation according to the Alberta Building Code and Alberta Fire Code, provide verification report and sealed certificate for completion.

### **3.4 MANUFACTURER'S FIELD SERVICES**

- .1 Upon completion of the system's modification and installation, an approved representative of the system manufacturer shall be employed to conduct a thorough test of the system and submit a written report of the findings to the Departmental Representative. The test shall be per Alberta Building Code and Alberta Fire Code and shall include, at the least, verifying the following:
  - .1 The functional operation of each resettable initiating device (manual stations, detectors, etc.) and circuit.
  - .2 The functional operation of each and every alarm device and circuit.
  - .3 The functional operation of each monitored device circuit.
  - .4 The functional operation of each control circuit.
  - .5 The supervision functions of each Initiating, Indicating, Monitoring, Control and Supply Circuit.
  - .6 Control station automatic signalling.
  - .7 All tests shall be completed in the presence of the Departmental representative.

**3.5 DEMONSTRATION**

- .1 Provide systems demonstration by a fully qualified, trained representative of the equipment supplier.

**3.6 VERIFICATION**

- .1 Verify the system to ULC 537-04.

**END OF SECTION**



EDMONTON MAXIMUM SECURITY

EDMONTON, ALBERTA

FIRE ALARM UPGRADE

LIST OF DRAWINGS

DRAWING	DESCRIPTION
E00	COVER SHEET
E01	OVERALL SITE PLAN—LEGEND/NOTES
E02	ADMINISTRATION BUILDING AND BLOCKS D/S—PARTIAL LOWER FLOOR PLANS—MAIN BUILDING
E03	PARTIAL LOWER FLOOR PLAN—MAIN BUILDING—BLOCKS A/B/C & D
E04	PARTIAL LOWER FLOOR PLAN—MAIN BUILDING—BLOCKS H/G/F & E
E05	PARTIAL UPPER FLOOR PLAN—MAIN BUILDING—BLOCKS A/B/D/M/K/L & S
E06	PARTIAL MAIN FLOOR PLAN—MAIN BUILDING—BLOCKS C/D & Q
E07	PARTIAL UPPER FLOOR PLAN—MAIN BUILDING—BLOCKS J/M/P/N/R/C/H & G
E08	PARTIAL MAIN FLOOR PLAN—MAIN BUILDING—BLOCKS R/S/T/V/X/W/E & F
E09	TUNNEL PLAN FOR MAIN BUILDING
E10	PARTIAL UPPER FLOOR PLAN—MAIN BUILDING
E11	PARTIAL UPPER FLOOR PLAN—MAIN BUILDING
E12	FAMILY VISIT BUILDING 1 AND 2—FIREARMS BUILDING GATEHOUSE BUILDING
E13	PUMPHOUSE/GENERATOR/GUARD TOWERS/DOG KENNEL BUILDINGS
E14	WAREHOUSE BUILDING MAIN AND MEZZANINE FLOORS
E15	FIRE ALARM RISER
E16	OVERALL BLOCK DIAGRAM FLOOR PLAN F/A SHUTDOWN—INFORMATION ONLY
E17	OVERALL BLOCK DIAGRAM FLOOR PLAN F/A SHUTDOWN—INFORMATION ONLY

RECORD DRAWINGS DATE: JUNE 12–2013

E00–CoverSheet.dwg

REAL PROPERTY SERVICES  
Western Region

Client

**CORRECTIONAL SERVICE  
CANADA**

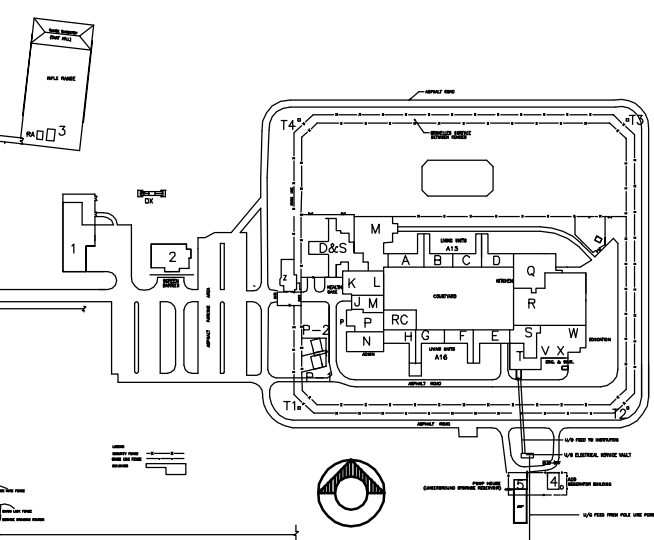
Client

Client

Client



Job #5783



KEY PLAN  
N.T.S.

RECORD DRAWING

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9	ISSUED FOR RECORD DRAWING	13/06/12
8	E01 SITE PLAN ISSUED FOR RECORD DRAWING	12/10/18
7	ISSUED FOR CONSTRUCTION	09/06/01
6	ADDENDUM E1	09/03/18
5	ISSUED FOR TENDER	09/02/03
4	ISSUED FOR 100% TENDER	09/01/02
3	ISSUED FOR 99% REVIEW	08/10/13
2	ISSUED FOR 50% RE-SUBMISSION	08/09/10
1	ISSUED FOR 50% REVIEW	08/04/11
REVISIONS	DESCRIPTION	DATE

A	A detail number number du detail	A
B	B source drawing no. de dessin no.	B
C	C detail on drawing no. detail sur dessin no.	C

project title  
**EDMONTON MAXIMUM  
SECURITY  
INSTITUTE**  
FIRE ALARM UPGRADE

titre du projet

drawing title  
**OVERALL SITE PLAN  
LEGEND/NOTES**

titre du dessin

designed by  
**P. BEAUBIEN**

conçu par

drawn by  
**L. HONDERD**

dessiné par

approved by  
**P. BEAUBIEN**

approuvé par

PWOSC Project Manager  
Administrateur de Projets TPSGC

scale  
**AS NOTED**

échelle

project no.  
**R.014522.001**

projet no.

date  
**APRIL 17, 2013**

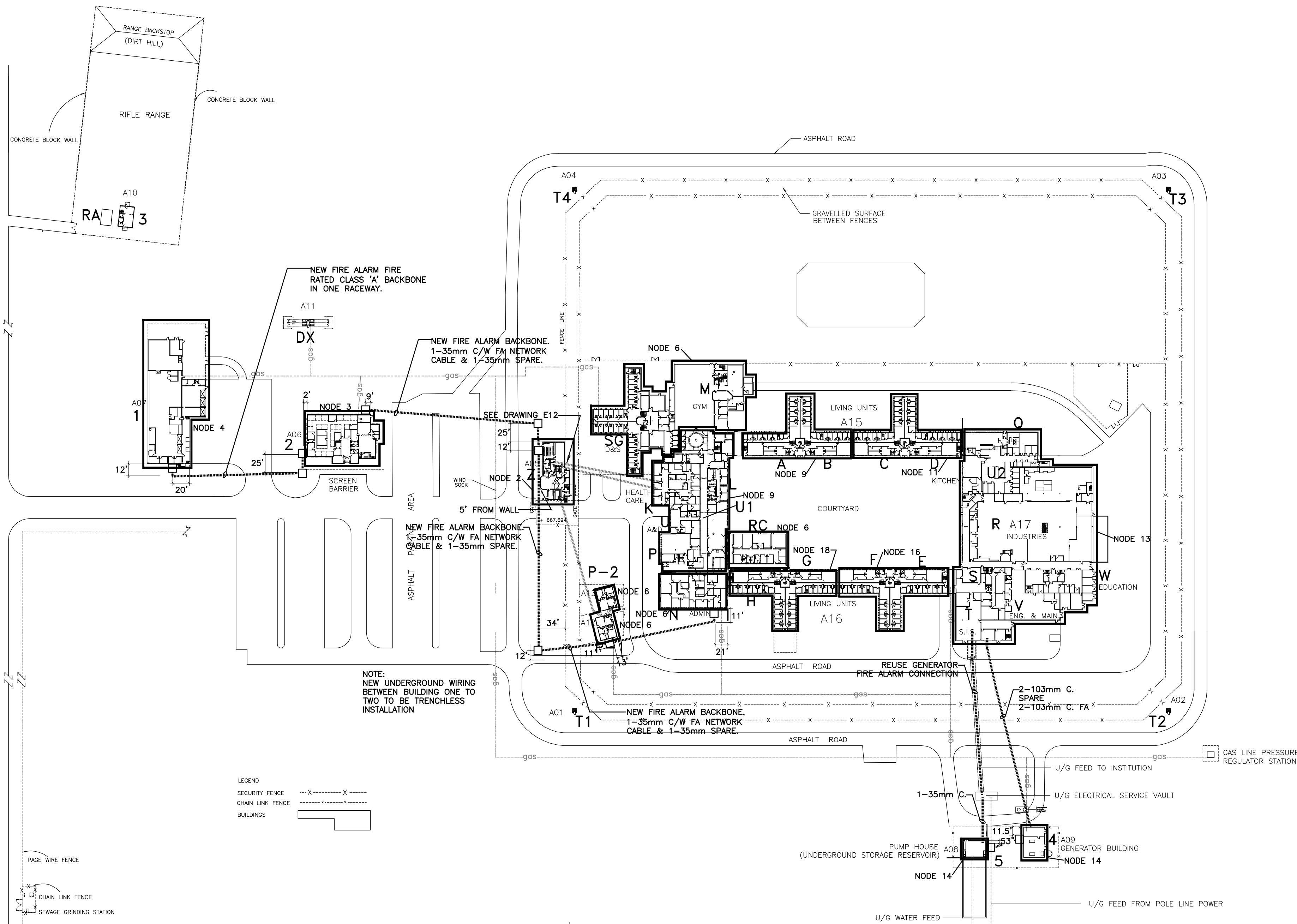
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**E01**  
OF 17

LEGEND

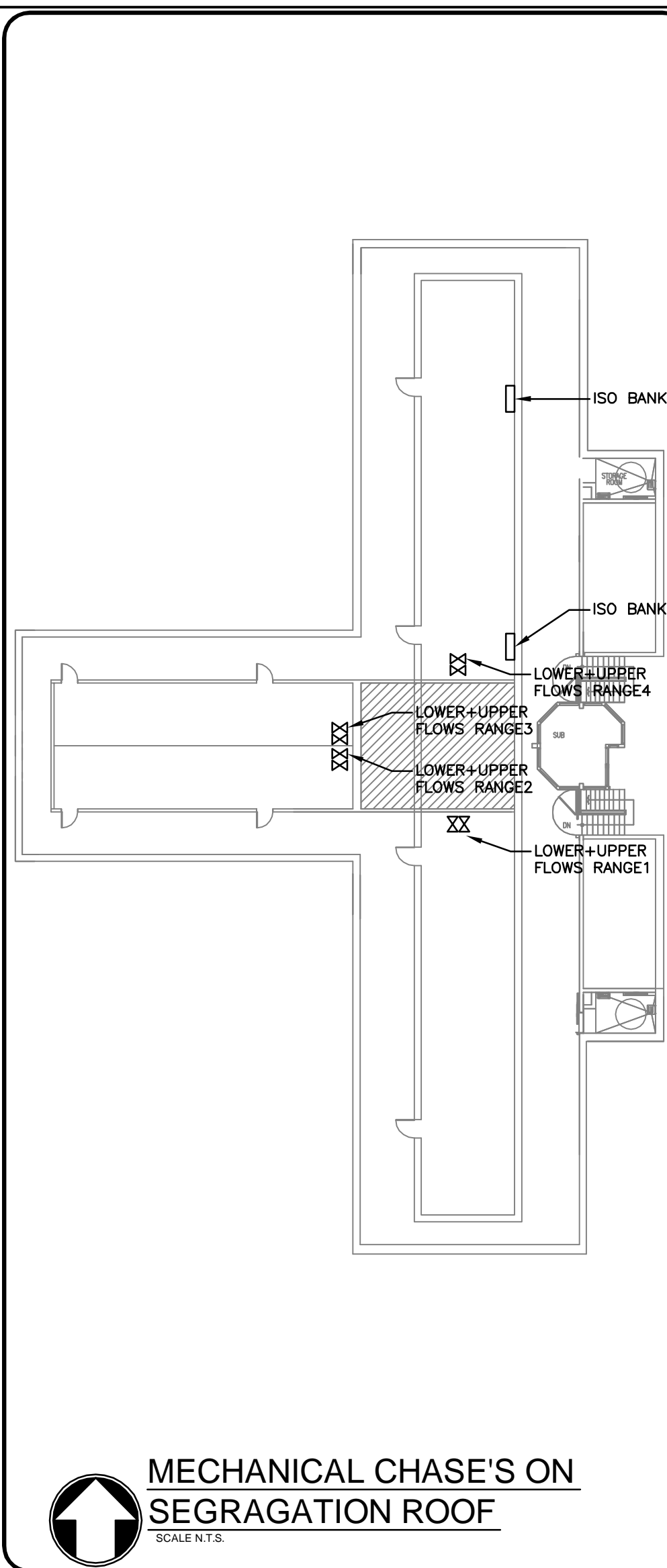
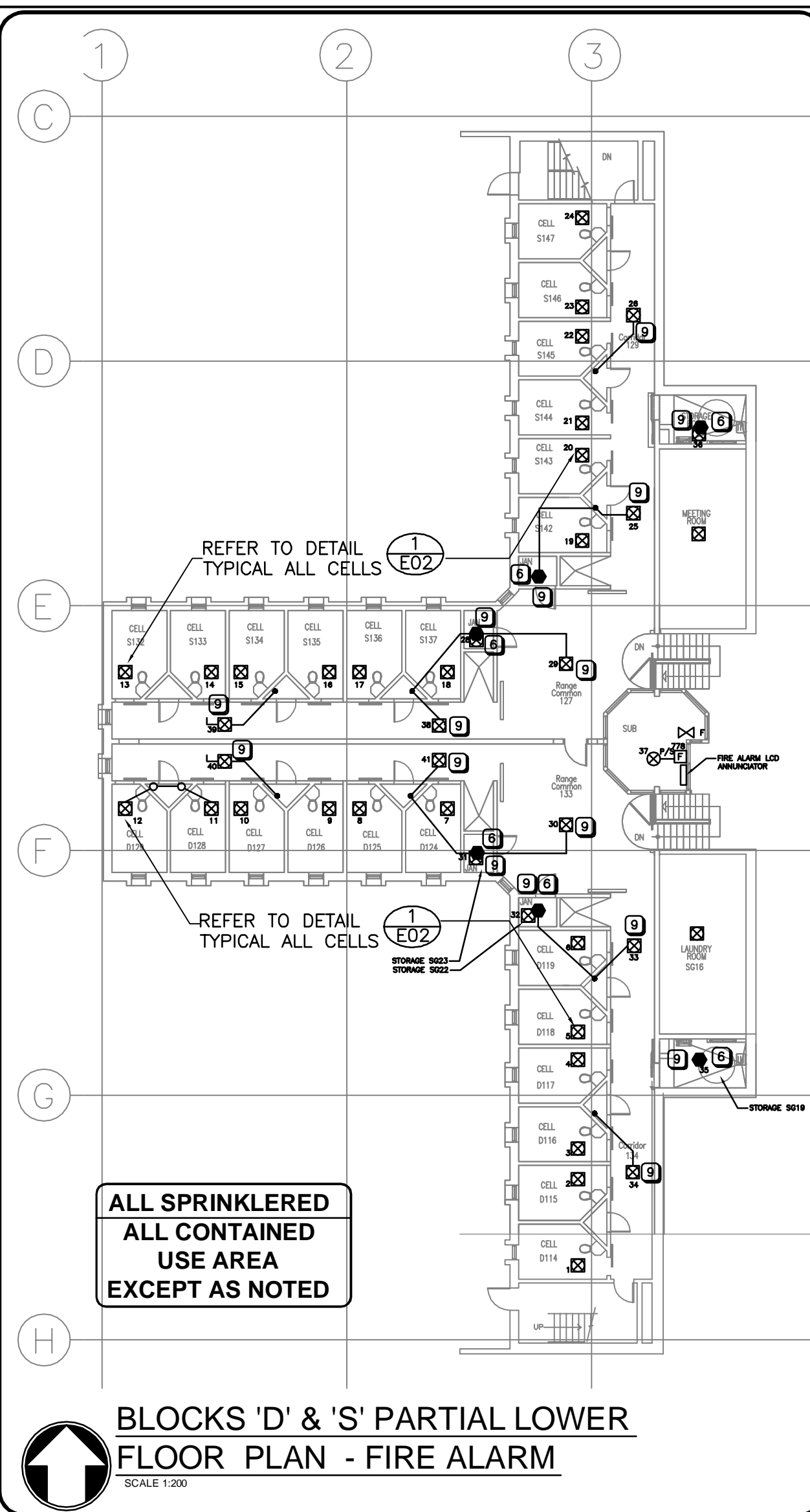
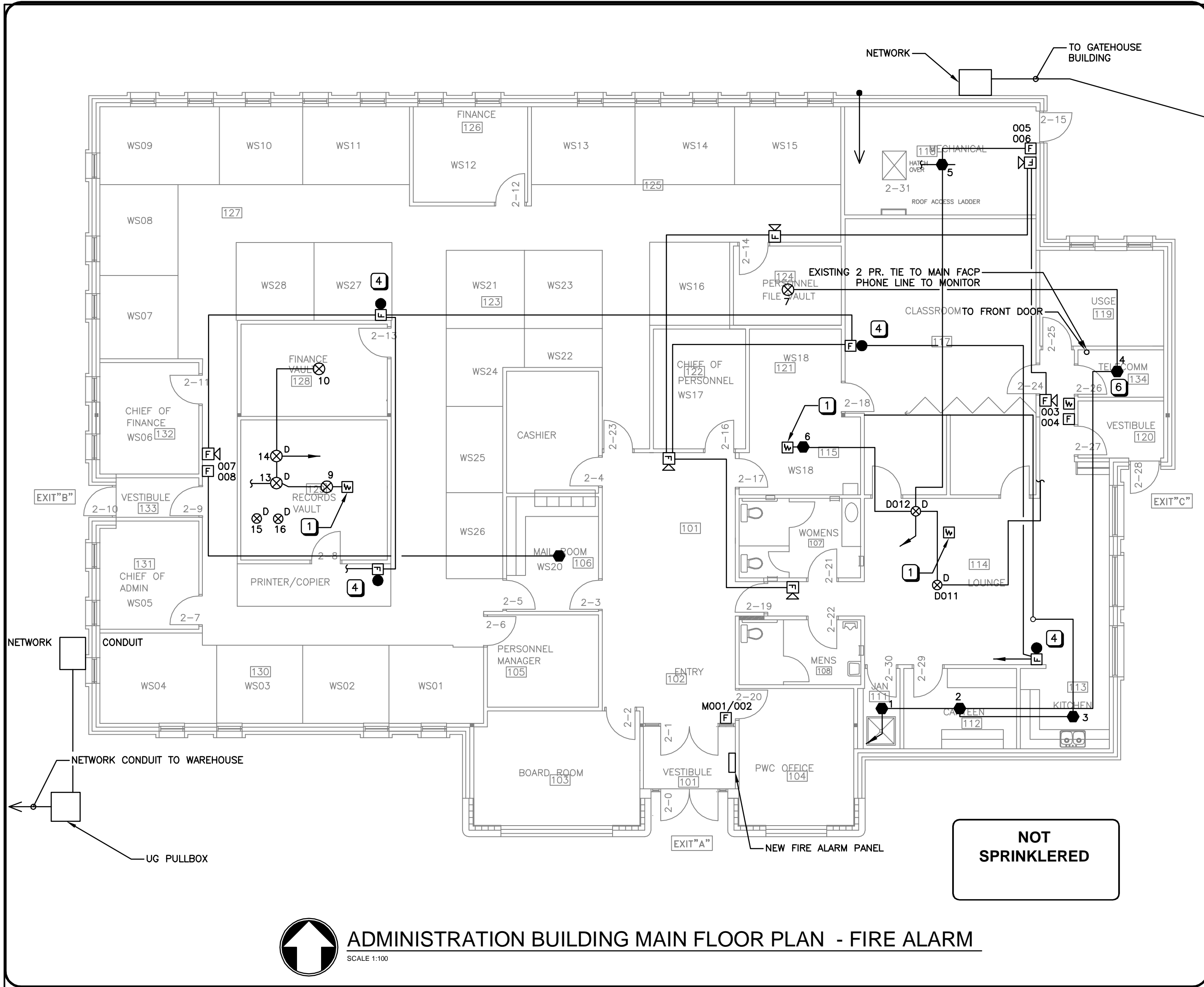
- F FIRE ALARM MANUAL PULL STATION
- F K FIRE ALARM MANUAL PULL STATION-KEY OPERATED
- F P FIRE ALARM MANUAL PULL STATION-KEY OPERATED
- FIXED TEMPERATURE HEAT DETECTOR (55°C OR 88°C)
- RATE OF RISE HEAT DETECTOR
- RATE OF RISE HEAT DETECTOR C/W GUARD COVER
- ⊗ SMOKE DETECTOR
- ⊗ SMOKE DETECTOR C/W GUARD COVER
- ⊗ AUX AUXILIARY SMOKE DETECTOR
- ⊗ D DUCT DETECTOR
- DEVICE REMOTE INDICATING LIGHT
- W END OF LINE RESISTOR
- D DOOR CONTACT
- F● FIRE ALARM BELL
- F H FIRE ALARM HORN/STROBE
- F H FIRE ALARM HORN
- F H FIRE ALARM HORN C/W GUARD
- S FIRE ALARM STROBE
- FIRE ALARM CONTROL PANEL (FACP)
- ⊗ FT SPRINKLER TAMPER SWITCH
- ⊗ F SPRINKLER FLOW SWITCH
- ⊗ P SPRINKLER PRESSURE SWITCH
- ⊗ AUX SPRINKLER AUXILIARY SWITCH
- ME MONITORING ELEMENT
- CE CONTROL ELEMENT
- R/A RETURN AIR
- GA GENERAL ALARM
- NIC NOT IN CONTRACT
- WG WIRE GUARD ENCLOSURE
- WP WEATHER PROOF
- UF UNDER FLOOR
- ⊗ REMOVE EQUIPMENT
- SOLID IS NEW
- EXISTING IS HALF TONE

OVERALL SITE PLAN  
SCALE: 1:4000



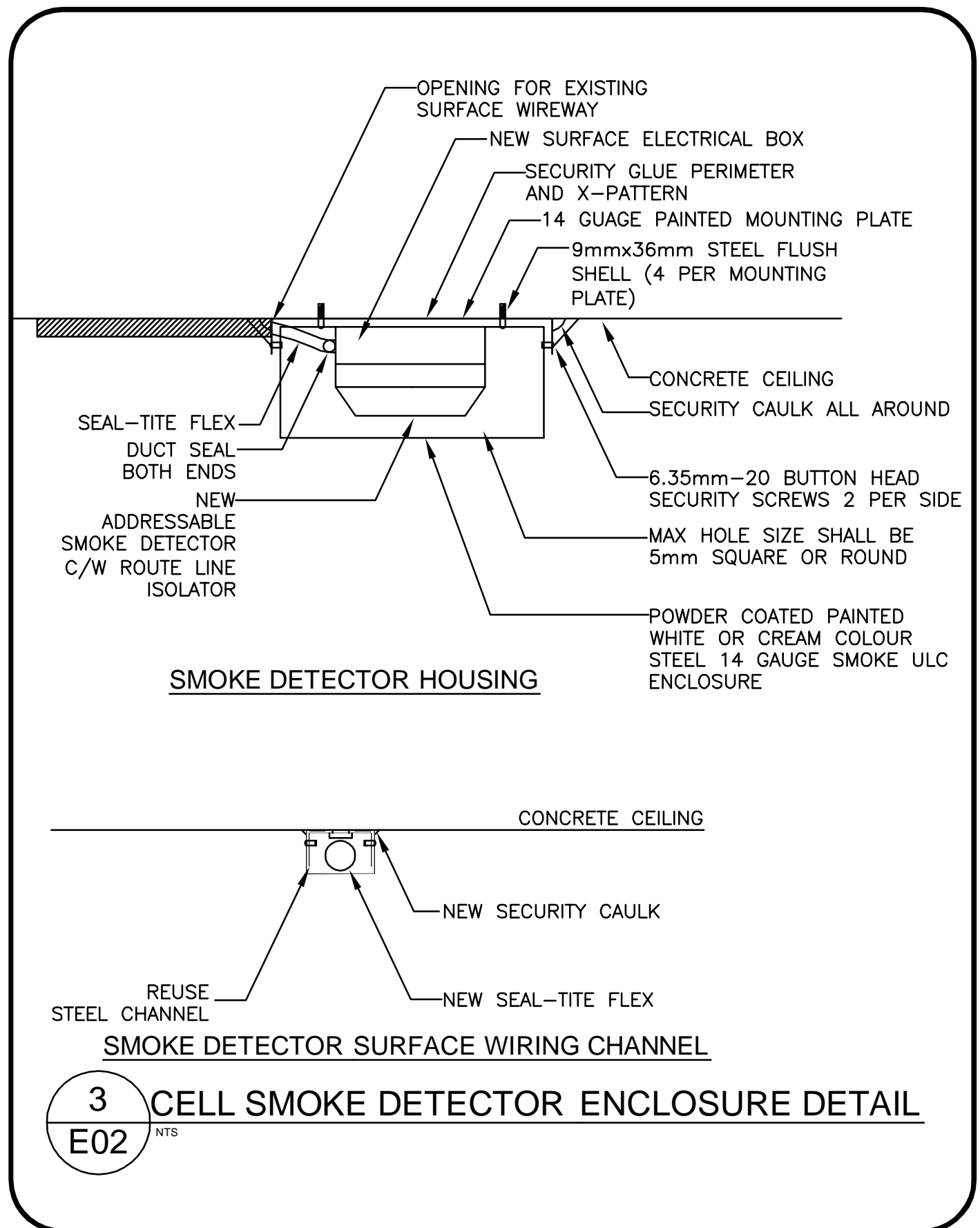
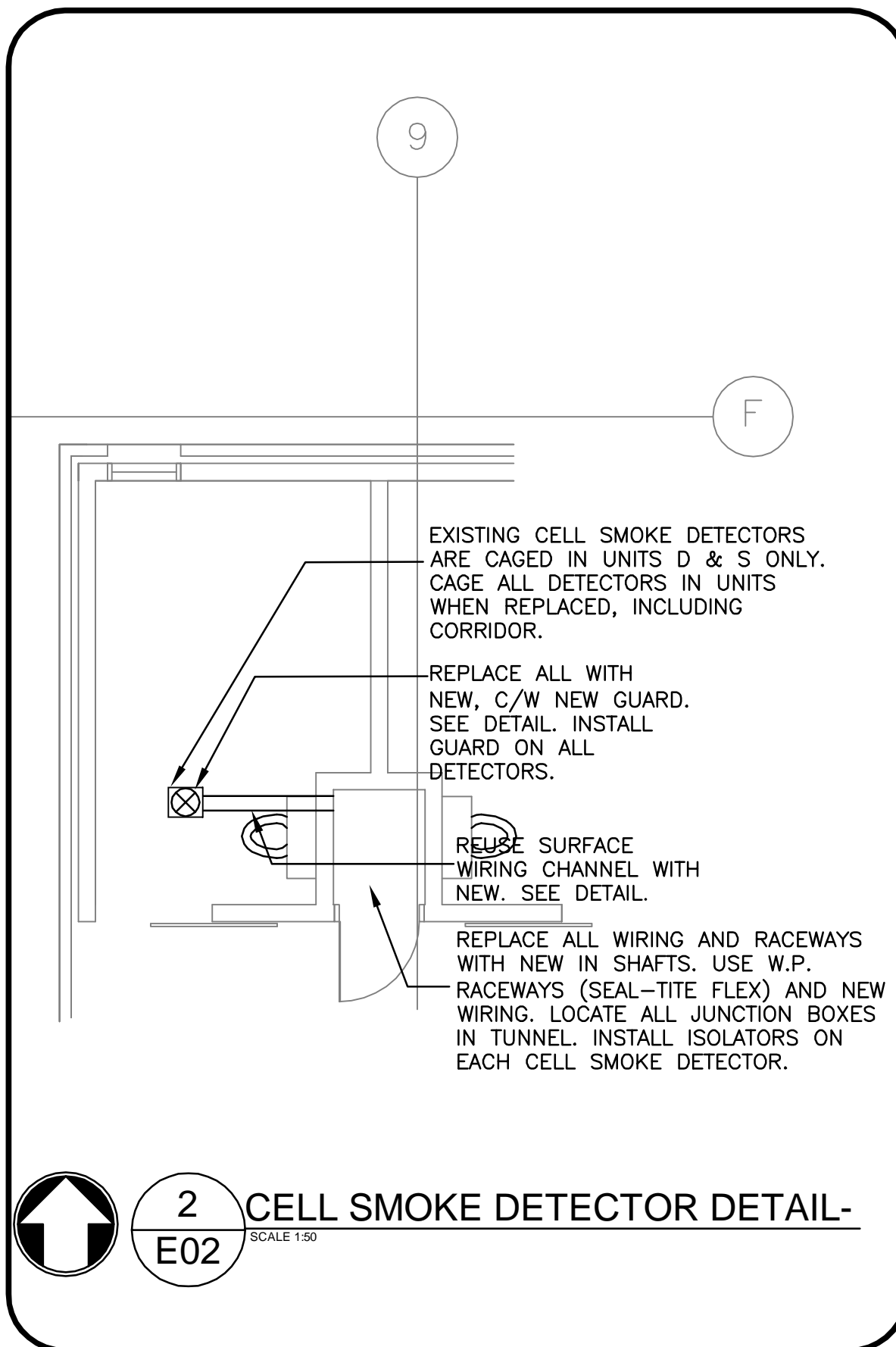
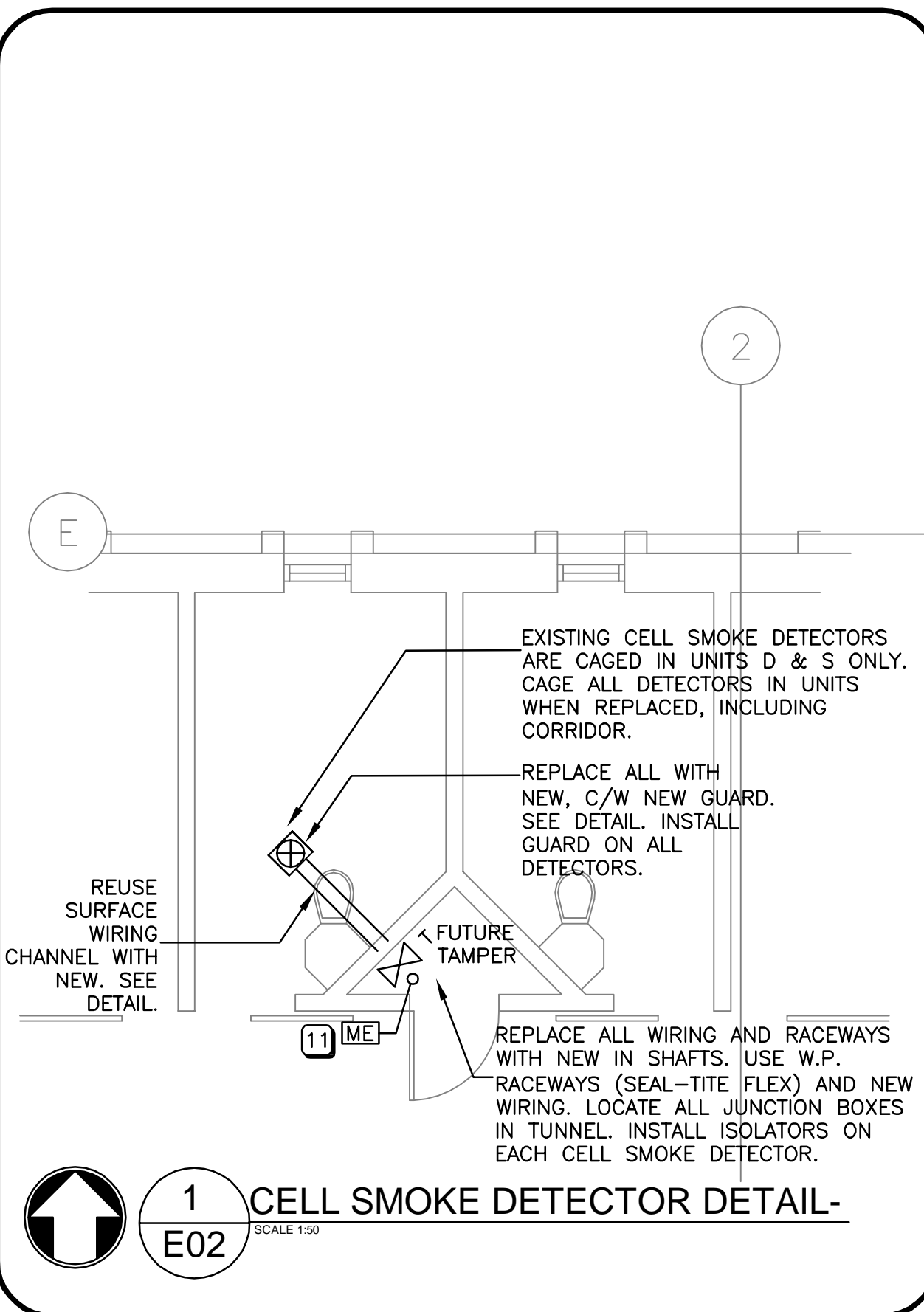
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A to C	CELL BLOCKS	U-1	EAST MECHANICAL ROOM
D	MENTAL HEALTH CELL BLOCK	U-2	WEST MECHANICAL ROOM
E to F	CELL BLOCKS	V	ENGINEERING & MAINTENANCE
G to H	INTAKE ASSESSMENT CELL BLOCKS	W	SCHOOL
I	TUNNEL AREA	X	-
J	ADMISSION & DISCHARGE	Z	GATEHOUSE
K	HEALTH CARE CENTRE	DX	DOG KENNELS & RUNS
L	PSYCHOLOGY & CHAPEL AREA	RC	INTAKE ASSESSMENT PROGRAMS BUILDING
M	PSYCHOLOGY	SG	DISSOCIATION & SEGREGATION
N	PROGRAM & CHAPEL AREA	T1	GUARD TOWER
M	GYM, LIBRARY & NATIVE BROTHERHOOD	T2	GUARD TOWER
M	GYM	T3	GUARD TOWER
N	EXECUTIVE SERVICES	T4	GUARD TOWER
P	VISITS & CORRESPONDENCE	RA	GAS/FIRE TRAINING
P-1	PRIVATE FAMILY VISIT-1	1	WAREHOUSE/GARAGE
P-2	PRIVATE FAMILY VISIT-2	2	ADMINISTRATION
Q	KITCHEN	3	WEAPONS RANGE
R	CORCAN	4	GENERATOR BLDG
S	INSTITUTIONAL SERVICES	5	PUMP HOUSE
T	SERVICES AND BOILER ROOM	Y	CATWALK (SEE DRAWING E11)

NO FIRE ALARM TO BE INSTALLED



#### KEYNOTES

- 1 REMOVE AND BLANK OFF.
- 2 SURFACE INSTALLATION.
- 3 RECESSED INSTALLATION.
- 4 CHANGE FROM BELL TO HORN
- 5 NOT USED
- 6 CHANGE FROM HEAT DETECTOR TO SMOKE DETECTOR.
- 7 NOT USED
- 8 CHANGE HORN TO SURFACE 100mm WALL HORN/STROBE
- 9 ADD GUARD COVER
- 10 FIRE ALARM BACKBONE
- 11 FOR FUTURE CELL SPRINKLER TAMPER SWITCHES. DO NOT LOCATE IN SERVICE SHAFT BUT INSTALL 2 PAIR FROM EACH MONITORING ELEMENT TO FUTURE TAMPER SWITCH LOCATION (D AND S ONLY)



Public Works and Government Services Canada

Travaux publics et Services gouvernementaux Canada

**REAL PROPERTY SERVICES**  
Western Region

Client
**CORRECTIONAL SERVICE CANADA**
Client

Client
**beaubien glover maskell engineering**
Client

Suite 4700, 4400 - 42 Avenue  
Edmonton, Alberta, T6E 5V6  
Tel: 780-429-2266 Fax: 780-429-4466  
www.bgm.ca  
Job #5783

**KEY PLAN**  
N.T.S.

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A detail number  
number du detail

B source drawing no.  
de dessin no.

C detail on drawing no.  
detail sur dessin no.

**EDMONTON MAXIMUM SECURITY INSTITUTE**  
**FIRE ALARM UPGRADE**

drawing title  
titre du projet  
**ADMINISTRATION BUILDING AND BLOCKS D & S PARTIAL LOWER FLOOR PLAN - MAIN BUILDING**

designed by  
conçu par  
**P. BEAUBIEN**

drawn by  
dessiné par  
**L. HONDERD**

approved by  
approuvé par  
**P. BEAUBIEN**

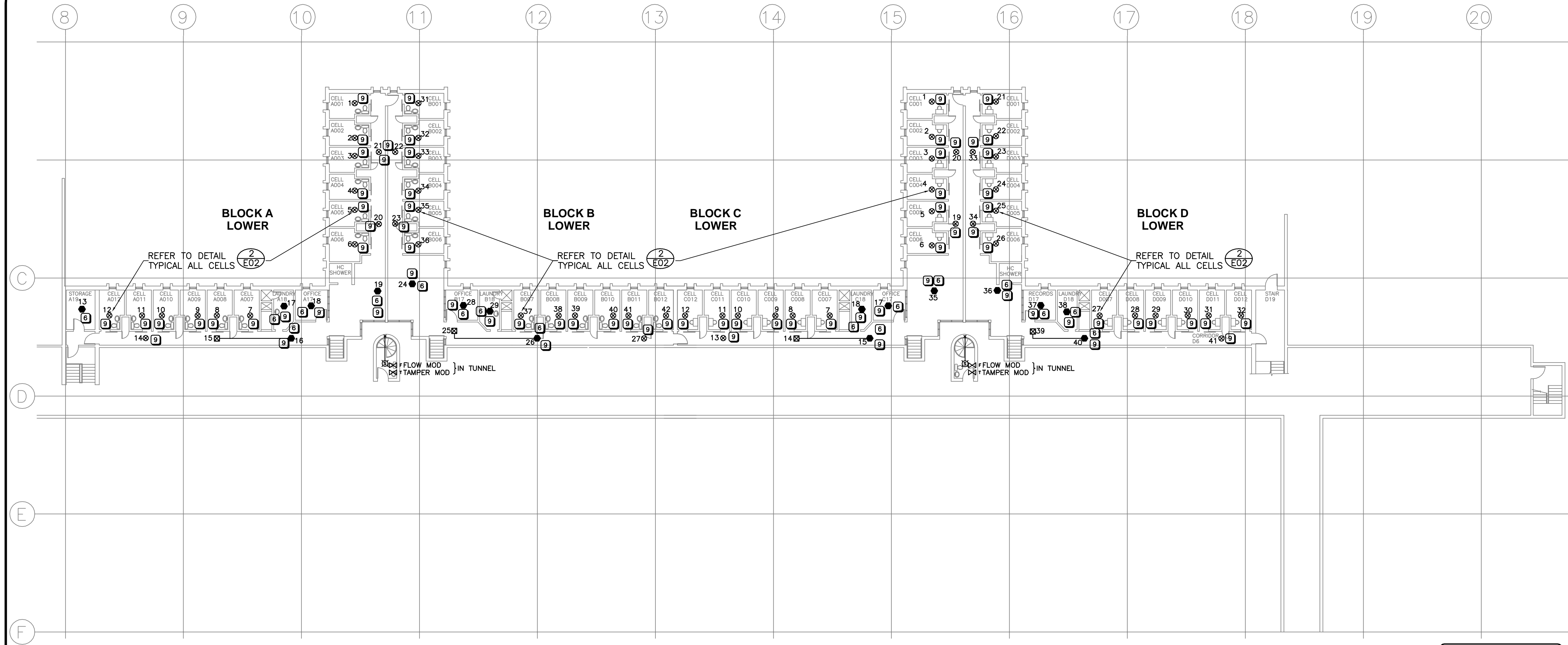
PWSC Project Manager  
Administrateur de Projets TPSCG

scale  
échelle  
**AS NOTED**

project no.  
projet no.  
**R.014522.001**

date  
date  
**APRIL 17, 2013**

**E02**  
OF 17



ALL SPRINKLERED  
USE AREA


 PARTIAL LOWER FLOOR PLAN - FIRE ALARM  
SCALE 1:200

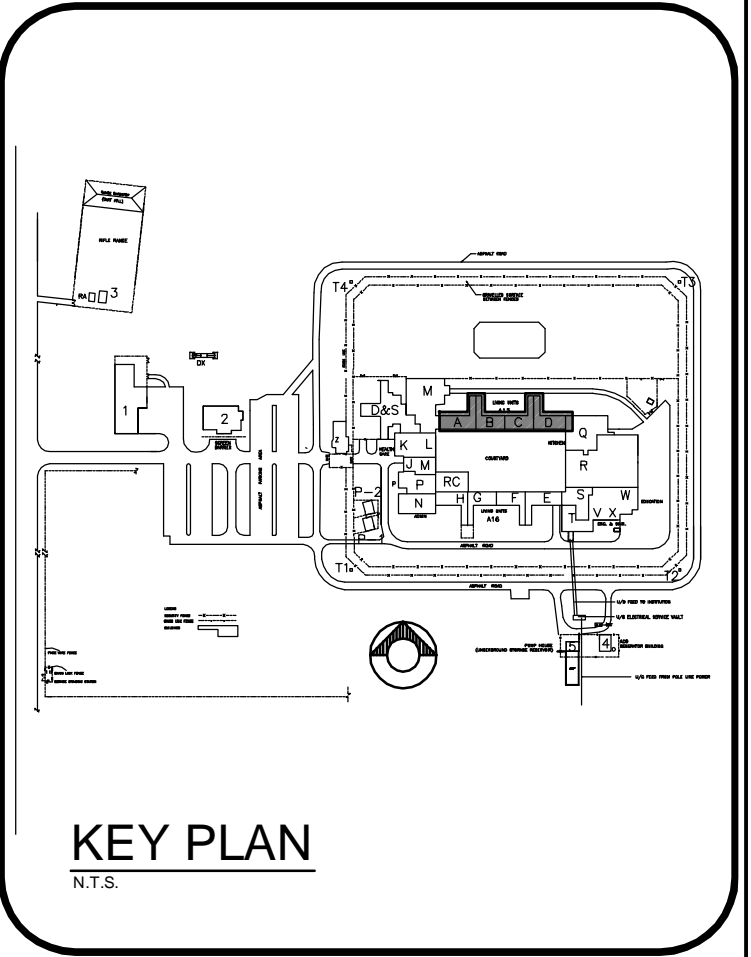
KEYNOTES

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- 8 CHANGE HORN TO SURFACE  
100mm WALL HORN/STROBE
- 9 ADD GUARD COVER
- 10 FIRE ALARM BACKBONE
- 11 FOR FUTURE CELL SPRINKLER TAMPER SWITCHES. DO NOT LOCATE IN SERVICE SHAFT BUT INSTALL 2 PAIR FROM EACH MONITORING ELEMENT TO FUTURE TAMPER SWITCH LOCATION

REAL PROPERTY SERVICES  
Western Region

Client  
**CORRECTIONAL SERVICE CANADA**

Client  
 beaubien glover maskell engineering  
Suite #700, 4408 - 42 Avenue  
Edmonton, Alberta, T6E 5V6  
Tel: 780-429-2244 Fax: 780-429-4466  
www.bgm.ca  
Job #5783



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1	ISSUED FOR 50% REVIEW	08/04/11

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	C detail on drawing no. detail sur dessin no.	

project title  
**EDMONTON MAXIMUM SECURITY INSTITUTE**  
titre du projet  
**FIRE ALARM UPGRADE**

drawing title  
**PARTIAL LOWER FLOOR PLAN MAIN BUILDING BLOCKS A/B/C & D**  
titre du dessin

designed by  
**P. BEAUBIEN**  
conçu par

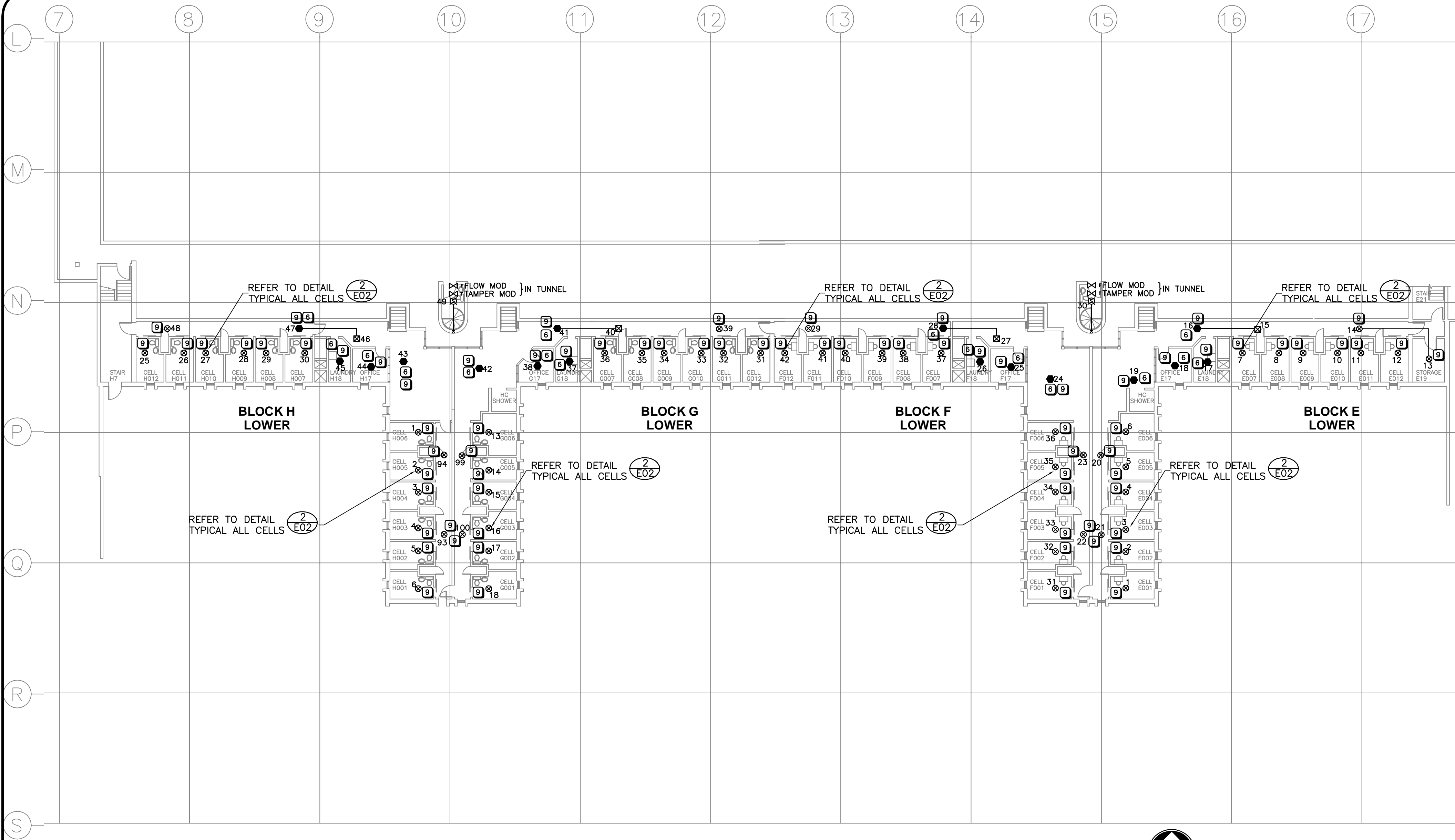
drawn by  
**L. HONDERD**  
dessiné par

approved by  
**P. BEAUBIEN**  
approuvé par

PWOSC Project Manager  
Administrateur de Projets TPSGC

scale <b>AS NOTED</b>	echelle	sheet <b>E03</b>	feuille <b>OF 17</b>
project no. <b>R.014522.001</b>	projet no.		
date <b>APRIL 17, 2013</b>	date		





PARTIAL LOWER FLOOR PLAN - FIRE ALARM

SCALE 1:200

KEYNOTES

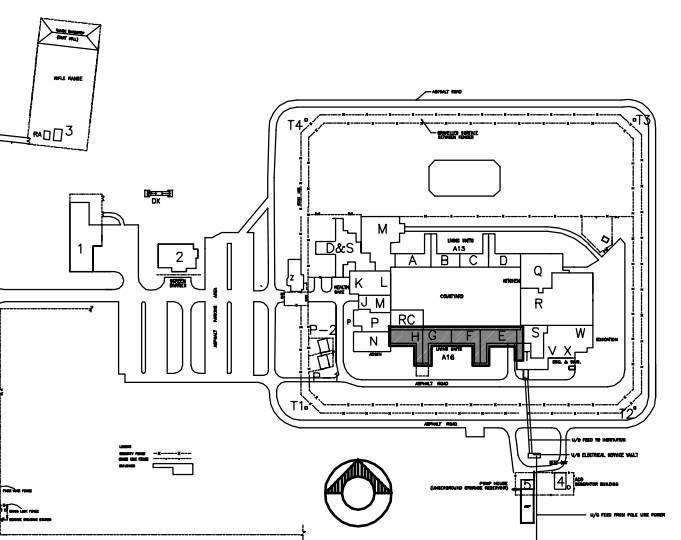
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- 11 FOR FUTURE CELL SPRINKLER TAMPER SWITCHES. DO NOT LOCATE IN SERVICE SHAFT BUT INSTALL 2 PAIR FROM EACH MONITORING ELEMENT TO FUTURE TAMPER SWITCH LOCATION

REAL PROPERTY SERVICES Western Region

Client CORRECTIONAL SERVICE CANADA



Job #5783



KEY PLAN

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1	ISSUED FOR 50% REVIEW	08/04/11

A	A detail number number du detail	A
B	B source drawing no. de dessin no.	B
C	C detail on drawing no. detail sur dessin no.	C

project title EDMONTON MAXIMUM SECURITY INSTITUTE  
titre du projet

FIRE ALARM UPGRADE

drawing title PARTIAL LOWER FLOOR PLAN  
titre du dessin

MAIN BUILDING  
BLOCKS H/G/F & E

designed by P. BEAUBIEN  
conçu par

drawn by L. HONDERD  
dessiné par

approved by P. BEAUBIEN  
approuvé par

PWOSC Project Manager Administrateur de Projets TPSGC

scale AS NOTED  
échelle

project no. R.014522.001  
feuille

date APRIL 17, 2013  
E04 OF 17



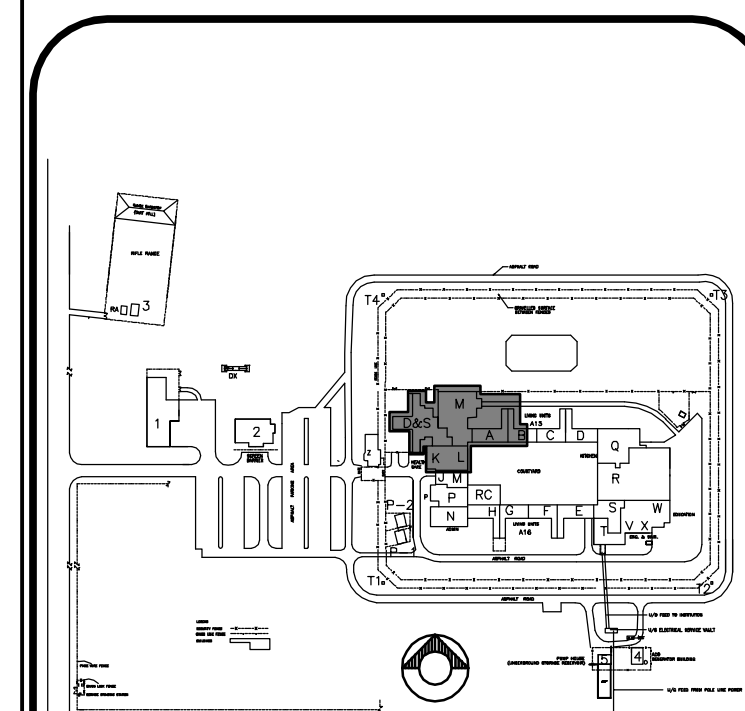
Client Client

**CORRECTIONAL SERVICE  
CANADA**

Client	Client
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Job #5783





## KEY PLAN

## RECORD DRAWING

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7	ISSUED FOR CONSTRUCTION	09/06/
6	ADDENDUM E1	09/03/
5	ISSUED FOR TENDER	09/02/
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1	ISSUED FOR 50% REVIEW	08/04/0
REVIEWS	DESCRIPTION	DATE

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project title	titre du projet
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project title	EDMONTON MAXIMUM SECURITY INSTITUTE	title
	FIRE ALARM UPGRADE	

drawing title	titre du dessin
---------------	-----------------

**PARTIAL UPPER FLOOR PLAN  
MAIN BUILDING  
BLOCKS A/B/D/M/K/L & S**

designed by	conçu p
<b>P. BEAUBIEN</b>	

drawn by **L. HONDERD** dessine par

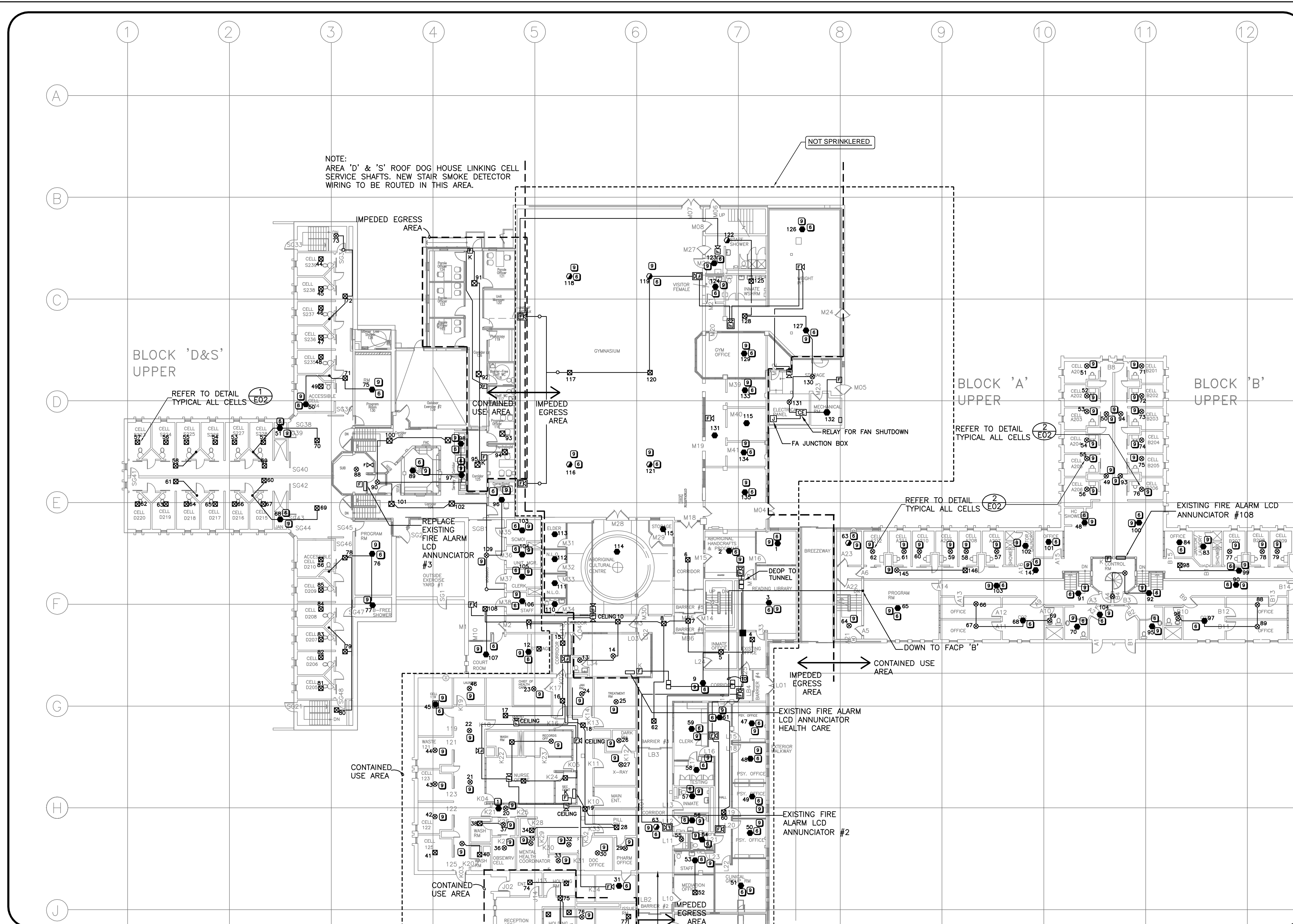
approved by **P. BEAUBIEN** approve p

PWGSC Project Manager	Administrateur de Projets TPSG
-----------------------	--------------------------------

scale	echelle	sheet	feuille
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scale	echelle	sheet	feuille
<b>AS NOTED</b>			
project no.	projet no.		

project no.	<b>R.014522.001</b>	project no.	<b>E05</b>
date	<b>APRIL 17, 2013</b>	date	<b>OF 17</b>



FOR CONTINUATION SEE DRAWING E06

FOR CONTINUATION SEE DRAWING E07



### PARTIAL MAIN & UPPER FLOOR PLAN - FIRE ALARM

SCALE 1:25

## KEYNOTES

- 1 REMOVE AND BLANK OFF.
- 2 SURFACE INSTALLATION.
- 3 RECESSED INSTALLATION.
- 4 CHANGE FROM BELL TO HORN
- 5 NOT USED

- 6 CHANGE FROM HEAT DETECTOR TO SMOKE DETECTOR.
- 7 CHANGE FROM SMOKE DETECTOR TO HEAT DETECTOR.
- 8 CHANGE HORN TO SURFACE  
100mm WALL HORN/STROBE
- 9 ADD GUARD COVER
- 10 FIRE ALARM BACKBONE
- 11 FOR FUTURE CELL SPRINKLER TAMPER SWITCHES. DO  
NOT LOCATE IN SERVICE SHAFT BUT INSTALL 2 PAIR  
FROM EACH MONITORING ELEMENT TO FUTURE  
TAMPER SWITCH LOCATION

ALL SPRINKLERED  
EXCEPT AS NOTED  
ALL CONTAINED  
USE AREA

REAL PROPERTY SERVICES  
Western Region

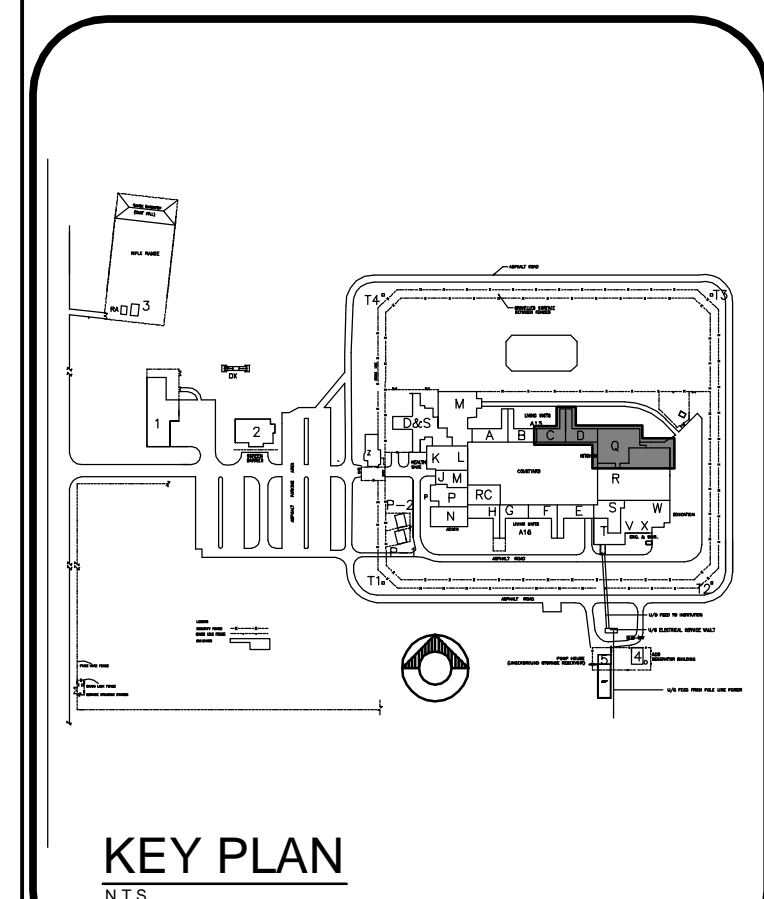
Client  
**CORRECTIONAL SERVICE  
CANADA**

Client

**beaubien glover maskell  
engineering**

Suite 400, 4408 - 42 Avenue  
Edmonton, Alberta, T6E 5V6  
Tel: 780-429-2266 Fax: 780-429-4466  
www.bgm.ca

Job #5783



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project title  
**EDMONTON MAXIMUM  
SECURITY  
INSTITUTE  
FIRE ALARM UPGRADE**

drawing title  
**PARTIAL MAIN FLOOR PLAN  
MAIN BUILDING  
BLOCKS C/D & Q**

designed by  
**P. BEAUBIEN**

drawn by  
**L. HONDERD**

approved by  
**P. BEAUBIEN**

PWSC Project Manager  
Administrateur de Projets TPSGC

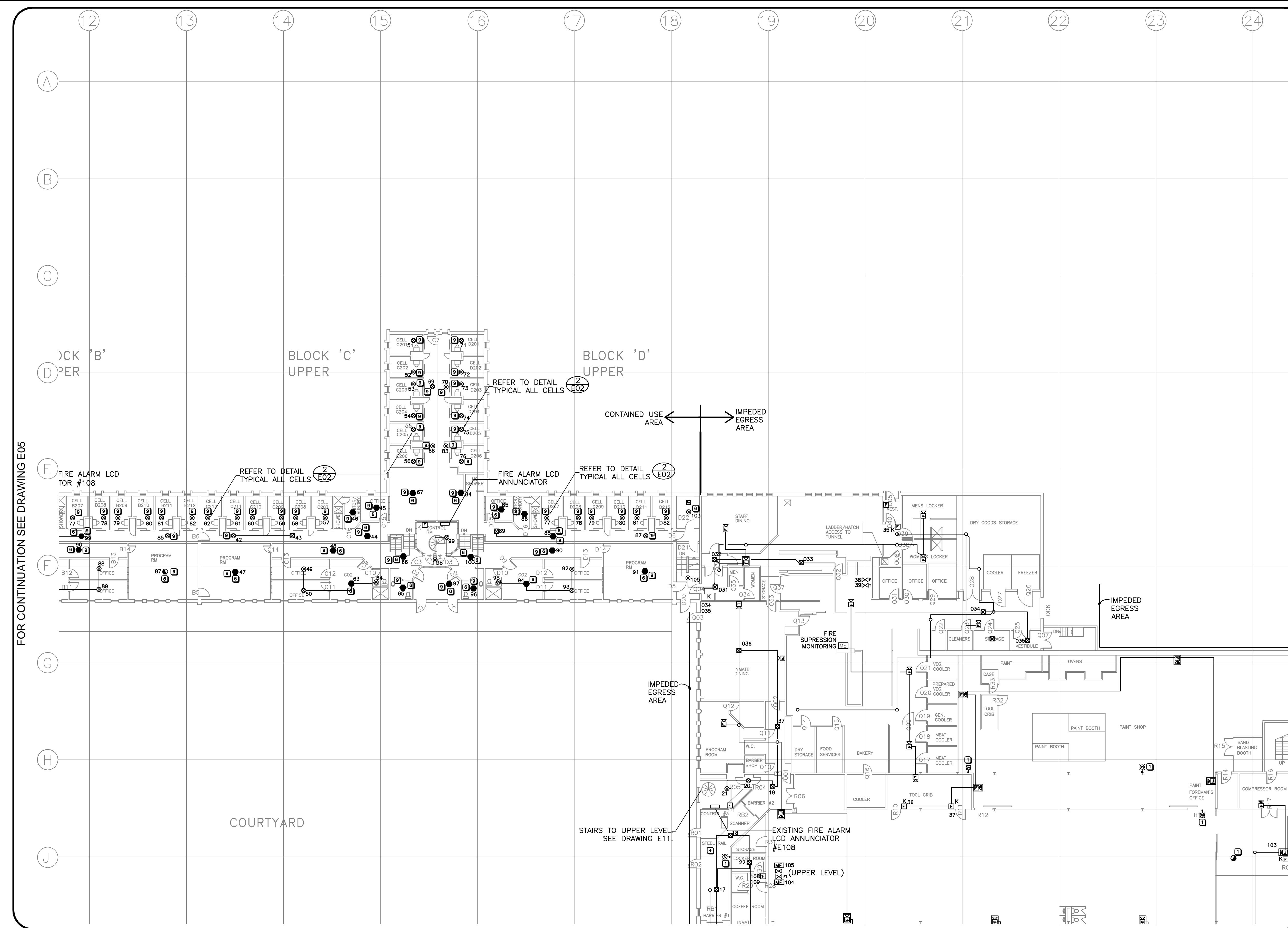
scale  
**AS NOTED**

project no.  
**R.014522.001**

date  
**APRIL 17, 2013**

sheet  
**E06**

feuille  
**OF 17**



FOR CONTINUATION SEE DRAWING E05

FOR CONTINUATION SEE DRAWING E08

**PARTIAL MAIN & UPPER FLOOR PLAN - FIRE ALARM**  
SCALE 1:200

- KEYNOTES**
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**ALL SPRINKLERED**

REAL PROPERTY SERVICES  
Western Region

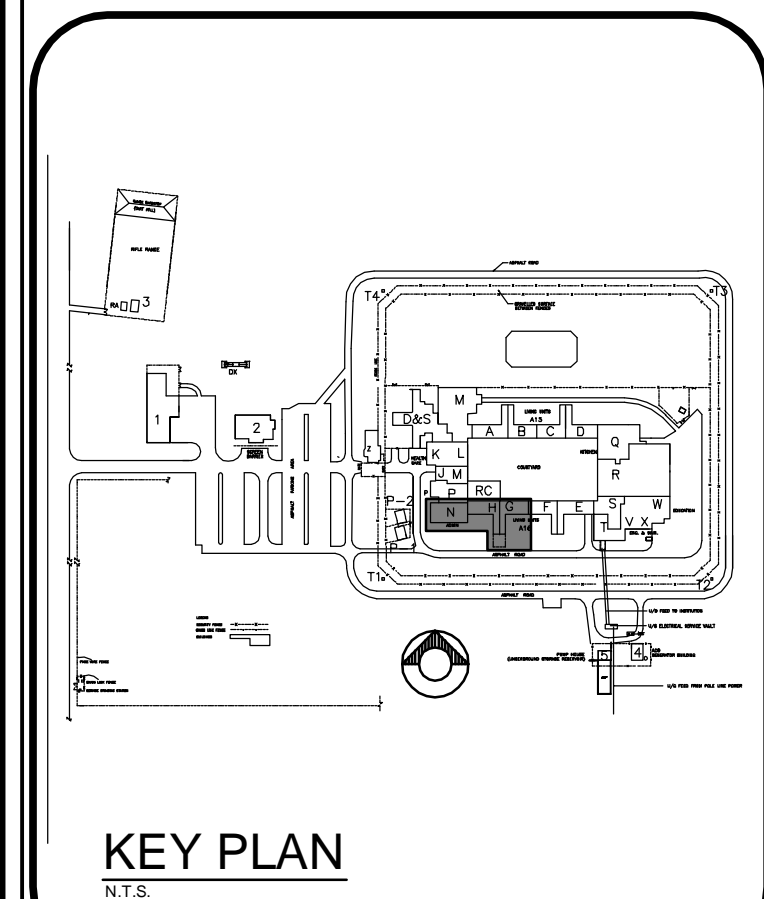
Client  
**CORRECTIONAL SERVICE  
CANADA**

Client

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7	ISSUED FOR CONSTRUCTION	09/06/01
6	ADDENDUM E1	09/03/18
5	ISSUED FOR TENDER	09/02/03
4	ISSUED FOR 100% TENDER	09/01/02
3	ISSUED FOR 99% REVIEW	08/10/13
2	ISSUED FOR 50% RE-SUBMISSION	08/09/10
1	ISSUED FOR 50% REVIEW	08/04/11
REVISIONS	DESCRIPTION	DATE

A	A detail number number du detail	A
B	B source drawing no. de dessin no.	B
C	C detail on drawing no. detail sur dessin no.	C

project title  
**EDMONTON MAXIMUM  
SECURITY  
INSTITUTE**

titre du projet

**FIRE ALARM UPGRADE**

drawing title  
**PARTIAL UPPER FLOOR PLAN  
MAIN BUILDING  
BLOCKS J/M/P/N/R/C/H & G**

titre du dessin

designed by  
**P. BEAUBIEN**

conçu par

drawn by  
**L. HONDERD**

dessiné par

approved by  
**P. BEAUBIEN**

approuvé par

PWOSC Project Manager  
Administrateur de Projets TPSGC

scale  
**AS NOTED**

échelle

sheet  
**E07**

feuille

project no.  
**R.014522.001**

projet no.

date  
**APRIL 17, 2013**

date

FOR CONTINUATION SEE DRAWING E05

FOR CONTINUATION SEE DRAWING E08

EXISTING  
UNDER-GROUND TO  
GATEHOUSE FOR NEW  
CLASS 'A' FIRE ALARM  
FIRE RATED BACKBONE.

EXISTING ROOF  
TOP UNIT

REPLACE EXISTING  
LCD ANNUNCIATOR  
#H108

EXISTING MAIN  
FIRE ALARM  
CABINET-REPLACE  
BUILDING 'N'  
BLOCK 'H'  
UPPER

BLOCK 'G'  
UPPER

**KEYNOTES**

- |   |                          |    |   |
|---|--------------------------|----|---|
| 1 | REMOVE AND BLANK OFF.    | 6  | CHANGE FROM HEAT DETECTOR TO SMOKE DETECTOR.  |
| 2 | SURFACE INSTALLATION.    | 7  | CHANGE FROM SMOKE DETECTOR TO HEAT DETECTOR.  |
| 3 | RECESSED INSTALLATION.   | 8  | CHANGE HORN TO SURFACE<br>100mm WALL HORN/STROBE  |
| 4 | CHANGE FROM BELL TO HORN | 9  | ADD GUARD COVER   |
| 5 | NOT USED                 | 10 | FIRE ALARM BACKBONE   |
|   |                          | 11 | FOR FUTURE CELL SPRINKLER TAMPER SWITCHES. DO<br>NOT LOCATE IN SERVICE SHAFT BUT INSTALL 2 PAIR<br>FROM EACH MONITORING ELEMENT TO FUTURE<br>TAMPER SWITCH LOCATION |



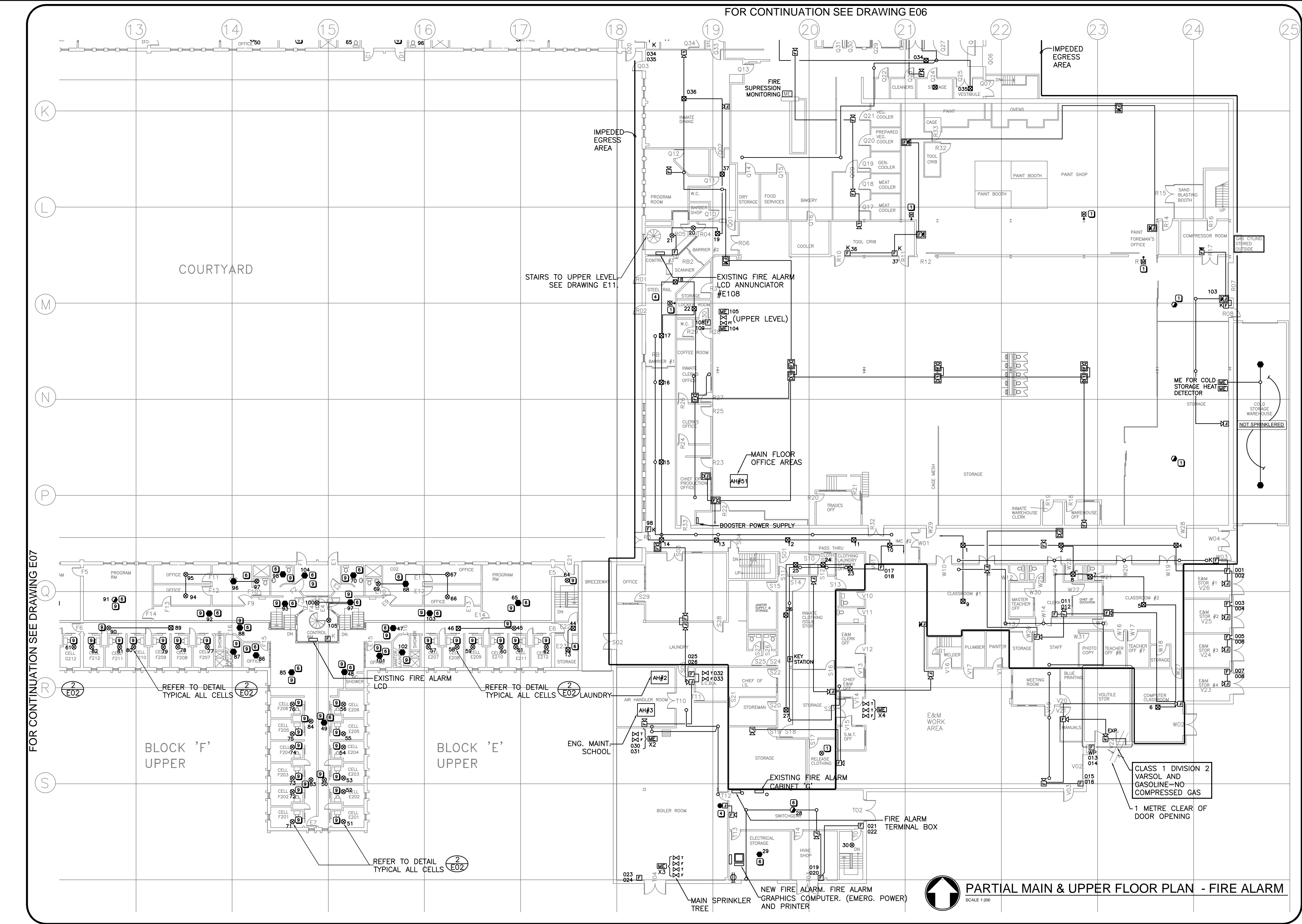
**PARTIAL MAIN & UPPER FLOOR PLAN - FIRE ALARM**

SCALE 1:200

**ALL SPRINKLERED  
EXCEPT AS NOTED**

**ALL CONTAINED  
USE AREA EXCEPT  
AS NOTED**





KEYNOTES

- 1 REMOVE AND BLANK OFF.
- 2 SURFACE INSTALLATION.
- 3 RECESSED INSTALLATION.
- 4 CHANGE FROM BELL TO HORN
- 5 NOT USED

- 6 CHANGE FROM HEAT DETECTOR TO SMOKE DETECTOR.
- 7 CHANGE FROM SMOKE DETECTOR TO HEAT DETECTOR.
- 8 CHANGE HORN TO SURFACE 100mm WALL HORN/STROBE
- 9 ADD GUARD COVER
- 10 FIRE ALARM BACKBONE
- 11 FOR FUTURE CELL SPRINKLER TAMPER SWITCHES. DO NOT LOCATE IN SERVICE SHAFT BUT INSTALL 2 PAIR FROM EACH MONITORING ELEMENT TO FUTURE TAMPER SWITCH LOCATION

ALL SPRINKLERED  
ALL CONTAINED USE AREA EXCEPT  
'E' & 'M' WORK AREA  
BLOCK 'T'

Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

REAL PROPERTY SERVICES Western Region

Client CORRECTIONAL SERVICE CANADA

Client

beaubien glover maskell engineering

Job #5783

KEY PLAN

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1	ISSUED FOR 50% REVIEW	08/04/11

project title EDMONTON MAXIMUM SECURITY INSTITUTE

titre du projet

drawing title PARTIAL MAIN FLOOR PLAN MAIN BUILDING BLOCKS R/S/T/N/X/W/E & F

titre du dessin

designed by P. BEAUBIEN

conçu par

drawn by L. HONDERD

dessiné par

approved by P. BEAUBIEN

approuvé par

PWOSC Project Manager Administrateur de Projets TPSSC

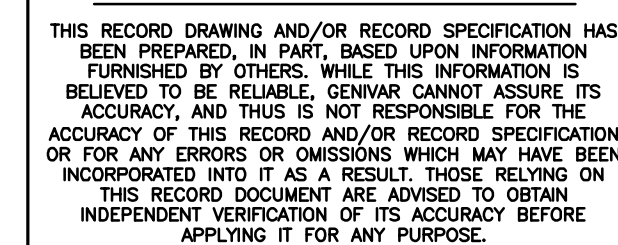
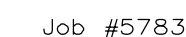
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AS NOTED			
project no. R.014522.001		project no.	E08
date		date	OF 17


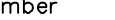
APRIL 17, 2013





- 1 REMOVE AND BLANK OFF.
- 2 SURFACE INSTALLATION.
- 3 RECESSED INSTALLATION.
- 4 CHANGE FROM BELL TO HORN
- 5 NOT USED
- 6 CHANGE FROM HEAT DETECTOR TO SMOKE DETECTOR.
- 7 NOT USED
- 8 CHANGE HORN TO SURFACE  
100mm WALL HORN/STROBE
- 9 ADD GUARD COVER
- 10 FIRE ALARM BACKBONE
- 11 FOR FUTURE CELL SPRINKLER TAMPER SWITCHES. DO  
NOT LOCATE IN SERVICE SHAFT BUT INSTALL 2 PAIR  
FROM EACH MONITORING ELEMENT TO FUTURE TAMPER  
SWITCH LOCATION (D AND S CELLS ONLY)



	<p>A detail number number du détail</p> <p>B source drawing no. de dessin no.</p> <p>C detail on drawing no. détail sur dessin no.</p>	
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project title	titre du projet
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drawing title	titre du dessin
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designed by	concu p
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drawn by	dessine par
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approved by	approuvé par
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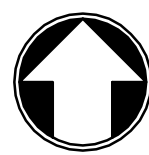
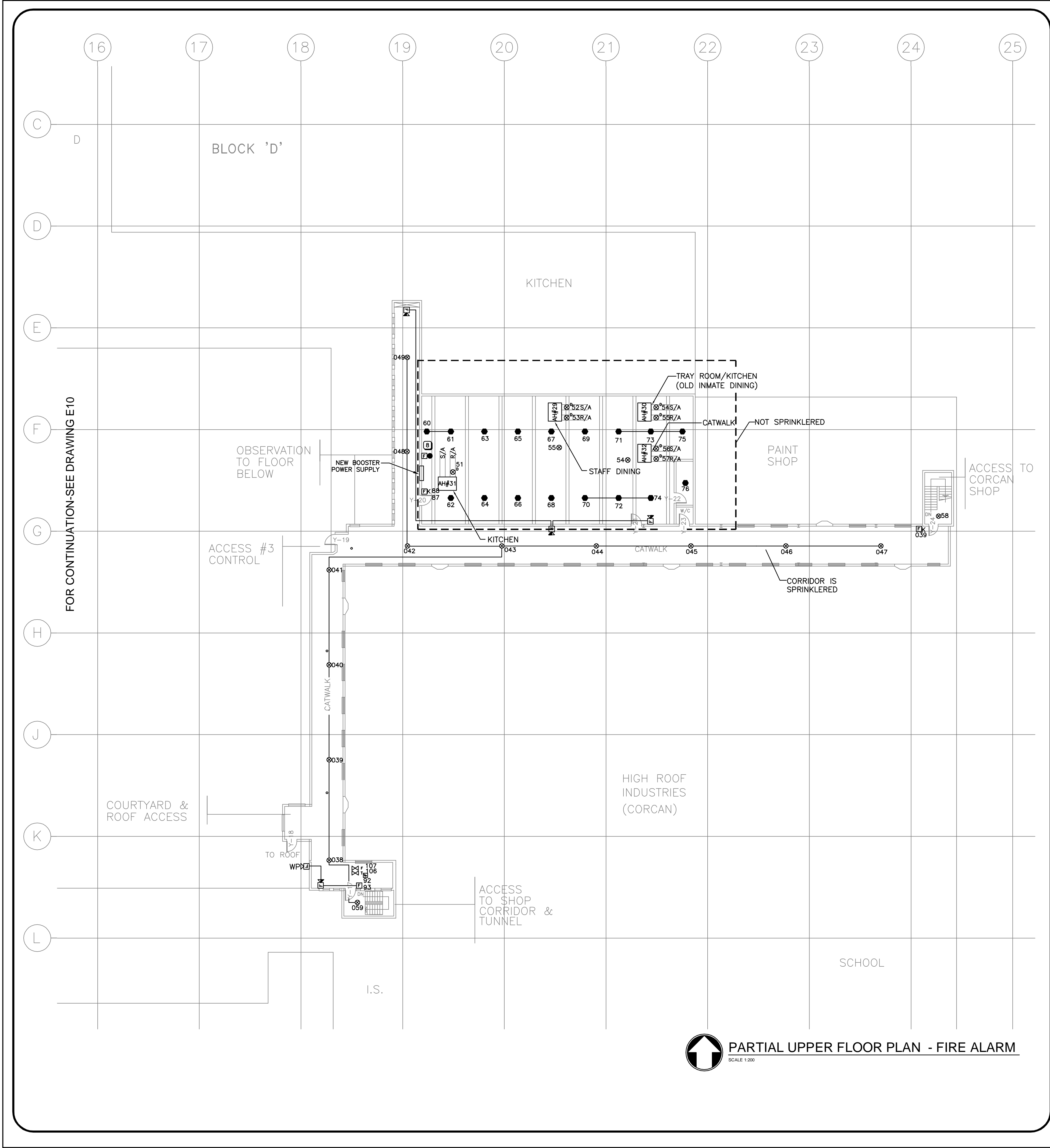
PWGSC Project Manager	Administrateur de Projets TPSO
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scale	echelle	sheet	feuille
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project no.	<b>B 014533 001</b>	projet no.	<b>E10</b>
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date	APRIL 17, 2013	date	OF	17
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NOT SPRINKLERED
NOT CONTAINED USE



PARTIAL UPPER FLOOR PLAN - FIRE ALARM

SCALE 1:200

KEYNOTES

- 1 REMOVE AND BLANK OFF.
- 2 SURFACE INSTALLATION.
- 3 RECESSED INSTALLATION.
- 4 CHANGE FROM BELL TO HORN
- 5 NOT USED
- 6 CHANGE FROM HEAT DETECTOR TO SMOKE DETECTOR.
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100mm WALL HORN/STROBE
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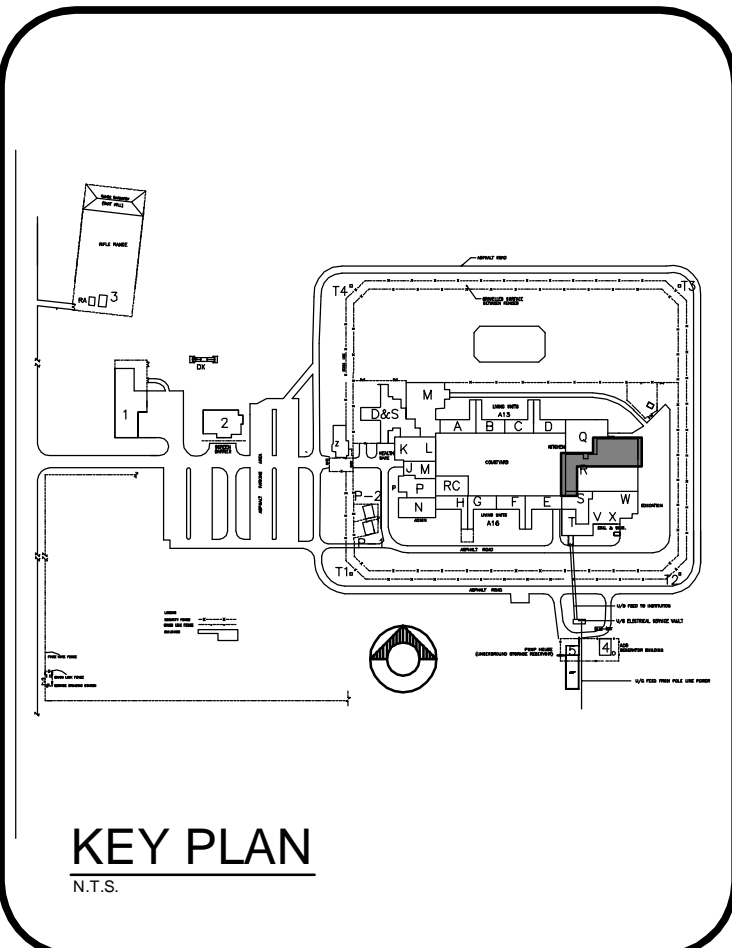
REAL PROPERTY SERVICES  
Western Region

Client  
**CORRECTIONAL SERVICE CANADA**

Client



Job #5783



KEY PLAN  
N.T.S.

RECORD DRAWING

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A	A detail number number du detail	A
B	B source drawing no. de dessin no.	B
C	C detail on drawing no. detail sur dessin no.	C

project title  
**EDMONTON MAXIMUM SECURITY INSTITUTE**  
titre du projet  
**FIRE ALARM UPGRADE**

drawing title  
**PARTIAL UPPER FLOOR PLAN**  
titre du dessin  
**MAIN BUILDING**

designed by  
**P. BEAUBIEN**  
conçu par

drawn by  
**L. HONDERD**  
dessiné par

approved by  
**P. BEAUBIEN**  
approuvé par

PWSC Project Manager  
Administrateur de Projets TPSGC

scale  
**AS NOTED**  
échelle  
sheet  
**E11**  
feuille

project no.  
**R.014522.001**  
date  
**APRIL 17, 2013**  
project no.  
date  
**OF 17**

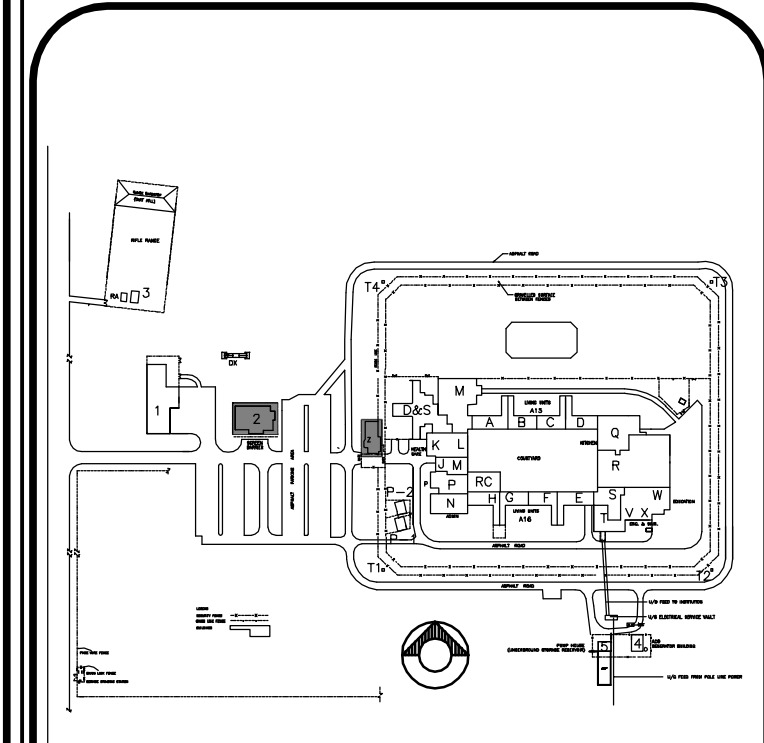


REAL PROPERTY SERVICES  
Western Region

Client  
**CORRECTIONAL SERVICE CANADA**

Client

**beaubien glover maskell engineering**  
Suite #700, 4408 - 42 Avenue  
Edmonton, Alberta, T6E 5V6  
Tel: 780-429-2266 Fax: 780-429-4466  
www.bgm.ca  
Job #5783



**KEY PLAN**  
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C	C detail on drawing no. detail sur dessin no.	C

project title  
**EDMONTON MAXIMUM SECURITY INSTITUTE**  
FIRE ALARM UPGRADE

drawing title  
**FAMILY VISIT BUILDING 1 AND 2  
FIREARMS BUILDING  
GATEHOUSE BUILDING**

designed by  
**P. BEAUBIEN**

drawn by  
**L. HONDERD**

approved by  
**P. BEAUBIEN**

PWSC Project Manager  
Administrateur de Projets TPSGC

scale  
**AS NOTED**

project no.  
**R.014522.001**

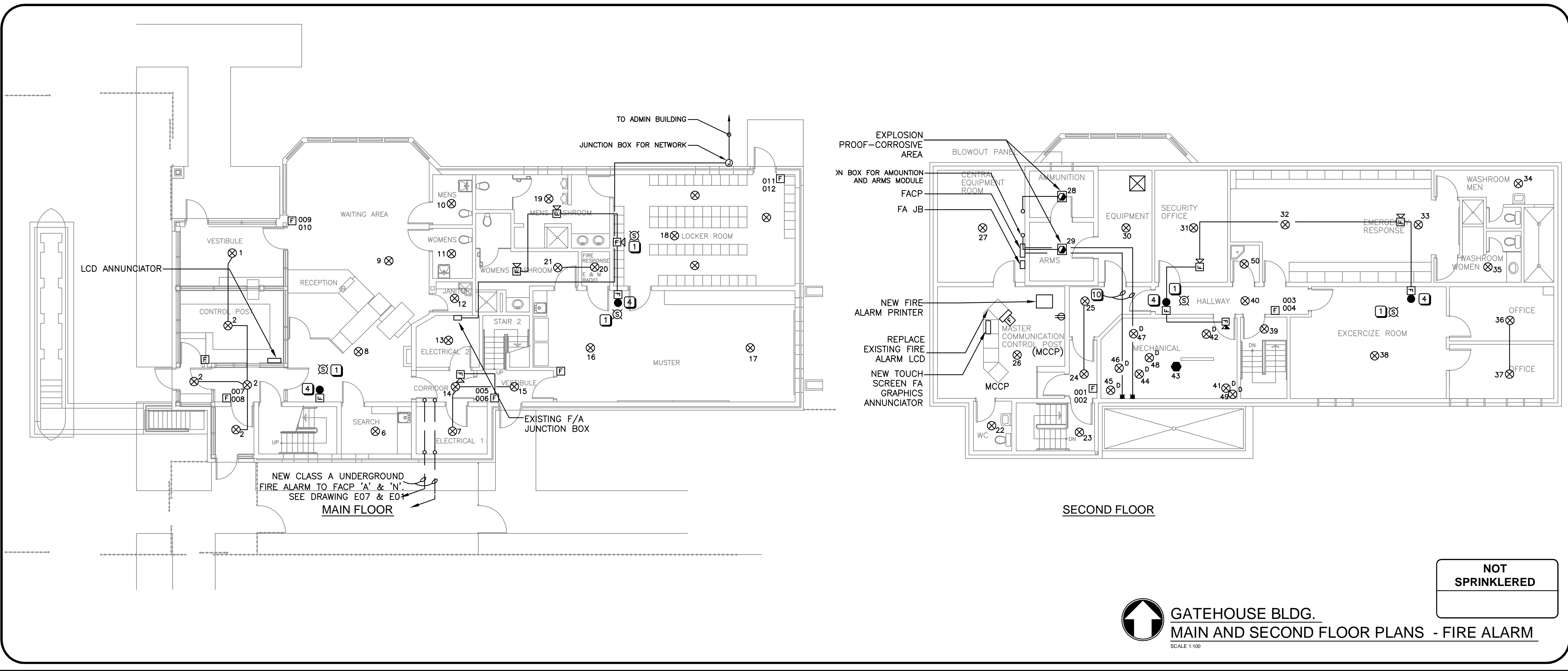
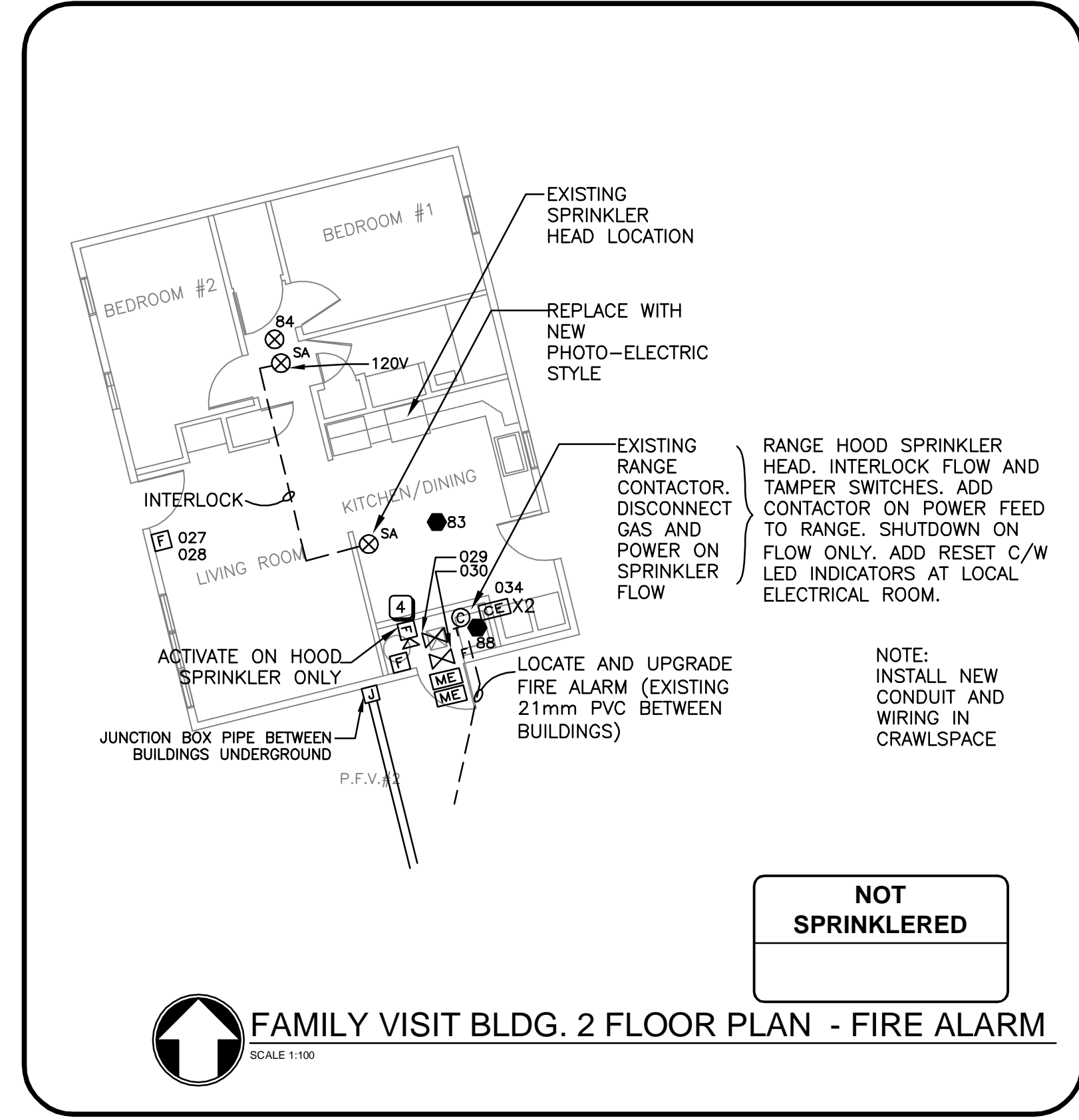
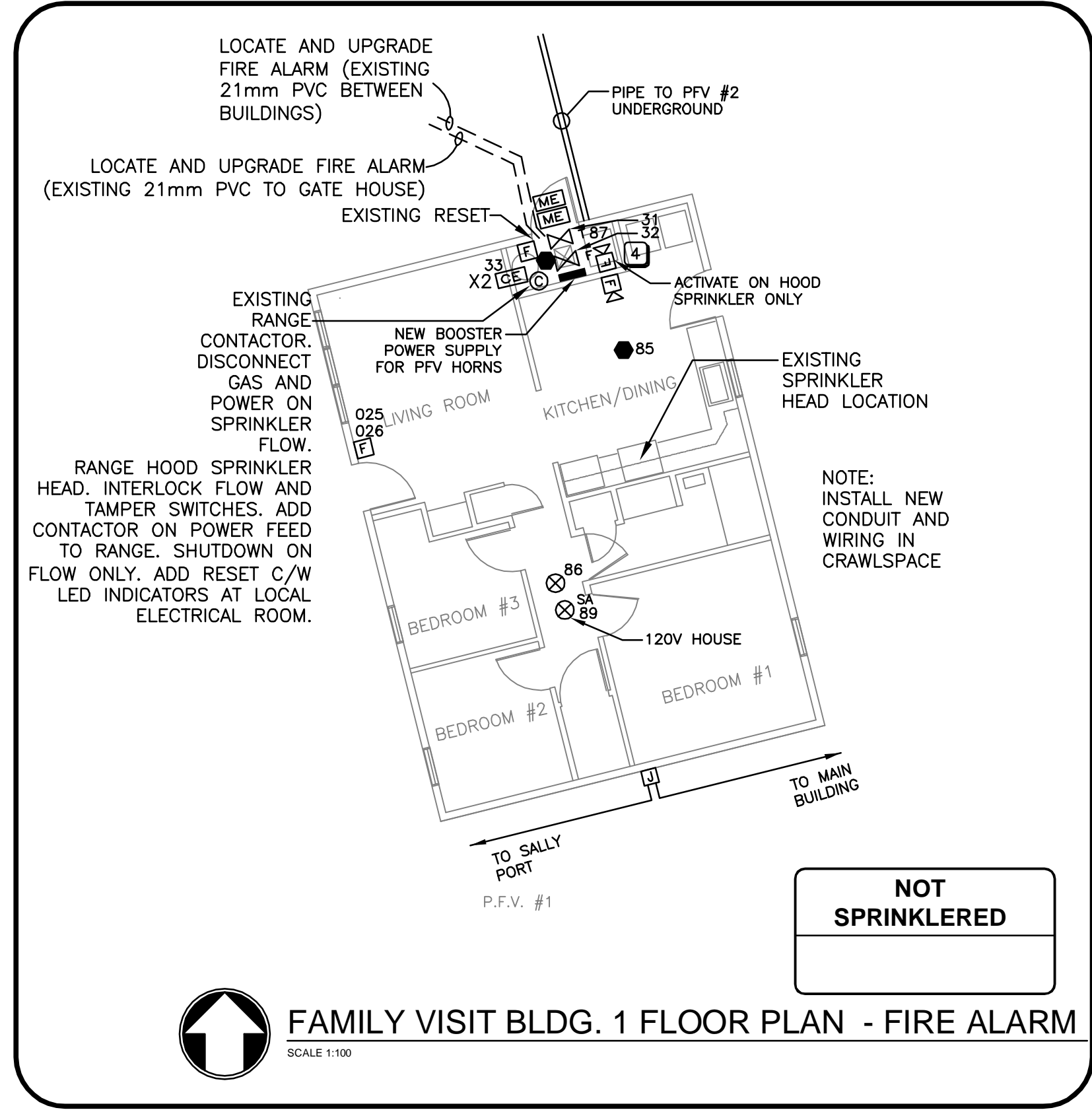
date  
**APRIL 17, 2013**

sheet  
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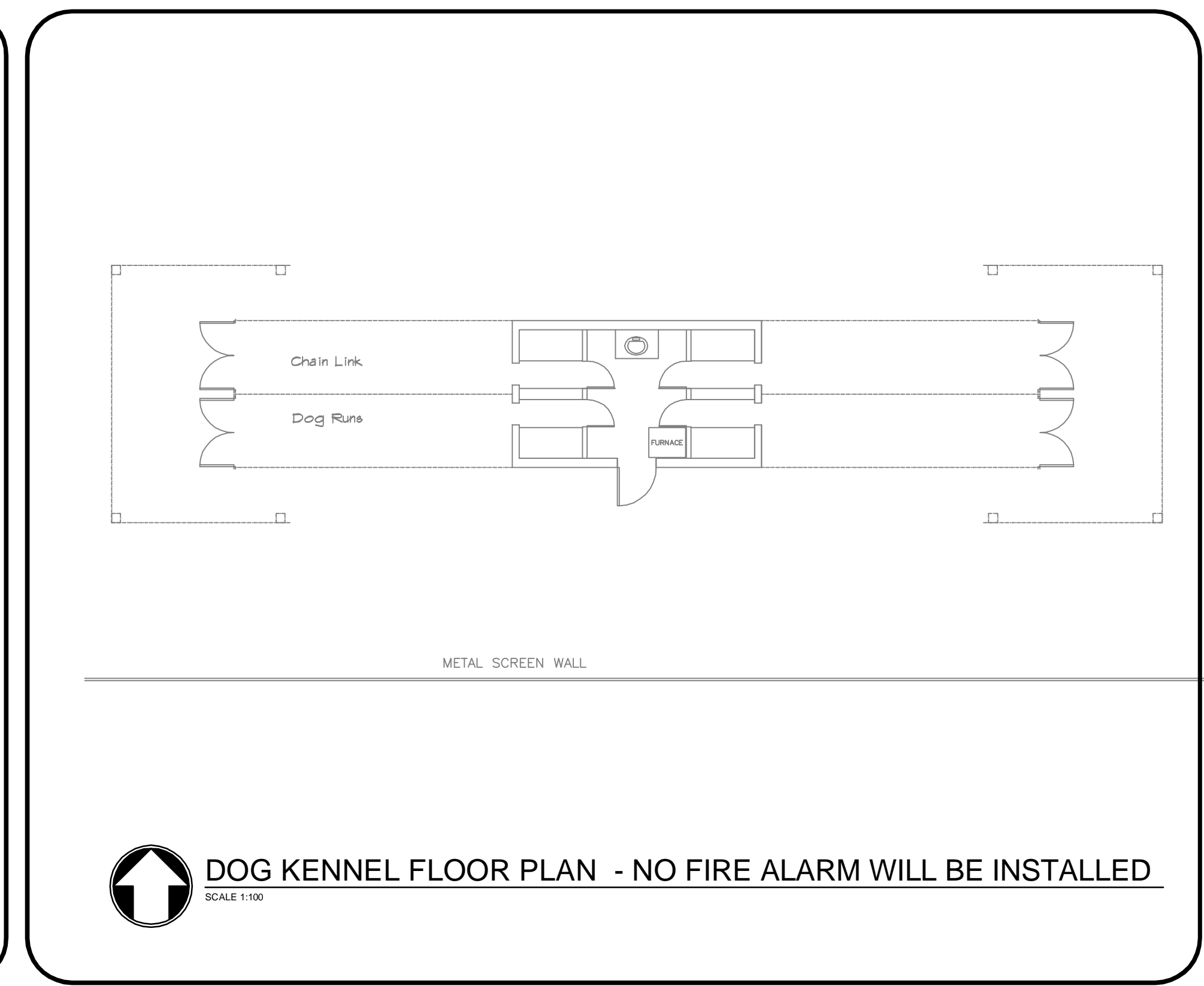
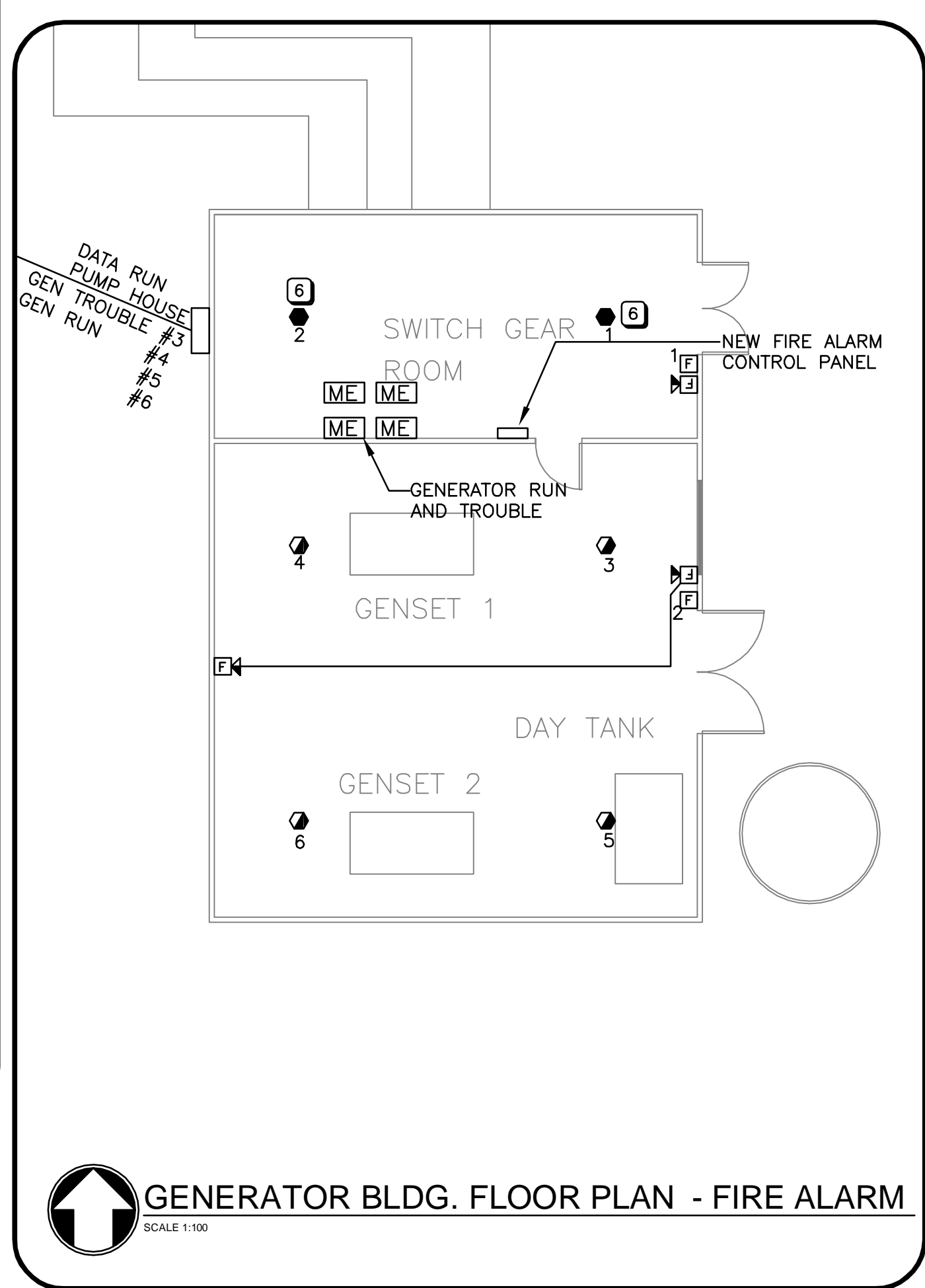
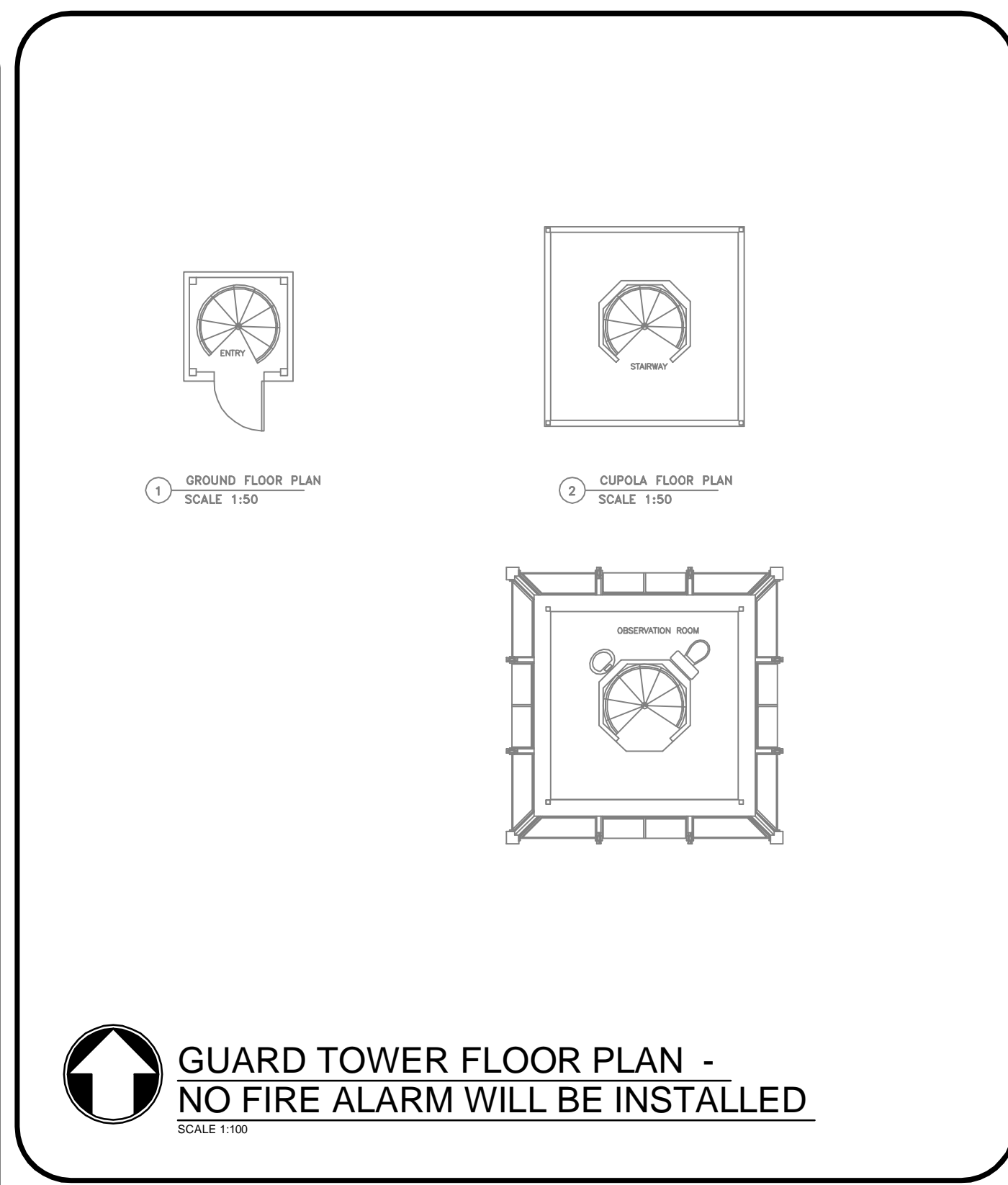
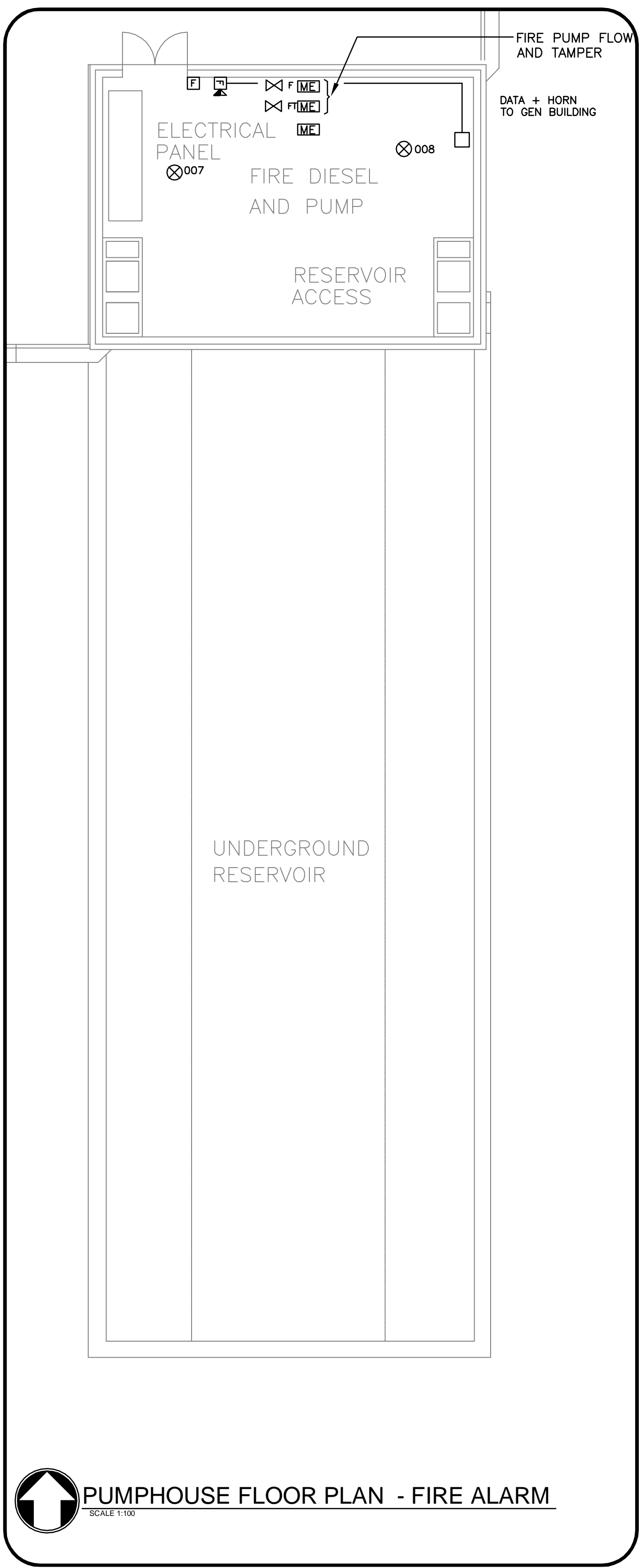
feuille  
**OF 17**

**KEYNOTES**

- 1 REMOVE AND BLANK OFF.
- 2 SURFACE INSTALLATION.
- 3 RECESSED INSTALLATION.
- 4 CHANGE FROM BELL TO HORN
- 5 NOT USED
- 6 CHANGE FROM HEAT DETECTOR TO SMOKE DETECTOR.
- 7 NOT USED
- 8 CHANGE HORN TO SURFACE 100mm WALL HORN/STROBE
- 9 ADD GUARD COVER
- 10 FIRE ALARM BACKBONE
- 11 FOR FUTURE CELL SPRINKLER TAMPER SWITCHES. DO NOT LOCATE IN SERVICE SHAFT BUT INSTALL 2 PAIR FROM EACH MONITORING ELEMENT TO FUTURE TAMPER SWITCH LOCATION







- KEYNOTES**
- 1 REMOVE AND BLANK OFF.
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  - 3 RECESSED INSTALLATION.
  - 4 CHANGE FROM BELL TO HORN
  - 5 NOT USED
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Public Works and Government Services Canada

Travaux publics et Services gouvernementaux Canada

REAL PROPERTY SERVICES  
Western Region

Client

**CORRECTIONAL SERVICE CANADA**

Client

Client

Suite #700, 4408 - 42 Avenue  
Edmonton, Alberta, T6E 5V1  
Tel: 780-429-2266 Fax: 780-429-4466  
www.bgm.ca

Job #5783

**KEY PLAN**  
N.T.S.

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A

B

C

A detail number  
number du detail  
B source drawing no.  
de dessin no.  
C detail on drawing no.  
detail sur dessin no.

A

B

C

project title

**EDMONTON MAXIMUM SECURITY INSTITUTE**

titre du projet

**FIRE ALARM UPGRADE**

drawing title

**PUMPHOUSE/ GENERATOR/ GUARD TOWERS/ DOG KENNEL BUILDINGS**

titre du dessin

designed by

P. BEAUBIEN

conçu par

drawn by

L. HONDERD

dessiné par

approved by

P. BEAUBIEN

approuvé par

PWSC Project Manager

Administrateur de Projets TPSGC

scale

AS NOTED

échelle

sheet

feuille

project no.

R.014522.001

projet no.

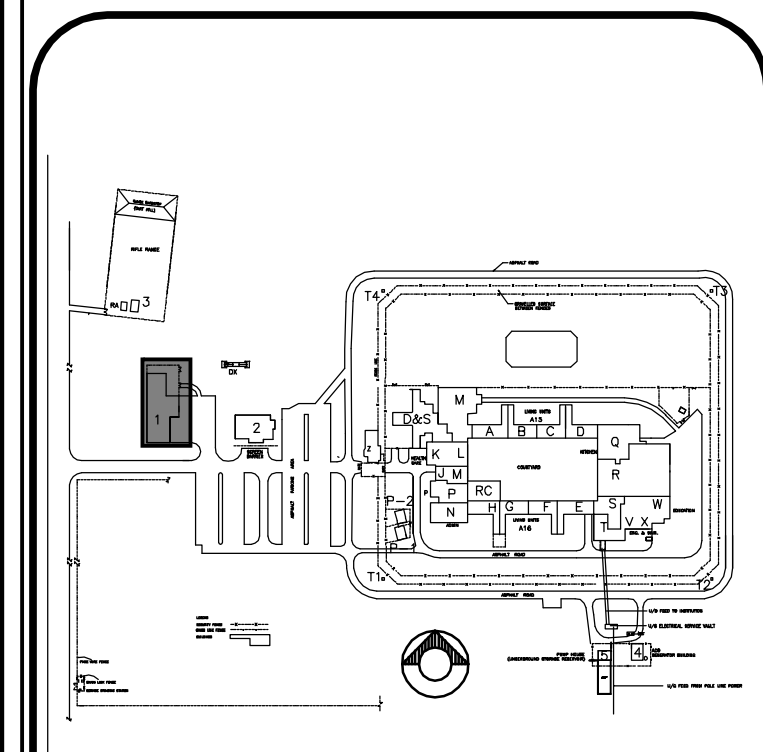
date

APRIL 17, 2013

date

E13

OF 17



KEY PLAN  
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project title

EDMONTON MAXIMUM  
SECURITY  
INSTITUTE

fire alarm upgrade

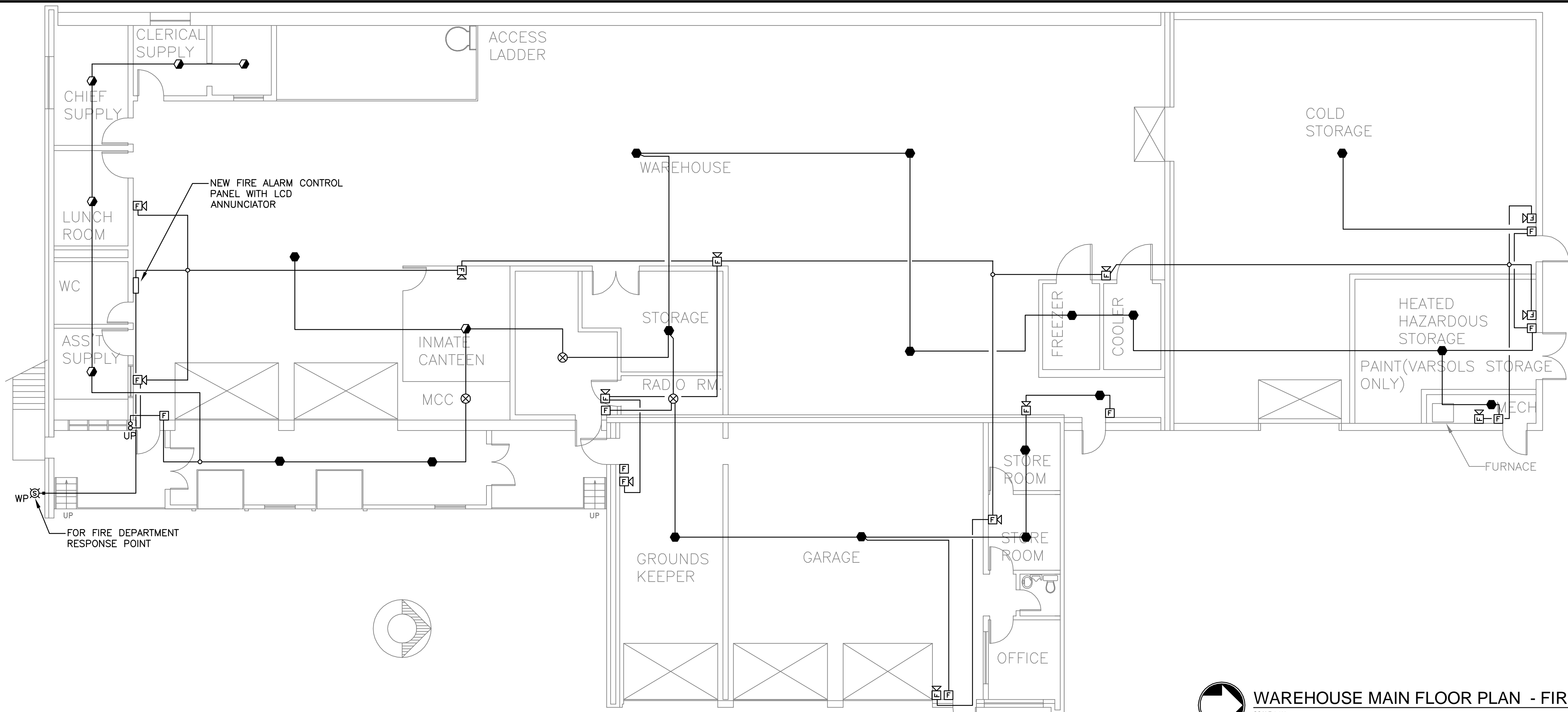
titre du projet

drawing title

WAREHOUSE BUILDING  
MAIN & MEZZANINE  
FLOORS

titre du dessin

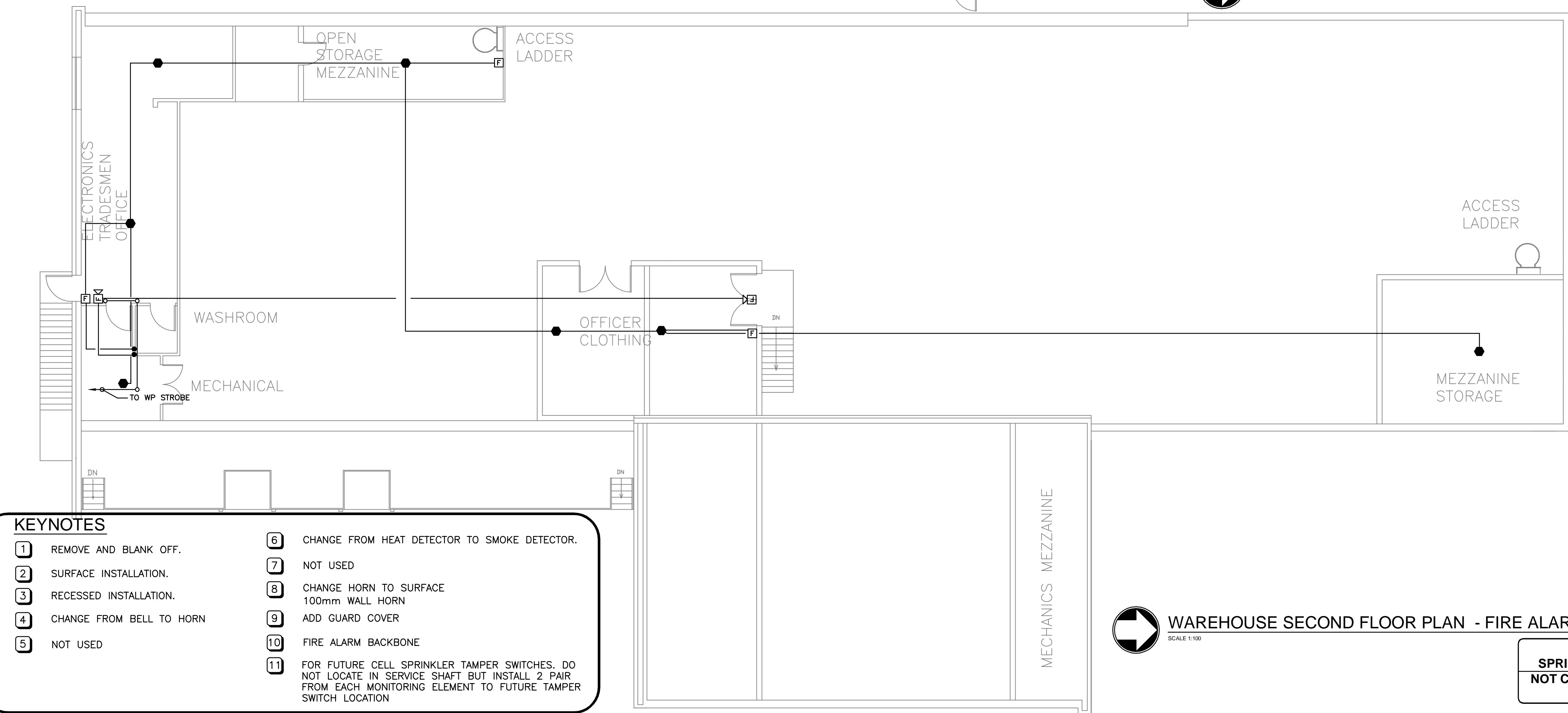
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drawn by	L. HONDERD	dessiné par
approved by	P. BEAUBIEN	approuvé par
PWOSC Project Manager	Administrateur de Projets TPSSC	
scale	AS NOTED	echelle
project no.	R.014522.001	projet no.
date	APRIL 17, 2013	date
		sheet
		feuille
		E14
		OF 17





WAREHOUSE MAIN FLOOR PLAN - FIRE ALARM

SCALE 1:100



- KEYNOTES
- 1 REMOVE AND BLANK OFF.

2 SURFACE INSTALLATION.

3 RECESSED INSTALLATION.

4 CHANGE FROM BELL TO HORN

5 NOT USED

6 CHANGE FROM HEAT DETECTOR TO SMOKE DETECTOR.

7 NOT USED

8 CHANGE HORN TO SURFACE 100mm WALL HORN

9 ADD GUARD COVER

10 FIRE ALARM BACKBONE

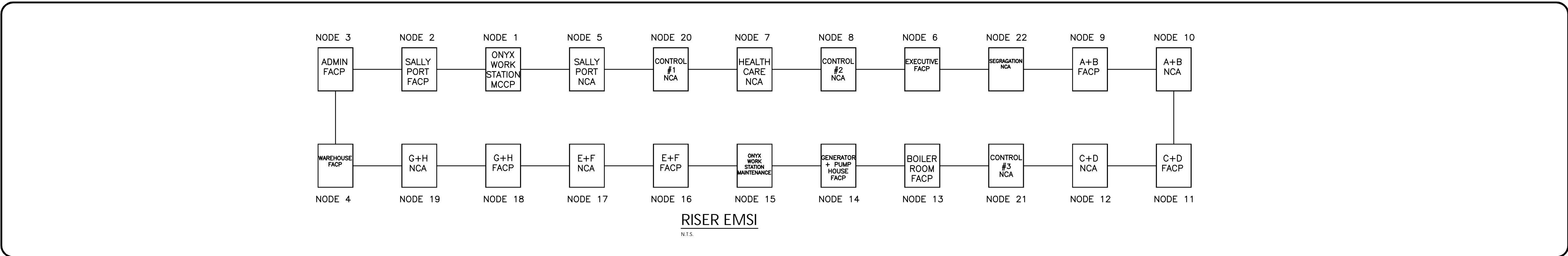
11 FOR FUTURE CELL SPRINKLER TAMPER SWITCHES. DO NOT LOCATE IN SERVICE SHAFT BUT INSTALL 2 PAIR FROM EACH MONITORING ELEMENT TO FUTURE TAMPER SWITCH LOCATION




WAREHOUSE SECOND FLOOR PLAN - FIRE ALARM

SCALE 1:100

NOT  
SPRINKLERED  
NOT CONTAINED  
USE





Public Works and  
Government Services  
Canada


Travaux publics et  
Services gouvernementaux  
Canada

REAL PROPERTY SERVICES  
Western Region

Client

CORRECTIONAL SERVICE  
CANADA

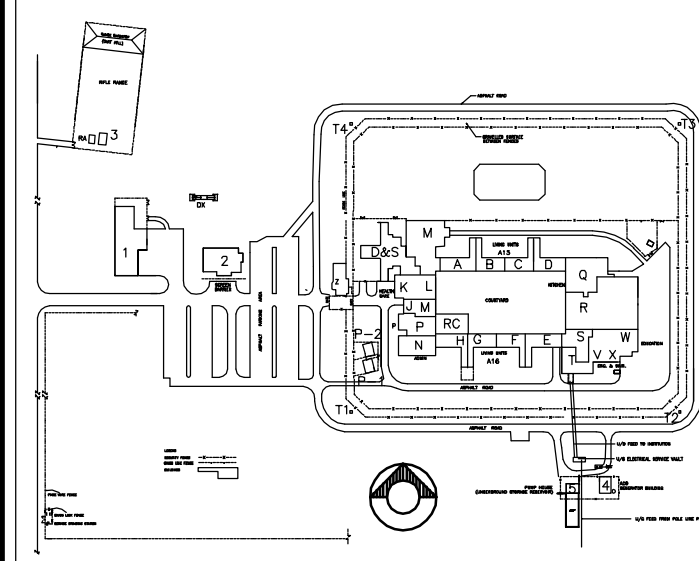
Client



beaubien glover maskell  
engineering

Suite #700, 4408 - 42 Avenue  
Edmonton, Alberta, T6E 5V6  
Tel: 780-426-2266 Fax: 780-426-4466  
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Job #5783



KEY PLAN  
N.T.S.

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3	ISSUED FOR 99% REVIEW	08/10/13
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1	ISSUED FOR 50% REVIEW	08/04/11
REVISIONS	DESCRIPTION	DATE

A

C

A detail number  
number du detail

A

B

C

B source drawing no.  
de dessin no.

C detail on drawing no.  
detail sur dessin no.

project title

EDMONTON MAXIMUM  
SECURITY  
INSTITUTE  
FIRE ALARM UPGRADE

titre du projet

drawing title

FIRE ALARM  
RISER

titre du dessin

designed by

P. BEAUBIEN

conçu par

drawn by

L. HONDERD

dessiné par

approved by

P. BEAUBIEN

approuvé par

PWSC Project Manager

Administrateur de Projets TPSGC

scale

AS NOTED

échelle

sheet

feuille

project no.

R.014522.001

projet no.

date

APRIL 17, 2013

date

E15

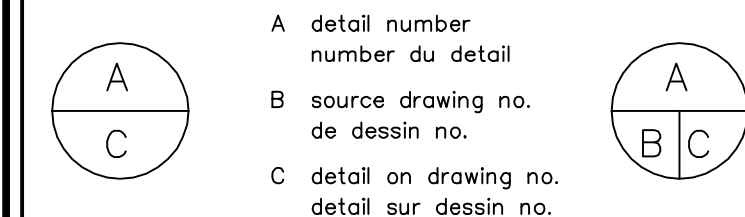
OF

17



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9	ISSUED FOR RECORD DRAWING	13/06/
8	E01 SITE PLAN ISSUED FOR RECORD DRAWING	12/10/
7	ISSUED FOR CONSTRUCTION	09/06/
6	ADDENDUM E1	09/03/
5	ISSUED FOR TENDER	09/02/
4	ISSUED FOR 100% TENDER	09/01/
3	ISSUED FOR 99% REVIEW	08/10/
2	ISSUED FOR 50% RE-SUBMISSION	08/09/
1	ISSUED FOR 50% REVIEW	08/04/
REVISIONS	DESCRIPTION	DATE



project title	titre du projet
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**EDMONTON MAXIMUM  
SECURITY  
INSTITUTE**

**FIRE ALARM UPGRADE**

drawing title	titre du dessin
---------------	-----------------

**OVERALL BLOCK  
DIAGRAM  
FLOOR PLAN F/A  
ZONES AND F/A  
SHUTDOWN  
INFORMATION ONLY**

designed by	conçu par
<b>P. BEAUBIEN</b>	

drawn by **L. HONDERD** dessine par

approved by	approuvé par
<b>P. BEAUBIEN</b>	

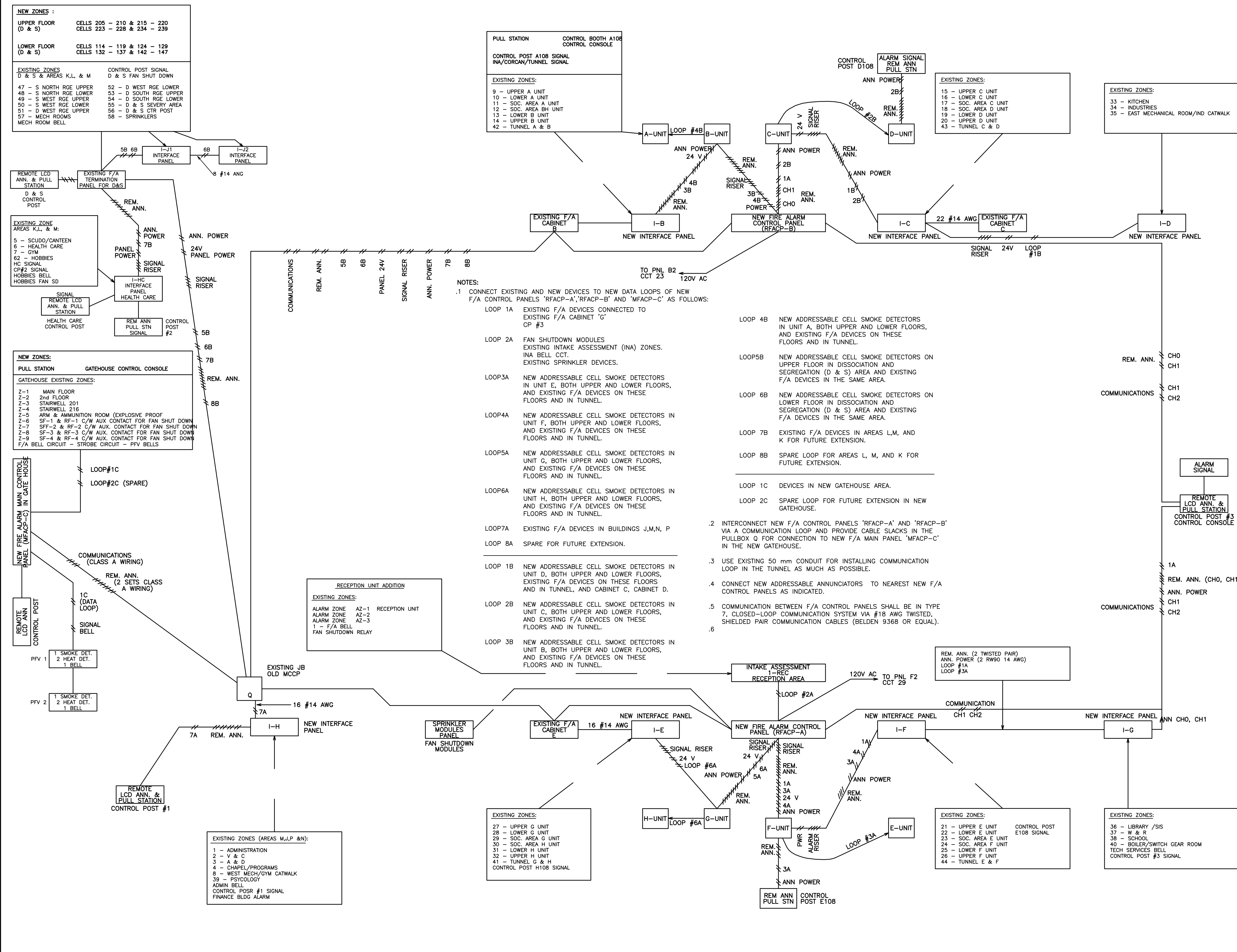
PWGSC Project Manager	Administrateur de Projets TPSG
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scale	echelle	sheet	feuille
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AS NOTED	
1 1	1 1

project no.	R.014522.001	project no.	E16
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date	date	OF	17
APRIL 17 2013			



NOTES

1 EXISTING F/A INITIATING ZONE CCTS, BELL CCTS, AND F/A MECHANICAL FAN SHUT-DOWN CONTROLS SHOWN ON THIS SHEET ARE FOR INFORMATION ONLY. CONTRACTOR SHALL REFER TO SITE CONDITIONS FOR ALL DEVICES AND ZONE LOCATIONS.

- 3 INSTALL NEW F/A CONTROL PANELS  
REFLECT-A AND REACP-B IN TUNNEL  
AND PANEL MFAC-C IN GATEHOUSE.
- 4 RE-USE EXISTING CONDUITS FOR NEW  
WIRING IN TUNNEL AND IN OTHER  
AREAS AS MUCH AS POSSIBLE.
- 5 IDENTIFY AND VERIFY ALL EXISTING  
F/A CCTS AND LOCATION OF EACH  
ZONE/CCT. CONDUIT RUNS TO  
EXISTING CABINET IN ARM  
CONTROL PANEL AND UTILITY CORRIDOR.
- 6 CONNECT AND PROGRAM ALL EXISTING  
AND NEW DEVICES SUCH THAT NEW  
ADDRESSABLE CELL SMOKE DETECTORS  
SHALL BE IDENTIFIED BY ZONE NUMBER  
AND THE EXISTING ZONE FOR F/A  
INITIATING DEVICES, BELL CCTS.  
CONTROLS SHALL BE IDENTIFIED BY  
ZONE NUMBERS.

- 7 IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR NOT TO OMIT ANY EXISTING F/A AND CONTROL CCT WITHIN THE COMPLEX INSIDE THE FENCE INCLUDING THE NEW RECEPTION ENTRY ADDITION AND THE NEW GATEHOUSE FOR INTEGRATION INTO THE NEW F/A CONTROL SYSTEM.
- 8 ALL NEW ZONE ADAPTER INTERFACE MODULES SHALL BE INSTALLED IN INTERFACE PANEL TO PICK UP EXISTING CONVENTIONAL F/A ZONE CCTS.
- 9 PROVIDE ONE SPARE F/A CABLE IN EACH CONDUIT.
- 10 PULL STATION AT CONTROL POST/BOOTH SHALL BE ADDRESSABLE UNIT AND MOUNTED ON CONTROL CONSOLE.
- 11 24V d.c. POWER CCTS AND BELL CCTS ARE NOT SHOWN IN THE BLOCK DIAGRAM.
- 12 FOR EXISTING F/A SYSTEM REFER TO EXISTING F/A RISER DIAGRAM ON SHEET 10.

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CAD FILE: \625921\25921-1

revision		date
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A detail no.  
no. du détail

B location drawing no.  
sur dessin no.

C drawing no.  
dessin no.

project	project
EDMONTON, ALBERTA MAXIMUM SECURITY INSTITUTION	

AS-BUILT 95/03/31  
CANADIAN PENITENTIARY SERVICE

drawing	dessin
OVERALL BLOCK DIAGRAM	
PROVISION OF CELL SMOKE DETECTORS AND UPGRADING OF FIRE ALARM CONTROL SYSTEM	

DESIGNED	CONCU
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DATE \_\_\_\_\_

DATE	SDE	FEB. 15, 1994
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DATE	
APPROVED	APPROUVÉ

DATE \_\_\_\_\_

TENDER	SOUSSION
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PWC PROJECT MANAGER	
PROJECT NUMBER	NO. DU PRO

625921

DRAWING NUMBER	NO. DU DESS
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SHEET 11 of 12

REAL PROPERTY SERVICES  
Western Region

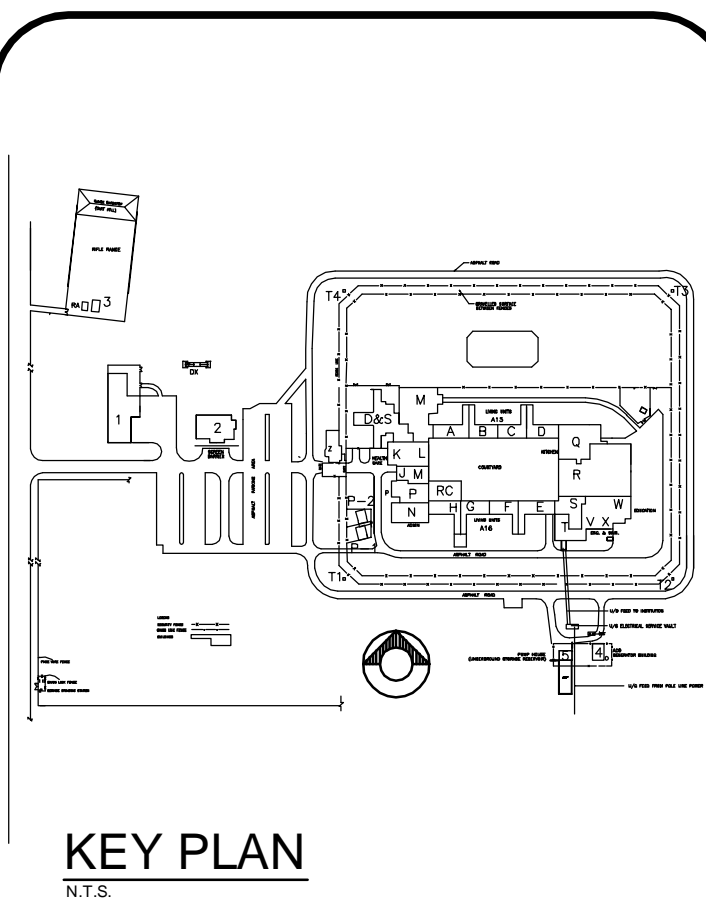
Client

**CORRECTIONAL SERVICE  
CANADA**

Client



Job #5783



KEY PLAN  
N.T.S.

**RECORD DRAWING**

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REVISIONS	DESCRIPTION	DATE
9	ISSUED FOR RECORD DRAWING	13/06/12
8	ED1 SITE PLAN ISSUED FOR RECORD DRAWING	12/10/18
7	ISSUED FOR CONSTRUCTION	09/06/01
6	ADDENDUM E1	09/03/18
5	ISSUED FOR TENDER	09/02/03
4	ISSUED FOR 100% TENDER	09/01/02
3	ISSUED FOR 99% REVIEW	08/10/13
2	ISSUED FOR 50% RE-SUBMISSION	08/09/10
1	ISSUED FOR 50% REVIEW	08/04/11

REVISIONS	DESCRIPTION	DATE
A	A detail number du detail	
B	B source drawing no. de dessin no.	
C	C detail on drawing no. detail sur dessin no.	

project title

**EDMONTON MAXIMUM  
SECURITY  
INSTITUTE**

titre du projet

**FIRE ALARM UPGRADE**

drawing title

titre du dessin

**OVERALL BLOCK  
DIAGRAM  
FLOOR PLAN F/A  
ZONES AND F/A  
SHUTDOWN  
INFORMATION ONLY**

designed by

P. BEAUBIEN

conçu par

drawn by

L. HONDERD

dessiné par

approved by

P. BEAUBIEN

approuvé par

PWOSC Project Manager

Administrateur de Projets TPSSC

scale

AS NOTED

échelle

sheet

feuille

project no.

R.014522.001

project no.

date

APRIL 17, 2013

date

**E17**  
OF 17

Architectural & Engineering Services  
Pacific-Western Region

NOTES:

1 EXISTING F/A INITIATING ZONE CCTS, BELL CCTS, AND F/A MECHANICAL FAN SHUT-DOWN CONTROLS SHOWN ON THIS SHEET ARE FOR INFORMATION ONLY. CONTRACTOR SHALL REFER TO SITE CONDITIONS FOR ALL DEVICES AND ZONE LOCATIONS.

2 CONTRACTOR SHALL IDENTIFY AND VERIFY ALL EXISTING F/A AND CONTROL CIRCUITS. DRAWINGS WILL BE MADE AVAILABLE BY PWOSC FOR REFERENCE.

3 IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR NOT TO OMIT ANY EXISTING F/A AND CONTROL CCTS WITHIN THE COMPLEX INSIDE THE FENCE INCLUDING THE NEW RECEPTION UNIT ADDITION AND THE NEW GATEHOUSE FOR INTEGRATION INTO NEW F/A CONTROL SYSTEM.

4 ALL NEW ADDRESSABLE CELL SMOKE DETECTORS SHALL BE IDENTIFIED BY CELL NUMBER AND THE EXISTING ZONES FOR F/A INITIATING DEVICES, BELL CCTS, AND AIR HANDLING CONTROLS SHALL BE IDENTIFIED BY ZONE NUMBERS.

5 PROVIDE DIFFERENT TYPES OF NECESSARY ZONE ADAPTER INTERFACE MODULES FOR CONNECTING EXISTING F/A CCTS TO THE NEW ADDRESSABLE F/A CONTROL SYSTEM.

6 RE-CONNECT EXISTING CERBERUS ADDRESSABLE "CONVENTIONAL ZONE MODULES" (CZM) FOR THE SPRINKLER ALARM VALVES (NOT SHOWN ON DRAWING) IN THE UTILITY CORRIDOR (TOTAL 24) TO THE NEAREST F/A CONTROL PANEL. PROVIDE NEW ZONE ADAPTER INTERFACE MODULES COMPATIBLE TO THE NEW F/A CONTROL SYSTEM.

7 SUPPLY AND INSTALL ADDRESSABLE REMOTE ANNUNCIATORS WITH ALPHA-NUMERIC LCD DISPLAY AT DIFFERENT CONTROL POSTS AS INDICATED.

8 REFER TO SCOPE OF WORK IN THE DETAILED SPECIFICATIONS FOR FURTHER DETAIL.

9 REMOVE ALL EXISTING F/A CONTROL PANELS IN THE MAIN COMMUNICATIONS CONTROL POST (MCCP) AFTER COMPLETE UPGRADING OF THE F/A CONTROL SYSTEM.

CAD FILE: \625921\25921-10

revision	date
A	
B	
C	

project

EDMONTON, ALBERTA  
MAXIMUM SECURITY  
INSTITUTE

AS-BUILT 95/03/31  
CANADIAN PENITENTIARY SERVICE

drawn by

FLOOR PLANS FOR EXISTING  
F/A ZONES AND AIR HANDLER  
F/A SHUTDOWN SCHEMATIC  
PROVISION OF CELL SMOKE  
DETECTORS AND UPGRADING  
OF FIRE ALARM CONTROL  
SYSTEMS

designé par

DESIGNED

Y.K. & M.H.

CONÇU

DATE

FEB. 15, 1994

DESSINÉ

DRAWN

SDE

APPROUVÉ

APPROVED

APPROUVÉ

DATE

29

DATE

TENDER

SOUSSION

PWOC PROJECT MANAGER

PROJECT NUMBER

625921

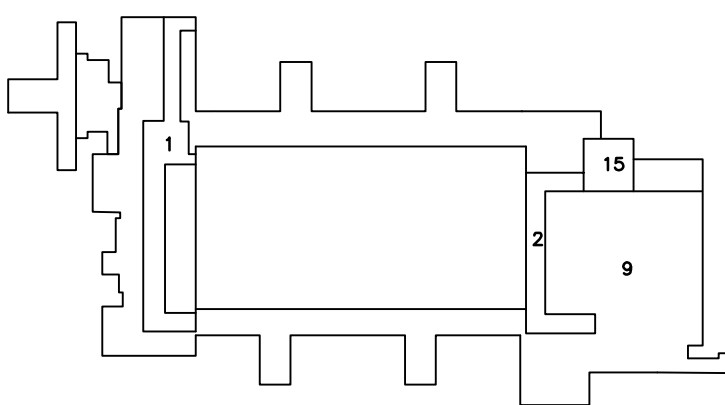
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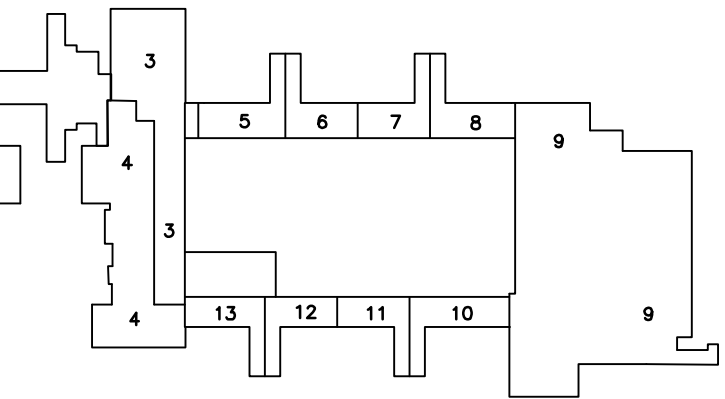
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SHEET 10 of 12

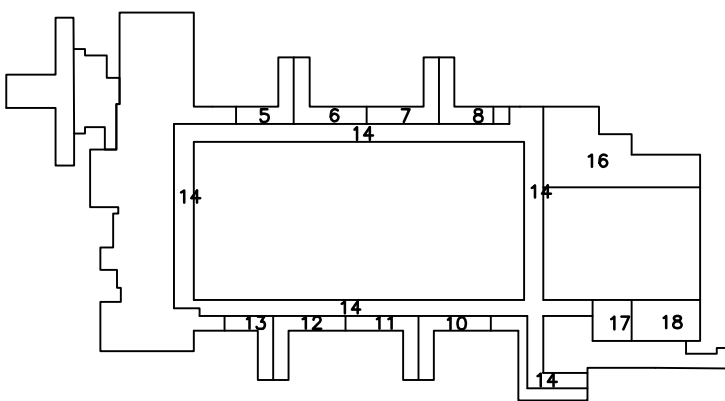
AIR HANDLER FIRE ALARM SHUTDOWN SCHEMATIC



UPPER FLOOR KEY PLAN  
N.T.S.



MAIN FLOOR KEY PLAN  
N.T.S.



LOWER FLOOR (& TUNNEL) KEY PLAN  
N.T.S.

- | ZONE | LOCATION                             |
|------|--------------------------------------|
| 1    | ADMINISTRATION                       |
| 2    | V & C                                |
| 3    | A & D                                |
| 4    | CHAPEL/PROGRAMS                      |
| 5    | SCUDO/CANTEEN                        |
| 6    | HEALTH CARE                          |
| 7    | GYM/HOBBIES                          |
| 8    | WEST MECHANICAL RM/GYM CATWALK       |
| 9    | UPPER A UNIT                         |
| 10   | LOWER A UNIT                         |
| 11   | SOC AREA A UNIT                      |
| 12   | SOC AREA B UNIT                      |
| 13   | LOWER B UNIT                         |
| 14   | UPPER B UNIT                         |
| 15   | UPPER C UNIT                         |
| 16   | LOWER C UNIT                         |
| 17   | SOC AREA C UNIT                      |
| 18   | SOC AREA D UNIT                      |
| 19   | LOWER D UNIT                         |
| 20   | UPPER D UNIT                         |
| 21   | UPPER E UNIT                         |
| 22   | LOWER E UNIT                         |
| 23   | SOC AREA E UNIT                      |
| 24   | SOC AREA F UNIT                      |
| 25   | LOWER F UNIT                         |
| 26   | UPPER F UNIT                         |
| 27   | UPPER G UNIT                         |
| 28   | LOWER G UNIT                         |
| 29   | SOC AREA G UNIT                      |
| 30   | SOC AREA H UNIT                      |
| 31   | LOWER H UNIT                         |
| 32   | UPPER H UNIT                         |
| 33   | KITCHEN                              |
| 34   | INDUSTRIES                           |
| 35   | EAST MECHANICAL RM/IND CATWALK       |
| 36   | LIBRARY/SIS                          |
| 37   | W & E                                |
| 38   | SCHOL                                |
| 39   | PSYCHOLOGY                           |
| 40   | BOILER/SWITCH GEAR RM                |
| 41   | TUNNEL G & H                         |
| 42   | TUNNEL A & B                         |
| 43   | TUNNEL C & D                         |
| 44   | TUNNEL E & F                         |
| 47   | S NORTH RGE UPPER                    |
| 48   | S NORTH RGE LOWER                    |
| 49   | S WEST RGE UPPER                     |
| 50   | S WEST RGE LOWER                     |
| 51   | D WEST RGE UPPER                     |
| 52   | D WEST RGE LOWER                     |
| 53   | D SOUTH RGE UPPER                    |
| 54   | D SOUTH RGE LOWER                    |
| 55   | D & S SERVRY AREA                    |
| 56   | D & S CTL POST                       |
| 57   | UPSTAIRS ELECTRIC                    |
| 58   | INDICATES YOU HAVE ACTUAL WATER FLOW |
| 59   | COMMAND POST #3                      |

- GATEHOUSE:
- | ZONE         | LOCATION                                      |
|--------------|---|
| Z-1          | MAIN FLOOR                                    |
| Z-2          | 2ND FLOOR                                     |
| Z-3          | STAIRWELL 201                                 |
| Z-4          | STAIRWELL 216                                 |
| Z-5          | ARMS AND AMMUNITION ROOM (EXPLOSION PROOF)    |
| Z-6          | SF-1 & RF-1 c/w AUX. CONTACT FOR FAN SHUTDOWN |
| Z-7          | SF-2 & RF-2 c/w AUX. CONTACT FOR FAN SHUTDOWN |
| Z-8          | SF-3 & RF-3 c/w AUX. CONTACT FOR FAN SHUTDOWN |
| Z-9          | SF-4 & RF-4 c/w AUX. CONTACT FOR FAN SHUTDOWN |
| F/A BELL CCT |   |

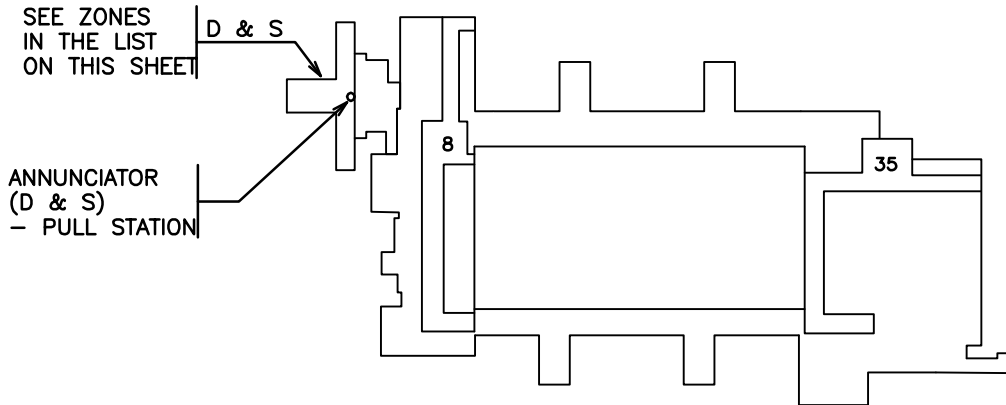
- RECEPTION UNIT ADDITION:
- | ZONE           | LOCATION   |
|----------------|--|
| AZ-1           | ALARM ZONE RECEPTION UNIT                                |
| AZ-2           | ALARM F-1 (SUPPLY FAN c/w FAN SHUTDOWN AUX. F/A CONTACT) |
| AZ-3           | ALARM ZONE SPRINKLER FLOW SWITCH                         |
| TZ-1           | TROUBLE ZONE SPRINKLER VALVE                             |
| 1 F/A BELL CCT |  |

- REMOTE ANNUNCIATORS & PULL STATIONS:
- |               |        |
|---------------|--------|
| D & S         | - 1    |
| HEALTH CARE   | - 1    |
| CONTROL POST  | - #1   |
| CONTROL POST  | - #2   |
| CONTROL POST  | - #3   |
| CONTROL BOOTH | - A108 |
| CONTROL BOOTH | - B108 |
| CONTROL BOOTH | - E108 |
| CONTROL BOOTH | - H108 |

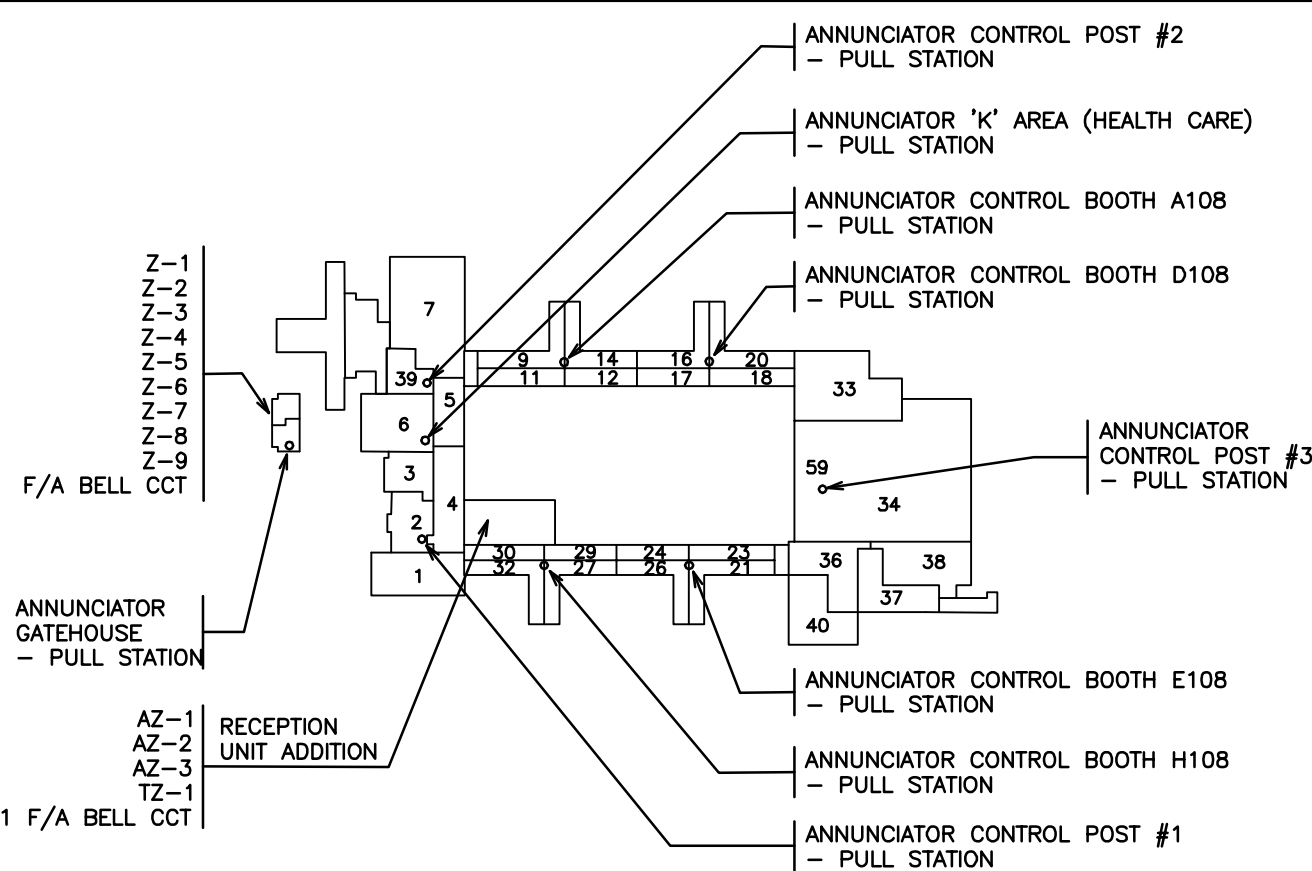
GATE HOUSE ENTRANCE

OTHER BELL CCTS:

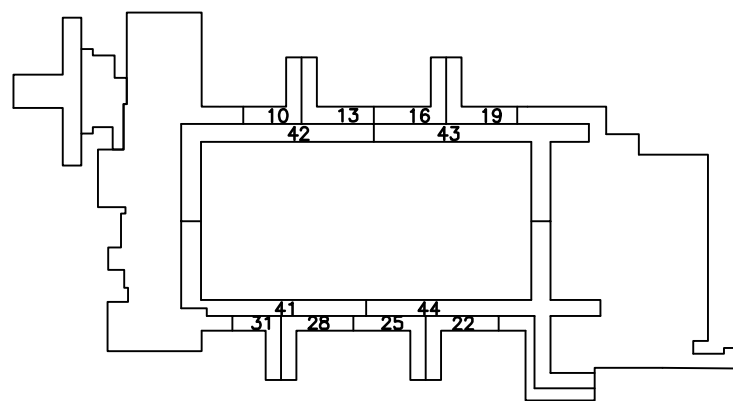
- |          |              |
|----------|--------------|
| AREA 'Q' | - 1          |
| AREA 'R' | - 1          |
| AREA 'W' | - 1          |
| AREA 'N' | - 1          |
| TUNNEL   | - 4 (BUZZER) |



UPPER FLOOR FIRE ALARM KEY PLAN  
N.T.S.



MAIN FLOOR FIRE ALARM KEY PLAN  
N.T.S.



LOWER FLOOR (& TUNNELS) FIRE ALARM KEY PLAN  
N.T.S.