Public Works and Government Services Canada

Requisition No. EZ899-221216

DRAWINGS & SPECIFICATIONS
For Issued for Tender

Aldergrove, BC
CBSA Chilled Water Piping Insulation
R.106124.001

APPROVED BY:

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Regional Manager, AES — Date

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Real Property Services Branch, Professional and Technical Services, Pacific Region
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CONSULTANTS – SEAL & SIGNATURE

Discipline	**Seal / Signature / Date**
Mechanical (Prime) Nasser Koochek	 2020-06-02
Structural Richard Mastschuch	 2020-06-02
Electrical Sanjot Cheema	 02/06/2020

END OF SECTION

END OF SPECIFICATIONS

Appendices (All Appendices Are For Reference Only)

END OF APPENDICES

Drawings List (Bounded Separately)

END OF DRAWING

END OF SECTION

Part 1 General

1.1 SUMMARY OF WORK

Work covered by Contract Documents covers the following works in the Main Building and Commercial Building at CBSA Aldergrove, BC.:

.1 Contractors are encouraged to attend the optional site visit to review the existing situation and be familiar with the contract documents and the implications. Based on this site visit and thorough and complete understanding of scope of work, contractors shall provide their bid price. Any uncertainty shall be sought for clarification by official Request For Information.

.2 The main objective is to remove the chilled water piping and current non-standard insulation, and provide new piping and proper insulation with vapour barrier and finish. The summary of work includes, but not limited to, the following:

- .1 Demolition Work:
  - .1 Demolish all the insulation on chilled water piping system in the mechanical room.
  - .2 Demolish all the piping system and valves.
  - .3 Retain pumps, control valves, control devices, expansion tank, glycol tank and electrical devices and installation.
- .2 New work:
  - .1 Provide new piping system including valves. The Piping system connections and fittings to be Victaulic Coupling system for ease of installation and repairs.
  - .2 Provide pipe hangers with insulated pipe saddles.
  - .3 Provide insulated chilled water buffer tank in line with the piping system.
  - .4 Provide proper insulation with vapour barrier and finishing, with sealed lose ends, including all valves and pumps bodies.
  - .5 Override the Exhaust Fan ON thru a dewpoint temperature sensor, to allow adequate ventilation of the mechanical room.
  - .6 Remove and re-install electrical and control connections to pumps, control valves, etc.
  - .7 Prove the control system integrity and operation to be same as existing and provide report to Consultant and Departmental Representative.
  - .8 Provide balancing and commissioning with report, including client training.

.3 The new insulation shall comply with BC Insulation Contractors Association (BCICA) standard manual. The project shall be registered with BCICA, and installation shall be certified in full compliance with the BCICA Quality Assurance Certificate Program (QACP).

.4 Construction Process:

.1 Main Building and Commercial Building air systems and mechanical systems shall be kept operational during construction. The intent is to have the construction scheduled to start and be completed during the colder and/or shoulder seasons when the mechanical cooling by the chillers is not required, otherwise the contractor shall provide temporary cooling.

.5 Retain the base building controls contractor for this project.

.6 Work to be performed under this Contract includes, but not limited to, the following items covered further in the Contract Documents:

.1 Provide a detailed work plan including a project schedule and construction phasing plan. This detailed work plan shall be submitted to the Departmental Representative for review to verify that there will be no interruption of service.

.2 All equipment and associated components are to be delivered to the site in a timely manner so that the work can proceed without delays.

.3 Work shall be provided considering all hazard risks noted in the “Pre-construction Hazard Assessment Form” included in “Appendix C”. A signed copy of this form shall be returned to the Departmental Representative.

.4 Provide as-built drawings and closeout submittals.

.7 Contractor’s Use of Premises:

.1 Contractor has limited use of site for work of this contract until Substantial Completion:

.1 Contractor use of premises for storage and access, as approved by the Departmental representative.

.2 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.

.8 Vehicular access through the site. The Contractor shall coordinate with BGIS (refer to Work Permit process). Copy of work permit form included in Appendix B.

1.2 EXISTING SERVICES

.1 Notify Departmental Representative, governing authorities and utility companies of intended interruption of services and obtain required permission.

.2 Submit schedule to and obtain approval from Departmental Representative for any shut-down or closure of active services including power and communications services. Adhere to approved schedule and provide notice to affected parties.

1.3 WORK RESTRICTIONS

.1 Notify Departmental Representative of intended interruption of power, heating, cooling, ventilation, communication and water services and provide schedule of interruption times.

.2 Where Work involves breaking into or connecting to existing services, give departmental Representative 48 hours of notice for necessary interruption of services throughout course of work. Keep duration of interruptions to a minimum. Coordinate interruptions with local authority having jurisdiction and local residences and businesses affected by the disruption.

.3 Provide for access by pedestrian and vehicular traffic on and around site where work is in progress.

.4 Security Requirements: refer to Section 01 14 10 - Security Requirements.

.5 Hours of work:

.1 Perform work during normal working hours of the Facility 0730 to 1600, Monday through Friday except holidays. –

.2 When it is necessary, arrange in advance with Departmental Representative to work outside of normal working hours.

1.4 CONSTRUCTION WORK SCHEDULE

.1 Contractor shall manage and provide adequate work force for completion of all work under this contract without delay.

.1 Completion date: 31st March, 2022

.2 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Substantial Certificate and Final Certificate as defined times of completion are of essence of this contract.

.3 Submittal:

.1 Submit to Departmental Representative within 5 working days of Award of Contract, a Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of construction progress.

.2 Identify each trade or operation.

.3 Show dates for delivery of items requiring long lead time.

.4 Identify construction plan for each Living Cell.

.5 Departmental Representative will review schedule and return one copy.

.6 Re-submit two (2) copies of finalized schedule to Departmental Representative within five (5) working days after return of reviewed preliminary copy.

.4 Project Scheduling Reporting:

.1 Update Project Schedule on bi-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.

.5 Project Meetings:

.1 Discuss Project Schedule at bi-weekly 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 approved dates shown on baseline schedule.

.2 Weather related delays with their remedial measures will be discussed and negotiated.

.3 Before submitting first progress claim submit breakdown of Contract price in detail as directed by Departmental Representative and aggregating contract price. After approval by Departmental Representative cost breakdown will be used as basis for progress payments. Only PWGSC paper work is acceptable.

1.5 SUBMITTAL PROCEDURES

.1 Administrative:

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

.2 Work affected by submittal shall not proceed 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 submittal 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. Submittal not stamped, signed, dated and identified as to specific project will be returned without being examined and shall be 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 coordinated.

.8 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative review of submittal.

.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.

.2 Shop Drawings:

.1 Drawings to be originals prepared by Contractor, Subcontractor, Supplier or Distributor, which illustrate appropriate portion of work; showing fabrication, layout, setting or erection details as specified in appropriate sections.

.3 Product Data:

.1 Certain specification Sections specify that manufacturer's standard schematic drawings, catalogue sheets, diagrams, schedules, performance charts, illustrations and other standard descriptive data will be accepted in lieu of shop drawings, provided that the product concerned is clearly identified. Submit in sets, not as individual submissions.

.4 Samples:

.1 Submit samples in sizes and quantities specified.

.2 Where colour is criterion, submit full range of colours.

.3 Submit all samples as soon as possible after the contract is awarded, to facilitate production of complete colour scheme by the Departmental Representative.

.5 Mock-ups:

.1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of all Sections required to provide mock-ups.

.2 Construct in location as specified in specific Section.

.3 Prepare mock-ups for Departmental Representative' review with reasonable promptness and in an orderly sequence, so as not to cause any delay in Work.

.4 Failure to prepare mock-ups in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.

.5 Specification section identifies whether mock-up may remain as part of Work or if it is to be removed and when.

.6 Progress Photographs

.1 Provide construction photographs in accordance with procedures and submission requirements specified in this clause.

.2 Progress Photographs:

.1 Provide digital photographs with images of minimum 3.1 mega pixel resolution and stored in Jpeg format with minimal compression.

.2 Frequency: Bi-weekly, submitted on USB drive with progress statement, sent via e-mail or as directed by Departmental Representative.

.3 Identify photos by location, date and sequential numbering system.

.7 Submission Requirements:

.1 Schedule submissions at least ten days before dates reviewed submissions will be needed.

.2 Submit number of copies of product data, shop drawings which Contractor requires for distribution plus four (4) copies which will be retained by Departmental Representative.

.3 Accompany submissions with transmittal letter in duplicate.

.4 Submit bond copies (hard copy) as directed by Departmental Representative.

.8 Coordination of Submissions:

.1 Review shop drawings, product data and samples prior to submission.

.2 Coordinate with field construction criteria.

.3 Verify catalogue numbers and similar data.

.4 Coordinate each submittal with requirements of the work of all trades and contract documents.

.5 Responsibility for errors and omissions in submittal is not relieved by Departmental Representative's review of submittal.

.6 Responsibility for deviations in submittal from requirements of Contract documents is not relieved by Departmental Representative's review of submittal, unless Departmental Representative gives written acceptance of specified deviations.

.7 Notify Departmental Representative, in writing at time of submission, of deviations in submittal from requirements of Contract documents.

.8 Make any changes in submissions which Departmental Representative may require consistent with Contract Documents and re-submit as directed by Departmental Representative.

.9 After Departmental Representative's review, distribute copies.

.10 Shop Drawings Review:

.1 Review of shop drawings by Public Works and Government Services Canada (PWGSC) is for the sole purpose of ascertaining conformance with the general concept.

.2 The Departmental Representative’s review does not mean that PWGSC approves the detail design inherent in the shop drawings, responsibility remains with the contractor submitting same, and such review will not relieve the Contractor of responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of the construction and contract documents.

.3 Without restricting the generality of the foregoing, the Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation, and for co-ordination of the work of all subtrades.

1.6 HEALTH AND SAFETY

.1 Specified in Section 01 35 33.

1.7 ENVIRONMENTAL PROCEDURES

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

.2 Do not bury rubbish and waste materials on site unless approved by Departmental Representative.

.3 Do not dispose of waste or volatile materials such as oil, paint thinner or mineral spirits into waterways, storm or sanitary systems.

.4 Provide temporary drainage and pumping as necessary to keep excavations and site free from water during excavation and grading activities.

.5 Control disposal of run-off of water containing suspended materials or other harmful substances in accordance with local authority requirements. Construct settlement ponds and silt fences as required by the Provincial Environmental authority.

.6 Cover or wet down dry materials and rubbish to prevent blowing dust and debris.

.7 Under no circumstances dispose of rubbish or waste materials on adjoining property.

1.8 REGULATORY REQUIREMENTS

.1 References and Codes:

.1 Perform Work in accordance with National Building Code of Canada latest and most stringent version and where applicable British Columbia Building Code latest and most stringent version including all amendments up to bid closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply. –

.2 Meet or exceed requirements of:

.1 Contract documents.

.2 Specified standards, codes and referenced documents.

1.9 QUALITY CONTROL

.1 Inspection:

.1 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.

.2 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.

.3 Departmental Representative may order any 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.

.2 Procedures:

.1 Notify appropriate agency and Departmental Representative in advance of requirement for tests, in order that attendance arrangements can be made.

.2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in Work.

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

.3 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.

.4 Reports:

.1 Submit (4) four copies of inspection and test reports to Departmental Representative.

.5 Tests and Mix Designs:

.1 Furnish test results and mix designs as may be requested.

.6 Mock-ups:

.1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of all Sections required to provide mock-ups.

.2 Construct in locations acceptable to Departmental Representative and as specified in specific Section.

.3 Prepare mock-ups for Departmental Representative review with reasonable promptness and in an orderly sequence, so as not to cause any delay in Work.

.4 Failure to prepare mock-ups in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.

.5 If requested, Departmental Representative will assist in preparing a schedule fixing dates for preparation.

.6 Specification section identifies whether mock-up may remain as part of Work or if it is to be removed and when.

.7 Mill Tests:

.1 Submit mill test certificates as requested and as required of specification Sections.

.8 Equipment and Systems:

.1 Submit adjustment and balancing reports for mechanical, electrical and building equipment systems.

.2 Refer to specific Section for definitive requirements.

1.10 TEMPORARY UTILITIES

.1 Installation and Removal:

.1 Provide temporary utilities controls in order to execute work expeditiously.

.2 Remove from site all such work after use.

.2 Dewatering:

.1 Provide temporary drainage and pumping facilities to keep excavations and site free from standing water.

.3 Water Supply:

.1 Arrange, pay for and maintain temporary water supply in accordance with local authority, governing regulations and ordinances.

.2 Permanent water supply system installed under this contract may be used for construction requirements provided that guarantees are not affected thereby. Replace damaged components.

.4 Temporary Power and Light:

.1 Arrange, pay for and maintain temporary electric power supply in accordance with local power authority governing regulations and ordinances.

.2 Electrical power and lighting installed under this contract may be used for construction purposes at no extra cost, provided that guarantees are not affected thereby and electrical components used for temporary power are replaced when damaged.

.3 Replace lighting bulbs/tubes and clean reflectors and lenses used for more than three months.

.5 Temporary Communication Facilities:

.1 Provide and pay for temporary telephone and fax hook up, line(s) necessary for own use.

.6 Fire Protection:

.1 Provide and maintain temporary fire protection equipment during performance of Work required by governing codes, regulations and bylaws.

1.11 CONSTRUCTION FACILITIES

.1 Installation and Removal:

.1 Provide construction facilities in order to execute work expeditiously.

.2 Remove from site all such work after use.

.2 Scaffolding:

.1 Design, construct and maintain scaffolding in rigid, secure and safe manner, in accordance with WorkSafeBC regulations and Section 01 35 33.

.2 Erect scaffolding independent of walls. Remove promptly when no longer required.

.3 Hoisting:

.1 Provide, operate and maintain hoists required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for use thereof.

.2 Hoists to be operated by qualified operator.

.4 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 a weight or force that will endanger the Work.

.5 Construction Parking:

.1 Make good damage to existing roads used for access to project site.

.2 Build and maintain temporary access where required and provide snow removal during period of Work.

.3 Park vehicles outside perimeter fence in designated parking areas.

.6 Contractor's Site Office and enclosure:

.1 Provide office of size to accommodate site meetings and Contractor's operations.

.2 Provide a clearly marked and fully stocked first-aid case in a readily available location.

.3 Provide temporary fenced area to enclose site and operations.

.7 Equipment, Tools and Material Storage:

.1 Provide and maintain, in a 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 a manner to cause least interference with work activities.

.8 Sanitary Facilities:

.1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.

.2 When permanent water and drain connections are completed, provide temporary water closets and urinals complete with temporary enclosures. Permanent facilities may be used on approval of Departmental Representative.

1.12 TEMPORARY BARRIERS AND ENCLOSURES

.1 Hoarding:

.1 Erect temporary site enclosure using new 1.8 m high temporary construction fencing. Provide lockable truck gate. Maintain fence in good repair.

.2 Enclosure of Structure:

.1 Provide temporary weathertight enclosures and protection for exterior openings until permanently enclosed. Design enclosures to withstand wind pressure. Provide lockable entry as required for moving personnel equipment and materials.

.2 Provide temporary enclosures to secure building from entry of unauthorized personnel during construction period.

.3 Guardrails and Excavations:

.1 Provide secure, rigid guard rails and barricades around deep excavations, open edges of floors and roofs etc.

.2 Provide as required by governing authorities.

.4 Access to Site:

.1 Maintain immediate local access roads in clean condition used during work of this contract.

.5 Protection for Off-Site and CBSA Property:

.1 Protect surrounding CBSA property from damage during performance of Work.

.2 Be responsible for damage incurred.

.6 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.

1.13 COMMON PRODUCT REQUIREMENTS

.1 Reference Standards:

.1 If there is question as to whether any product or system is in conformance with applicable standards, Departmental Representative reserves right to have such products or systems tested to prove or disprove conformance.

.2 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.

.3 Conform to latest date of issue of referenced standards in effect on date of submission of Bids, except where specific date or issue is specifically noted.

.2 Quality:

.1 Products, materials, equipment and articles (referred to as products throughout specifications) incorporated in Work shall be new, not damaged or defective, and of best quality (compatible with specifications) for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.

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

.3 Should any dispute arise as to quality or fitness of products, decision rests strictly with Departmental Representative based upon requirements of Contract Documents.

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

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

.6 The use of asbestos containing materials is prohibited in this project. Contractor shall provide a letter to the Departmental Representative prior to Substantial Completion confirming that asbestos containing materials are not used in this project.

.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.

.4 Transportation:

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

.2 Transportation cost of products supplied by Departmental Representative will be paid for by Departmental Representative. Unload, handle and store such products.

.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 that Departmental Representative may 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.

.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.

.7 Co-ordination:

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

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

.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 by Departmental Representative.

.9 Remedial Work:

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

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

.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.

.3 Submit field drawings to indicate relative position of various services and equipment when required by Departmental Representative.

.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.

.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.

.13 Protection of Work in Progress:

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

.14 Existing Utilities:

.1 Where work involves breaking into or connecting to existing services, carry out work at times directed by governing authorities, with minimum of disturbance to pedestrian and vehicular traffic.

.2 Before commencing work, establish location and extent of service lines in areas of work and notify Departmental Representative of findings.

.3 Submit schedule to and obtain approval from Departmental Representative for any shut-down or closure of active service or facility. Adhere to approved schedule and provide notice to affected parties.

.4 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.

.5 Record locations of maintained, capped and re-routed services lines.

.15 Contractors Options for Selection of Products:

.1 Products specified by **"Prescriptive" specifications**: select any product meeting or exceeding specifications.

.2 Products specified under "**Acceptable Products**" (used for complex Mechanical or Electrical Systems): select any one of the indicated manufacturers, or any other manufacturer meeting or exceeding the Prescriptive specifications and indicated Products.

.3 Products specified by performance and referenced standard: select any product meeting or exceeding the referenced standard.

.4 Products specified to meet particular design requirements or to match existing materials: use only material specified Approved Product. Alternative products may be considered provided full technical data is received in writing by Departmental Representative in accordance with “Instructions to Bidders".

.5 When products are specified by a referenced standard or by Performance specifications, upon request of Departmental Representative, obtain from manufacturer an independent laboratory report showing that the product meets or exceeds the specified requirements.

.16 Substitution after award of Contract:

.1 No substitutions are permitted without prior written approval of the Departmental Representative.

.2 Proposals will be considered by the Departmental Representative if:

.1 products selected by tenderer from those specified are not available;

.2 delivery date of products selected from those specified would unduly delay completion of Contract, or

.3 alternative product to that specified, which is brought to the attention of and considered by Departmental Representative as equivalent to the product specified, and will result in a credit to the Contract amount.

.3 Should the proposed substitution be accepted either in part or in whole, assume full responsibility and costs when substitution affects other work on the project. Pay for design or drawing changes required as result of substitution.

.4 Amounts of all credits arising from approval of the substitutions will be determined by the Departmental Representative, and the Contract price will be reduced accordingly.

1.14 EXAMINATION AND PREPARATION

.1 Existing Services:

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

.2 Remove abandoned service lines within 2 m of structures. Cap or otherwise seal lines at cut-off points as directed by Departmental Representative.

.2 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.

1.15 EXECUTION REQUIREMENTS

.1 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 may be exposed by uncovering work; maintain excavations free of water.

.2 Execution:

.1 Execute cutting, fitting, and patching including excavation and fill, 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.

.6 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.

.7 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.

.8 Cut rigid materials using purpose made saw or core drill. Pneumatic or impact tools not allowed on brittle materials without prior approval.

.9 Restore work with new products in accordance with requirements of Contract Documents.

.10 Fit Work airtight 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, full thickness of the construction element.

.12 Refinish surfaces to match adjacent finishes: For continuous surfaces refinish to nearest intersection; for an assembly, refinish entire unit.

.13 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

1.16 CLEANING

.1 Project Cleanliness:

.1 Maintain Work in tidy condition, free from accumulation of waste products and debris.

.2 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.

.3 Clear snow and ice from access to building.

.4 Provide on-site containers for collection of waste materials and debris.

.5 Provide and use clearly marked separate bins for recycling. Refer to-Construction/Demolition Waste Management And Disposal.

.6 Clean interior areas prior to start of finish work, and maintain areas free of dust and other contaminants during finishing operations.

.7 Store volatile waste in covered metal containers, and remove from premises at end of each working day.

.8 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.

.9 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

.10 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

.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 clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.

.5 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, and floors.

.6 Clean lighting reflectors, lenses, and other lighting surfaces.

.7 Vacuum clean and dust building interiors, behind grilles, louvres and screens.

.8 Wax, seal, vacuum clean, shampoo or prepare floor finishes, as recommended by manufacturer.

.9 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.

.10 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.

.11 Remove dirt and other disfiguration from exterior surfaces.

.12 Sweep and wash clean paved areas.

.13 Clean equipment and fixtures to a sanitary condition; clean or replace filters of mechanical equipment.

.14 Clean roofs, downspouts, and drainage systems.

.15 Remove snow and ice from access to building.

1.17 CONSTRUCTION/DEMOLITION WASTE MANAGEMENT AND DISPOSAL

.1 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and/or recyclable materials and waste.

.1 Separate non-salvageable materials from salvaged items.

.2 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.

.3 Transport and deliver non-salvageable items to licensed disposal facility.

.2 Provide containers to deposit reusable and/or recyclable materials. Locate containers in locations, to facilitate deposit of materials without hindering daily operations. Provide containers to deposit reusable and/or recyclable materials.

.3 Collect, handle, store on-site and transport off-site, salvaged materials in separate condition. Transport to approved and authorized recycling facility and/or users of material for recycling.

.4 Locate waste and salvage bins on site as directed by Departmental Representative.

.5 Provide removal of hazardous materials in accordance with Section 01 35 33 – Health and Safety Requirements.

1.18 CLOSEOUT PROCEDURES

.1 Inspection and Declaration:

.1 Contractor's Inspection: Conduct an inspection of Work with all subcontractors, identify deficiencies and defects, and repair as required to conform to Contract Documents.

.2 Notify Departmental Representative in writing of satisfactory completion of Contractor's Inspection and that corrections have been made.

.3 Request Departmental Representative's Inspection.

.2 Inspection: Departmental Representative and Contractor will perform inspection of Work to identify obvious defects or deficiencies. Contractor shall correct Work accordingly.

.3 Substantial Completion: submit written certificate that following have been performed:

.1 Work has been completed and inspected for compliance with Contract Documents.

.2 Defects have been corrected and deficiencies have been completed.

.3 Equipment and systems have been tested, adjusted and balanced and are fully operational.

.4 Certificates required by Authority Having Jurisdictions for seismic restraints.

.5 Operation of systems have been demonstrated to Departments personnel.

.6 Work is complete and ready for Final Inspection.

.7 Asbestos containing materials are not used in this project.

.4 Final Inspection: when items noted above are completed, request final inspection of Work by Departmental Representative. If Work is deemed incomplete by Departmental Representative, complete outstanding items and request re-inspection.

1.19 CLOSEOUT SUBMITTAL

.1 Record Drawings:

.1 As work progresses, maintain accurate records to show all deviations from the Contract Drawings. Note on as-built drawings as changes occur. At completion supply:

.1 Four (4) USB thumb drives in AutoCad file format (version: 2010) and PDF (searchable) format with all as-built information on the diskettes.

.2 Four (4) sets of printed as-built drawings.

.3 Submit one copy of check plots to Departmental Representative prior to final printing of as-built drawings.

.4 Departmental Representative will supply copies of the original AutoCad files.

.5 Retain original logo and title block on the as-built drawings. Contractor may place on the upper right-hand title block area a small company logo, the text "AS-BUILT" and the date.

.2 Costs for transferring as-built information from marked up working set of drawings to electronic format using ACAD and plotting service is included in the Contract.

.2 Operation and Maintenance Manuals (O&M Manuals):

.1 On completion of project submit to Departmental Representative four (4) USB thumb drives and four (4) paper copies (in loose leaf type binder) of Operation and Maintenance Manual, made up as follows:

.1 Provide maintenance manual on USB thumb drive using searchable pdf with minimum resolution of 300 dpi, or other approved format for descriptive writing, page size images and page size drawings. Organize manuals into industry standard maintenance manual tabs with links in index to each descriptive section describing the component or maintenance procedure etc.

.2 Organize files into CBSA numbering system or other approved descriptive titles.

.3 Label USB thumb drive "Operation and Maintenance Data", project name, date, names of Contractor, subcontractors, consultants and subconsultants.

.4 Include scanned guarantees, diagrams and drawings.

.5 Organize contents into applicable sections of work to parallel project specification break-down. Mark each section by labeled tabs (navigational buttons).

.6 Drawings, diagrams and manufacturer's literature must be legible.

.7 Refer to Mechanical and Electrical Divisions for specific details for Mechanical and Electrical data.

.2 At the time of review of substantial completion documents, an amount equal to one percent (1%) of total contract value must be allocated for operation and maintenance manuals and as-built drawings shown as a line item in the contractor progress billing. This amount shall be released after review and approval of O&M manuals by Departmental Representative.

.3 Maintenance Materials, Special Tools and Spare Parts:

.1 Specific requirements for maintenance materials, tools and spare parts are specified in individual sections.

.2 Deliver maintenance materials, special tools and spare parts to Departmental Representative and store in designated area as directed by Departmental Representative.

.3 Prepare lists of maintenance materials, special tools and spare parts for inclusion in O&M Manual specified in Clause 1.18.2.

.4 Maintenance materials:

.1 Deliver wrapped, identify on carton or package, colour, room number, system or area as applicable where item is used.

.5 Special tools:

.1 Assemble as specified;

.2 Include identifications and instructions on intended use of tools.

.6 Spare parts:

.1 Assemble parts as specified;

.2 Include part number, identification of equipment or system for which parts are applicable;

.3 Installation instructions;

.4 Name and address of nearest supplier.

.4 Warranties and Bonds:

.1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing in maintenance manual.

.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 the applicable item of work.

.4 Except for items put into use with Departmental Representative's permission, leave date of beginning of time of warranty until the Date of Interim Completion is determined.

.5 Verify that documents are in proper form, contain full information, and are notarized.

.6 Retain warranties and bonds until time specified for submittal.

1.20 DEMONSTRATION AND TRAINING

.1 Demonstration and Training:

.1 Demonstrate operation and maintenance of equipment and systems to maintenance personnel following interim Completion and prior to date of final certificate of completion

.2 Departmental Representative will provide list of personnel to receive instructions, and will coordinate their attendance at agreed-upon times.

1.21 GENERAL COMMISSIONING

.1 Commission installed systems in accordance with Section 01 91 00 - Commissioning prior to Demonstration and Training.

END OF SECTION

Part 1 General

1.1 PURPOSE

.1 To ensure that both the construction project and the CBSA operations may proceed without undue disruption or hindrance and that the security of the CBSA 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 any applicable prescribed limit, , and

.5 Any item not described in paragraphs (1) to (4) above that could jeopardize the security or the safety of persons, when that item is possessed without prior authorization.

.2 Unauthorized smoking and related items means all smoking items including, but not limited to, cigarettes, cigars, tobacco, chewing 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 "CBSA" means Canada Border Services Agency.

.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 representative defined in General Conditions.

.7 "Construction zone" means the area, as indicated in the contract documents, that the contractor will be allowed to work". This area may or may not be isolated from the security area of the CBSA. Limits to be confirmed at construction start-up meeting.

1.3 PRELIMINARY PROCEEDINGS

.1 At construction start-up meeting:

.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 CBSA’s particular requirements.

.2 The Contractors' responsibilities:

.1 Ensure that all construction employees are aware of the CBSA and BGIS security requirements.

.2 Ensure that a copy of the CBSA and BGIS security requirements is always prominently on display at the job site.

.3 Co-operate with CBSA and BGIS personnel in ensuring that security requirements are observed by all construction employees.

.4 Submit work permit to BGIS weekly during entirety of time on site. Permit form attached in Appendix B.

1.4 CONSTRUCTION EMPLOYEES

.1 Entry to CBSA Property will be refused to any person there may be reason to believe may be a security risk.

.2 Any person employed on the construction site will be subject to immediate removal from CBSA 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.

.3 Construction employees must be escorted by a Commissionaire at all times on site. The Contractor is responsible for Commissionaire escort costs for entire duration of construction schedule.

1.5 VEHICLES

.1 All unattended vehicles on CBSA property must have windows closed; fuel caps locked, doors and trunks locked and keys removed. The keys must be securely in the possession of the owner or an employee of the company that owns the vehicle.

1.6 PARKING

.1 The parking area(s) to be used by construction employees will be designated by BGIS. Parking in other locations will be prohibited and vehicles may be subject to removal.

1.7 SHIPMENTS

.1 To avoid confusion with the CBSA's own shipments, address all shipments of project material, equipment and tools in the Contractor's name and have a representative on site to receive any deliveries or shipments. CBSA or PSPC staff will **NOT** accept receipt of deliveries or shipments of any material equipment or tools for the contractor.

1.8 TELEPHONES

.1 The installation of telephones, facsimile machines and computers with Internet connections is not permitted within the CBSA perimeter

1.9 WORK HOURS

.1 Work hours within the CBSA are generally 7:30am to 16:00 with some exceptions. Refer to Division 1 and coordinate with BGIS for exceptions.

.2 Work is not permitted during weekends and statutory holidays without the permission of the BGIS. A minimum of seven days advance notice will be required to obtain the required permission. In case of emergencies or other special circumstances, this advance notice may be waived by BGIS.

1.10 OVERTIME WORK

.1 Conform to Division 1.

.2 Provide 48 hours advance notice to BGIS for all work to be performed after normal working hours of the CBSA. Notify ~~Director~~ BGIS immediately if emergency work is required, such as to complete a concrete pour or make the construction site safe and secure.

1.11 SMOKING RESTRICTIONS

.1 Smoking is not permitted inside CBSA facilities or outdoors within the perimeter of a CBSA facility and persons must not possess unauthorized smoking items within the perimeter of a CBSA facility.

.2 Smoking is permitted outside the perimeter of a CBSA facility in an area designated by BGIS.

1.12 CONTRABAND

.1 Weapons, ammunition, explosives, alcoholic beverages, drugs and narcotics are prohibited on CBSA 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 BGIS.

.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 security clearance of the affected employee. Serious infractions may result in the removal of the company from the CBSA 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 security clearances for the driver of the vehicle.

1.13 STOPPAGE OF WORK

.1 BGIS may request at any time that the contractor, his employees, sub-contractors and their employees not enter or leave the work site immediately due to a security situation . The contractor's site supervisor will note the name of the staff member giving the 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.

1.14 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 as part of the construction contract.

END OF SECTION

1 GENERAL

PWGSC Update on Asbestos Use
Effective April 1, 2016, all Public Works and Government Services of Canada (PWGSC) contracts for new construction and major rehabilitation will prohibit use of asbestos-containing materials. Further information can be found at http://www.tpsgc-pwgsc.gc.ca/comm/vedette-features/2016-04-19-00-eng.html

COVID 19
All contractors shall follow Canadian Construction Association COVID-19 - Standardized Protocols for All Canadian Construction Sites.

1.1 REFERENCES

.1 Government of Canada.

- .1 Canada Labour Code - Part II (as amended)
- .2 Canada Occupational Health and Safety Regulations. (as amended)

.2 National Building Code of Canada (NBC): (as amended)

- .1 Part 8, Safety Measures at Construction and Demolition Sites.

.3 The Canadian Electrical Code (as amended)

.4 Canadian Standards Association (CSA) as amended:

- .1 CSA Z797-2018 Code of Practice for Access Scaffold.
- .2 CSA S269.1-2016 Falsework for Construction Purposes.
- .3 CSA S350-M1980 (R2003) Code of Practice for Safety in Demolition of structures.
- .4 CSA Z1006-10 Management of Work in Confined Spaces.
- .5 CSA Z462-18 Workplace Electrical Safety Standard

.5 National Fire Code of Canada 2015 (as amended)

- .1 Part 5 – Hazardous Processes and Operations and Division B as applicable and required.

.6 American National Standards Institute (ANSI): (as amended)

- .1 ANSI/ASSP A10.3-2013, Operations – Safety Requirements for Powder-Actuated Fastening Systems.

.7 Province of British Columbia:

- .1 Workers Compensation Act Part 3-Occupational Health and Safety. (as amended)
- .2 Occupational Health and Safety Regulation (as amended)

.8 Refer to Appendix C for Preliminary Hazard Assessment Form.

1.2 RELATED SECTIONS

.1 Refer to the following current NMS sections as required:

.1 Section 01 01 50 - General Instructions

.2 Section 02 41 19 – Selective Demolition

1.3 WORKERS' COMPENSATION BOARD COVERAGE

.1 Comply fully with the Workers' Compensation Act, regulations and orders made pursuant thereto, and any amendments up to the completion of the work.

.2 Maintain Workers' Compensation Board coverage during the term of the Contract, until and including the date that the Certificate of Final Completion is issued.

1.4 COMPLIANCE WITH REGULATIONS

.1 PWGSC may terminate the Contract without liability to PWGSC where the Contractor, in the opinion of PWGSC, refuses to comply with a requirement of the Workers' Compensation Act or the Occupational Health and Safety Regulations.

.2 It is the Contractor's responsibility to ensure that all workers are qualified, competent and certified to perform the work as required by the Workers' Compensation Act or the Occupational Health and Safety Regulations.

1.5 SUBMITTALS

.1 Submit to Departmental Representative submittals listed for review in accordance with Section 01 01 50General Instructions.

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

.3 Submit the following:

.1 Organizations Health and Safety Plan.

.2 Site Specific Safety Plan or Health and Safety Plan (SSSP or HASP)

.3 Copies of reports or directions issued by Federal and Provincial health and safety inspectors.

.4 Copies of incident and accident reports.

.5 Complete set of Material Safety Data Sheets (MSDS), and all other documentation required by Workplace Hazardous Materials Information System (WHMIS) requirements.

.6 Emergency Response Procedures.

.4 The Departmental Representative will review the Contractor's Site Specific Safety Plan or Health and Safety Plan (SSSP/HASP) and emergency response procedures, and provide comments to the Contractor within 5 days after receipt of the plan. Revise the plan as appropriate and resubmit to Departmental Representative.

.5 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.

.6 Submission of the Site Specific Safety Plan or Health and Safety Plan, and any revised version, to the Departmental Representative is for information and reference purposes only. It shall not:

.1 Be construed to imply approval by the Departmental Representative.

.2 Be interpreted as a warranty of being complete, accurate and legislatively compliant.

.3 Relieve the Contractor of his legal obligations for the provision of health and safety on the project.

1.6 RESPONSIBILITY

.1 Assume responsibility as the Prime Contractor for work under this contract.

.2 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.

.3 Comply with and enforce compliance by employees with safety requirements of Contract documents, applicable Federal, Provincial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.7 HEALTH AND SAFETY COORDINATOR

.1 Assign a competent and qualified Health and Safety Coordinator who shall:

.1 Be responsible for completing all health and safety training, and ensuring that personnel that do not successfully complete the required training are not permitted to enter the site to perform work.

.2 Be responsible for implementing, daily enforcing, and monitoring the Site Specific Safety Plan (SSSP) or Health and Safety Plan (HASP)

.3 Be on site during execution of work.

.4 Have minimum two (2) years' site-related working experience

.5 Have working knowledge of the applicable occupational safety and health regulations.

1.8 GENERAL CONDITIONS

.1 Provide safety barricades and lights around work site as required to provide a safe working environment for workers and protection for pedestrian and vehicular traffic.

.2 Ensure that non-authorized persons are not allowed to circulate in designated construction areas of the work site.

.1 Provide appropriate means by use of barricades, fences, warning signs, traffic control personnel, and temporary lighting as required.

.2 Secure site at night time or provide security guard as deemed necessary to protect site against entry.

1.9 PROJECT/SITE CONDITIONS

.1 Work at site will involve contact with:

.1 Multi-employer work site.

.2 Federal employees and general public.

.3 Energized electrical services.

.4 Working from heights.

.5 Persons incarcerated in the federal institutional system.

.6 Hazards - PSPC Preliminary Hazard Assessment included as an Appendix C to Specifications

1.10 UTILITY CLEARANCES

.1 The Contractor is solely responsible for all utility detection and clearances prior to starting the work.

.2 The Contractor will not rely solely upon the Reference Drawings or other information provided for Utility locations.

1.11 REGULATORY REQUIREMENTS

.1 Comply with specified codes, acts, bylaws, standards and regulations to ensure safe operations at site.

.2 In event of conflict between any provision of the above authorities, the most stringent provision will apply. Should a dispute arise in determining the most stringent requirement, the Departmental Representative will advise on the course of action to be followed.

1.12 WORK PERMITS

.1 Obtain specialty permit(s) related to project before start of work.

1.13 FILING OF NOTICE

.1 The General Contractor is to file Notice of Project with Provincial authorities prior to commencement of work. (All construction projects require a Notice of Work)

.2 Provide copies of all notices to the Departmental Representative.

1.14 SITE SPECIFIC HEALTH AND SAFETY PLAN

.1 Conduct a site-specific hazard assessment based on review of Contract documents, required work, and project site. Identify any known and potential health risks and safety hazards.

.2 Prepare and comply with the Site Specific Safety Plan (SSSP) or Health and Safety Plan (HASP) based on the required hazard assessment, including, but not limited to, the following:

.1 Primary requirements:

.1 Contractor's safety policy.

.2 Identification of applicable compliance obligations.

.3 Definition of responsibilities for project safety/organization chart for project.

.4 General safety rules for project.

.5 Job-specific safe work, procedures.

.6 Inspection policy and procedures.

.7 Incident reporting and investigation policy and procedures.

.8 Occupational Health and Safety Committee/Representative procedures.

.9 Occupational Health and Safety meetings.

.10 Occupational Health and Safety communications and record keeping procedures.

.11 COVID 19 Protocols and Procedures

.2 Summary of health risks and safety hazards resulting from analysis of hazard assessment, with respect to site tasks and operations which must be performed as part of the work.

.3 List hazardous materials to be brought on site as required by work. MSDS required for all products.

.4 Indicate Engineering and administrative control measures to be implemented at the site for managing identified risks and hazards.

.5 Identify personal protective equipment (PPE) to be used by workers.

.6 Identify personnel and alternates responsible for site safety and health.

.7 Identify personnel training requirements and training plan, including site orientation for new workers.

.3 Develop the plan in collaboration with all subcontractors. Ensure that work/activities of subcontractors are included in the hazard assessment and are reflected in the plan.

.4 Revise and update Site Specifc Safety Plan (SSSP) and/or Health and Safety Plan (HASP) as required, and re-submit to the Departmental Representative.

.5 Departmental Representative's review: the review of Site Specific Safety Plan and/or Health and Safety Plan by Public Works and Government Services Canada (PWGSC) shall not relieve the Contractor of responsibility for errors or omissions in final Site Specific Safety Plan and/or Health and Safety Plan of responsibility for meeting all requirements of construction and Contract documents and legislated requirements.

1.15 EMERGENCY PROCEDURES

.1 List standard operating procedures and measures to be taken in emergency situations. Include an emergency response and emergency evacuation plan and emergency contacts (i.e.names/telephone numbers) of:

.1 Designated personnel from own company.

.2 Regulatory agencies applicable to work and as per legislated regulations.

.3 Local emergency resources.

.4 Departmental Representative.

.5 A route map with written directions to the nearest hospital or medical clinic.

.2 Include the following provisions in the emergency procedures:

.1 Notify workers and the first-aid attendant, of the nature and location of the emergency.

.2 Evacuate all workers safely.

.3 Check and confirm the safe evacuation of all workers.

.4 Notify the fire department or other emergency responders.

.5 Notify adjacent workplaces or residences which may be affected if the risk extends beyond the workplace.

.6 Notify Departmental Representative.

.3 Provide written rescue/evacuation procedures as required for, but not limited to:

.1 Work at high angles.

.2 Work in confined spaces or where there is a risk of entrapment.

.3 Work with hazardous substances.

.4 Underground work.

.5 Work on, over, under and adjacent to water.

.6 Workplaces where there are persons who require physical assistance to be moved.

.4 Design and mark emergency exit routes to provide quick and unimpeded exit.

.5 Revise and update emergency procedures as required, and re-submit to the Departmental Representative.

.6 Contractors must not rely solely upon 911 for emergency rescue in a confined space, working at heights, etc.

1.16 HAZARDOUS PRODUCTS

.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS 2015) regarding use, handling, storage and disposal of hazardous materials, and regarding labelling and provision of Safety Data Sheets (MSDS) acceptable to the Departmental Representative and in accordance with the Canada Labour Code.

.2 Where use of hazardous and toxic products cannot be avoided:

.1 Advise Departmental Representative beforehand of the product(s) intended for use. Submit applicable MSDS and WHMIS 2015 documents as per Section 01 01 50General Instructions.

.2 In conjunction with Departmental Representative schedule to carry out work during "off hours" when tenants have left the building.

.3 Provide adequate means of ventilation in accordance with Section 01 01 50 – General Instructions.

.4 The contractor shall ensure that the product is applied as per manufacturers recommendations.

.5 The contractor shall ensure that only pre-approved products are bought onto the work site in an adequate quantity to complete the work.

1.17 ASBESTOS HAZARD

.1 Carry out any activities involving asbestos in accordance with current applicable Federal and Provincial Regulations.

.2 Removal and handling of asbestos will be in accordance with current applicable Provincial / Federal Regulations.

1.18 PCB REMOVALS

.1 Mercury-containing fluorescent tubes and ballasts which contain polychlorinated biphenyls (PCBs) are classified as hazardous waste.

.2 Remove, handle, transport and dispose of as indicated in Division 2 specifications.

1.19 REMOVAL OF LEAD-CONTAINING PAINT

.1 All paint containing TCLP lead concentrations above 5 ppm are classified as hazardous.

.2 Carry out demolition and/or remediation activities involving lead-containing paints in accordance with current applicable Provincial / Territorial Regulations.

.3 Work with lead-containing paint shall be completed as per Provincial and Federal regulations.

.4 Dry Scraping/Sanding of any materials containing lead is strictly prohibited.

.5 The use of Methylene Chloride based paint removal products is strictly prohibited.

1.20 ELECTRICAL SAFETY REQUIREMENTS (Reference: Worksafe BC OHS Reguation Part 19 – Electrical Safety)

.1 Comply with authorities and ensure that, when installing new facilities or modifying existing facilities, all electrical personnel are completely familiar with existing and new electrical circuits and equipment and their operation.

.1 Before undertaking any work, coordinate arc flash protection, required energizing and de-energizing of new and existing circuits with Departmental Representative.

.2 Maintain electrical safety procedures and take necessary precautions to ensure safety of all personnel working under this Contract, as well as safety of other personnel on site.

1.21 ELECTRICAL LOCKOUT

.1 Develop, implement and enforce use of established procedures to provide electrical lockout and to ensure the health and safety of workers for every event where work must be done on any electrical circuit or facility.

.2 Prepare the lockout procedures in writing, listing step-by-step processes to be followed by workers, including how to prepare and issue the request/authorization form. Have procedures available for review upon request by the Departmental Representative.

.3 Keep the documents and lockout tags at the site and list in a log book for the full duration of the Contract. Upon request, make such data available for viewing by Departmental Representative or by any authorized safety representative.

1.22 OVERLOADING

.1 Ensure no part of work is subjected to a load which will endanger its safety or will cause permanent deformation.

1.23 FALSEWORK

.1 Design and construct falsework in accordance with CSA S269.1-1975 (R2003) (as amended)

1.24 SCAFFOLDING

.1 Design, construct and maintain scaffolding in a rigid, secure and safe manner, in accordance with CSA Z797-2009 Code of Practice for Access Scaffold(as amended) and B.C. Occupational Health and Safety Regulations. (as amended)

1.25 CONFINED SPACES

.1 Carry out work in compliance with current Provincial / Territorial regulations.

1.26 POWDER-ACTUATED DEVICES

.1 Use powder-actuated devices in accordance with ANSI A10.3 (as amended) only after receipt of written permission from the Departmental Representative.

1.27 FIRE SAFETY AND HOT WORK

.1 Obtain Departmental Representative's authorization before any welding, cutting or any other hot work operations can be carried out on site.

.2 Hot work includes cutting/melting with use of torch, flame heating roofing kettles, or other open flame devices and grinding with equipment which produces sparks.

.3 Hot Work permits are a mandatory requirement for any hot work activities.

1.28 FIRE SAFETY REQUIREMENTS

.1 Store oily/paint-soaked rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.

.2 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada. (as amended)

.3 Portable gas and diesel fuel tanks are not permitted on most federal work sites. Approval from the Departmental Representative is required prior to any gas or diesel tank being brought onto the work site.

1.29 FIRE PROTECTION AND ALARM SYSTEM

.1 Fire protection and alarm systems shall not be:

.1 Obstructed.

.2 Shut off.

.3 Left inactive at the end of a working day or shift.

.2 Do not use fire hydrants, standpipes and hose systems for purposes other than firefighting.

.3 Be responsible/liable for costs incurred from the fire department, the building owner and the tenants, resulting from false alarms.

1.30 UNFORESEEN HAZARDS

.1 Should any unforeseen or peculiar safety-related factor, hazard or condition become evident during performance of the work, immediately stop work and immediately advise the Departmental Representative verbally and in writing.

1.31 POSTED DOCUMENTS

.1 Post legible versions of the following documents on site:

.1 Site Specific Safety Plan (SSSP) or Health and Safety Plan (HASP)

.2 Sequence of work.

.3 Emergency procedures.

.4 Site drawing showing project layout, locations of the first-aid station, evacuation route and marshalling station, and the emergency transportation provisions.

.5 Notice of Project.

.6 Floor plans or site plans. Must be posted in a non-inmate access area and locked up when not being used.

.7 Notice as to where a copy of the Workers' Compensation Act and Regulations are available on the work site for review by employees and workers.

.8 Workplace Hazardous Materials Information System (WHMIS 2015) documents.

.9 Material Safety Data Sheets (MSDS).

.10 List of names of Joint Health and Safety Committee members, or Health and Safety Representative, as applicable.

.11 All Hazardous Material and Substance Reports including Lab Analysis

.2 Post all Material Safety Data Sheets (MSDS) on site, in a common area, visible to all workers and in locations accessible to tenants when work of this Contract includes construction activities adjacent to occupied areas.

.3 Postings should be protected from the weather, and visible from the street or the exterior of the principal construction site shelter provided for workers and equipment, or as approved by the Departmental Representative.

1.32 MEETINGS

.1 Attend health and safety pre-construction meeting and all subsequent meetings called by the Departmental Representative.

1.33 CORRECTION OF NON-COMPLIANCE

.1 Immediately address health and safety non-compliance issues identified by the Departmental Representative.

.2 Provide Departmental Representative with written report of action taken to correct non-compliance with health and safety issues identified.

.3 The Departmental Representative may issue a "stop work order" if noncompliance of health and safety regulations is not corrected immediately or within posted time. The General Contractor/subcontractors will be responsible for any costs arising from such a "stop work order".

2 PRODUCTS

.1 Not used.

3 EXECUTION

.1 Not used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 General requirements relating to commissioning of project's components and systems, specifying general requirements to PV of components, equipment, sub-systems, systems, and integrated systems.

.2 Acronyms:

AFD - Alternate Forms of Delivery, service provider.

BMM - Building Management Manual.

Cx - Commissioning.

EMCS - Energy Monitoring and Control Systems.

O&M - Operation and Maintenance.

PI - Product Information.

PV - Performance Verification.

TAB - Testing, Adjusting and Balancing.

.3 Provide third party commissioning agent(s) for mechanical and electrical systems. Provide costs of commissioning in tender price.

.4 Refer to sections of Mechanical, Electrical and Communications disciplines for specific requirements

1.2 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 assists 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.

1.3 COMMISSIONING OVERVIEW

.1 Cx Agent:

.1 Hired and paid for by the Contractor.

.2 Responsibilities:

.1 Plan, coordinate, and carry out the Cx process.

.2 Develop Cx plan and Cx check forms (component, system and integrated system verification).

.3 Undertakes the component, system and integrated system performance verification testing and commissioning.

.4 Plans and carry out equipment demonstration and acceptance tests.

.5 Complete all Cx verification documentations.

.6 Chair Cx meetings.

.2 Cx to be a line item of Contractor's cost breakdown.

.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 built 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 Commissioning work to be completed prior Contractor’s request for Substantial Performance:

.1 Completed Cx documentation has been received, reviewed for suitability and approved by Departmental Representative.

.2 Equipment, components and systems have been commissioned.

.3 O&M training has been completed.

1.4 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 non-functional system(s), 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 hold-back assessments.

1.5 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 Coordinate provision, location and installation of provisions for Cx.

.3 Before start of Cx:

.1 Have completed Cx Plan up-to-date.

.2 Ensure installation of related components, equipment, sub-systems, systems is complete.

.3 Fully understand Cx requirements and procedures.

.4 Have Cx documentation shelf-ready.

.5 Understand completely design criteria and intent and special features.

.6 Submit complete start-up documentation to Departmental Representative.

.7 Have Cx schedules up-to-date.

.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.

1.6 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.

1.7 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals: in accordance with Section 01 01 50 – General Instructions.

.2 Submit immediately after award of Contract:

.1 Name of Contractor’s Cx Agent.

.3 Submit no later than 4 weeks after award of Contract:

.1 Draft Cx documentation.

.2 Preliminary Cx schedule.

.4 Request in writing to Departmental Representative for changes to submittals and obtain written approval at least 2 weeks prior to start of Cx.

.5 Submit proposed Cx procedures to Departmental Representative where not specified and obtain written approval at least 2 weeks prior to start of Cx.

.6 Provide additional documentation relating to Cx process required by Departmental Representative.

1.8 COMMISSIONING DOCUMENTATION

.1 Provide the following verification check sheets.

.1 Installation Check Lists and Product Information (PI) forms.

.2 Performance Verification (PV) forms.

.2 Departmental Representative to review and approve Cx documentation.

.3 Provide completed and approved Cx documentation to Departmental Representative.

1.9 COMMISSIONING SCHEDULE

.1 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:

.1 Approval of Cx reports.

.2 Verification of reported results.

.3 Repairs, retesting, re-commissioning, re-verification.

.4 Training.

1.10 COMMISSIONING MEETINGS

.1 Convene Cx meetings following project meetings.

.2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.

.3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.

.4 At 60% construction completion stage. Departmental Representative to 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 and subcontractors, addressing delays and potential problems.

.2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.

.5 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.

.6 Meeting will be chaired by Cx Agent who will record and distribute minutes.

1.11 QUALITY ASSURANCE

.1 Testing organization: current member in good standing of AABC certified to perform specified services.

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

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

1.12 REFERENCES

.1 Associated Air Balance Council (AABC): National Standards for Field Measurement and Instrumentation, Total Systems Balance, Air Distribution-Hydronics Systems.

.2 Commissioning shall be provided per CSA Standard Z320-11 requirements.

1.13 SUBMITTALS

.1 Prior to start of Work, submit name of organization proposed to perform services. Designate who has managerial responsibilities for coordination of entire testing, adjusting and balancing.

.1 Submit documentation to confirm organization compliance with quality assurance provision.

.2 Submit 3 preliminary specimen copies of each of report forms proposed for use.

.3 Ten (10) days prior to Substantial Performance, submit 3 copies of final reports on applicable forms.

.4 Submit reports of testing, adjusting and balancing postponed due to seasonal, climatic, occupancy, or other reasons beyond Contractor's control, promptly after execution of those services.

1.14 PROCEDURES

.1 Comply with procedural standards of certifying association under whose standard services will be performed.

.2 Notify Departmental Representative 3 days prior to beginning of operations.

.3 Accurately record data for each step.

.4 Report to Departmental Representative any deficiencies or defects noted during performance of services.

1.15 CONTRACTOR’S RESPONSIBILITIES

.1 Prepare each system for testing and balancing.

.2 Cooperate with testing organization and provide access to equipment and systems.

.3 Provide personnel and operate systems at designated times, and under conditions required for proper testing, adjusting, and balancing.

.4 Notify testing organization 7 days prior to time project will be ready for testing, adjusting, and balancing.

.5 Commission cost to be borne by Contractor.

1.16 PREPARATION

.1 Provide instruments required for testing, adjusting, and balancing operations.

.2 Make instruments available to Departmental Representative to facilitate spot checks during testing.

.3 Retain possession of instruments and remove at completion of services.

.4 Verify systems installation is complete and in continuous operation.

.5 Verify lighting is turned on when lighting is included in cooling load.

.6 Verify equipment such as computers, laboratory and electronic equipment are in full operation.

1.17 FINAL REPORTS

.1 Organization having managerial responsibility shall make reports.

.2 Ensure each form bears signature of recorder, and that of supervisor of reporting organization.

.3 Identify each instrument used, and latest date of calibration of each.

1.18 COMPLETION OF COMMISSIONING

.1 Upon completion of Cx leave systems in normal operating mode.

.2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx prior to issuance of Interim Certificate of Completion.

.3 Cx deliverables have been submitted and accepted by Departmental Representative.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 22 05 00 – Common Work Results for Plumbing

1.2 DESCRIPTION

.1 Demonstrate scheduled operation and maintenance of equipment and systems to Departmental Representative and maintenance personnel two weeks prior to date of interim completion.

.2 Departmental Representative will provide list of CBSA personnel to Contractor and coordinate dates and times.

1.3 QUALITY CONTROL

.1 When specified in individual Sections, require manufacturer to provide authorized representative to demonstrate operation of equipment and systems, instruct Departmental Representative's personnel, and provide written report that demonstration and instructions have been completed.

1.4 SUBMITTALS

.1 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.

.2 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.

.3 Give time and date of each demonstration, with list of persons present.

1.5 CONDITIONS FOR DEMONSTRATIONS

.1 Equipment has been inspected and put into operation.

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

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

1.6 PREPARATION

.1 Verify that conditions for demonstration and instructions comply with requirements. Prepare supplemental literature and handouts.

.2 Verify that designated personnel are present.

1.7 DEMONSTRATION AND INSTRUCTIONS

.1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at scheduled times, at the equipment location. All operational modes shall be demonstrated.

.2 Instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.

.3 Review contents of manual in detail to explain all aspects of operation and maintenance.

.4 Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instructions.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Removal and or salvage of designated construction.

.2 Disposal of materials.

1.2 RELATED SECTIONS

.1 Section 01 01 50 – General Instructions

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.

.2 National Building Code Part 8

1.4 GENERAL

.1 Submit detailed schedule for any and all work affecting the existing building. Consult with CBSA regarding work required. Submit schedule minimum 10 calendar days prior to scheduled work.

.2 Comply with requirement of the Waste Management and Disposal Requirements in Section 01 01 50 – General Instructions.

1.5 SCHEDULING

.1 Submit with the project schedule a coordinated complete series of drawings, diagrams, details and supporting data clearly showing sequence of demolition and removal work, reconstruction, occupant moves required, material storage, temporary barriers for all phases of the demolition construction work.

.2 Perform noisy, malodorous, dusty, work as directed by CBSA and the Departmental Representative.

1.6 SITE CONDITIONS

.1 Review the Project Specific Hazardous Building Materials Assessment for the project with the Departmental Representative. Work shall be provided considering all hazard risks noted in the “Pre-construction Hazard Assessment Form” included in “Appendix C”. A signed copy of this form shall be returned to the Departmental Representative.

.1 Remove hazardous materials in a manner consistent with the Occupational Health & Safety Regulation, General Hazard Requirements of the Work Safe BC, and other applicable regulations. Changes to the Work will be dealt in accordance with the provisions of the Contract Documents.

.2 Handle and dispose of all hazardous and banned materials in accordance with the Special Waste Regulation, and Regional and Municipal regulations. These hazardous and banned materials include but are not limited to asbestos, drywall (banned from disposal), Polychlorinated Biphenyls (PCBs), abandoned chemicals (gasoline, pesticides, herbicides, flammable and combustible substances), all refrigerant from cooling equipment, lead-based paints, smoke detectors, and mercury containing switches.

.2 Should material resembling spray or trowel-applied asbestos or other designated substance listed as hazardous be encountered, stop work, take preventative measures, and notify Departmental Representative immediately.

.1 Do not proceed until written instructions have been received from the Departmental Representative.

.3 Notify Departmental Representative minimum 5 working days before disrupting building access or services.

.4 The Contractor shall accept the site as it exists and will be responsible for all deconstruction work as required.

1.7 DEMOLITION 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 existing 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, submit recommendation for providing a smooth transition; to Departmental Representative for review. Request instructions from the 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.

1.8 PROTECTION

.1 Prevent movement, settlement, or other damage to adjacent structures, utilities, and parts of building to remain in place. Provide bracing and shoring required.

.2 Keep noise, dust, and inconvenience to occupants to a minimum. Noisy work will only be permitted at times agreed to and accepted by the Departmental Representative.

.3 Protect building mechanical and electrical systems, services and equipment.

.4 Provide temporary dust screens, covers, railings, supports and other protection as required.

.5 Do not overload any portion of the structure with material or equipment

.6 Where existing load bearing partitions are to be removed, do not commence work until new support structure is installed, inspected and approved by the Departmental Representative.

.7 Cease operations and notify the Departmental Representative if safety of any adjacent work or structure appears to be endangered. Take all precautions to support the structure. Do not resume operations until reviewed with the Departmental Representative.

.8 Ensure safe passage of building occupants around area of demolition. Remove debris and clean areas of access immediately.

.9 Conduct demolition to minimize interference with adjacent and occupied building areas.

1.9 QUALITY ASSURANCE

.1 Salvage or Demolition Firm: Company (ies) must be experienced and specializing in performing the work of this section with documented experience in similar types of deconstruction work.

.2 Qualifications of Workers: Provide a supervisor who shall be present at all times during the deconstruction work and who shall be thoroughly familiar with the work required and who shall direct all work. Provide one (1) person on site who is responsible for maintaining the safety barriers and protection of the workers and the public.

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 PREPARATION

.1 Inspect building & site with Departmental Representative and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.

.2 Provide, erect, and maintain temporary barriers security partitions at locations indicated agreed to with CBSA and the Departmental Representative.

.1 Erect and maintain temporary partitions to prevent spread of dust, odours, and noise to permit continued occupancy. Refer to complete project drawings. The extent of the partitions required may exceed the information shown on the demolition drawings.

.3 Erect and maintain weatherproof closures for exterior openings.

.4 Protect existing materials which are not to be demolished.

.5 Prevent movement of structure; provide bracing and shoring.

3.2 PROTECTION

.1 Maintain public safety and traffic control precautions at all times during the demolition work, using properly trained qualified persons to control all Contractor's activities, vehicles, equipment, traffic and all public pedestrian and vehicles traffic that are coming to and from the site or passing along the vicinity of the site access locations.

.2 Prevent movement, settlement, or damage to adjacent structures, utilities, and parts of building to remain in place. Provide bracing and shoring required.

.3 Keep noise, dust, and inconvenience to occupants to minimum.

.4 Protect building systems, services and equipment.

.5 Do Work in accordance with Section 01 35 33 - Health and Safety.

3.3 SITE REMOVALS

.1 Remove items as indicated.

3.4 DEMOLITION

.1 The electrical, BSCS, or mechanical services MUST NOT be terminated within the building at any time. Notify the building Departmental Representative of any requirements for partial termination of services in accordance with Division 1 requirements. Keep down time at a minimum.

.2 Remove parts of existing building to permit new construction. Sort materials into appropriate piles for reuse, recycling, or disposal.

.1 Demolish in an orderly and careful manner. Protect existing supporting structural members.

.2 Remove materials as Work progresses. Upon completion of Work, leave areas in clean condition.

.3 Remove temporary Work.

3.5 DISPOSAL

.1 Dispose of removed materials, to appropriate recycling facilities except where specified otherwise, in accordance with authority having jurisdiction.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 01 50 – General Instructions.

.2 Section 01 35 33 – Health and Safety Requirements.

1.2 REFERENCES

.1 CSA International

.1 CSA S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.

.2 National Research Council Canada (NRC)

.1 National Building Code of Canada (2015) (NBC)

.2 National Fire Code of Canada (2015) (NFC)

.3 U.S. Environmental Protection Agency (EPA)/Office of Water

.1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

.4 Federal Halocarbon Regulations

.1 For removal of refrigerant containing equipment and piping, ensure compliance with Federal Halocarbon Regulations.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 01 50 – General Instructions.

.2 Design Submittals:

.1 Construction Waste Management:

.1 Submit project Waste Management highlighting recycling and salvage requirements.

.2 Erosion and Sedimentation Control: submit erosion and sedimentation control plan in accordance with authorities having jurisdiction.

1.4 SITE CONDITIONS

.1 Review "Designated Substance Report" and take precautions to protect environment.

.2 If material resembling spray or trowel-applied asbestos or other designated substance listed as hazardous be encountered, stop work, take preventative measures, and notify Departmental Representative immediately.

.1 Proceed only after receipt of written instructions have been received from Departmental Representative.

.3 Notify Departmental Representative before disrupting building access or services.

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 EXAMINATION

.1 Inspect building and site with Departmental Representative and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.

.2 Locate and protect utilities. Preserve active utilities traversing site in operating condition.

.3 Notify and obtain approval of utility companies before starting demolition.

.4 Disconnect, cap, plug or divert, as required, existing public utilities within the property where they interfere with the execution of the work, in conformity with the requirements of the authorities having jurisdiction. Mark the location of these and previously capped or plugged services on the site and indicate location (horizontal and vertical) on the record drawings. Support, shore up and maintain pipes and conduits encountered.

.1 Immediately notify Departmental Representative and utility company concerned in case of damage to any utility or service, designated to remain in place.

.2 Immediately notify the Departmental Representative should uncharted utility or service be encountered, and await instruction in writing regarding remedial action.

3.2 PREPARATION

.1 Temporary Erosion and Sedimentation Control:

.1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to: sediment and erosion control plan, specific to site, that complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.

.2 Inspect, repair, and maintain erosion and sedimentation control measures during demolition.

.3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal after completion of demolition work..

.2 Protection of In-Place Conditions:

.1 Prevent movement, settlement, or damage to adjacent structures, utilities, and landscaping features and parts of building to remain in place. Provide bracing and shoring required.

.2 Keep noise, dust, and inconvenience to occupants to minimum.

.3 Protect building systems, services and equipment.

.4 Provide temporary dust screens, covers, railings, supports and other protection as required.

.5 Do Work in accordance with Section 01 35 33 - Health and Safety Requirements.

.3 Demolition/Removal:

.1 Remove items as indicated.

.2 Removal of Pavements, Curbs and Gutters:

.3 Remove parts of existing building to permit new construction.

.4 Trim edges of partially demolished building elements to tolerances as defined by Departmental Representative to suit future use.

.5 Dispose of all equipment and material legally.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 01 50 – General Instructions.

.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 01 50 – General Instructions.

.3 Refer to demolition drawings and specifications for items to be salvaged for reuse.

.4 Waste Management: separate waste materials for reuse or recycling in accordance with Section 01 01 50 – General Instructions.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Firestop systems consisting of a material, or combination of materials installed to retain integrity of fire-rated construction by maintaining a barrier against spread of flame, smoke, and hot gases through penetrations, blank openings, construction joints, or at perimeter fire containment in or adjacent to fire-rated barriers in accordance with the requirements of the National Building Code and National Plumbing Code (NBC 2015, NPC 2015).

1.2 REFERENCES

.1 Underwriter's Laboratories of Canada (ULC)

.1 ULC-S115-1995, Fire Tests of Firestop Systems.

1.3 PERFORMANCE REQUIREMENTS

.1 Penetrations: firestopping systems produced to resist spread of fire and passage of smoke and other gases according to requirements indicated, including but not limited to:

.1 Firestop penetrations passing through fire resistance rated wall and floor assemblies, and other locations as indicated.

.2 Where there is no specific third party tested and classified firestop system is available for a particular firestop configuration, obtain Engineering Judgement (EJ) or Equivalent Fire Resistance Rated Assembly (EFFRA) for submittal from firestop manufacturer.

1.4 SUBMITTALS

.1 Submit samples, product data, and shop drawings for review.

.2 Informational Submittals:

.1 Submit system design listings, including illustrations from qualified testing and inspection agency applicable to each firestop configuration. Indicate proposed material, reinforcement, anchorage, fastenings, and method of installation. Construction details should accurately reflect actual job conditions.

.2 Submit manufacturer's product data for materials and prefabricated devices, providing descriptions are sufficient for identification at job site. Include manufacturer's printed instructions for installation.

.3 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in Section 01 01 50 – General Instructions.

.4 Operations and maintenance manual in accordance with Section 01 01 50 – General Instruction. Include for each firestop system:

.1 Room number/name, location within room, rating, engineering judgements, product description, maintenance requirements.

1.5 QUALITY ASSURANCE

.1 Fire-Test-Response Characteristics: Provide firestopping System Design Listing by testing and inspection agency in accordance with appropriate ASTM standard(s).

.1 Qualified testing and inspection agencies include UL, ULC, cUL, Intertek Testing Services, or another agency performing testing and follow-up inspection services for firestop materials that is acceptable to authority having jurisdiction.

.2 Installer qualifications:

.1 Firestop Contractors International Association Contractor (FCIA) Member in good standing.

.2 Licensed by local authority, where applicable.

.3 Shown to have successfully completed not less than five comparable scale projects.

.3 Single Source Responsibility: Obtain firestop systems for each kind of penetration and construction conditions indicated from a single primary firestop systems manufacturer.

.1 Do not intermix materials of different manufacture than allowed by tested and listed system in the same firestop system or opening.

.2 Tested and listed firestop systems are to be used first. If such systems are not possible, install an Engineering Judgement (EJ) or Equivalent Fire Resistance Rated Assembly (EFRRA).

.4 Schedule pre-construction meeting for parties involved prior to start of construction.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Deliver firestopping products to Project Site in original, unopened containers, or packages with intact and legible manufacturer’s labels identifying product and manufacturer.

.2 Store and handle firestopping materials in accordance with manufacturer’s written instructions.

1.7 SITE CONDITIONS

.1 Environmental Conditions: Install firestopping in accordance with manufacturers written instructions.

.2 Ventilation: Ventilate in accordance with firestopping manufacturers' instructions or Material Safety Data Sheet (MSDS).

1.8 SEQUENCING AND SCHEDULING

.1 Do not cover up firestopping installations until Departmental Representative or Authorities Having Jurisdiction have examined installation.

1.9 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 01 50 – General Instructions.

Part 2 Products

2.1 MATERIALS

.1 Fire stopping and smoke seal systems: in accordance with ULC-S115.

.1 Firestop system rating: FT.

.2 Firestop products produced by FCIA Manufacturer Members in good standing

.3 Service penetration assemblies: certified by ULC in accordance with ULC-S115 and listed in ULC Guide No.40 U19.

.4 Service penetration firestop components: certified by ULC in accordance with ULC-S115 and listed in ULC Guide No.40 U19.13 and ULC Guide No.40 U19.15 under the Label Service of ULC.

.5 Fire-resistance rating of installed fire stopping assembly in accordance with British Columbia Building Code.

.6 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.

.7 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal.

.8 Primers: to manufacturer's recommendation for specific material, substrate, and end use.

.9 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.

.10 Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.

.11 Sealants for vertical joints: non-sagging.

.1 Maximum VOC Content: 250 g/L (less water)

Part 3 Execution

3.1 EXAMINATION

.1 Examine substrates and conditions with installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of firestopping.

.1 Notify Departmental Representative of unsatisfactory conditions.

.2 Do not proceed with installation until unsatisfactory conditions have been corrected.

.2 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials. Ensure that substrates and surfaces are clean, dry and frost free.

.3 Verify that field dimensions are as indicated and as recommended by manufacturer.

3.2 PREPARATION

.1 Prepare surfaces in contact with firestopping materials and smoke seals to manufacturer's instructions.

.2 Maintain insulation around pipes and ducts penetrating fire separation without interruption to vapour barrier.

.3 Mask where necessary to avoid spillage and over coating onto adjoining surfaces.

.4 Remove masking as soon as it is possible to do so without disturbing the firestopping seal with substrates.

.5 Remove stains on adjacent surfaces.

3.3 INSTALLATION

.1 General:

.1 Install fire stopping and smoke seal material and components in accordance with ULC certification and manufacturer's instructions.

.2 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.

.3 Tool or trowel exposed surfaces to a neat finish.

.2 Penetration Firestops:

.1 Coordinate with other trades to ensure pipes, conduit, cable, and other items, which penetrate fire rated construction, have been permanently installed prior to installation of firestop assemblies.

.2 Schedule Work to ensure partitions and other construction that conceals penetrations are not erected prior to installation of firestop and smoke seals.

.3 Install fill materials for through-penetrations firestop systems to produce the following result:

.1 Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.

.2 Install materials so they contact and adhere to substrates formed by opening and penetrating items.

.3 For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces.

.3 Firestop Joint Systems:

.1 Install joint fillers to provide support of firestop materials during application and at position required to produce cross-sectional shapes and depths of installed firestop material relative to joint widths that allow optimum sealant movement capability and develop fire-resistance rating required.

.2 Install systems by proved techniques that result in firestop materials:

.1 Directly contacting and wetting joint substrates.

.2 Filling recesses provided for each joint configuration.

.3 Providing uniform, cross-sectional shapes and depths relative to joint width that optimize movement capability.

.3 Tool non-sag firestop materials immediately after application and prior to skinning. Form smooth, uniform beads of configuration indicated or required to:

.1 Produce fire-resistance rating.

.2 Eliminate air pockets.

.3 Ensure contact and adhesion with sides of joint.

3.4 FIELD QUALITY CONTROL

.1 Inspections: notify when ready for inspection and prior to concealing or enclosing fire stopping materials and service penetration assemblies.

.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 Section 01 01 50 – General Instructions.

.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.

3.5 CLEANING

.1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment in accordance with Section 01 01 50 – General Instructions

.2 Remove temporary dams after initial set of fire stopping and smoke seal materials.

3.6 SCHEDULE

.1 Fire stop and smoke seal at:

.1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.

.2 Top of fire-resistance rated masonry and gypsum board partitions.

.3 Intersection of fire-resistance rated masonry and gypsum board partitions.

.4 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.

.5 Penetrations through fire-resistance rated floor slabs.

.6 Around mechanical and electrical assemblies penetrating fire separations.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 01 50 – General Instructions.

.2 Section 01 91 00 – Commissioning.

1.2 REFERENCES

.1 National Building Code Canada 2015

.2 National Plumbing Code Canada 2015

.3 Authority Having Jurisdiction

.4 ULC and FM Standards for applicable products

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 01 50 General Instructions.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for all plumbing equipment and include product characteristics, performance criteria, physical size, finish and limitations.

.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, where applicable.

.4 Manufacturer to certify current model production.

.5 Certification of compliance to applicable codes.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 01 50 General Instructions.

.2 Operation and Maintenance Data: submit operation and maintenance data for all plumbing equipment 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 where applicable.

.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 where applicable.

.5 Approvals:

.1 Submit two hard 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. PDF draft copy may be submitted for review if agreed upon 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 set of reproducible mechanical drawings. Provide sets of 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 to reproducibles, revising reproducibles to show work as actually installed.

.3 Use different colour waterproof ink for each service.

.4 Make available for reference purposes and inspection.

.8 As-built (as-constructed) drawings:

.1 Prior to start of Testing, Adjusting and Balancing, 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 using as-built drawings.

.5 Submit completed reproducible as-built drawings (hardcopy, CAD and PDF) with Operating and Maintenance Manuals.

.9 Submit copies of as-built drawings for inclusion in final TAB report.

1.5 MAINTENANCE MATERIAL SUBMITTALS

.1 Submit in accordance with Section 01 01 50 General Instructions.

.2 Provide one set of special tools required to service equipment as recommended by manufacturers.

.1 TORX with pin (to remove fasteners).

1.6 DELIVERY, STORAGE, AND HANDLING

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

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect products from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section.

Part 2 Products

2.1 SECURITY FASTENERS

.1 Fasteners used in areas accessible by inmates shall be TORX with pin, stainless steel screws, which require a special tool to remove the fasteners. Use fasteners compatible with material through which they pass.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that existing conditions are acceptable for connection to new materials to be installed within this contract.

.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 PAINTING REPAIRS AND RESTORATION FOR PLUMBING EQUIPMENT

.1 Prime and touch up marred finished paintwork to match original.

.2 Restore to new condition, finishes which have been damaged.

3.3 SYSTEM CLEANING

.1 Clean interior and exterior of all plumbing equipment.

3.4 FIELD QUALITY CONTROL

.1 Site Tests: conduct operational tests and submit report as described in Section 01 01 50 General Instructions.

3.5 COMMISSIONING

.1 Test and verify operation of each fixture, valve, and electrically controlled device in accordance with Section 01 91 00 Commissioning.

3.6 DEMONSTRATION

.1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing. Random equipment will be tested.

.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 Perform in accordance with Section 01 01 50 General Instructions.

3.7 CLEANING

.1 Clean in accordance with Section 01 01 50 General Instructions.

.1 Progress Cleaning: 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 01 50 General Instructions.

3.8 WASTE MANAGEMENT

.1 Separate waste materials for recycling in accordance with Section 01 01 50 General Instructions.

.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 SECTION INCLUDES

.1 Materials and installation of thermal insulation for plumbing piping.

1.2 RELATED SECTIONS

.1 Section 01 01 50 – General Instructions.

.2 Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment.

1.3 REFERENCES

.1 American Society for Testing and Materials International, (ASTM)

.1 ASTM C335/C335M-10e1, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.

.2 ASTM C449/C449M-07(2013), Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.

.3 ASTM C547-15, Standard Specification for Mineral Fiber Pipe Insulation.

.4 ASTM E814-13a(2017) Standard Test Method for Fire Tests of Penetration Firestop Systems

.2 National Building Code of Canada

.1 NBCC-2015

.3 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (R2015).

.4 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S115-11(R2016), Standard Method of Fire Tests of Firestop Systems

.3 CAN/ULC-S702-14, Standard for Mineral Fibre Thermal Insulation for Buildings

1.4 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" - will mean "not concealed" as defined herein.

1.5 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 01 50 General Instructions.

.2 Submit following shop drawing information:

.1 Pipe insulation: manufacturer's catalogue literature

.2 Installation requirements

.3 Schedule of all piping systems and proposed insulation types, thicknesses and finishes.

1.6 MANUFACTURERS' INSTRUCTIONS

.1 Submit manufacturer's installation instructions in accordance with Section 01 01 50 General Instructions.

.2 Installation instructions to include procedures used, and installation standards achieved.

1.7 QUALIFICATIONS

.1 Installer: specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, member of TIAC.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Protect from weather and construction traffic.

.3 Protect against damage from any source.

.4 Store at temperatures and conditions recommended by manufacturer.

1.9 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 01 50 General Instructions.

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 CAN/ULC-S702 or ASTM C547.

.2 Maximum "k" factor: to CAN/ULC-S702.

2.1 INSULATION SECUREMENT

.1 Tape: self-adhesive, aluminum, plain, 50 mm wide minimum.

.2 Contact adhesive: quick setting.

2.2 CEMENT

.1 Thermal insulating and finishing cement:

.1 Air drying on mineral wool, to ASTM C449/C449M.

2.3 VAPOUR RETARDER LAP ADHESIVE

.1 Water based, fire retardant type, compatible with insulation.

2.4 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.5 OUTDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: fibrous glass, untreated 305 g/m^2.

2.6 JACKETS

.1 Not applicable.

2.7 Fire Stopping And Smoke Seal Materials

.1 References:

.1 CAN4-S115-M, Standard Method of Fire Tests of Firestop Systems.

.2 ASTM E814 Standard Method of Fire Tests and Through-Penetration Firestops.

.3 1997 Certifications Listings Intertek Testing Services N.A. Ltd. (Warnock Hersey).

.4 Underwriters Laboratories of Canada. Listing of Equipment and Materials Vol. 3 Fire Resistance Ratings -Revision 4/95.

.2 Work Included:

.1 Furnish all labour, material, equipment and services necessary to supply and install firestopping and smoke seals around piping penetrations through fire rated wall and floor assemblies, as indicated and as specified.

.3 Quality Assurance:

.1 The work of this section shall be carried out only by an approved specialist firm, employing skilled tradesmen experienced in firestopping and smoke seal application and approved, licensed and supervised by the manufacturer of fire stopping materials.

.2 All work to be of the highest quality according to best trade practice and in strict accordance with manufacturer's printed specifications.

.4 Submittals:

.1 Submit shop drawings to show proposed material, reinforcement, anchorage, fastenings and method of installation.

.2 Submit manufacturers' product data for materials and prefabricated devices. Include assembly/location design system number references with copies of test information. Construction details should accurately reflect actual job conditions.

.3 For building assemblies which do not correspond to any previously tested and rated assemblies, submit proposals based on related designs using accepted fireproofing design criteria.

.5 Materials:

.1 Asbestos-free materials and systems capable of maintaining an effective barrier against flame, smoke and gases in compliance with requirements of ULC CAN4-S115 and not to exceed opening sizes for which they are intended.

.2 Service penetration assemblies and design numbers: Certified by ULC in accordance with CAN4-S115 and listed in ULC Guide No. 40 U19. 1997 Certification Listings Intertek Testing Services N.A. Ltd. (Warnock Hersey).

.3 Service penetration firestop components: Certified by ULC in accordance with CAN4-S115 and listed in ULC Guide No. 40 U19.13 and ULC Guide No. 40 U19.15 under the Label Service of ULC or equivalent approved tests by Warnock Hersey.

.4 Fire resistance rating of installed fire stopping assembly shall be not less than the fire resistance rating of surrounding floor and wall assembly.

Part 3 Execution

3.1 PRE-INSTALLATION REQUIREMENTS

.1 Pressure testing of piping systems to be complete, witnessed and certified.

.2 Surfaces clean, dry, free from foreign material.

3.2 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturer’s 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.

3.3 PIPING INSULATION SCHEDULES

.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.

.2 TIAC Code: (A-1).

.1 Securements: Tape at 300 mm on centre.

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code (1501-H).

.3 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	Insulation thickness (mm)					
Pipe sizes (NPS)			Up to 1	1¼ -2	2½-4	5-6	6½-8	>8
Domestic Water	All	A-1	25	25	25	25	38	38

.4 Finishes:

.1 Exposed indoors: PVC jacket.

.2 Exposed in mechanical rooms: PVC jacket.

.3 Concealed, indoors: canvas on valves, fittings. No further finish.

.4 Outdoors: Water-proof aluminum jacket.

3.4 Insulation Packing of Pipe Sleeves

.1 Tightly pack the space between all pipe sleeves and pipe or between pipe sleeve and pipe insulation with mineral wool insulation - Thermal Ceramics to full depth of sleeve to prevent transmission of sound and/or passage of smoke.

3.5 CLEANING

.1 Clean in accordance with Section 01 01 50 General Instructions.

.1 Progress Cleaning: Leave work area clean at end of each day.

.2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment.

.2 Waste Management in accordance with Section 01 01 50 General Instructions.

.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 01 50 – General Instructions.

.2 Section 22 05 00 – Common Work Results for Plumbing.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/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.

.2 ASTM International Inc.

.1 ASTM A307-14e1, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.

.2 ASTM B88M-16, Standard Specification for Seamless Copper Water Tube (Metric).

.3 American National Standards Institute/American Water Works Association (ANSI)/(AWWA)

.1 ANSI/AWWA C111/A21.11-17, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.4 Canadian Standards Association (CSA International)

.1 CSA B242-05 (R2016), Groove and Shoulder Type Mechanical Pipe Couplings.

.5 National Building Code of Canada

.1 NBCC-2015

.6 National Plumbing Code

.1 NPC-2015

.7 National Sanitation Foundation (NSF) / American National Standards Institute (ANSI).

.1 NSF/ANSI 61-16, Drinking Water System Components.

1.3 QUALITY ASSURANCE

.1 All potable water system components shall conform to NSF/ANSI Standard 61.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 01 50 General Instructions.

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for insulation and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Closeout Submittals:

.1 Provide maintenance data for incorporation into manual specified in Section 01 01 50 General Instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packaging Waste Management: remove in accordance with Section 01 01 50 General Instructions.

.2 Place materials defined as hazardous or toxic in designated containers.

Part 2 Products

2.1 PIPING

.1 Domestic hot, cold and recirculation systems, within building.

.1 Above ground: copper tube, hard drawn, type K: 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: to ANSI/ASME B16.24.

.2 Cast bronze threaded fittings, Class 125: 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: wrought copper to ANSI/ASME B16.22; with 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: tin copper alloy.

.4 Teflon tape: for threaded joints.

.5 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.

2.4 PROTECTIVE CONDUIT

.1 Not applicable.

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 NPC, and local authority having jurisdiction.

.2 Assemble piping using fittings manufactured to ANSI standards.

.3 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.

.4 Buried tubing:

.1 Not applicable.

3.3 VALVES

.1 Isolate equipment, fixtures and branches with isolation valves.

.2 Balance recirculation system using existing valves. Mark settings and record on as-built drawings on completion.

3.4 PRESSURE TESTS

.1 Not applicable.

3.5 FLUSHING AND CLEANING

.1 Flush entire system for 8 h. Ensure outlets flushed for 2 hours. Let stand for 24 hours, then draw one sample off longest run. Submit to testing laboratory to verify that system is clean to Federal potable water guidelines. Let system flush for additional 2 hours, 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 is fully functional.

3.7 DISINFECTION

.1 Flush out, disinfect and rinse system to approval of Departmental Representative.

3.8 START-UP

.1 Timing: start up after:

.1 Disinfection procedures have been completed.

.2 Certificate of static completion has been issued.

.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.

.4 Rectify start-up deficiencies.

3.9 PERFORMANCE VERIFICATION

.1 Scheduling:

.1 Verify system performance after leakage tests and disinfection are completed.

.2 Procedures:

.1 Verify that flow rate and pressure meet Design Criteria.

.2 Verify performance of temperature controls.

.3 Verify compliance with safety and health requirements.

.4 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.

.5 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.

.3 Reports:

.1 Not applicable.

3.10 CLEANING

.1 Clean in accordance with Section 01 01 50 General Instructions.

.1 Progress Cleaning: Leave work area clean at end of each day.

.2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment.

3.11 WASTE MANAGEMENT

.1 Separate waste materials for recycling in accordance with Section 01 01 50 General Instructions.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

.1 Read all Divisions of the building specification, Tendering Requirements, Contract Forms, and Conditions of Contract, and Division 1 which contain items affecting Mechanical Work.

.2 If similarity or discrepancies are found between contents of Divisions 21, 22, 23, 25 and Division 1 or other documents stated above, the one with most stringent content shall be applicable.

.3 The Mechanical Work shall consist of the supply and installation of complete and operable systems and shall include all necessary labour, plant, materials, and incidentals for the work involved.

.4 The drawings and specifications are intended to describe complete working systems including all necessary labour and materials. Where items required to complete working system are not specified or shown on drawings, contractor shall include costs at no additional expense to Departmental Representative.

.5 Immediately inform the Departmental Representative, in writing, of all discrepancies, errors, omissions, contradictions and ambiguities during tender stage. The necessary Addendum or bulletin will be issued to all Bidders. Include a complete cross-checking of Drawing and Specifications for sizes and quantities to correspond correctly. Data mentioned in the Specifications and not shown on Drawings, and vice-versa, must be interpreted as part of the Work. Bring obvious discrepancies or omissions to the attention of the Departmental Representative during the Tender Period. Where discrepancies still exist within the documents, contractors shall allow for the more demanding installation or more stringent requirement.

1.2 SUBMITTALS

.1 Submittals: in accordance with Section 01 01 50 – General Instructions.

.2 Shop drawings to show:

- .1 Mounting arrangements.
- .2 Operating and maintenance clearances.

.3 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.

.4 Closeout Submittals:

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 01 50 – General Instructions.

.2 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.

.3 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.

.4 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.

.5 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.

.6 Approvals:

.1 Submit four 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.

.7 Additional data:

.1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

.2 Prepare and insert into each operation and maintenance manual a CD containing electronic copy of approved O&M manual including approved AS BUILT drawings.

.8 Site records:

.1 Departmental Representative will provide 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 reproducible, revising reproduciblep to show work as actually installed.

.3 Use different colour waterproof ink for each service.

.4 Make available for reference purposes and inspection.

.9 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 in CADD with Operating and Maintenance Manuals.

.10 Submit copies of as-built drawings for inclusion in final TAB report.

1.3 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 01 50 – General Instructions.

.2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 33 – Health and Safety Requirements.

1.4 MAINTENANCE

.1 Furnish spare parts in accordance with Section 01 01 50 – General Instructions 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.

.2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 01 50 – General Instructions.

.3 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycle in accordance Section 01 01 50 – General Instructions.

Part 2 Product

2.1 ACCESS DOORS

.1 Provide access doors for maintenance or adjustment purposes for all mechanical system components including:

.1 Valves;

.2 Volume and splitter dampers;

.3 Fire dampers;

.4 Controls, coils and terminal units;

.5 Expansion joints;

.6 Filters;

.7 Strainers

.2 Mark removable ceiling tiles used for access with colour coded dots.

.3 Provide ULC-listed fire rated access doors installed in rated wall and ceilings.

Part 3 Execution

3.1 PAINTING REPAIRS AND RESTORATION

.1 Do painting in accordance with Division 9 - Painting.

.2 Prime and touch up marred finished paintwork to match original.

.3 Restore to new condition, finishes which have been damaged.

3.2 CLEANING

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

3.3 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Section 01 01 50 – General Instructions.

.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 Section 01 01 50 – General Instructions.

.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 Section 01 01 50 – General Instructions.

3.4 DEMONSTRATION

.1 Contractor 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 HVAC Systems

.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 Contractor will record these demonstrations on video tape for future reference. Submit the recording media to Departmental Representative.

3.5 PROTECTION

.1 Protect equipment, pipes and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 23 07 15 - Thermal Insulation for Piping

.2 22 11 16 - Domestic Water Piping

.3 23 21 13.02 – Hydronic Systems Steel

.4 This section applies to all related work under Div. 22 and Div. 23.

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.181Ready-Mixed Organic Zinc-Rich Coating.

.2 National Fire Code of Canada (NFCC 2015)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 01 50 – General Instructions.

.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.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 01 50 – General Instructions and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements:

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse and return of pallets crates padding and packaging materials in accordance with Section 01 01 50 – General Instructions.

Part 2 Products

2.1 MATERIAL

.1 Paint: zinc-rich to CAN/CGSB-1.181-99.

.1 Primers Paints Coating: in accordance with manufacturer's recommendations for surface conditions.

.2 Primer: maximum VOC limit to Standard GS-11.

.3 Paints: maximum VOC limit to Standard GS-11.

.2 Fire Stopping: in accordance with Section 01 01 50 – General Instructions.

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 PIPE TYPE APPLICATIONS

.1 All above ground piping shall be SCH 40 black steel.

3.3 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.

.3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.4 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 of Canada.

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer without interrupting operation of other system, equipment, components.

3.5 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: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.6 AIR VENTS

.1 Install 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.

3.7 DIELECTRIC COUPLINGS

.1 General: compatible with system, to suit pressure rating of system.

.2 Locations: where dissimilar metals are joined.

.3 NPS 2 and under: isolating unions or bronze valves.

.4 Over NPS 2: isolating flanges.

3.8 PIPEWORK INSTALLATION

.1 Install pipework to applicable standard.

.2 Screwed fittings jointed with Teflon tape.

.3 Protect openings against entry of foreign material. Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.4 Assemble piping using fittings manufactured to ANSI standards.

.5 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.

.6 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

.7 Install concealed pipework to minimize furring space, maximize headroom, conserve space.

.8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

.9 Install, except where indicated, to permit separate thermal insulation of each pipe.

.10 Group piping wherever possible.

.11 Ream pipes, remove scale and other foreign material before assembly.

.12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

.13 Provide for thermal expansion as indicated.

.14 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. Use gate or ball valves at branch take-offs for isolating purposes except where specified.

.6 Use chain operators on valves NPS 2 1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.

.15 Check Valves:

.1 Install silent check valves on discharge of pumps and as indicated.

.2 Install swing check valves in horizontal lines on discharge of pumps and as indicated.

3.9 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.

3.10 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.

3.11 PREPARATION FOR FIRE STOPPING

.1 Install firestopping within annular space between pipes, ducts, insulation and adjacent fire separation in accordance with Section 07 84 00 - Fire Stopping.

.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 fires topping material or installation.

.4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

3.12 FLUSHING OUT OF PIPING SYSTEMS

.1 Flush system in accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping.

.2 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 01 50 – General Instructions.

.3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.13 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

.1 Advise Departmental Representative 48 hours minimum prior to performance of pressure tests.

.2 Hydrostatic test heating water piping, to 1400 kPa or 1.5 times the working pressure of final system pressure, whichever higher, which shall hold without pressure drop for a period of not less than 2 hours. Make correction for variations in ambient temperature between start and finish of this test.

.3 Test drains for tightness and grade as required by the local plumbing inspector.

.4 Hydrostatically test domestic water piping to a pressure of 1.5 times operating pressure or at least 120 psi (860 kPa) and maintain test pressure without loss for a minimum of 4 hours.

.5 Test natural gas piping in accordance with local requirements.

.6 Tests shall last at least 4 hours and if leaks develop, these shall be corrected and test repeated in an approved manner and to satisfaction of Inspection Authorities.

.7 Arrange for a potable water purity test. Submit a laboratory report at substantial completion.

.8 Test all backflow preventers and include report in Data Books.

.9 Submit written confirmation of all testing.

.10 Pipework: test as specified in relevant sections.

.11 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.

.12 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

.13 Conduct tests in presence of Departmental Representative.

.14 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.

.15 Insulate or conceal work only after approval and certification of tests by Departmental Representative.

3.14 CLEANING

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 23 21 13.02 - Hydronic Systems Steel

1.2 REFERENCES

.1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)

.1 ANSI/ASME B31.1-2016, Power Piping.

.2 ANSI/ASME B31.3-2016, Process Piping.

.3 ANSI/ASME Boiler and Pressure Vessel Code-2017:

.1 BPVC 2017Section I: Power Boilers.

.2 BPVC 2017Section V: Nondestructive Examination.

.3 BPVC 2017Section IX: Welding and Brazing Qualifications.

.2 American National Standards Institute/American Water Works Association (ANSI/AWWA)

.1 ANSI/AWWA C206-17, Field Welding of Steel Water Pipe.

.3 American Welding Society (AWS)

.1 AWS C1.1M/C1.1-2012), Recommended Practices for Resistance Welding.

.2 AWS Z49.1-2012, Safety in Welding, Cutting and Allied Process.

.3 AWS W1-2015, Welding Inspection Handbook.

.4 Canadian Standards Association (CSA International)

.1 CSA W47.2-11(R2015), Certification of Companies for Fusion Welding of Aluminum.

.2 CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding.

.3 CSA B51-14, Boiler, Pressure Vessel and Pressure Piping Code.

.4 CSA-W117.2-2012, Safety in Welding, Cutting and Allied Processes.

.5 CSA W178.1-2014, Certification of Welding Inspection Organizations.

.6 CSA W178.2-2014, Certification of Welding Inspectors.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 01 50 – General Instructions.

1.4 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 Departmental 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.

.2 Copy of welding procedures available for inspection.

.3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 01 50 – General Instructions.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse and return in accordance with Section 01 01 50 – General Instructions.

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.

.2 Provide welding at outside of building away from air intakes.

3.2 QUALITY OF WORK

.1 Welding: in accordance with ANSI/ASME B31.1 and B31.3, 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.

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 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 Departmental Representative before work is started.

.2 Formulate "Inspection and Test Plan" in co-operation with Departmental 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 Departmental Representative.

.2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.

.3 Inspect and test 100 % of welds in accordance with "Inspection and Test Plan" by non-destructive visual examination.

.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 Departmental Representative.

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:

.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 1500 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 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 Clean in accordance with Section 01 01 50 – General Instructions.

.2 Waste Management: separate waste materials for recycling in accordance with Section 01 01 50 – General Instructions.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 This section applies to all related work under Division 22 and Division 23.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B40.100-2005, Pressure Gauges and Gauge Attachments.

.2 ASME B40.200-2008, Thermometers, Direct Reading and Remote Reading.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-14.4-M88, Thermometers, Liquid-in-Glass, Self-Indicating, Commercial/Industrial Type.

.2 CAN/CGSB-14.5-M88, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.

.3 Efficiency Valuation Organization (EVO)

.1 International Performance Measurement and Verification Protocol (IPMVP)

.1 IPMVP 2016 Version.

.4 Green Seal Environmental Standards (GS)

.1 GS-11-11.Standard for Paints and Coatings.

.2 GS-36-11.Standard for Commercial Adhesives.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance Section 01 01 50 – General Instructions.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for thermometers and pressure gauges and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 01 50 – General Instructions.

.4 Certificates:

.1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 01 50 – General 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 thermometers and pressure gauges indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect thermometers and pressure gauges from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return in accordance with Section 01 01 50 – General Instructions.

Part 2 Products

2.1 GENERAL

.1 Design point to be at mid-point of scale or range.

2.2 DIRECT READING THERMOMETERS

.1 Industrial, variable angle type, mercury-free, liquid filled, 200 mm scale length: to CAN/CGSB-14.4, ASME B40.200.

.1 Resistance to shock and vibration.

2.3 REMOTE READING THERMOMETERS

.1 100 mm diameter mercury-free vapour activated dial type: to CAN/CGSB-14.5 and ASME B40.200. Accuracy within one scale division, brass movement, stainless steel capillary, stainless steel spiral armour, stainless steel bulb and polished stainless steel case for wall mounting.

2.4 THERMOMETER WELLS

.1 Copper pipe: copper or bronze.

.2 Steel pipe: stainless steel.

2.5 PRESSURE GAUGES

.1 112 mm, dial type: to ASME B40.100, Grade 2A, stainless steel bourdon tube having 0.5% accuracy full scale unless otherwise specified.

.2 Provide:

.1 Siphon for steam service.

.2 Snubber for pulsating operation.

.3 Diaphragm assembly for corrosive service.

.4 Gasketted pressure relief back with solid front.

.5 Bronze stop cock.

.6 Oil filled for high vibration applications.

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 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.

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 in locations as indicated and on inlet and outlet of:

.1 Water heating and cooling AHU’s coils.

.3 Install wells as indicated only 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.

.2 Inlet and outlet of AHU’s coils.

.3 In other locations as indicated.

.2 Install gauge cocks.

.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 section, identifying medium.

3.6 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 01 50 – General Instructions.

.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 01 50 – General Instructions.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 01 50 – General Instructions.

.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 SUMMARY

.1 Related Sections

.1 Section 01 01 50 – General Instructions.

.2 Section Includes

.1 Pads, hangers and supports for mechanical piping and equipment.

.3 This section applies to all related work under Division 22 and Division 23.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B31.1-07 - Power Piping, ASME B31.3-06 - Process Piping

.2 ASTM International

.1 ASTM A125-1996 (2007), Standard Specification for Steel Springs, Helical, Heat-Treated.

.2 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.3 ASTM A563-07a, Standard Specification for Carbon and Alloy Steel Nuts.

.3 Factory Mutual (FM)

.4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)

.1 MSS SP58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.

.2 MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.

.3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.

.5 Underwriter's Laboratories of Canada (ULC)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 01 50 – General Instructions.

.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.

.3 Shop Drawings:

.1 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.

1.4 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified Section 01 01 50 – General Instructions.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 01 50 – General Instructions with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements:

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 01 50 – General Instructions.

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.

2.2 GENERAL

.1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP58.

.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.3 PIPE HANGERS

.1 Finishes:

.1 Pipe hangers and supports: galvanized after manufacture.

.2 Use hot dipped galvanizing process.

.3 Ensure steel hangers in contact with copper piping are epoxy coated.

.2 Upper attachment structural: suspension from lower flange of I-Beam:

.1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.

.1 Rod: 13 mm FM approved.

.2 Cold piping NPS 2 1/2 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.

.3 Upper attachment structural: suspension from upper flange of I-Beam:

.1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed and FM approved to MSS SP69.

.2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut FM approved.

.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 FM approved to MSS SP69.

.5 Shop and field-fabricated assemblies:

.1 Trapeze hanger assemblies

.2 Steel brackets

.3 Sway braces for seismic restraint systems

.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.

.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.

.4 Oversize pipe hangers and supports.

.8 Adjustable clevis: material to MSS SP69 FM approved, 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 2 nuts at each end to ASTM A563.

.1 Finishes for steel pipework: galvanized.

.2 Finishes for copper, glass, brass or aluminum pipework: galvanized, with formed portion 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.

.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^3 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 NPS 12 and over, carbon steel to comply with MSS SP69.

2.6 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 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.

2.7 EQUIPMENT SUPPORTS

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel. Submit calculations with shop drawings.

2.8 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

.1 Provide templates to ensure accurate location of anchor bolts.

2.9 PLATFORMS AND CATWALKS

.1 None are required for HVAC equipment

2.10 HOUSE-KEEPING PADS

.1 Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size per manufacturers' instructions; chamfer pad edges.

2.11 OTHER EQUIPMENT SUPPORTS

.1 Fabricate equipment supports from structural grade steel. Submit structural calculations with shop drawings.

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 where applicable with 4 minimum concrete inserts, one 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 Provincial Code and authority having jurisdiction.

.2 Fire protection: to applicable fire code.

.3 Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.

.4 Copper piping: up to NPS 1/2: every 1.5 m.

.5 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.

.6 Within 300 mm of each elbow.

Maximum Pipe Size : NPS	*Maximum Spacing Steel*	*Maximum Spacing Copper*
up to 1-1/4	2.4 m	1.8 m
1-1/2	3.0 m	2.4 m
2	3.0 m	2.4 m
2-1/2	3.7 m	3.0 m
3	3.7 m	3.0 m
3-1/2	3.7 m	3.3 m
4	3.7 m	3.6 m
5	4.3 m	
6	5.0 m	
8	5.0 m	
10	5.0 m	
12	5.0 m	

.7 Pipework greater than 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.

3.5 HORIZONTAL MOVEMENT

.1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.

.2 Where horizontal pipe movement is less than 13 mm, 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 Site Tests: conduct following tests in accordance with Section 01 01 50 – General Instructions.

.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 Section 01 01 50 – General Instructions.

.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 Section 01 01 50 – General Instructions.

3.8 CLEANING

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 01 50 – General Instructions.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Vibration isolation materials and components, seismic control measures and their installation including chiller, pumps, all equipment, and piping system.

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 13- Standard for the Installation of Sprinkler Systems.

.3 National Building Code of Canada (NBC)

1.3 SUBMITTALS

.1 Submittals: in accordance with Section 01 01 50 – General Instructions.

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 – General Instructions. 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 01 50 – General Instructions.

.2 Submit shop drawings in accordance with Section 01 01 50 – General Instructions.

.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 01 50 – General Instructions.

.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.

.3 Manufacturer's Field Reports: manufacturer's field reports specified.

1.4 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 01 50 – General Instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 01 50 – General Instructions.

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

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycle in accordance with Section 01 01 50 – General Instructions.

1.6 WORK INCLUDED

.1 Provide vibration isolation on all motor driven equipment with motors of 0.37 kW (0.5 HP) and greater power output (as indicated on the motor nameplate) and on piping, as specified herein. For equipment less than 0.37 kW, provide neoprene grommets at the support points. Electrical grommets are not acceptable.

.2 Provide seismic restraints for all isolated and non-isolated equipment and piping systems.

.3 Ensure isolators and restraining devices which are factory supplied with equipment meet the requirements of this section. Provide signed and sealed Letter of Assurance as required by this section.

.4 Ensure equipment manufacturers provide attachment points capable of withstanding specified seismic forces.

1.7 DESIGN CRITERIA

.1 Ensure that the minimum distance between adjacent corner isolators is at least equal to the height of the centre of gravity of the equipment. Include height of centre of gravity on shop drawings. Otherwise, design for increased forces on the supports, and submit design calculations with shop drawings for approval.

.2 Ensure isolation systems have a vertical natural frequency no higher than one third of the lowest forcing frequency, unless otherwise specified. Use dynamic stiffness for elastomers and do not exceed 60 durometers.

.3 Design isolators and seismic restraints to meet the structural requirements of the Building Code.

.4 Where integral isolation/snubbing devices do not meet the seismic requirements provide secondary all directional snubbing devices.

.5 Design attachments to both the equipment and the structure to meet the specified forces involved. Have the attachment details to the structure approved by a Professional Engineer registered in British Columbia.

.6 Provide seismic restraints for pipes 65 mm diameter and larger except where the pipe hanger rod length, from attachment to structure to attachment of support hardware (i.e. top of clevis hanger) is less than 305 mm.

.7 Provide seismic restraints for all isolated piping and equipment, regardless of size.

1.8 QUALIFICATIONS

.1 Have all isolation/seismic restraint products tested and certified by an independent testing laboratory, or certified by a registered professional engineer, to demonstrate that the products meet the requirements of this section. If particular tests are carried out to represent an isolator type, the tests shall be valid for the full load range of the isolator. Submit such tests or certification on request.

1.9 DESIGN PROFESSIONAL AND LETTERS OF ASSURANCE

.1 Have the complete and functional seismic restraint system designed and certified by a British Columbia registered professional engineer.

.2 Submit Letters of Assurance for the design Work of this Section, signed and sealed by the design professional engineer.

.3 Have the design professional engineer undertake such field reviews as he or she determines to be necessary to confirm that the construction generally conforms with the design intent.

.4 Submit letters of Assurance of Field Review and Compliance for the design Work of this Section, signed and sealed by the design professional engineer, upon completion of the Work of this Section.

.5 Ensure that Letters of Assurance conform to the standard requirements of the Authority Having Jurisdiction.

1.10 SUBMITTALS

.1 Obtain all relevant equipment information and provide calculations, shop and placement drawings for all vibration isolation elements and steel bases for review before materials are ordered. Provide attachment to both the equipment and the structure meeting the specified forces involved. Have attachment details to the structure approved by a BC registered Professional Engineer.

.2 Submit samples of materials required to complete the work of this section for inspection and review if requested.

.3 Have the vibration isolation vendor provide a full inspection report of isolation/restraint products provided and installed, listing all deficiencies.

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 durometers; 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 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 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 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 Performance: as indicated.

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 degrees 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 Type H4 - stable spring, elastomeric element with pre-compression washer and nut with deflection indicator.

.6 Performance: as indicated.

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 ISOLATORS

.1 Supply all of the vibration isolation equipment from one approved supplier with the exception of isolators which are factory installed and are standard equipment with the machinery. In the latter case have the manufacturer supply certified calculations of the internal restraints as well as certified calculations for anchorage to the structure.

.2 Provide isolators of the following types

.1 Pad Isolators

.1 Neoprene pad isolators, as defined by CAN/CSA-S6. Select pads for a 15% static deflection. Hold down equipment mounted on neoprene pad isolators using anchor bolts, nuts, washers, and hemi-grommets.

.2 Neoprene Floor Isolators

.1 Neoprene-in-shear isolators designed to meet specified seismic requirements. Select isolators for a 5-mm minimum static deflection, and bolt to structure. In the case of rubber isolators, provide protection in the design of the isolator to avoid contact of the rubber element with oil in the mechanical room.

.3 Spring Floor Isolators

.1 Spring mounts, with a minimum 25 mm deflection, complete with levelling devices, and minimum 6 mm thick ribbed neoprene sound pads with 1.3 mm minimum deflection. Design isolator to meet specified seismic requirements and bolt down using neoprene grommets.

.4 Hanger Isolators

.1 Spring hangers within minimum 25 mm deflection, complete with 6 mm thick sound pads sized for 0.5 mm minimum deflection, or neoprene hangers. A neoprene element alone, without a hanger box, is acceptable provided no short-circuiting occurs and equipment rotates above 1170 rpm.

.3 Select isolators at the supplier's optimum recommended loading, and do not load beyond the limit specified in the manufacturer's literature.

.4 Design springs with stiffeners ratio of kx/ky = 1.0 to 1.5 with a working deflection between 0.3 and 0.6 of solid deflection.

.5 Provide hot-dipped galvanized housings and neoprene coated springs, or other acceptable weather protection, for all isolation equipment located out-of-doors or in areas where moisture may cause corrosion.

2.10 FLEXIBLE PIPE CONNECTORS

.1 Install Neoprene of EPDM flexible connectors between vibrating equipment and piping over 65 mm, except those pumps handling domestic water.

2.11 SEISMIC ROD CLAMP

.1 Use seismic rod clamps where the length of the threaded support rod for equipment/pipe/ductwork is over 50 times the rod diameter.

.2 Use 25 mm x 25 mm x 6.4 mm angle for threaded rod size 9.5 to 15.9 mm diameter.

.3 Use 38 mm x 38 mm x 6.4 mm angle for threaded rod size 19 to 32 mm diameter.

.4 Provide rod clamps complete with locking bolt.

2.12 SEISMIC SOLID BRACE FOR NON-ISOLATED EQUIPMENT/PIPING/DUCTWORK

.1 Provide two solid braces at 90E to each other at attachment point, for non-isolated hung equipment, piping, and ductwork.

.2 Use braces complete with formed steel solid brace anchors with two bolts holds for the solid brace and swivel hinge on a support bracket on each end of the brace.

2.13 MECHANICAL EQUIPMENT ANCHORS

.1 Anchors shall be provided by vibration isolation/seismic restraint supplier. The responsibility for the seismic restraint of resiliently mounted equipment, from attachment to structure to point of attachment to equipment, is that of the vibration isolation/seismic restraint supplier.

2.14 EPOXY PUTTY

.1 Steel reinforced epoxy putty with an ultimate compressive strength of 82,700 kPa.

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 Seismic control measures to meet requirements of NBC.

.2 Install vibration isolation equipment in accordance with manufacturer's instructions and adjust mountings to level equipment.

.3 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.

.4 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 NPS4: first 3 points of support. NPS5 to NPS8: first 4 points of support. NPS10 and Over: first 6 points of support.

.2 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.

.5 Where isolation is bolted to floor use vibration isolation rubber washers.

.6 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.

.7 Chiller CH-1 is to be mounted on seismic spring isolators with 65 mm static deflection.

3.3 ISOLATORS

.1 Execute the work in accordance with the specifications, and where applicable, in accordance with the manufacturer's instructions and only use workmen experienced in this type of work.

.2 For all equipment mounted on vibration isolators, provide a minimum clearance of 50 mm to other structures, piping, equipment, and similar items.

.3 Isolate all floor or pier mounted equipment on spring floor isolators, unless otherwise specified.

.4 Isolate pumps and axial fans rotating at more that 1170 RPM on neoprene floor isolators. Use the lowest RPM scheduled for two speed equipment in determining isolator deflection.

.5 Before bolting isolators to the structure, start equipment and balance the systems so that the isolators can be adjusted to the correct operating position before installing seismically rated drilled inserts.

.6 For equipment mounted on a slab on grade, chillers and in-line pumps, mount on neoprene floor isolators, unless otherwise specified.

.7 For all electrical connections to isolated equipment, provide a 90° bend of flexible conduit for 25 mm conduit and smaller or 90° Crouse-Hind EC couplings for larger conduit. Use connections long enough so that the conduit will remain intact if the equipment moves laterally 300 mm from the installed position, and flexible enough to transmit less vibration to the structure than is transmitted through the springs.

.8 Select Spring Hangers for a minimum static deflection of 25 mm for all ceiling hung fans, and air handling units, and any other vibrating sources.

.9 Provide Spring Hangers on all piping, tanks, etc. connected to a vibrating source, if the piping is in excess of 40 mm dia. Provide the hangers for a distance of 6.5 m for a 50-mm pipe and 11.5 m for a 250 mm pipe. Isolate other pipe sizes for a proportionate distance. Isolate all piping in mechanical rooms. If neoprene hangers are proposed for non-critical spaces, change to spring hangers at no additional cost in the event that the isolation proves inadequate.

.10 Where piping connected to noise generating equipment is routed from the mechanical room through walls and plumbing chases, position piping to avoid contact with the concrete structure, future framing, drywall and other finishes which may radiate noise.

3.4 EQUIPMENT INSTALLATION

.1 Bolt all equipment to the supporting structure. Do not bridge isolation elements.

3.5 NON-ISOLATED HANGING SYSTEM

.1 Follow the Seismic Restraint Manual Guidelines for Mechanical systems published by SMACNA in the selection of the appropriate diameter of threaded rod for the associated load at each attachment point. Use the next largest size of rod if any doubt exists.

.2 Wherever possible keep piping, ducting and equipment within 300 mm of the structure (i.e. top of pipe/duct or equipment to the attachment point at underside of structure). Intermediate points may exceed this 300-mm rule but a consecutive 300 mm attachment must occur with 9 m for ducting and 12 m for piping. No further seismic restraint is required if these parameters are met and all threaded rods at restraint points exceed 6.3 mm diameter.

.3 Piping/ducting may be attached to walls and require no further restraint as long as it is attached within 300 mm of that wall.

.4 Use pipe riser clamps wherever possible on piping without thermal expansion, instead of clevis hangers.

.5 Trapeze parallel runs of piping/ducting except those pipes where thermal expansion is expected. Attach pipes to trapeze with "U" bolts. Where pipes are of different diameter, set the bottom of all pipes on the same horizontal plane, to accommodate attachment to the trapeze.

.6 Anchor ducts to trapezes at flange locations.

.7 Anchor pipes without thermal expansion penetrating structural walls to the wall at the point of penetration.

.8 Anchor ducts penetrating walls to the wall at the point of penetration.

.9 Place piping closer to the structural ceiling than ductwork, except where maintenance prone valves or other devices are installed in the piping.

.10 Set the minimum distance from drill holes to the edge of the concrete or adjacent drill holes as recommended by the manufacturer of the drill inserts.

.11 Place seismic bracing or cables for ductwork within 600 mm, in both directions from every turn on jog, then:

.1 space the transverse bracing at 9 m intervals;

.2 space the longitudinal bracing at 18 m intervals.

.12 Place seismic bracing or cables for pipes within 600 mm, in both directions from every turn or jog, then:

.1 space the transverse bracing at 12 m intervals;

.2 space the longitudinal bracing at 24 m intervals.

.13 Include anchored wall penetrations when calculating the 9/18 and 12/24 bracing spacings to determine the number of transverse and axial restraints required.

.14 Install the required restraints equidistantly between corner and penetration anchor points.

3.6 ANCHORING RIGIDITY

.1 Maximum air gap between anchor bolt and restraint housing anchor hole shall not exceed 3 mm.

.2 If the air gap exceeded 3 mm, the clearance must be reduced by hemi-grommets (where the bolt is concentric with the hole) or epoxy putty.

.3 Follow manufacturer's instructions to hand knead the 0.5 fast epoxy putty and fill the entire gap between the bolt hole and the anchor bolt.

3.7 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 Departmental Representative within 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.

.2 Provide Departmental Representative with notice 24 h in advance of commencement of tests.

.3 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations (including sound curves).

.4 Submit complete report of test results including sound curves.

3.8 CLEANING

.1 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 SUMMARY

.1 Section Includes:

.1 Materials and requirements for the identification of piping systems, duct work, valves and controllers, including the installation and location of identification systems.

.2 This section applies to all related work under Division 22 and Division 23.

1.2 REFERENCES

.1 Canadian Gas Association (CGA)

.1 CSA/CGA B149.1-15, Natural Gas and Propane Installation Code.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.

.2 CAN/CGSB-24.3-92, Identification of Piping Systems.

1.3 SUBMITTALS

.1 Product Data:

.1 Submittals: in accordance with Section 01 01 50 – General Instructions.

.2 Product data to include paint colour chips, other products specified in this section.

.2 Samples:

.1 Submit samples in accordance with Section 01 01 50 – General Instructions.

.2 Samples to include nameplates, labels, tags, lists of proposed legends.

1.4 QUALITY ASSURANCE

.1 Quality assurance submittals: submit following in accordance with Section 01 01 50 – General Instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 01 50 – General Instructions.

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

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 01 50 – General Instructions.

.2 Dispose of unused paint coating material at official hazardous material collections site approved by Departmental Representative.

.3 Do not dispose of unused paint material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

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, 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 EXISTING IDENTIFICATION SYSTEMS

.1 Apply existing identification system to new work.

.2 Where existing identification system does not cover for new work, use identification system specified this section.

.3 Before starting work, obtain written approval of identification system from Departmental Representative.

2.4 PIPING SYSTEMS GOVERNED BY CODES

.1 Identification:

.1 Natural gas: to CSA/CGA B149.1 and authority having jurisdiction.

.2 Sprinklers: to NFPA 13.

.3 Standpipe and hose systems: to NFPA 14.

2.5 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 vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees 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
Condenser water loop supply	Green	COND. WTR. LOOP SUPPLY
Condenser water loop return	Green	COND. WTR. LOOP RETURN
Chilled water supply	Green	CH. WTR. SUPPLY
Chilled water return	Green	CH. WTR. RETURN
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
Exhaust coil heating supply	Yellow	EXHAUST COIL SUPPLY
Exhaust coil heating return	Yellow	EXHAUST COIL RETURN
Fluid cooler supply	Green	FC SUPPLY
Fluid cooler return	Green	FC RETURN
Air handling unit supply	Yellow	AHU SUPPLY
Air handling unit return	Yellow	AHU RETURN
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

Contents	*Background colour marking*	*Legend*
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Natural gas	to Codes	
Fire protection water	Red	FIRE PROT. WTR
Sprinklers	Red	SPRINKLERS

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 this section.

.2 Inscriptions to include function and (where appropriate) fail-safe position.

2.8 LANGUAGE

.1 Identification in English.

.2 Use one nameplate and label.

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 Division 9 - 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 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.

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 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 copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Departmental Representative. Provide one copy reduced in size if required in each operating and maintenance manual.

.3 Number valves in each system consecutively.

3.7 CLEANING

.1 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 SUMMARY

.1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.

.2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 QUALIFICATIONS OF TAB PERSONNEL

.1 Submit names of personnel to perform TAB to Departmental Representative within 30 days of award of contract.

.2 Provide documentation confirming qualifications, successful experience.

.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 2016.

.2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-2015.

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-2002.

.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, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.3 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.

1.4 EXCEPTIONS

.1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.

1.5 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.

1.6 PRE-TAB REVIEW

.1 Review contract documents before project construction is started and confirm in writing to Departmental 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 Departmental 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.

1.7 START-UP

.1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.

.2 Follow special start-up procedures specified elsewhere in Division 23.

1.8 OPERATION OF SYSTEMS DURING TAB

.1 Operate systems for length of time required for TAB and as required by Departmental Representative for verification of TAB reports.

1.9 START OF TAB

.1 Notify Departmental Representative 7 days prior to start of TAB.

.2 Start TAB when building is essentially completed, including:

.3 Installation of ceilings, doors, windows, other construction affecting TAB.

.4 Application of weatherstripping, sealing, and caulking.

.5 Pressure, leakage, other tests specified elsewhere Division 23.

.6 Provisions for TAB installed and operational.

.7 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 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.

1.10 APPLICATION TOLERANCES

.1 Do TAB to following tolerances of design values:

.1 Hydronic systems: plus or minus 5 %.

1.11 ACCURACY TOLERANCES

.1 Measured values accurate to within plus or minus 2 % of actual values.

1.12 INSTRUMENTS

.1 Prior to TAB, submit to Departmental 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 3 months of TAB. Provide certificate of calibration to Departmental Representative.

1.13 SUBMITTALS

.1 Submit, prior to commencement of TAB:

.2 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.14 PRELIMINARY TAB REPORT

.1 Submit for checking and approval of Departmental 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.

1.15 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 6 copies of TAB Report to Departmental Representative for verification and approval, in English in D-ring binders, complete with index tabs.

1.16 VERIFICATION

.1 Reported results subject to verification by Departmental Representative.

.2 Provide personnel and instrumentation to verify up to 30 % of reported results.

.3 Number and location of verified results as directed by Departmental Representative.

.4 Pay costs to repeat TAB as required to satisfaction of Departmental Representative.

1.17 SETTINGS

.1 After TAB is completed to satisfaction of Departmental 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.

1.18 COMPLETION OF TAB

.1 TAB considered complete when final TAB Report received and approved by Departmental Representative.

1.19 AIR / WATER SYSTEMS

.1 Standard: TAB to most stringent of this section or TAB standards of AABC SMACNA and ASHRAE.

.2 Do TAB of systems, equipment, components, controls including but not limited to the following:

.1 HVAC Systems

.3 Qualifications: personnel performing TAB current member in good standing of AABC qualified to standards of AABC.

.4 Quality assurance: perform TAB under direction of supervisor qualified to standards of AABC.

.5 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop, temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.

.6 Locations of equipment measurements: to include as appropriate:

.1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.

.2 At controllers, controlled device.

.7 Locations of systems measurements to include as appropriate.

1.20 OTHER TAB REQUIREMENTS

.1 General requirements applicable to work specified this paragraph:

.1 Qualifications of TAB personnel: as for air and water systems specified this section.

.2 Quality assurance: as for air and water systems specified this section.

.2 Measurement of noise and vibration from equipment specified in Division 23.

.3 Smoke management

.1 Test for proper operation of all fire dampers, installed as a component port of air system specified in Division 23.

.2 Test for proper operation of duct smoke and fire detectors installed in air handling unit systems.

1.21 POST-OCCUPANCY TAB

.1 Participate twice in system checks during warranty period 3 months after acceptance and within 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 SUMMARY

.1 Section Includes:

.1 Thermal insulation for piping and piping accessories in commercial type applications.

.2 This section apples to all related work under Division 23.

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ASHRAE Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).

.2 American Society for Testing and Materials International (ASTM)

.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 Horizontal 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 C533, Calcium Silicate Block and Pipe Thermal Insulation.

.6 ASTM C547, Mineral Fiber Pipe Insulation.

.7 ASTM C795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.8 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.

.2 CAN/CGSB-51.53, Poly (Vinyl Chloride) Jacketting Sheet, for Insulated Pipes, Vessels and Round Ducts

.4 Department of Justice Canada (Jus) Canadian Environmental Assessment Act (CEAA), 2012, c. 37.

.1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.

.2 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.6 Manufacturer's Trade Associations

.1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).

.7 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.

1.3 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.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals: in accordance with Section 01 01 50 – General Instructions.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 – General Instructions. 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 01 50 – General Instructions.

.3 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 01 50 – General Instructions.

.4 Samples:

.1 Submit samples in accordance with Section 01 01 50 – General Instructions.

.2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix label beneath sample indicating service.

.5 Quality assurance submittals: submit following in accordance with Section 01 01 50 – General Instructions.

.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.

1.5 QUALITY ASSURANCE

.1 Qualifications:

.2 Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, qualified to standards

.3 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 01 50 – General Instructions.

1.6 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 01 50 – General Instructions.

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

.3 Deliver materials to site in original factory packaging, labelled 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 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 01 50 – General Instructions.

.2 Place excess or unused insulation and insulation accessory materials in designated containers.

.3 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.

.4 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 CAN/ULC-S702.

.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.

.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 CAN/ULC-S702.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to CAN/ULC-S702.

2.3 INSULATION SECUREMENT

.1 Tape: self-adhesive, aluminum, 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, 19mm 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/m5.

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: by Departmental Representative.

.3 Minimum service temperatures: -20 degrees C.

.4 Maximum service temperature: 65 degrees C.

.5 Moisture vapour transmission: 0.02 perm.

.6 Thickness: 0.5 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 Outdoor: UV rated material at least 0.5 mm thick.

.2 ABS Plastic:

.1 One-piece moulded type and sheet with pre-formed shapes as required.

.2 Colours: by Departmental Representative.

.3 Minimum service temperatures: -40 degrees C.

.4 Maximum service temperature: 82 degrees C.

.5 Moisture vapour transmission: 0.012 perm.

.6 Thickness: 0.75 mm.

.7 Fastenings:

.1 Solvent weld adhesive compatible with insulation to seal laps and joints.

.2 Tacks.

.3 Pressure sensitive vinyl tape of matching colour.

.8 Locations:

.1 For outdoor use ONLY.

.3 Canvas:

.1 220 gm/m5 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.2 Lagging adhesive: compatible with insulation.

.4 Aluminum:

.1 To ASTM B209.

.2 Thickness: 0.50 mm sheet.

.3 Finish: stucco embossed.

.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, 0.5mm thick at 300 mm spacing.

.5 Stainless steel:

.1 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, 0.5mm thick at 300 mm spacing.

2.9 WEATHERPROOF MEMBRANE FOR INSULATION INSTALLED OUTDOORS

.1 Prefabricated, self-adhering, sheet-type waterproofing membrane: FlexClad-400 or approved alternative.

.1 Description:

.1 Top Layer: Stucco-embossed, UV-resistant aluminum weathering surface.

.2 Middle Layer: Double layer of high-density polyethylene reinforcement.

.3 Bottom Layer: Uniform layer of rubberized Caulking.

.2 Heat Aging, No visible blistering or deterioration.

.3 Tear Resistance, ASTM D 1424, Average: 660 grams.

.4 Elongation, ASTM D 412, Minimum: 450 percent.

.5 Low Temperature Flexibility, 1,000,000 cycles at –10°F, 1,200 cycles at –20°F: No cracking.

.6 Water Vapor Transmission, ASTM E 96: 0.009 perms.

.7 Flame Spread Index, ASTM E 84: 0.

.8 Smoke Density Index, ASTM E 84: 5.

.9 Wind-Driven Rain, SFBC TAS-110-95, 100 mph: No leakage or failure.

.10 UV Stability: Excellent.

.2 Application: All insulated pipework exposed to outdoors.

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 manufacturer’s instructions and this specification. Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.

.3 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Install hangers, supports outside vapour retarder jacket.

.4 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, valve, primary flow measuring elements flanges and unions at equipment.

.2 Design: to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

.3 Insulation:

.1 Insulation, fastenings and finishes: same as system.

.2 Jacket: aluminum SS PVC ABS.

3.5 INSTALLATION OF ELASTOMERIC INSULATION

.1 Insulation to remain dry. Overlaps to manufacturer’s 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.TIAC Code: A-1.

.1 Securements: bands Tape at 300 mm on centre.

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code 1501-H.

.2 TIAC Code: A-3.

.1 Securements: bands at 300 mm on centre.

.2 Seals: VR lap seal adhesive, VR lagging adhesive.

.3 Installation: TIAC Code: 1501-C.

.3 TIAC Code: A-6.

.1 Insulation securements

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code

.4 TIAC Code: C-2 with vapour retarder jacket.

.1 Insulation securements

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code: 1501-C.

.5 TIAC Code: A-2.

.1 Insulation securements:

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code: 1501-H.

.6 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<1 ½*	*1 ½ <4*	*4 to<8*	*8 & over*
Hot Water Heating	60-94	A-1	25	38	38	50	50	50
Hot Water Heating	up to 59	A-1	25	25	25	38	38	38
Refrigerant Hot Gas Liquid Suction & Chilled Water & Brine	4-16	A-6	25	25	25	25	25	25
Refrigerant Hot Gas Liquid Suction & Chilled Water & Brine	below 4	A-6	25	25	25	38	38	38
Cooling Coil Condensate Drain		C-2	25	25	25	25	25	25

.7 Finishes:

.1 Exposed indoors: PVC jacket to match existing..

.2 Exposed in mechanical rooms: PVC jacket to match existing.

.3 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.

.4 Outdoors: water-proof aluminum jacket.

.5 Finish attachments: SS bands at 150 mm on centre. Seals: closed.

.6 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.7 CLEANING

.1 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 REFERENCES

.1 Section 01 01 50 – General Instructions

.2 Section 01 91 00 – Commissioning

.3 Section 26 05 00 – Common Work

1.2 GENERAL COMMISSIONING CONCEPT AND COMMISSIONING PLAN

.1 Commissioning Agent being hired by Contractor.

.2 The Commissioning as applied to buildings is the process of bringing a building into use concluding all activities directed to that end, and including equipment as well as staffing involved in the subject facility.

.3 Verification, as related to the Mechanical, Electrical and Specialty systems installed in the building, represents the process of proving the performance of the equipment as defined in the technical specifications.

.4 Departmental Representative shall retain and pay for Commissioning Authority, which manages and oversees the commissioning process.

.5 The Commissioning Plan (provided by the Commissioning Authority):

.1 Identifies the role of each participant in the Commissioning Process and maps out both overall and phase-specific strategies for the project.

.2 Describes the procedures for verification of each system.

.6 The Commissioning Process covers the full life cycle of the project from the initial planning activities through to the point where that facility is in full operation and in full compliance with predefined user, operator, design and contract requirements.

.7 The Commissioning Process includes the following five major components:

.1 Thorough documentation and monitoring of all facets of construction.

.2 Extensive tests of all subsystems, their components and controls.

.3 Testing of whole systems that include a multiple of subsystems.

.4 Specific and detailed training on all major equipment for operational personnel.

.5 Ongoing monitoring and checking during the warranty period.

1.3 OBJECTIVES

.1 Support quality management through monitoring and checking of the installation.

.2 Verify systems performance through inspection and performance testing of the completed installation.

.3 Move the completed facility from the "static completion" state to the optimal "dynamic" operating state.

.4 Optimize operating and maintenance through delivery of comprehensive quality training and instruction to the CBSA's operating personnel.

.5 System debugging and optimization.

.6 Completion of training and instruction for the operating and maintenance personnel.

.7 Assure provision of accurate and useful historical records, such as "as-built drawings", test certificates etc. Such records provide important data for operating and maintaining the systems as well as for future system testing, maintenance or renovations.

.8 Completion of testing and verification through seasonal review.

.9 Specifically, the Commissioning Process shall deliver to the Departmental Representative:

.1 A complete set of documentation on the design intent and maintenance requirements of each system involved in the commissioning process.

.2 A system that functions in accordance with the design intent.

.3 Operators who fully understand the design intent and the operation and maintenance requirements of the equipment.

1.4 CONTRACTOR'S RESPONSIBILITIES

.1 Start-up Phase

.1 Ensures that start-up program is implemented in accordance with the facility start-up requirements within the contract documents.

.2 Following start-up, which may be observed by the CBSA/Departmental Representative/Commissioning Authority, and must therefore be pre-scheduled, begins Performance Testing under conditions which simulate varying load and all operating modes, including emergency modes of operation.

.3 Following contractor's thorough testing, schedules, and performs verification-related tasks in the presence of the Commissioning Authority.

.2 Post-Construction Phase

.1 Post construction commissioning is the continued adjustment, optimization and modification of the systems to meet specified requirements. It includes updating documentation to reflect minor set point adjustments, system maintenance and calibration, major system modifications and provision of ongoing training of operation and maintenance personnel.

.2 The objective of post construction phase commissioning is to maintain the performance of the systems throughout the useful life of the facility in accordance with the current design intent.

.3 Complete all commissioning procedures, activities, and performance verification, which were delayed or not executed during the construction phase.

.4 Executes system checks with the CBSA/Departmental Representative/Commissioning Authority:

.1 Once during the first month of building operation.

.2 Once during the third month of building operation.

.3 Once between the fourth and tenth months in a season opposite to the first or third month visit.

.5 Completes rectification of all deficiencies revealed by the above checks.

.6 Revises all as-builts and operating and maintenance documents to reflect all changes, modifications, revisions and adjustments upon completion of commissioning.

1.5 Standard of acceptance

.1 Commissioning Agent services shall be performed by a separate independent company.

.2 Standard of acceptance:

.1 K.D. Engineering.

.2 Western Mechanical.

.3 Design Intent

Part 2 Products

2.1 COMMISSIONING INVOLVEMENT

.1 The Commissioning Authority shall direct, witness and verify equipment performance testing. Accordingly, the Contractor and/or his suppliers and/or his Independent Third Party Commissioning Agents shall perform the following:

.1 Check and ensure the installation of the systems and equipment to ensure that the installation is complete, is in a proper and safe state, has been pre-tested to ensure all complete and proper operation, and is ready for verification.

.2 Run and test the systems and equipment through their design parameters to verify their capabilities in performance, sequencing, safety protection and alarms annunciation.

2.2 SYSTEMS TO BE COMMISSIONED

.1 Mechanical systems shall include, but are not limited to, the following (Refer to Division 1 – General Commissioning (Cx) requirements):

.1 Hydronic heating systems.

.2 Air distribution systems.

.3 Direct expansion (DX) cooling / heating systems.

.4 Control systems.

2.3 TESTING EQUIPMENT

.1 The Contractor shall provide all instrumentation and test equipment necessary to conduct the tests specified during the commissioning process.

2.4 DOCUMENTATION

.1 Contractor shall record all test results and procedures on approved record forms, and submit the forms together with copies of test certificates to Departmental Representative and Commissioning Authority for review and approval.

.2 When the results are verified, the Commissioning Agent shall incorporate those records in his Systems Operations Manual. He shall also make entry of those test results into appropriate sections of the Operating and Maintenance Manual for reference.

Part 3 Execution

3.1 COMMISSIONING PROCESS

.1 Perform and complete all works as specified in the Mechanical specifications. In general, it shall include complete activation of all systems; calibration; testing; verification of performance of all components, equipment and systems; verification of performance of all systems through all specified modes of control and sequences of operation, recording of test results for submission; demonstration, instruction and training of CBSA operating and maintenance personnel; and follow-up during the first year of operation for fine tuning and monitoring purposes.

.2 Advise the CBSA/Departmental Representative/Commissioning Authority at least 3 days in advance of any test.

.3 Complete the testing form provided by the Commissioning Authority for each test, and submit copies to the Departmental Representative and Commissioning Authority.

3.2 TESTING OF MECHANICAL SYSTEMS – ADDITIONAL REQUIREMENTS

.1 Plumbing and Drainage System Testing

.1 The plumbing and drainage system shall be tested in accordance with the Plumbing Code under the National Building Code.

.2 The Contractor shall notify the Building Inspector when systems are available for testing. The Contractor shall document all tests performed and shall arrange for the Building Inspector to witness tests completed.

.3 Also perform hydrostatic pressure test for domestic hot and cold water systems.

.2 Water Treatment/Flushing of New Piping

.1 The Specialist shall complete the Manufacturers' testing forms and submit a report to the Departmental Representative and Commissioning Agent.

.2 The Specialist shall assist the Contractor in cleaning all new piping systems. The Specialist shall take samples and repeat the cleaning process if the specification requirements are not met.

.3 The specialist shall provide:

.1 Initial water analysis and treatment recommendations

.2 Start-up assistance

.3 All necessary laboratory services and technical assistance required

.4 During circulation of cleaning solutions, periodically examine and clean filters and screens and measure and monitor changes in pressure drop across equipment.

.5 The specialist shall revisit the site after one month of operation of each system and re-test the systems, and provide a report to the Departmental Representative and Commissioning Authority.

.6 Where multiple cut-ins are required into an existing system, the Specialist shall repeat the above steps, and report after the completion of each cut-in.

.3 Fire Protection

.1 The Contractor shall hydrostatically test the systems as per the specification and NFPA requirements to meet all certifications. The test shall be witnessed by the Departmental Representative and/or the Commissioning Authority. Provide a copy of the report in NFPA 13 and 14 reporting format for all such tests to the Commissioning Authority.

.2 The Contractor shall obtain approval certificates from the Authorities having Jurisdiction and submit copies of the certificates to the Commissioning Agent and Commissioning Authority for review.

.4 Piping Systems (Hydronic Circulation)

.1 Before testing, ensure that all installed valves and equipment are accessible for servicing and replacement, as per manufacturer's recommendations.

.2 Test all piping systems in accordance with all applicable Plumbing Codes.

.3 All other systems not covered by Codes noted above shall be tested and proven tight over a period of four (4) hours by a hydrostatic test. Remove fixtures, appliances, devices, vents and gauges and temporarily plug connections, as required. Provide temporary bypass when required.

.4 Repair any leaks or defects and repeat the tests to the satisfaction of the Departmental Representative.

.5 Complete the testing forms and forward copies of the test reports to the Departmental Representative and Commissioning Authority.

.6 After testing, TAB contractor shall measure the water flow at each existing reheat coil via the existing circuit setters. Submit report to the Departmental Representative and Commissioning Agent for review.

.7 The Contractor shall co-ordinate with the TAB Contractor and provides assistance during the balancing process. Review the complete installation with the balancing contractor, and provide a report stating that all systems can be balanced by the balancing contractor as per the design. Any concerns or discrepancies must be highlighted to the Departmental Representative and Commissioning Authority prior to installation. Notify the Departmental Representative and Commissioning Authority in writing that this coordination has taken place before installation begins. Additional costs related to the lack of proper type or location of balancing devices will be borne by the Contractor.

3.3 COMMISSIONING MEETINGS AND REPORTING

.1 The Contractor shall include all responsibilities noted in the commissioning specifications, including all tests, within his construction schedule.

.2 The commissioning meetings, as required by the Commissioning Authority, shall follow the regular construction meetings. The testing schedules and results of all tests shall be reviewed.

.3 All testing forms and reports associated with the mechanical systems shall be directed to the Commissioning Authority with copies to the Departmental Representative.

.4 The forms and reports to be issued shall include:

.1 Reviewed shop drawings

.2 Equipment verification/data forms

.3 Testing forms

.4 Reports resulting from tests

.5 Testing schedule

3.4 OPERATING AND MAINTENANCE MANUAL

.1 The Contractor shall prepare and submit the Operating and Maintenance Manual as detailed in the specification Section 01 01 50 – General Instructions.

.2 The Contractor shall re-submit the manual should the Departmental Representative find deficiencies. Training shall not begin until the manual has been accepted by the Departmental Representative.

.3 One (1) copy of the manual shall be forwarded to the Commissioning Authority in good quality, vinyl covered binders at the time of submission to the Departmental Representative. Four (4) final hard copies and 3 digital final copies of the manuals (after incorporating the Departmental Representative/Commissioning Authority comments) shall be submitted to the Commissioning Authority in 75mm (3") D-ring white vinyl covered binders with transparent sleeve.

.4 Each mechanical manual shall be organized as follows, but not limited to the following:

.1 Project Directory

.2 Plumbing

.3 Fire Protection

.4 Heating and cooling

.5 Ventilation

.6 Energy Monitoring and Controls System

.5 The project directory shall contain the names, addresses, fax numbers and telephone numbers of Contractors, Sub-Contractors, Manufacturers and Manufacturers representatives.

.6 Sections 3.4.4.2 to 3.4.4.6 noted above shall be divided into the following sub-sections.

.1 Shop drawings (reduced to 8½" x 11")

.2 As-built drawings (reduced to 8½" x 11")

.3 As-built riser diagrams (reduced to 8½" x 11")

.4 Systems description

.5 Operating procedures

.6 Maintenance procedures

.7 Trouble shooting guide;

.8 Valve chart (where applicable)

.9 Filter size chart (where applicable)

.10 Equipment lists

.11 Testing and verification forms

.12 Certification forms

.7 Systems description shall be a detailed description of each major component, describing the intent, function, operational modes, and any information that may be pertinent to day-to-day operation.

.8 The operating procedures, maintenance procedures, spare parts list, and troubleshooting guide shall be as recommended by the Manufacturer.

.9 The equipment list shall include make, model, serial number, electrical characteristics, RPM, pump impeller sizes, fan belt and sheave sizes.

3.5 DEMONSTRATION AND OPERATOR TRAINING

.1 Systems' demonstration shall be conducted by the Contractor. The demonstration shall cover all operation and maintenance requirements and a physical demonstration of equipment installation and operation.

.2 CBSA demonstration shall include a walk-through of the building by the Contractor. During the walk-through, the Contractor shall:

.1 Identify equipment

.2 Identify starters associated with equipment

.3 Identify valves and balancing dampers

.4 Identify access doors

.5 Review general maintenance of equipment

.6 Review drain points in pipe work systems

.7 Identify maintenance items

.3 The Contractor and equipment Manufacturer shall provide operator training for each mechanical system and item of equipment.

.4 Training and instruction shall be provided by qualified Technicians and shall be conducted in a classroom setting and at the equipment or system.

.5 Training and instruction will begin after the Operating and Maintenance manual has been approved and delivered to the Departmental Representative.

.6 Each session shall be structural to cover.

.1 The operating and maintenance manual

.2 System description

.3 Operating procedures

.4 Maintenance procedures

.5 Trouble shooting procedures

.6 The Manufacturer's or Service Representative's name, address and telephone number

.7 Provide course documentation for up to six (6) people.

.8 Training and instruction shall be provided for the following systems wherever applicable:

.1 Life Safety & Fire Protection Systems

.2 Heating and Cooling Systems

.3 Building Automation & Controls Systems.

.4 Mechanical Systems

.5 Ventilation Systems

.9 Time Allocation

.1 The time allocation for various CBSA training sessions is not predetermined. The agenda for training sessions will be outlined and agreed upon with the mechanical contractor and commissioning authority through the commissioning program to ensure the CBSA staff receives adequate training.

3.6 TESTING FORMS

.1 The Contractor and Manufacturer shall provide testing and commissioning forms for review and acceptance.

.2 Mechanical testing and verification forms shall include, but are not limited to, the following:

.1 Equipment test form

.2 Piping pressure test form

.3 Test identification form

.4 Chemical treatment data sheet

.5 Fan data sheet

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Procedures and cleaning solutions for cleaning mechanical piping systems.

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM)

.1 ASTM E202-00, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 – General Instructions. Include product characteristics, performance criteria, and limitations.

1.4 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 33 – Health and Safety requirements.

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 01 50 – General Instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal in accordance with Section 01 01 50 – General Instructions.

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 SYSTEMS

.1 Timing: systems operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.

.2 Cleaning Agency:

.1 Contract with existing Chemical Treatment Company under existing facility maintenance contract.

.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 h. 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. Circulate for 12 h, 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 h 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).

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 Commission water treatment systems as specified in Section 23 25 00 - HVAC Water Treatment Systems.

.7 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.

.8 Repeat with water at design temperature.

.9 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.

.10 Bring system up to design temperature and pressure slowly over a 48 hour period.

.11 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing system.

.12 Adjust pipe supports, hangers, springs as necessary.

.13 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.

.14 If sliding type expansion joints bind or if bellows type expansion joints flex incorrectly, shut down system, re-align, repeat start-up procedures.

.15 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.

.16 Check operation of drain valves.

.17 Adjust valve stem packings as systems settle down.

.18 Fully open balancing valves (except those that are factory-set).

.19 Check operation of over-temperature protection devices on circulating pumps.

.20 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

3.4 CLEANING

.1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment, in accordance with Section 01 01 50 – General Instructions.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 01 01 50 – General Instructions

.2 23 05 00 – Common Work Results for HVAC

.3 23 05 05 – Installation of Pipework

.4 23 05 17 – Pipe Welding

.5 23 05 48 – Vibration and Seismic Control for HVAC Piping and Equipment

1.2 REFERENCES

.1 American National Standards Institute/American Water Works Association (ANSI/AWWA)

.1 ANSI/AWWA C111/A21.11-17, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.2 American Society of Mechanical Engineers (ASME)

.1 ANSI/ASME B1.20.1-2-13, Pipe Threads, General Purpose (Inch).

.2 ASME B16.1-15, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

.3 ASME B16.3-16, Malleable Iron Threaded Fittings: Classes 150 and 300.

.4 ASME B16.5-17, Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.

.5 ASME B16.9-12, Factory-Made Wrought Buttwelding Fittings.

.6 ANSI/ASME B16.25, Buttwelding Ends.

.7 ANSI/ASME B16.34, Valves - Flanged, Threaded and Welding Ends.

.8 ASME B18.2.1-12, Square Hex, Heavy Hex and Askew Head Bolts and Hex, Heavy Hex, Hex Flange. Loded Head and Lag Screws (Inch Series).

.9 ASME B18.2.2-15, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).

.3 ASTM International

.1 ASTM A49, Standard Specification for Heat-Treated Carbon Steel Joint Bars.

.2 ASTM A126, Standard Specification for Grey 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 A276, Standard Specification for Stainless Steel Bars and Shapes.

.6 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.

.7 ASTM B283, Standard Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).

.8 ASTM B505/B505M, Standard Specification for Copper-Base Alloy Continuous Castings.

.9 ASTM A47/A47M-99(2014), Standard Specification for Ferritic Malleable Iron Castings.

.10 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.

.11 ASTM A536-84(2014), Standard Specification for Ductile Iron Castings.

.12 ASTM B61-15, Standard Specification for Steam or Valve Bronze Castings.

.13 ASTM B62-17, Standard Specification for Composition Bronze or Ounce Metal Castings.

.4 CSA Standards

.1 CSA B242-05(R2016), Groove and Shoulder Type Mechanical Pipe Couplings.

.2 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.

.5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS)

.1 MSS-SP-25, Standard Marking System for Valves, Fittings, Flanges and Unions.

.2 MSS-SP-67-2017, Butterfly Valves.

.3 MSS-SP-70-11, Gray Iron Gate Valves, Flanged and Threaded Ends.

.4 MSS-SP-71-11, Gray Iron Swing Check Valves Flanged and Threaded Ends.

.5 MSS-SP-78-11, Cast Iron Plug Valves, Flanged and Threaded Ends.

.6 MSS-SP-80-13, Bronze Gate, Globe, Angle and Check Valves.

.7 MSS SP-82, Valve Pressure Testing Methods

.8 MSS-SP-85-11, Gray Iron Globe and Angle Valves, Flanged and Threaded Ends.

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

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 01 50 – General Instructions.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for hydronic systems and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 01 50 – General Instructions.

.2 Indicate on drawings:

.1 Components and accessories.

.4 Sustainable Design Submittals:

.1 Construction Waste Management:

.1 Submit project Waste Management highlighting recycling and salvage requirements.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 01 50 – General Instructions.

.2 Operation and Maintenance Data: submit operation and maintenance data for hydronic systems for incorporation into manual.

.1 Include special servicing requirements.

1.5 EXTRA STOCK MATERIALS

.1 Supply spare parts as follows:

.1 Valve seats: 1 minimum for every ten valves, each size. Minimum one. Discs: 1 minimum for every ten valves, each size. Minimum one.

.2 Stem packing: 1 minimum for every ten valves, each size. Minimum one.

.3 Valve handles: 2 minimum of each size.

.4 Gaskets for flanges: 1 minimum for every ten flanges.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 01 50 – General Instructions 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 hydronic systems from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management in accordance with Section 01 01 50 – General Instructions.

Part 2 Products

2.1 PIPE

.1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:

.1 To NPS 6: Schedule 40.

.2 NPS 8 and over, 10 mm wall thickness.

2.2 PIPE JOINTS

.1 NPS 2 and under: screwed fittings with PTFE tape or lead-free pipe dope.

.2 NPS 2-1/2 and over: welding fittings and flanges to CSA W48.

.3 Roll grooved: standard rigid coupling to CSA B242.

.4 Flanges: plain or raised to ANSI/AWWA C111/ A21.11.

.5 Orifice flanges: slip-on raised face, 2100 kPa.

.6 Flange gaskets: to ANSI/AWWA C111/ A21.11.

.7 Pipe thread: taper.

.8 Bolts and nuts: to ASME B18.2.1 and ASME B18.2.2.

.9 Roll grooved coupling gaskets: type EPDM.

2.3 FITTINGS

.1 Screwed fittings: malleable iron, to ASME B16.3, Class 150.

.2 Pipe flanges and flanged fittings:

.1 Cast iron: to ASME B16.1, Class 125.

.2 Steel: to ASME B16.5.

.3 Butt-welding fittings: steel, to ASME B16.9.

.4 Unions: malleable iron, to ASTM A47/A47M and ASME B16.3.

.5 Fittings for roll grooved piping: malleable iron to ASTM A47/A47M and ductile iron to ASTM A536.

2.4 VALVES

.1 New valves to match style of existing equipment wherever possible.

.2 Except for specialty valves, to be single manufacturer.

.3 Products to have CRN registration numbers.

.4 Connections:

.1 NPS 2 and smaller: screwed ends.

.2 NPS 2-1/2 and larger: flanged ends.

.5 Gate valves:

.1 NPS 2 and under, Bronze:

.1 Mechanical Rooms: Class 150, rising stem, wedge disc,
Elsewhere: Class 150, non- rising stem, solid wedge disc.

.2 Standard specification: MSS SP-80.

.3 Bonnet: union with hexagonal shoulders.

.4 Connections: screwed with hexagonal shoulders.

.5 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.

.6 Packing: non-asbestos.

.7 Handwheel: non-ferrous.

.8 Handwheel Nut: bronze to ASTM B62.

.2 NPS 2-1/2 and over, Cast Iron to MSS SP-70:

.1 Mechanical Rooms: Class 125 rising stem, split wedge disc, lead free bronze trim.

.1 Operators: manual.

.2 Elsewhere: non- rising stem, solid wedge disc, lead free bronze trim.

.1 Operators: manual

.3 Body, bonnet: cast iron to ASTM B209 Class B.

.4 Connections: flanged ends to ANSI B16.1.

.5 Inspection and pressure testing: to MSS SP-82.

.6 Bonnet gasket: non-asbestos.

.7 Stem: to have precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut.

.8 Stuffing box: non-galling two-piece ball-jointed packing gland, gland bolts and nuts.

.9 Gland packing: non-asbestos.

.10 Handwheel: die-cast aluminum alloy to ASTM B85/B85M or malleable iron to ASTM A49. Nut of bronze to ASTM B62.

.11 Body and multiple-bolted bonnet: with full length disc guides designed to ensure correct re-assembly.

.12 Disc: solid offset taper wedge, bronze to ASTM B62.

.13 Seat rings: renewable bronze to ASTM B62, screwed into body.

.14 Stem: bronze to ASTM B62.

.15 Disc: solid offset taper wedge, cast iron to ASTM A126 Class B, secured to wrought steel stem.

.16 Seat: integral with body.

.17 Stem: wrought steel.

.18 Operator: handwheel.

.6 Butterfly valves: to MSS-SP-67

.1 NPS 2” to 4” (50 to 100 mm): lug or wafer body.

.1 Class 200, cast iron body, Class B, aluminium bronze disc, EPDM liner, 416 stainless steel stem, 10 position hand release lock lever handle operator.

.2 NPS 6” (150 mm) and larger: lug or wafer body.

.1 Class 200, cast iron body, Class B, aluminium bronze disc, EPDM liner, 416 stainless steel stem, self-locking gear operated with handwheel.

.7 Globe valves: to MSS-SP-80, application: throttling, flow control, emergency bypass:

.1 NPS 2 and under, Bronze, 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 Standard specification: MSS SP-80.

.5 Bonnet: union with hexagonal shoulders.

.6 Connections: screwed with hexagonal shoulders.

.7 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.

.8 Packing: non-asbestos.

.9 Handwheel: non-ferrous.

.10 Handwheel Nut: bronze to ASTM B62.

.2 NPS 2-1/2 and over, Cast Iron Class 125:

.1 With lead free bronze disc, lead free bronze trim.

.2 Body: with multiple-bolted bonnet.

.3 1.4 MPa CWP.

.4 Bonnet-yoke gasket: non-asbestos.

.5 Disc: bronze to ASTM B62, fully guided from bottom, securely yet freely connected to stem for swivel action and accurate engagement with disc.

.6 Seat ring: renewable, regrindable, screwed into body.

.7 Stem: bronze to ASTM B62.

.8 Operator: handwheel.

.8 Swing check valves:

.1 NPS 2 and under, Bronze:

.1 Class 125, swing, with composition disc.

.2 Standard specification: MSS SP-80.

.3 Connections: screwed with hexagonal shoulders.

.4 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.

.2 NPS 2-1/2 and over, Cast Iron, 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.

.2 Ratings: 860 kPa 1.4 MPa CWP.

.3 Disc: rotating for extended life.

.1 Up to NPS 6: Bronze to ASTM B62.

.2 NPS 8 and over: bronze-faced cast iron.

.4 Seat rings: renewable bronze to ASTM B62 screwed into body.

.5 Hinge pin, bushings: renewable bronze to ASTM B62.

.6 Disc: A126 Class B, secured to stem, rotating for extended life.

.7 Seat: cast iron, integral with body.

.8 Hinge pin: exelloy; bushings: malleable iron.

.9 Silent check valves:

.1 NPS 2 and under, Bronze.

.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 Stainless steel spring, heavy duty.
.6 Seat: regrindable.

.2 NPS 2-1/2 and over:

.1 Body: ductile iron with integral seat.
.2 Pressure rating: Class 125, WP = 860 kPa.
.3 Connections: grooved ends.
.4 Disc: bronze renewable rotating disc.
.5 Seat: renewable, EPDM.
.6 Stainless steel spring, heavy duty.

.10 Ball valves:

.1 NPS 2 and under, Bronze.

.1 Body and cap: cast high tensile bronze to ASTM B62.
.2 Pressure rating: 2760-kPa CWP, Class125.
.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 solid ball and Teflon seats.
.7 Stem seal: TFE with external packing nut.
.8 Operator: removable lever handle.

.11 Lubricated Plug Valves

.1 Testing: to MSS SP-78 for non-shock pressure as per manufacturers.

.2 End connections:

.1 NPS ½ to 2: screwed ends.
.2 NPS 2½ to 12: flanged ends.

.3 Valve:

.1 Body: cast iron to ASTM A126 Class B semi-steel.
.2 Pressure rating: NPS ½ to 12:
.1 Screwed end valves: screwed to NPT standards.
.2 Flanged end valves: flanged to ANSI B16.1 Class 125.
.3 Hydrostatic tests: body 300 psig. Seat: 100 psig.
.3 Plug: 90 degrees from full open to full closed, complete with PFTE thrust ring: 100% full port.
.4 Seals: Teflon

.4 Service: Natural Gas.

.12 Balancing, for TAB:

.1 Calibrated balancing valves.

.2 With metering ports with check valves and caps.

.3 Equal percentage valve plugs, positive shut-off.

.4 Handwheel adjustment with micrometer indicator.

.5 Adjustable tamperproof memory stop.

.6 NPS 2 and under:

.1 Bronze body, screwed ends.

.2 1725 kPa (250 psi) working pressure and 121℃ (250℉).

.7 NPS 2 1/2 and over:

.1 Ductile iron body, bronze trim, flanged..

.2 1725 kPa (250 psi) working pressure and 121℃ (250℉).

.13 Drain valves: Gate, Class 150, non-rising stem, solid wedge disc, Bronze.

.14 Bypass valves: Globe, with PTFE disc Bronze.

2.5 STRAINERS

.1 2" (50 mm) and smaller with iron body, (bronze for domestic water service), screwed connections, Y-pattern, 200 psi (1380 kPa) WOG and 20-mesh 304 stainless steel screen.

.2 2½" (65 mm) and larger with iron body, (bronze for dom. water service), flanged connections, Y-pattern, 200 psi (1380 kPa) WOG and 20-mesh Monel or stainless steel screen, and drain valve.

.3 Provide strainers on upstream side of control valves, pumps, and where indicated.

2.6 AIR VENTS

.1 Float type air vents with brass body and NPS 1/2 connection, integral stop, 150 psi (1035 kPa) rating.

.2 Provide air vents at high points of heating water distribution systems, including risers.

.3 Provide vacuum breaker at top of each heating system riser, and drain valve at bottom.

Part 3 Execution

3.1 PIPING INSTALLATION

.1 Install pipework in accordance with Section 23 05 05 - Installation of Pipe Work.

.2 All piping in mechanical rooms shall have roll grooved joints, unless if not available for certain smaller sizes. In such cases screwed or welded joints shall be used.

3.2 CIRCUIT BALANCING VALVES

.1 Install flow measuring stations and flow balancing valves as indicated.

.2 Remove handwheel after installation and when TAB is complete.

3.3 CLEANING, FLUSHING AND START-UP

.1 In accordance with Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems.

3.4 TESTING

.1 Test system to 1400 kPa with water for 2 hours. Provide report to Departmental Representative.

3.5 BALANCING

.1 Balance water systems to within plus or minus 5 % of design output.

.2 In accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

3.6 CLEANING

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.7 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by hydronic systems installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME-04 (2007), Boiler and Pressure Vessel Code.

.2 ASTM International Inc.

.1 ASTM A47/A47M 99 (2004), Standard Specification for Ferritic Malleable Iron Castings.

.2 ASTM A278/A278M-01 (2006), Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (350 degrees C).

.3 ASTM A516/A516M-06, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.

.4 ASTM A536-84 (2004), Standard Specification for Ductile Iron Castings.

.5 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.

.3 Canadian Standards Association (CSA International)

.1 CSA B51-03(R2003), Boiler, Pressure Vessel, and Pressure Piping Code.

.2 CSA B51-03(R2005), Boiler, Pressure Vessel, and Pressure Piping Code, Supplement #1.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 01 50 – General Instructions.

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for expansion tanks, air vents, separators, valves, and strainers and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 In accordance to Section 01 01 50- General Instructions.

1.3 CLOSEOUT SUBMITTALS

.1 Submit maintenance and operation data in accordance with Section 01 01 50 – General Instructions.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 01 50 – General Instructions.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 01 50 – General Instructions.

Part 2 Products

2.1 AUTOMATIC AIR VENT

.1 Standard float vent: brass body and NPS 1/8 connection and rated at 690 kPa working pressure.

.2 Industrial float vent: cast iron body and NPS 1/2 connection and rated at 860 kPa working pressure.

.3 Float: solid material suitable for 115 degrees C working temperature.

2.2 COMBINATION LOW PRESSURE RELIEF AND REDUCING VALVE

.1 Adjustable pressure setting: 206 kPa relief, 55 to 172 kPa reducing.

.2 Low inlet pressure check valve.

.3 Removable strainer.

2.3 PIPE LINE STRAINER

.1 NPS 1/2 to 2: bronze body to ASTM B62, screwed connections, Y pattern.

.2 NPS 2 1/2 to 12: cast steel body to ASTM A278/A278M, Class 30, cast iron body to ASTM A278/A278M, Class 30 flanged connections.

.3 NPS 2 to 12: T type with ductile iron body to ASTM A536, malleable iron body to ASTM A47M.

.4 Blowdown connection: NPS 1.

.5 Screen: stainless steel with 1.19 mm perforations.

.6 Working pressure: 860 kPa.

2.4 SUCTION DIFFUSER

.1 Body: cast iron with flanged connections.

.2 Strainer: with built-in, disposable 1.19 mm mesh, low pressure drop screen and NPS 1 blowdown connection.

.3 Permanent magnet particle trap.

.4 Full length straightening vanes.

.5 Pressure gauge tappings.

.6 Adjustable support leg.

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 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 directive.

.4 Check shop drawings for conformance of tappings for ancillaries and for equipment operating weights.

3.3 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 and also as indicated.

3.4 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.

3.5 PRESSURE SAFETY RELIEF VALVES

.1 Run discharge pipe to terminate above nearest drain.

3.6 SUCTION DIFFUSERS

.1 Install on inlet to pumps having suction size greater than 50.

3.7 CLEANING

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 01 50 – General Instructions.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE)

.1 Standard 90.1-2016, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 Electrical Equipment Manufacturers Advisory Council (EEMAC)

.3 Canadian Standards Association (CSA International)

.1 CSA-B214-16, Installation Code for Hydronic Heating Systems.

.4 National Electrical Manufacturers' Association (NEMA)

.1 NEMA MG 1-2016, Motors and Generators.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 01 50 – General Instructions.

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets 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 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 Provide maintenance and operation data for incorporation into manual specified in Section 01 01 50 – General Instructions.

1.4 MAINTENANCE

.1 Provide maintenance materials in accordance with 01 01 50 – General Instructions.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with 01 01 50 – General Instructions.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, paddling and packaging materials in accordance with 01 01 50 – General Instructions.

Part 2 Products

2.1 PUMPS – Not Applicable, as existing pumps shall be removed and re-installed.

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 hydronic pumps to: 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 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.

.4 Pipe drain tapping to floor drain.

.5 Install volute venting pet cock in accessible location.

.6 Check rotation prior to start-up.

.7 Install pressure gauge test cocks.

3.3 START-UP

.1 General:

.1 In accordance with Section 01 91 00 – Commissioning.

.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.

3.4 PERFORMANCE VERIFICATION (PV)

.1 General:

.1 Verify performance in accordance with Section 01 91 00 – Commissioning.

.2 Verify that manufacturer's performance curves are accurate.

.3 Ensure valves on pump suction and discharge provide tight shut-off.

.4 Multiple Pump Installations - Series and Parallel:

.1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.

.5 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.

.6 Commissioning Reports: in accordance with Section 01 91 00 – Commissioning:

.1 Record of point(s) 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 00 – Commissioning.

.3 Pump performance curves (family of curves).

3.5 CLEANING

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 01 50 – General Instructions.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 This section is complimentary to and supplements the requirements of Division 1. Refer to and coordinate with Division 1 requirements.

.1	01 01 50	General Instructions
.2	23 05 00	Common Work Results for HVAC
.3	23 21 13.02	Hydronic Systems: Steel

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ANSI/ASME Boiler and Pressure Vessel Code-2010:

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

Part 2 Products

2.1 Identify chemicals used for chilled water systems in this facility. Use the same chemicals and confirm with facility maintenance.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

.1 Install HVAC water treatment systems in accordance with ASME Boiler Code Section VII, and requirements and standards of authorities having jurisdiction, except where specified otherwise.

.2 Ensure adequate clearances to permit performance of servicing and maintenance of equipment.

3.3 CHEMICAL FEED PIPING

.1 Install crosses at changes in direction. Install plugs in unused connections.

3.4 DRAINING, CLEANING AND REFILLING OF MECHANICAL SYSTEM

.1 Flush mechanical systems and equipment with approved cleaning chemicals designed to remove deposition from construction such as pipe dope, oils, loose mill scale and other extraneous materials. Use chemicals to inhibit corrosion of various system materials that are safe to handle and use.

.2 Examine and clean filters and screens, periodically during circulation of cleaning solution, and monitor changes in pressure drop across equipment.

.3 Drain and flush systems until alkalinity of rinse water is equal to make-up water. Refill with pre-mixed 30% Propylene Glycol treated to prevent scale and corrosion during system operation.

.4 Provide legally disposal of drained propylene glycol solution and cleaning solutions approved by authority having jurisdiction.

3.5 FIELD QUALITY CONTROL

.1 Start-up:

.1 Start up water treatment systems in accordance with manufacturer's instructions.

3.1 TRAINING, DEMONSTRATION, COMMISSIONING

.1 Refer to sections 01 91 00 and 23 08 00.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 General requirements for building Energy Monitoring and Control System (EMCS) that are common to NMS EMCS Sections.

.2 Related Sections:

.1 Section 01 01 50 – General Instructions.

.2 All sections of Division 23

.3 The existing facility is equipped with a BACnet-based Johnson Controls DDC system. Retain the base building controls contractor for this project. All newly added software, graphics and hardware required for proper operation of existing and new equipment (if applicable for this project) shall be fully compatible with the existing system. Contractor shall carry out an inventory and condition assessment of the existing control system prior to commencement of the contract. Responsibility for any subsequent failures of the existing system being modified by this contractor will rest solely with this contractor for the duration of the contract.

.4 All new DDC controllers (if applicable for this project) shall be BACnet, controlled and programmable from the existing system frontend. Provide software and graphics upgrade complete with full documentation for software and equipment.

.5 Provide, install, calibrate, program and commission the DDC control system to achieve the performance **exactly same is existing system, and/or** as specified in the following clauses. Refer to Section 01 01 50-General Instructions for requirements including scheduling and phasing responsibilities by the contractors including sub-contractors.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).

.1 ANSI/ISA 5.5- 1985, Graphic Symbols for Process Displays.

.2 American National Standards Institute (ANSI)/ Institute of Electrical and Electronics Engineers (IEEE).

.1 ANSI/IEEE 260.1- 1993, 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- R2001, BACNET - Data Communication Protocol for Building Automation and Control Network.

.4 Canadian Standards Association (CSA International).

.1 CAN/CSA-Z234.1- 89(R1995), Canadian Metric Practice Guide.

.5 Consumer Electronics Association (CEA).

.1 CEA-709.1- B-2002, Control Network Protocol Specification.

.6 Department of Justice Canada (Jus).

.1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.

.2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.

.7 Electrical and Electronic Manufacturers Association (EEMAC).

.1 EEMAC 2Y-1- 1958 , 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), 1992, c. 34.

1.3 ACRONYMS AND ABBREVIATIONS

.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 Center.

.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.

1.4 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 CDL's.

.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 Object Type: points fall into following object types:

.1 AI (analog input).

.2 AO (analog output).

.3 DI (digital input).

.4 DO (digital output).

.3 Symbols and engineering unit abbreviations utilized in displays: to ANSI/ISA S5.5.

.1 Printouts: to ANSI/IEEE 260.1.

1.5 SYSTEM DESCRIPTION

.1 Refer to existing control system documents.

.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 Data communications equipment necessary to effect EMCS data transmission system.

.4 Field control devices.

.5 Software/Hardware complete with full documentation.

.6 Complete operating and maintenance manuals.

.7 Training of personnel.

.8 Acceptance tests, technical support during commissioning, full documentation.

.9 Wiring interface co-ordination of equipment supplied by others.

.10 Miscellaneous work as specified in these sections and as indicated.

.11 Removal of existing pneumatic controls components and tubing which are being replaced / upgraded to DDC and no longer be required for service.

.12 Retain an electrical sub-contractor to provide electrical work as covered in Division 26 as an integral part of the Division 25 sub-contract. Refer to Division 26 documents and coordinate scope with Division 26 sub-contractor.

.13 Line voltage power required for controls from dedicated circuits determined on site by Controls Contractor.

.14 Reinstate all existing fire alarm / smoke detectors interlocks with air handling equipment.

.15 Balancing work as required to setup the DDC systems and to match existing operating conditions.

.16 Firestopping for new penetrations through existing fire rated assemblies. Refer to Section 07 84 00 – Fire Stopping.

.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 to EMCS as required.

.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.

.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-definements).

.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 and to be able to operate one terminal in English and second in French. Point name expansions in both languages.

.3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.

1.6 SUBMITTALS

.1 Make submittals in accordance with Section 01 01 50 – General Instructions.and 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

.2 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. 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.

1.7 QUALITY ASSURANCE

.1 Have local office nearest to the 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 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:

.1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

1.8 EXISTING CONDITIONS - CONTROL COMPONENTS

.1 Utilize existing control wiring and piping as applicable.

.2 Re-use field control devices that are usable in their original configuration provided that they conform to applicable codes, standards specifications, unless otherwise noted.

.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 60 days of award of contract, and prior to installation of new devices.

.1 Furnish test report within 60 days of award of contract listing each component to be re-used and indicating whether it is in good order or requires repair approval 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 should approve repair or replacing 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 being repaired or replaced.

.2 Be responsible for repair costs due to negligence or abuse of equipment.

.3 Responsibility for existing devices terminates upon final acceptance of 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.

1.9 IDENTIFICATION, CALIBRATION AND PROGRAMMING

.1 Provide a written sequence of operation for each piece of equipment or system being controlled. Provide a print out of the complete data base, including program listings, inputs, outputs, controllers, virtual points, trend logs, alarm points, etc. Provide in an organized manner, separated for each panel.

.1 Procedures for daily operation of the system.

.2 Theory of operation of the equipment.

.3 Theory of operation of the control program.

.2 Mount an input/output layout sheet within each controller. This sheet shall include the name of the points connected to each controller channel.

.3 Identify all controllers and associated devices with symbols relating directly to the control diagram. Provide plastic labels for each input and output point with the following information:

.1 Point descriptor.

.2 Point type and channel number.

.3 Corresponding controller number.

.4 Program each controller immediately following installation. Setup and tune all control loops during the initial start-up of the systems. Submit a well-documented print out of the controller program for review.

.5 At the time of the Demonstration and Instruction Period:

.1 Demonstrate and confirm that all systems are programmed and operating correctly. Submit trend logs, 1 week in duration, that confirm systems are operating as designed and follow the internal building loads in an energy efficient manner.

.2 Submit CD's (including back-up diskettes) containing up to date copies of the programs in each controller.

.3 Submit (4) CD's with printed PDF copies of the final programs that include all point definitions, weekly and annual schedule settings, controller setpoints and tuning parameters, and documented general control language programs. (As Built control shop drawings)

.4 Provide the original software diskettes and the users' manuals for all software programs provided as part of this contract. Provide one set of original disks for each notebook, laptop, and desktop computer the software has been installed on.

.5 The controls contractor shall be responsible for registering all software with the manufacturer in the user's name. Provide copies of the registration of all software to the Departmental Representative as part of the final inspection.

.6 Check sensor calibration and control system operation twice during the first year of operation including the first heating season and prior to the first cooling season. Include all parts and labour in service. Following each visit submit:

.1 A report indicating all work performed.

.2 Printed graphs of trend logs one week in duration with hourly samples for all analog inputs connected to each controller.

.3 Update printed and diskette copies of any changes made to programs for any controller.

.7 Provide one day of on-site instruction to the CBSA operating personnel during the first year of operation, scheduled as requested by the CBSA.

Part 2 Products

2.1 EQUIPMENT

.1 Control Network Protocol and Data Communication Protocol: to ASHRAE STD 135.

.2 Complete list of equipment and materials to be used on project and forming part of tender documents by adding manufacturer's name, model number and details of materials, and submit for approval.

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 I/O WIRING

.1 All input/output device wiring will use #18-2 solid core cable with individually jacked conductors and jacketed sheath over the pair.

.2 Use plenum rated cable where required.

.3 All I/O wiring passing near or within the enclosure of a VFD will be shielded, with the shield terminated at the device end.

.4 All I/O wiring will be identified using Panduit adhesive wire-marker at the controller and end device ends. Description of point to include point mnemonic, point type and network location.

.5 All I/O wiring within controller enclosure shall be neat and tidy and suitably bundled and strapped or contained in plastic wire duct or equivalent.

3.3 POWER WIRING

.1 Where required, provide power wiring and transformers and grounding to each controller and transducer as per the manufacturer’s specification.

.2 Each building controller will have its own dedicated power supply. No other controller or input/output device will be powered from this supply.

.3 Power wiring as per manufacturer’s specification.

3.4 ENCLOSURE AND CONDUIT

.1 Relays, transformers, and I/O devices and peripherals shall be installed in separate enclosures and not in the enclosures containing the controllers.

.2 All wires penetrating the enclosure that are not required to be in conduit must be neatly bundled and strapped in place.

.3 All Building Controllers will be installed in CSA rated enclosures that are complete with hinged and key-locked doors. The door will be painted and labeled suitably bearing the manufacturer's system name/logos, the controller address, and the installing contractor's contact information. This enclosure will be mounted at a height that provides easy access without the need of a ladder.

.4 A hard points list shall be affixed on the inside of the door/cover of the enclosure.

.5 The inside bottom of the enclosure shall be clean of dirt, metal shavings, and debris.

.6 Provide tamperproof screws to new and relocated equipment, controls enclosures and devices which are located in inmate accessible areas. Tamperproof screws shall be stainless TORX with pin.

.7 Wiring is to be in EMT conduit with set screw metal fittings in all wall spaces and exposed locations as well as in pipe chases, service spaces, attics, and crawl spaces which are entered for service access. Wiring in suspended ceiling spaces does not require conduit but shall be neatly installed parallel to building lines using bridle rings. All conduits shall be piped smoothly and neatly following building lines. Wiring above existing ceilings and wall cavities may be run free-air.

.8 Exposed conduits located in areas where inmates have access shall comply with the following security measures:

- .1 Use two-hole straps.
- .2 Install straps within 100mm of device boxes.
- .3 Install straps within 100mm of both sides of fittings.
- .4 Install straps at a maximum spacing of 500mm.
- .5 All fittings steel.
- .6 Keep conduit close to the wall and avoid spaces behind the conduit
- .7 Route conduit along top of walls where possible.

.9 Liquid-tight flexible conduit to be used for roof mounted equipment wiring c/w liquid-tight fittings. Provide spun aluminum roof jack where control wiring penetrates roof unless penetration is within waterproof roof equipment curb.

.10 All junction boxes will have covers properly and firmly affixed after installation completion.

.11 Control panels located in occupied areas for relays or other similar field devices shall be accessible and located above corridor ceilings. For areas accessible by inmates, provide security type access panels.

3.5 CONTROL SYSTEM COMMISSIONING

.1 Upon completion of the installation of the controls system and the calibration of all sensors, this Subcontractor shall carry out all required testing, debugging, and revision of operations to suit the intent of the Sequence of Operation and to the review of the Departmental Representative.

.2 The contractor is to supply digital point and non-digital checkout data sheets for all controlled components installed in this contract, including components supplied by others. The data sheets shall indicate each components physical installation is complete, End to End, identification, tagged, the result of the functional test, calibration deviation recorded, setpoints and set-up of each device, digital and non-digital.

.3 Each digital input or control device shall be checked by physical operation of the monitored device in the field with the result noted. Each digital output or controlled device shall be commanded or tested On/Off, Open/Close as required and the corresponding field device checked for correct operation with the result and comments noted.

.4 Each analog input or control device shall have its field values measured with a calibrated test instrument, with the deviation recorded and adjusted, if necessary, at the AI set up. The field measurement and analog point deviation must be reported. A hard copy of the set up for each digital and non-digital controller with adjustments is required. Field set up and setpoints of other devices shall be reported.

.5 Each analog output, control or controlled device shall be field tested. The physical test data sheet is to indicate each controlled device function through its range 0, 25, 50, 75, 100% and 1 to 100% as required with no leakage or bypass of the controlled medium.

.6 Submit copies of all test data sheets intended to be used to the Departmental Representative and Commissioning Agent prior to the contractor’s verification at least one months before the scheduled substantial completion of the project.

.7 The controls contractor shall provide sequence of operation check sheets, to the Departmental Representative and Commissioning Agent in standard letter size for each DDC and non DDC system sequence. Each sequence to be verified with each item/page signed off with comments noted.

.8 The Commissioning Agent is not to commence controls checks until the above documentation is received. The Control System Supplier and Installer shall loan a current copy of all control software/devices needed for full access to the control system, at no charge to the Commissioning Agent The software/devices shall be returned to the Control Supplier in good working order at the completion of the commissioning process, or the Commissioning Agent must reimburse the Control System Supplier for the purchase price of the material.

.9 All documentation, tagging, identification, as-builts, software, instruction manuals, special control connection to access all devices and panels must be in place before the granting of substantial performance.

.10 The Controls Contractor shall loan a current copy of all control software/devices needed for full access to the control system, at no charge to the Commissioning Agent. The software/devices shall be returned to the Controls Contractor in good working order at the completion of the commissioning process, or the Commissioning Agent must reimburse the Controls Contractor for the purchase price of the material. The Control System Supplier shall cooperate fully with the Commissioning Agent to work together to obtain a fully operating system, providing additional technicians and trades people to assist the designated commissioning person as required. Refer to Section 01 91 00 - Commissioning and Section 23 08 00 - Commissioning of Mechanical Systems.

.11 The controls contractor is to provide the technicians for field checks, calibration, checkouts, and commissioning necessary for a complete and fully operational system. Provide two 2-way portable radios for the commissioning period.

3.6 Third Party BACnet Integration

.1 Where third party systems are installed with a BACnet compatible control panel, it is the responsibility of this contractor to integrate the system into the DDC control system.

.2 The contractor shall map over BACnet points that made available in the third party panels and provide control for all BACnet points permitted by the third party panels.

.3 Integrate the third party system into the DDC sequence of operation. This includes scheduling, outdoor conditions (temperature and ambient lighting levels), alarms, and any other information required to operate, diagnose, and maintain the equipment.

.4 Provide a detailed graphical display(s) depicting the third party equipment. The graphical display(s) shall contain ALL points that were mapped over from the third party system.

3.7 PAINTING

.1 Painting: in accordance with Division 9 - Painting, supplemented and 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.

3.8 CLEANING

.1 Proceed in accordance with Section 01 01 50 - General Instructions.

.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 SUMMARY

.1 Section Includes:

.1 Materials and installation for building automation controllers including:

.1 Master Control Unit (MCU).
.2 Local Control Unit (LCU).
.3 Equipment Control Unit (ECU).
.4 Terminal Control Unit (TCU).

.2 Related sections:

.1 Section 25 05 01 - EMCS: General Requirements.

.2 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

.3 Section 25 05 03 - EMCS: Project Record Documents.

.4 Section 25 30 02 - EMCS: Field Control Devices.

.5 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE).

.1 ASHRAE (2015), Applications Handbook, SI Edition.

.2 Canadian Standards Association (CSA International).

.1 C22.2 No.205, Signal Equipment.

.3 Institute of Electrical and Electronics Engineers (IEEE).

.1 IEEE C37.90.1, Surge Withstand Capabilities (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.

.4 Public Works and Government Services Canada (PWGSC)/Real Property Branch/Architectural and Engineering Services.

.1 MD13800, Energy Management and Control Systems (EMCS) Design Manual. English: ftp://ftp.pwgsc.gc.ca/rps/docentre/mechanical/me214-e.pdf

1.3 DEFINITIONS

.1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.4 SYSTEM 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).

1.5 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 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;

.3 100/10,000 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.

.3 Controllers and associated hardware and software: operate in conditions of 0 degrees C to 44 degrees C and 20 % to 90 % non-condensing RH.

.4 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.

.5 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.

.6 Provide surge and low voltage protection for interconnecting wiring connections.

1.6 SUBMITTALS

.1 Make submittals in accordance with Section 01 01 50 – General Instructions and Section 25 05 02 - EMCS: Submittals and Review Process.

.1 Submit product data sheets for each product item proposed for this project.

1.7 MAINTENANCE PROCEDURES

.1 Provide manufacturers recommended maintenance procedures for insertion in Section 25 05 03 - EMCS: Project Record Documents.

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 existing Proprietary Protocol.

.3 MCU local I/O capacity as follows:

.1 MCU I/O points as allocated in I/O Summary Table referenced in MD13800.

.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.

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.

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.

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 Update existing initial programming of Controllers, as required for the work under this contract. Refer to Section 25 05 01 – General Requirements and 25 90 11 – Sequence of Operation.

.2 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. CBSA 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.

.3 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.

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 Maintain existing point naming convention.

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 directed by Departmental Representative.

.2 Provide necessary power from local 120V branch circuit panel for equipment. Refer to electrical drawings and coordinate with electrical contractor.

.3 Install tamper locks on breakers of circuit breaker panel.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Control devices integral to the Building Energy Monitoring and Control System EMCS: transmitters, sensors, controls, meters, switches, transducers, dampers, damper operators, valves, valve actuators, and low voltage current transformers.

Related Sections:

.1 Section 01 01 50 – General Instructions
.2 Section 25 05 01 - EMCS: General Requirements.
.3 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
.4 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.
.5 Section 26 05 00 - Common Work Results - Electrical.
.6 Section 26 27 26 - Wiring Devices.

1.2 REFERENCES

.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 Canadian Standards Association (CSA International).

.1 CSA-C22.1, Canadian Electrical Code, Part 1 (19th Edition), Safety Standard for Electrical Installations.

1.3 DEFINITIONS

.1 Acronyms and Definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.4 SUBMITTALS

.1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 25 05 02 - EMCS: Submittals and Review Process and Section 01 01 50 – General Instructions.

.2 Manufacturer's Instructions:

.1 Submit manufacturer's installation instructions for specified equipment and devices.

1.5 EXISTING CONDITIONS

.1 Repair surfaces damaged during execution of Work to match the existing.

Part 2 Products

2.1 GENERAL

.1 Control devices of each category to be of same type and manufacturer, and be compatible with the existing system.

.2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight assembly.

.3 Operating conditions: 0 - 32 degrees 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 and sensors to be unaffected by external transmitters including 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 NEMA 4 enclosures.

.8 Devices installed in user occupied space 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, 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: to be resistance or thermocouple type to following requirements:

.1 Thermocouples: limit to temperature range of 200 degrees C and over.

.2 RTD's: 100 or 1000 ohm at 0 degrees C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored leadwires. Coefficient of resistivity: 0.00385 ohms/ohm degrees C.

.3 Sensing element: hermetically sealed.

.4 Stem and tip construction: copper or type 304 stainless steel.

.5 Time constant response: less than 3 seconds to temperature change of 10 degrees C.

.6 Immersion wells: NPS 3/4, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length 100 150mm as indicated.

.2 Room temperature sensors and display wall modules.

.1 Temperature sensing and display wall module.

.1 LCD display to show space temperature ed and temperature setpoint.

.2 Buttons for occupant selection of temperature setpoint and occupied/unoccupied mode.

.3 Jack connection for plugging in laptop personal computer for access to zone bus.

.4 Integral thermistor sensing element 10,000 ohm at 24 degrees.

.5 Accuracy 0.2 degrees C over range of 0 to 70 degrees C.

.6 Stability 0.02 degrees C drift per year.

.7 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 Outdoor air temperature sensors:

.1 Outside air type: complete with probe length 100 - 150mm long, non-corroding shield to minimize solar and wind effects, threaded fitting for mating to 13mm conduit, weatherproof construction in NEMA 4 enclosure.

2.3 TEMPERATURE TRANSMITTERS

.1 Requirements:

.1 Input circuit: to accept 3-lead, 100 or 1000 ohm at 0 degrees C, platinum resistance detector type sensors.

.2 Power supply: 24 V DC into load of 575 ohms. Power supply effect less than 0.01 degrees 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 plus or minus 10%.

.6 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 0.5% of full scale output.

.7 Maximum current to 100 or 1000 ohm RTD sensor: not to exceed 25 mA.

.8 Integral zero and span adjustments.

.9 Temperature effects: not to exceed plus or minus 1.0% of full scale/ 50 degrees 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.

2.4 PRESSURE TRANSDUCERS

.1 Requirements:

.1 Combined sensor and transmitter measuring pressure.

.1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.

.2 Output signal: 4 - 20 mA onto 500 ohm maximum load.

.3 Input and output short circuit and open circuit protection.

.4 Output variations: not to exceed 0.2 % of full scale output for supply voltage variations of plus or minus 10 %.

.5 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.

.6 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 degrees C.

.7 Over-pressure input protection to at least twice rated input pressure.

.8 Output short circuit and open circuit protection.

.9 Accuracy: plus or minus 1 % of Full Scale.

2.5 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 into 500 ohm maximum load.

.3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.

.4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.

.5 Integral zero and span adjustment.

.6 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 degrees C.

.7 Over-pressure input protection to at least twice rated input pressure.

.8 Output short circuit and open circuit protection.

.9 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

2.6 LIQUID FLOW METERS

.1 Requirements:

.1 Pressure rating: as specified in I/O summaries.

.2 Temperature rating: as specified in I/O summaries.

.3 Repeatability: plus or minus 0.2 %.

.4 Accuracy and linearity: plus or minus 1.0 %.

.5 Flow rangability: at least 10:1.

.6 Body material: stainless steel.

.7 Ends:

.1 NPS 2 and under: screwed.

.2 NPS 2.1/2 and over: flanged.

2.7 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES

.1 Requirements:

.1 Internal materials: suitable for continuous contact with compressed air, water, steam, etc., as applicable.

.2 Adjustable setpoint and differential.

.3 Switch: snap action type, rated at 120V, 15 amps AC or 24 V DC as required.

.4 Switch 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 switches with isolation valve and snubber, where code allows, between sensor and pressure source.

.7 Switches on steam and high temperature hot water service: provide pigtail syphon.

2.8 TEMPERATURE SWITCHES

.1 Requirements:

.1 Operate automatically. Reset automatically, except as follows:

.1 Low temperature detection: manual reset.

.2 High temperature detection: manual reset .

.2 Adjustable setpoint and differential.

.3 Accuracy: plus or minus 1 degrees 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 = half way in the air stream.

.3 Thermowell: stainless steel, with compression fitting for NPS 3/4 thermowell. Immersion length: 100 mm.

.4 Low temperature detection: continuous element with 6000 mm insertion length, duct mounting, to detect coldest temperature in any 30 mm length.

.5 Strap-on: with helical screw stainless steel clamp.

2.9 ELECTROMECHANICAL RELAYS

.1 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

2.10 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 degrees C to 70 degrees C.

.5 Relays to be CSA Certified.

.6 Input/output Isolation Voltage to be 4000 VAC at 25 degrees 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.

2.11 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.

2.12 CONTROL VALVES

.1 Body: globe style, characterized ball.

.1 Flow characteristic as indicated on control valve schedule equal percentage,

.2 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.

.3 Normally open or Normally closed, as required.

.4 Two or 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.

.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 Rangeability 50:1minimum.

.11 NPS 2 ½ and larger:

.1 Flanged connections.

.2 Valves to ANSI Class 150 or 250 as indicated, valves to bear ANSI mark.

.3 Rangeability 100:1 minimum.

2.13 ELECTRONIC / ELECTRIC VALVE ACTUATORS

.1 Requirements:

.1 Construction: steel, cast iron, aluminum.

.2 Control signal: 0-10V DC or 4-20 mA DC.

.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.

2.14 PANELS

.1 Wall mounted enamelled steel cabinets with hinged and key-locked front door.

.2 Multiple panels as required to handle requirements with additional space to accommodate 25% additional capacity without adding additional cabinets.

.3 Panels to be lockable with same key.

2.15 WIRING

.1 In accordance with Division 26.

.2 For wiring in concealed ceiling spaces and under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.

.3 For exposed wiring, run in EMT conduit.

.4 Wiring must be continuous without joints.

.5 Sizes:

.1 Field wiring to digital device: #18AWG.

.2 Analog input and output: shielded #18 minimum solid copper 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 Fire stopping: provide space for fire stopping. Maintain fire rating integrity.

.6 Electrical:

.1 Complete installation in accordance with Section 26 05 00 - Common Work Results - 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 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.

3.2 TEMPERATURE 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 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.

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 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.

3.5 TESTING AND COMMISSIONING

.1 Calibrate and test field devices for accuracy and performance in accordance with Section 01 01 50 – General Instructions.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 01 50 – General Instructions

.2 Section 25 05 01 – EMCS: General Requirements

1.2 SUMMARY

.1 Section Includes:

.1 At minimum detailed narrative description of Sequence of Operation of each system including ramping periods and reset schedules.

.1 Control Description Logic (CDL) for each system.

.2 Input/Output Point Summary Tables for each system.

.2 Allow for sequence of operation modification during commissioning.

.3 All set points shall be adjustable.

.4 General

.1 All other existing sequence of operation governing other equipment not specified in this section will remain unchanged.

.2 Control contractor shall submit within the shop drawings submittal one whole sequence of operation covering the new & existing systems.

1.3 REFERENCES

.1 MD13800-September 2000, Energy Management and Control Systems (EMCS) Design Manual. English: ftp://ftp.pwgsc.gc.ca/rps/docentre/mechanical/me214-e.pdf

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 SEQUENCE OF OPERATIONS

.1 Existing sequence of operations for all existing systems, including monitoring, logging and alarms to remain unchanged.

.2 Existing sequence of operation for Mechanical Rooms exhaust fans as following to remain unchanged:

.1 Units are general purpose exhaust fans for providing ventilation and cooling for the mechanical rooms in the winter. The system is equipped with a make-up air damper, return air damper and exhaust air damper for temperature control during fan operation and to limit the requirements for heat in the winter.

.2 Control description:

.1 Exhaust fans will cycle to maintain space temperature.

.2 When the exhaust fan is in operation, the outside air damper, return air damper and exhaust air damper will al modulate together to maintain the rom temperature set point (initially set to 26°c).

.3 When the systems are of, the dampers will be in full return position.

.3 Alarms:

.1 DDC will provide an alarm when fan status does not show the unit operating during the required operating time.

.2 DDC will provide an alarm when the room temperature drops below 5°c.

.3 New sequence of operation for Mechanical Rooms exhaust fans as following to be added:

.1 Provide a room dewpoint sensor in each mechanical room.

.2 When outdoor temperature is above 14℃ (adjustable) and room dewpoint temperature is above the chilled water supply temperature, start/override the exhaust fan in 100% outdoor air supply mode.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS & SUMMARY

.1 The General Conditions, Supplements and Amendments shall govern this Section (read in conjunction with Instructions to Tenderers / Bidders). This section covers items common to all Electrical sections and is intended only to supplement the requirements of Section 01 01 50.

.2 Reference to “Electrical Divisions” shall mean all related Electrical Sections and components including Division 26 and 28 in the Master Format Specifications.

.3 Reference to “Mechanical Divisions” shall mean all related Mechanical Sections and components including Divisions 23 and 25 in the Master Format Specifications.

.4 The word "Provide" shall mean "Supply, Install and Connect" the products and services specified. "As Indicated" means that the item(s) specified are shown on the drawings.

.5 Provide materials, equipment and plant, of specified design, performance and quality; and, current models with published certified ratings for which replacement parts are readily available. Provide project management and on-site supervision to undertake administration, meet schedules, ensure timely performance, and ensure coordination, establishing orderly completion and the delivery of a fully commissioned installation.

.6 The most stringent requirements of this and other electrical sections shall govern.

.7 All work shall be in accordance with the Project Drawings and Specifications and their intents, complete with all necessary components, including those not normally shown or specified, but required for a complete installation.

.8 Provide seismic restraints for all required equipment, piping and ductwork.

.9 Connect to equipment specified in other Sections and to equipment supplied and installed by other Contractors or by the Departmental Representative. Uncrate equipment, move in place and install complete; start-up and test. Include all field assembly of loosely/separately packaged accessories.

1.2 REFERENCES

.1 Install in accordance with CSA C22.1-2015 except where specified otherwise.

.2 Comply with CSA Electrical Bulletins and Local Authorities having jurisdiction.

.3 Comply with other applicable standards.

1.3 DEFINITIONS

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

1.4 DESIGN REQUIREMENTS

.1 Operating voltages to CAN3-C235-83.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.5 SCOPE OF WORK

.1 The main objective is to accommodate the removal and replacement of mechanical equipment and corresponding control. Services to be provided for the electrical infrastructure include inspection, disconnection, protection and retainment of existing infrastructure, demolition, relocation, new extensions and reconnection, with testing/commissioning of all systems.

.2 Contractor shall supply, install, commission and provide warranty for a complete and fully documented electrical system as per contract drawings and specified herein. The Work includes all hardware, and services necessary to provide fully functional, coordinated electrical system. Refer to Section 01 01 50 for scope of work and restrictions.

.3 Coordinate with Mechanical Div. 25 for all the demolition and installation work. Ensure safety. Ensure the minimization of downtime.

.4 Work is generally limited to the mechanical rooms of the Commercial Building and the Main building.

.5 Coordinate the exact location and requirements of the mechanical equipment with mechanical drawing package.

.6 All drawings to be read in conjunction with existing reference drawings provided with the package and other disciplines drawings.

.7 Component subsystems of the electrical system will include, but are not limited to the following:

.1 Connect mechanical equipment via a system of interior surface mounted conduit. Equipment shall be connected to an existing distribution system.

.2 Provide all required additional and new conduit, conductors, connectors, associated control wiring and local disconnect switches.

.8 Provide grounding/bonding of equipment as per CEC or as indicated in the contract drawings and specifications.

.9 Provide fire stopping as required.

.10 Perform commissioning in accordance with Section 01 01 50.

1.6 SUBMITTALS

.1 Submittals to be in accordance with Section 01 01 50.

.2 Submit shop drawings, product data and samples in accordance with Section 01 01 50. The submission shall be reviewed, signed and processed as described in Section 01 01 50.

.3 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.

.4 Where applicable, include wiring, line and schematic diagrams. Include wiring drawings or diagrams showing interconnection with work of other Sections.

.5 Content

.1 Shop drawings submitted in accordance with Section 01 01 50.

.2 Data shall be specific and technical.

.3 Identify each piece of equipment or device.

.4 Identify the electrical rating for each equipment.

.5 Information shall include all scheduled data.

.6 Indicate the exact proposed model number for certain equipment.

.7 Advertising literature will be rejected.

.8 The project and equipment designations shall be identified on each document.

.9 Information shall be given in S.I. units

.10 The shop drawings/product data shall include:

.1 Dimensioned construction drawings with plans and sections showing size, arrangement and necessary clearances, with all equipment weight and mounting point loads.

.2 Mounting arrangements.

.3 Detailed drawings of bases, supports and anchor bolts.

.4 Control explanation and internal wiring diagrams for packaged equipment.

.5 A written description of control sequences relating to the schematic diagrams.

.6 Format

.1 Electronic copy (PDF format).

.2 Bill of Quantities for related components, identified by model number, listed on the front cover with item identification numbers.

.7 Coordination

.1 Where electrical equipment requires support or backing by other trades or mechanical connections, the shop drawings shall also be circulated through the other "services" contractor(s) prior to submission to the Departmental Representative.

.8 Keep one copy of shop drawings and product data, on site, available for reference.

.9 Quality Control: in accordance with Section 01 01 50

.1 Provide CSA certified equipment and material. Where CSA certified equipment and/or material is not available, submit such equipment and/or material to the authority having jurisdiction for special approval before delivery to site.

.2 Submit test results of installed electrical systems and instrumentation.

.3 Submit, upon completion of Work, the electrical commissiong report.

.10 Permits and Fees:

.1 Submit to Electrical Inspection Department, Local Fire Authorities and Supply Authority the necessary number of drawings and specifications for examination and approval prior to commencement of work. Obtain all required permits and pay all fees.

.2 Arrange for inspection of all Work by the authorities having jurisdiction. On completion of the Work, furnish final unconditional certificates of approval by the inspecting authorities.

1.7 QUALITY ASSURANCE

.1 Quality Assurance in accordance with Section 01 01 50.

.2 Qualifications: Electrical Work to be carried out by qualified, licensed electricians in accordance with authorities having jurisdiction.

.1 Employees registered in apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.

.2 Permitted activities: Determined based on training level attained and demonstration of ability to perform specific duties.

.3 Site Meetings in accordance with Section 01 01 50.

.4 Health and Safety Requirements in accordance with Section 01 35 33.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Material Delivery Schedule: provide Departmental Representative with schedule within 4 weeks after award of Contract.

.2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and/or recycling in accordance with Section 01 01 50.

1.9 SYSTEM START-UP

.1 Refer to Section 01 01 50.

.2 Instruct the Departmental Representative and operating personnel in the operation, care and maintenance of equipment.

.3 Provide services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

1.10 OPERATING INSTRUCTIONS

.1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.

.2 Operating instructions to include following:

.1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

.2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.

.3 Safety precautions.

.4 Procedures to be followed in event of equipment failure.

.5 Other items of instruction as recommended by manufacturer of each system or item of equipment.

.3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.

.4 Post instructions where directed.

.5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.

.6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

1.11 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 01 50.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

.3 Place materials defined as hazardous or toxic waste in designated containers.

1.12 DRAWINGS AND MEASUREMENTS

.1 Drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of work and are not detailed installation drawings. Do not scale the drawings. Obtain accurate dimensions from the Structural drawings.

.2 Consult the mechanical drawings and details for exact locations of devices and equipment. Obtain this information from the Departmental Representative where definite locations are not indicated.

.3 Take field measurements, where equipment and material dimensions are dependent upon building dimensions.

1.13 PROJECT COORDINATION

.1 Check drawings of all trades to verify space limitations for work to be installed. Coordinate work with all trades and make changes to facilitate a satisfactory installation. Make no deviations to the design intent involving extra cost without the Departmental Representative’s written approval.

.2 The drawings indicate the general location and route to be followed by the electrical services. Where details are not shown on the drawings or only shown diagrammatically, the services shall be installed in such a way as to conserve head room and interfere as little as possible with the free use of space through which they pass. Service lines shall run parallel to building lines. All services in the ceiling shall be kept as tight as possible to beams or other limiting members at high level. All electrical services shall be coordinated in elevation to ensure that they are concealed in the ceiling or structural space provided unless detailed otherwise on drawings.

.3 Work out jointly all interference problems on the site and coordinate all work before fabricating, or installing any material or equipment. Where necessary, produce interference/coordination drawings showing exact locations of electrical systems or equipment within service areas, shafts and the ceiling space. Distribute copies of the final interference/coordination drawings to the Departmental Representative and all affected parties.

.4 Contractor to read the drawings in conjunction with existing reference drawings and specifications to understand the intent of the work. Notify Departmental Representative if there is any discrepancies. No extra cost will be considered for any misunderstanding of work to be done.

.5 Ensure that all materials and equipment fit into the allotted spaces and that all equipment can be properly serviced and replaced, if and when required. Advise the Departmental Representative of space problems before installing any material or equipment. Demonstrate to the Departmental Representative on completion of the work that all equipment installed can be properly, safely serviced and replaced, if and when required.

1.14 SPRINKLER PROOF REQUIREMENTS

.1 In sprinklered rooms where electrical equipment is installed surface mounted, electrical equipment contained in these rooms to be protected by non-combustible driphoods, shields, and gasketed doors as applicable to inhibit water ingress into electrical equipment. Exposed conduits connected to equipment to utilize watertight connectors.

1.15 EQUIPMENT RESTRAINT

.1 It is the entire responsibility of equipment manufacturers to design their equipment so that the strength and anchorage of internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.

1.16 WARRANTY

.1 Use of installed equipment during construction shall not shorten or alter the warranty period as specified in the Division 01 01 50.

.2 Take note of any extended warranties specified.

.3 Furnish a written warranty stating that all work executed under this Division will be free from defects of material and workmanship for a period of one year from the date of substantial performance.

.4 Promptly investigate any electrical or control malfunction, and repair or replace all such defective work and all other damages thereby which becomes defective during the time of the warranty.

1.17 EXAMINATION

.1 A site visit before the close of tender to be communicated with the Departmental Representative. No extra cost will be considered for any misunderstanding of work to be done.

.2 Examine the documents for details of work included. Obtain a written clarification in the event of conflict within the specification, between the specifications and the drawings, or in the drawings. Obtain written clarification from the Departmental Representative if work affecting the installation is not clear. Where this is not done in advance, allow in the tender sum for providing the more costly alternative.

1.18 RESPONSIBILITIES

.1 Ensure that equipment does not transmit noise and/or vibration to other parts of the building, as a result of poor installation practice.

.2 The Drawings and Specifications complement each other and what is called for by one is binding as if called for by both. If there is any doubt as to the meaning or true intent due to a discrepancy between the Drawings and Specifications, obtain a ruling from the Departmental Representative **prior** to Tender closing. Failing this, the most expensive alternative is to be allowed for.

.3 The Contractor shall advise the Departmental Representative during the Tender period of any specified material or equipment which is either no longer available from manufacturers or whose delivery is likely to exceed the requirements of the anticipated Construction Schedule. Failure of the Contractor to perform the above shall cause the Contractor to supply, at his own expense, alternate material or equipment as selected by the Departmental Representative at a later date. Alternatively, the Contractor shall procure the specified material or equipment at his own additional expense by means of air freight or other special means of transportation.

.4 Advise the Departmental Representative of any specified equipment, material, or installation of same which appears inadequate or unsuitable or which is in violation of laws, ordinances, rules, or regulations of authorities having jurisdiction. Provide all labour and materials which are obviously necessary or reasonably implied to be necessary to complete the work as if the work was shown on the Drawings and/or described in the Specifications.

.5 Check Drawings of all trades and coordinate the installation of all material and equipment to ensure adequate space and free access and to maintain headroom limitations for all new and indicated future work. Work out jointly, with all Subcontractors on the site, solutions to interference problems. Coordinate all work before fabricating or installing any material or equipment. It is incumbent on all Subcontractors on the site to ensure that all materials and equipment fit into the allocated spaces and that all equipment can be properly inspected, serviced and replaced if and when required. Advise the Departmental Representative of space problems before fabricating or installing any material or equipment. Demonstrate to the Departmental Representative on completion of his work that all equipment and material installed by him can be properly and safely serviced and replaced. Make no deviations from the intent of the design, or any involving additional cost, without the Departmental Representative’s written direction.

.6 Where electrical work and materials are noted as being provided by the Departmental Representative or under other Divisions of these Specifications, the responsibility for integrating, to the extent required, such work and materials into the complete installation, shall remain within Division 26.

.7 Protect equipment and material from the weather, moisture, dust and physical damage.

.8 Cover equipment openings and open ends of conduit, piping and pullboxes as work progresses. Failure to do so will result in the Trade being required to adequately clean or replace materials and equipment at no extra cost to the Departmental Representative.

.9 Protect all existing services encountered. Obtain instructions from the Departmental Representative when existing services require relocation or modification.

.10 Refinish damaged or marred factory finish to factory finish.

.11 The specifications and drawings form an integral part of the Contract Documents. Neither the drawings nor the specifications shall be used alone. Work omitted from the drawings but mentioned or reasonably implied in the specifications, vice versa, shall be considered as properly and sufficiently specified and shall be provided. Misinterpretation of any requirement of either plans or specifications shall not relieve this Contractor of the responsibility of properly completing his trade to the approval of the Departmental Representative.

1.19 EQUIPMENT LIST

.1 Submit a completed Equipment List, showing the make of equipment and material included in the Tender, including the names of the subtrades, 10 days after the award of the Contract.

.2 The equipment list shall be a full list of materials or systems intended for installation.

1.20 PROGRESS CLAIM AND CHANGE ORDER BREAKDOWNS

.1 Ten days after the award of contract, submit detailed progress claim breakdown for each division. Items to be included but shall not be necessarily limited to the following:

.1 Site services

.2 Distribution

.3 Feeders

.4 Branch circuit wiring, conduit and boxes

.5 Wiring devices

.6 Mechanical equipment and wiring

.7 Low tension

.8 Testing and commissioning

.9 As-built drawings and maintenance manuals

.10 Mobilization; not to exceed 2% of the contract value

.2 Progress claims will not be certified nor payment made beyond 95% of the overall Electrical contract until commissioning and verification of the systems are complete. This procedure is to allow for any necessary deficiency holdbacks on items which do not become apparent until the systems are commissioned.

.3 Change order breakdowns shall include but not be necessarily limited to the following:

.1 Labour hours per unit of material or equipment to be added, deleted or altered

.2 Units of material or equipment to be added or deleted.

.3 Per unit cost of material, equipment and labour broken down by category of labour and type of material or equipment

.4 Extensions of the above to arrive at total costs

.5 Miscellaneous and identifiable charges such as re-stocking, overhead, profit, etc

1.21 PROJECT CLOSE-OUT REQUIREMENTS

.1 Refer to Section 01 01 50.

.2 Refer to detailed specifications in each section for detailed requirements. Provide the following list of required substantial completion submissions.

.1 Final electrical inspector certificate.

.2 Drafted as-built drawings.

.3 Operating and maintenance manual.

.4 Contractors letter of guarantee.

.5 Complete Demonstration of systems to Departmental Representative.

.3 Record drawings to be submitted to the Departmental Representative and all life safety systems must be operational, verified and tested and demonstrated to Departmental Representative prior to issuance of Schedule C.

1.22 SUBSTANTIAL PERFORMANCE REQUIREMENTS

.1 Before the Departmental Representative is requested to make an inspection for substantial performance of the work:

.1 Commission all systems and prove out all components, interlocks and safety devices.

.2 Submit a letter certifying that all work is complete for the intended use, operational, clean and all required submissions have been completed.

.3 A complete list of incomplete or deficient items shall be provided by the Contractor. If, in the opinion of the Departmental Representative, this list indicates the project is excessively incomplete, a substantial completion inspection will not be performed.

.2 The work will not be considered to be ready for use or substantially complete until the following requirements have been met:

.1 All reported deficiencies have been corrected.

.2 Operating and Maintenance Manuals completed.

.3 "As Built" Record Drawing ready for review.

.4 Systems Commissioning has been completed and has been verified by Departmental Representative.

.5 All demonstrations to the user have been completed.

.6 All documents required have been submitted.

.3 Letters of Assurance will not be issued until the following requirements have been met:

.1 All items listed in 1.22 above have been completed or addressed.

.2 Certificate of penetrations through separations have been sealed and labelled with certified fire stopping material.

.3 Provincial Electrical Inspection - Certificate of inspection.

.4 final inspection report.

.5 Certificate of Substantial Performance.

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Section 01 01 50.

.2 Do verification requirements in accordance with Section 01 01 50.

2.2 MATERIALS AND EQUIPMENT

.1 Provide materials and equipment in accordance with Section 01 01 50 and as follows.

.2 Material and equipment to be CSA certified. Where CSA certified material or equipment is not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval.

.3 Where equipment or materials are specified by technical description only, they are to be of the best commercial quality available for the intended purpose.

2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

.1 Provide all power and electrical system related control wiring, conduit, wire, fittings, connectors, and hardware for all mechanical equipment unless otherwise specified.

.2 Ground all motors to conduit system with separate grounding conductor in flexible conduit or bonding conductor in the flexible conduit.

.3 Connections shall be made with watertight flexible conduit with watertight connectors.

.4 Control wiring and conduit standards are specified in the Electrical Divisions. Refer to Mechanical Divisions for scope of work and particular details.

2.4 WARNING SIGNS

.1 Provide warning signs, as specified or to meet requirements of Inspection Department and Departmental Representative.

.2 Use decal signs, minimum 175 x 250 mm size.

2.5 WIRING TERMINATIONS

.1 Lugs, terminals, screws used for termination of wiring to be suitable for copper conductors.

2.6 EQUIPMENT IDENTIFICATION

.1 Identify all electrical equipment including but not limited to starters, disconnects, remote ballasts and controls with nameplates and labels.

.2 Adhesive Labels:

.1 Good quality vinyl, self-laminating label as T & B E-Z Code WSL, Dymo Letratag or Brother P-Touch equivalent printable markers. Embossed Dymo or any labels with edges and corners that are prone to lift will be rejected.

2.7 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour code to CSA C22.1-15.

.4 Use colour coded wires in communication cables, matched throughout system.

2.8 CONDUIT, CABLE AND PULLBOX IDENTIFICATION

.1 All junction boxes, pull boxes and their covers shall be painted according to the colour coding schedule.

.2 Code with 25 mm plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor and at 15 m intervals.

.3 Colour coding to be as follows unless otherwise specified:

COMPONENT	*RACEWAY AND JUNCTION BOXES*	*RECEPTACLES AND OTHER*
Normal 120/208, 240 volt	Gray	White
Normal 347/600 volt	Sand	White
Emergency 120/208, 240 volt	Green with red bands	Red
Emergency 347/600 volt	Sand with red bands	n/a
Fire Alarm	Red	Strobe (red)

COMPONENT	*RACEWAY AND JUNCTION BOXES*	*RECEPTACLES AND OTHER*
Low voltage		
-switching/controls	Black	
-emergency/exit lighting	Black with red bands	
-security	Black with blue bands	Strobe (blue)
-mechanical alarms	Black with yellow bands	Strobe (amber)

2.9 FINISHES

.1 Shop finish metal enclosure surfaces by removal of rust and scale, cleaning, application of rust resistant primer inside and outside and at least two coats of finish enamel.

.2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original finish.

.3 Clean and prime paint exposed hangers, racks, fastenings to prevent rusting. Finish painting shall be provided by Division 09.

2.10 WIRING & CABLES – GENERAL

.1 Conductors: stranded for 12 AWG and larger. Minimum size #12 AWG.

.2 Insulation to be 1000 volt RW90XLPE (X link) for the general building wiring in conduit, unless otherwise specified.

.3 Main feeders to be conduit and insulated copper wiring unless otherwise noted on drawings. Provide ground wiring for all conduits in or below slabs. Increase conduit size as required.

.4 Conductors within cable trays shall have ‘plenum’ rated (FT6 type) outer jacket to comply with all applicable regulations and bylaws.

.5 Conductors to be colour-coded. Conductors No.10 gauge and smaller shall have colour impregnated into insulation at time of manufacture. Conductors size No.8 gauge and larger may be colour-coded with adhesive colour coding tape, but only black insulated conductors shall be employed in this case, except for neutrals which shall be white wherever possible. Where colour-coding tape is utilized, it shall be applied for a minimum of 50 mm at terminations, junctions and pullboxes and condulet fittings. Conductors shall not be painted.

2.11 FASTENING TO BUILDING STRUCTURE

.1 General:

.1 Do not use inserts in base material with a compressive strength less than 13.79 MPa (2000 psi).

.2 All inserts supporting conduit racks shall have a factor of safety of 5. All other inserts shall have a factor of safety of 4.

.2 Types:

.1 Cast-in-place type:

.1 Channel type - Burndy, Canadian Strut, Unistrut, Cantruss or Hilti Channel.

.2 Wedge type galvanized steel concrete insert, Grinnell Fig. 281 for up to 200 mm (8") pipe size.

.3 Universal type malleable iron body insert, Grinnell Fig. 282 for up to 200 mm (8") pipe size.

.2 Drilled, mechanical expansion type:

.1 Hilti HSL or UCAN LHL heavy duty anchor for use in concrete with compressive strength not less than 19.6 MPa (2840 psi).

.2 Hilti Kwik-Bolt or UCAN WED stud anchor for concrete. (Do not use in seismic restraint applications).

.3 Hilti HDI or UCAN IPA drop-in anchor for concrete.

.4 Hilti or UCAN Sleeve Anchor (medium and light duty) for concrete and masonry.

.5 Hilti ZBP or UCAN Zamac pin bolt (light duty) for concrete and masonry.

.3 Drilled, adhesive type:

.1 Hilti HVA or UCAN Adhesive Anchor consisting of anchor rod assembly with a capsule containing a two-component adhesive, resin and hardener.

.2 Hilti HY150 consisting of anchor rod with a 2 part adhesive system.

.3 For use in concrete housekeeping bases (in vertical downward position) where the distance to the edge of the concrete base could cause weakness if a mechanical expansion type anchor were used.

.4 Rod assemblies shall extend a minimum of 50 mm (2") into the concrete slab below the housekeeping bases.

.3 Note:

.1 All drilling for inserts shall be performed using the appropriate tool specifically designed for the particular insert. The diameter and depth of each drilled hole shall be to the exact dimensions as specified by the insert manufacturer.

.2 Refer to manufacturer's recommendations for tightening torques to be applied to inserts.

.3 Where specifically called for, drills shall include a dust vacuum system, Hilti SAV Dust Vacuum System.

.4 One hole steel straps to secure surface conduits 27 mm and smaller. Use two hole steel straps to conduits larger than 27 mm.

2.12 EQUIPMENT SUPPORTS

.1 Provide stands and supports for equipment and materials supplied.

.2 Construct equipment supports of structural steel. Securely brace. Employ only welded construction. Bolt mounting plates to the structure.

.3 Support ceiling hung equipment with rod hangers and/or structural steel.

2.13 MISCELLANEOUS METAL

.1 Be responsible for all miscellaneous steel work relative to Electrical Divisions of the Specifications, including but not limited to:

.1 Support of equipment.

.2 Hanging, support, anchoring, guiding and relative work as it applies to wiring raceways and electrical equipment.

.3 Earthquake restraint devices - refer also to “Seismic Restraint” sections

.4 Bridle rings - secure to structure or steel supports.

.2 All steel work shall be primed and undercoat painted ready for finish under the related Division.

2.14 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for incorporation into maintenance manual specified in Section 01 01 50 and as follows.

.2 Include in operations and maintenance data:

.1 Details of design elements, construction features, component function and maintenance requirements, to permit effective operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.

.2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists. Advertising or sales literature not acceptable.

.3 Wiring and schematic diagrams.

.4 Names and addresses of local suppliers for items included in maintenance manuals.

.3 Include in the manual the following major sections:

.1 Title page (in plastic cover).

.2 Comprehensive description of the operation of the systems, including the function of each item of equipment within the system.

.3 Detailed instructions for the normal maintenance of all systems and equipment installed including procedures and frequency of operational checks and service and trouble shooting instructions.

.4 Local source of supply for each item of equipment.

.5 Wiring and control diagrams.

.6 Spare parts list.

.7 Copies of guarantees and certificates.

.8 Manufacturer's maintenance brochures and shop drawings.

.9 Test and inspection reports.

.4 Submit a draft copy to the Departmental Representative for approval thirty days prior to start up of the systems and equipment.

2.15 PROJECT RECORD DRAWINGS

.1 Refer to Section 01 01 50.

.2 During the construction period, maintain on Site a clean set of drawings and specifications marked up clearly and indelibly in red, indicating "As-Built" conditions where such conditions deviate from the original directions of the Contract Documents and indicating final installation of feeders and branch circuits.

.3 “As-Built” drawing markings shall include but shall not be limited to the following:

.1 All changes in circuiting.

.2 Size and routing of all conduits for all branch circuits including power, lighting and systems. Note that branch circuit wiring is generally not shown on Drawings. Accurately record “As-Built” drawings the size and routing of all installed raceways and cables.

.3 Number and size of conductors (#10 AWG and larger) in raceways and cables.

.4 Location of all junction boxes and pullboxes.

.5 Location of all conduits or duct stubs, installed equipment, devices and fixtures.

.6 All changes to electrical installation resulting from Addenda, Change Orders and Field Instructions.

.7 Exact location of all services left for future work.

.8 Location by accurate horizontal and vertical dimensions of the routes and terminations of all raceways and cables installed underground beyond the building.

Part 3 EXECUTION

3.1 INSTALLATION

.1 Do complete installation in accordance with CSA C22.1 2015 except where specified otherwise.

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

.3 Comply with CSA Electrical Bulletins and Local Authorities having jurisdiction.

3.2 NAMEPLATES AND LABELS

.1 Ensure manufacturers nameplates and CSA labels are visible and legible after equipment is installed.

3.3 CONDUIT AND CABLE INSTALLATION

.1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit and protruding 50 mm.

.2 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

.3 Install roof jacks where conduit and cables penetrate roofs. Apply sealant after installation.

.4 All cables and conduits shall be concealed in finished areas.

3.4 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 indicated verify before proceeding with installation.

.3 Refer to detail on architectural drawings.

3.5 DELIVERY AND STORAGE

.1 Store all electrical equipment and devices other than conduits, fittings, boxes, and ducts in a heated and ventilated space, and protect from construction damage. Include in the tender price all costs related to such storage.

.2 Conduits, fittings, boxes, and ducts may be stored outside if properly protected against the weather.

.3 Ship and store floor mounted equipment in upright position.

.4 Ship equipment in adequate containers to assure it arrives undamaged at the site.

.5 Keep equipment doors locked. Protect equipment from damage and dust.

.6 Block moving parts when necessary to prevent damage during movement and shipment of equipment.

.7 Remove from the site, and replace with new, all materials showing evidence of damage or rust.

3.6 FIELD QUALITY CONTROL

.1 Load and Balance:

.1 Measure voltage and phase & neutral currents to panelboards with normal loads operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Conduct and pay for the following tests:

.1 Motors, and associated control equipment including sequenced operation of systems where applicable.

.3 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.4 Reports:

.1 Provide written reports in a timely manner upon completion of the testing and load balance. Indicate test hour and date.

3.7 DEMONSTRATION

.1 Demonstrate to and instruct the Departmental Representative on operating and maintenance procedures for all electrical systems using the assistance of specialist sub-trades and manufacturer's representatives for instruction and include all costs in the tender. Systems to be demonstrated shall include, but not be limited to, the following:

.1 Routing and installation of major feeders, cable trays, control conductors, grounding, and other systems as applicable.

.2 Arrange an acceptable time with the Departmental Representative and submit a program of instruction and demonstration for the Departmental Representative's approval. Assume that the Departmental Representative is not familiar with any of the special equipment and/or systems installed.

.3 Submit to the Departmental Representative, at the time of Substantial Performance inspection, a complete list of systems stating for each system:

.1 Date of instruction.

.2 Duration of instruction.

.3 Name of persons instructed.

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

.5 Signature of the Departmental Representative stating that they properly understood the system installation, operation, and maintenance requirements and identifying any systems or equipment which were not demonstrated to their satisfaction and which must be re-demonstrated.

3.8 CLEANING

.1 Do final cleaning in accordance with Section 01 01 50.

.2 At time of final cleaning, clean lighting reflectors, lenses and other lighting surfaces that have been exposed to construction dust and dirt.

.3 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.4 Clean and prime paint exposed non-galvanised hangers, racks, fastenings to prevent rusting. Coordinate finish painting with Section 01 01 50.

3.9 WORKMANSHIP

.1 Workmanship shall be in accordance with well established practice and standards accepted and recognized by the Departmental Representative and the Trade.

.2 The Departmental Representative shall have the right to reject any item of work that does not conform to the Contract Documents and accepted standards of performance, quietness of operation, finish and appearance.

.3 Employ only tradesmen holding valid Provincial Trade Qualification Certificates. Tradesmen shall perform only work that their certificate permits. Certificates shall be available for inspection by the Departmental Representative.

3.10 PROTECTION OF WORK

.1 Protect equipment and materials, stored or in place, from the weather, moisture, dust and physical damage.

.2 Refinish damaged or marred factory finish.

3.11 PROTECTION ELECTRICAL EQUIPMENT

.1 Protect exposed live equipment during construction for personnel safety.

.2 Shield and mark live parts, e.g. "LIVE 120 VOLTS".

.3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.

3.12 CONCEALMENT

.1 Conceal wiring and conduit in partitions, walls, crawlspaces and ceiling spaces, unless otherwise noted.

.2 Do not install wiring and conduit on outside walls or on roofs unless specifically directed.

3.13 SERVICE PENETRATIONS IN RATED FIRE SEPARATIONS

.1 Refer to 07 84 00.

.2 All cabling, wiring, conduits, cable trays, etc. passing through rated fire separations shall be smoke and fire stopped to a ULC or cUL tested assembly system, in accordance with CAN4-S115-95, that meets the requirements of the Building code in effect.

.3 The scope includes new services which pass through existing rated separations and also all existing services which pass through a new rated separation or existing separations whose rating has been upgraded.

.4 Fire resistance rating of installed firestopping assembly shall not be less than fire resistance rating of surrounding assembly indicated on Architectural drawings. Where this is not indicated assume a minimum of one hour for walls and two hours for floors.

.5 Install firestopping and smoke seal material and components in accordance with ULC certification and manufacturer's instructions. The Applicator shall be approved, licensed and supervised by the manufacturer in the installation of firestopping and are to follow the requirements of a rated system as detailed above.

.6 Contractors are expected to submit system information detailing firestopping product, backing, penetration, penetrated assembly, fire and temperature rating, and ULC or cUL system number.

.7 Provide fire stopping material and system information in the maintenance manuals and via labels at major penetrations that are likely to be re-penetrated.

.8 Allow openings for 100% capacity of raceway.

.9 Provide split systems where existing cables are involved.

3.14 SERVICE PENETRATIONS IN NON-RATED SEPARATIONS

.1 Provide metal sleeves for all cabling, wiring, conduits, cable trays, etc. passing through non-rated fire separations and non-rated walls and floors shall be tightly fitted and sealed on both sides of the separation with caulking or silicon sealant to prevent the passage of smoke and/or transmission of sound.

3.15 EQUIPMENT INSTALLATION

.1 Provide means of access for servicing equipment.

.2 CSA identification and equipment labels to be clearly visible after installation.

3.16 COORDINATION

.1 Coordinates starting of electrical equipment and systems with testing, adjusting and balancing, and demonstration and instruction of:

.1 Electrical equipment and systems specified in Division 26.

.2 Mechanical equipment and systems specified in Division 21, 22, 23 & 25.

.3 Other equipment and systems specified in other Divisions.

.2 Where any equipment or system requires testing, adjusting or balancing prior to starting, ensure that such work has been completed prior to starting of electrical equipment and systems.

3.17 STARTING MOTORS

.1 Prior to starting motors:

.1 Perform Megger test on the motors.

.2 Verify phase rotation at motor control centres.

.3 Confirm motor nameplate data with motor starter heater overloads.

3.18 ENERGIZING EQUIPMENT

.1 Complete all testing and provide testing result to Departmental Representative prior to energizing equipment.

.2 Confirm equipment nameplate data with characteristics of power supply.

3.19 CUTTING, PATCHING, DIGGING, CANNING, CORING & CONCRETE

.1 Lay out all cutting, patching, digging, canning and coring required to accommodate the electrical services. Coordinate with other Divisions. The performance of actual cutting, patching, digging, canning and coring is specified under other Divisions.

.2 Be responsible for correct location and sizing of all openings required under Electrical Divisions, including piped sleeves.

.3 Openings through structural members of the building shall not be made without the approval of the Departmental Representative.

.4 Openings in Concrete:

.1 Be responsible for the layout of all openings in concrete, where openings are not left ready under previous contract.

.2 All openings shall be core drilled or diamond saw cut.

.3 Refer to structural drawings for permissible locations of openings and permissible opening sizes in concrete floors and walls.

.4 Be responsible for repairing any damage to steel reinforcing.

.5 Openings in building surfaces other than concrete:

.1 Lay out all openings required.

.6 Poured concrete for duct encasements, pole bases, transformer pads and housekeeping pads shall be provided by other Divisions, coordinated and supervised by the Electrical Divisions.

.7 Excavation and backfilling will be provided by other Divisions. This division to supervise the work and provide all layouts and parameters.

3.20 PAINTING

.1 Clean exposed bare metal surfaces supplied under the Electrical Divisions removing all dirt, dust, grease and mill scale. Apply at least one coat of corrosion resistant primer paint to all supports and equipment fabricated from ferrous metal.

.2 Paint all hangers and exposed sleeves, in exposed areas, with a rust inhibiting primer, as they are installed.

.3 Repaint all marred factory finished equipment supplied under the Electrical Divisions, to match the original factory finish.

.4 Coordinate with Division 09.

.5 Finish painting of all equipment and materials, supplied under the Electrical Divisions, installed in Electrical Rooms of the building or exposed outside the building, is included under Division 09 of the Specification.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.2 CSA C22.1-12

.3 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)

.4 All grounding conductors to be stranded soft annealed copper unless otherwise noted.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 01 01 50.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 01 50.

Part 2 Products

2.1 MATERIALS

.1 Grounding equipment to: CSA C22.2 No.41-M87 (R99).

2.2 EQUIPMENT

.1 Clamps for grounding of conductor, size as required.

.2 Copper conductor at least 6m long for each concrete encased electrode, bare, stranded, soft annealed, size as indicated. If not indicated, use 3/0AWG which is the maximum in Table 43 CEC.

.3 Rod electrodes, copper clad steel 20mm dia by 3m long as indicated.

.4 System and circuit, equipment, grounding conductors, bare stranded copper, soft annealed, sized as indicated. Insulation where specified to be green.

.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 INSTALLATION GENERAL

.1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories.

.2 Provide separate, insulated, copper bonding conductor in EVERY conduit used for power, lighting, fire alarm and every low tension system required in the building. Where wire size is not indicates, provide minimum size per applicable CEC tables.

.3 Install connectors in accordance with manufacturer's instructions.

.4 Protect exposed grounding conductors from mechanical injury.

.5 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process or permanent mechanical connectors approved for the use.

.6 Use mechanical connectors for grounding connections to equipment provided with lugs.

.7 Soldered joints not permitted.

.8 Install bonding wire for flexible conduit, connected at both end to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit. Provide a ground conductor in all flexible conduit and secure to system grounding lugs at both the equipment and source.

.9 Connect building structural steel and metal siding to ground by welding copper to steel.

.10 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

.11 Bond single conductor, metallic armoured cables to cabinet at supply end and provide non-metallic entry plate at load end.

.12 Coordinate ground rod installation with local soil conditions to assure proper grounding system.

3.2 EQUIPMENT GROUNDING AND BONDING

.1 Install bonding connections to typical equipment included in, but not necessarily limited to following list. Frames of motors, starters, control panels, building steel work, distribution panels, cable systems.

3.3 MECHANICAL EQUIPMENT BONDING

.1 Ground wires to be installed in all conduit serving motor feeder circuits and to extend to ground screws on junction and outlet boxes for bonding.

3.4 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – Common Work.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions.

.3 Carry out all tests required by the Electrical Inspection Authority and provide all required reports and copied to the Departmental Representative. Include all associated costs.

.4 Ensure test results are satisfactory before energizing the electrical system.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

.1 Supply and install all hangers, supports and inserts for the installation shown on the drawings and specified herein, as necessary to fasten electrical equipment securely to the building structure.

.2 Supply all additional and new support structures as required due to relocations, extensions and modifications of the electrical infrastructure.

1.2 RELATED WORK

.1 Section 26 05 00 – Common Work:

Part 2 Product

2.1 FRAMING AND SUPPORT SYSTEM

.1 Materials:

.1 Intermediate duty supporting structures shall employ P1000 Unistrut or equal together with the manufactures connecting components and fasteners for a complete system.

.2 Heavy duty supporting structures to be fabricated and welded from steel structural members and prime painted before installation.

.2 Finishes:

.1 Outdoors, wet locations: Hot dipped galvanized.

.2 Indoors, dry locations: Galvanized when available, prime painted if not available.

.3 Nuts, bolts, machine screws: Cadmium plated.

.3 Unistrut:

.1 Section P1000 or as required for load and span, with mounting screws, or approved. P1000 or equal is a minimum standard for supporting conduits 50 mm and larger.

2.2 CONCRETE AND MASONRY ANCHORS

.1 Materials: Hardened steel inserts, zinc plated for corrosion resistance. All anchor bolts must be galvanized.

.2 Components: non-drilling anchors for use in predrilled holes, sized to safely support the applied load with a minimum safety factor of four.

2.3 NON-METALLIC ANCHORS

.1 Material: Plastic anchors for sheet metal screws.

2.4 CONDUIT SUPPORTS

.1 General: Malleable iron two-hole conduit straps where exposed to weather. Stamped steel two-hole straps indoors.

.2 Structural Steel: Bolt on clamp type supports.

.3 Masonry, concrete, stone, etc.: Anchors.

.4 Title: Toggle bolts.

.5 Metal studs, ceiling hangers, etc.: Push-on, snap in type supports

.6 Unistrut: Unistrut conduit clamps.

2.5 CABLE SUPPORTS AND CLAMPS

.1 General: As per conduit supports, except that for single conductor cables, suitable non-ferrous or approved stainless steel or aluminum clamps shall be used.

Part 3 Execution

3.1 GENERAL

.1 Do not cut or drill beams, joists or structural steel unless written permission of the Departmental Representative is obtained.

.2 Distance between conduit or cable supports not to exceed code requirements.

.3 Supports to be suitable for the real loads imposed by equipment.

.4 Supports to be securely fastened, free from vibration and excessive deflection or rotation. Maximum deflections are 4 mm over a 1 meter span and 8 mm over a 2 meter span.

.5 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer’s installation recommendations.

.6 Provide conduit rack with 25% spare capacity for multiple runs.

.7 Provide channel support with fittings for vertical runs of conduit and cables.

3.2 INSTALLATION

.1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors.

.2 Secure equipment to poured concrete with expandable inserts.

.3 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.4 Fasten exposed conduit or cables to building construction or support system using straps.

.1 One-hole malleable iron or steel straps to secure surface conduits and cables 50 mm and smaller.

.2 Two-hole steel straps for conduits and cables larger than 50 mm.

.3 Beam clamps to secure conduit to exposed steel work.

.5 Suspended support systems.

.1 Support individual cable or conduit runs with 6 mm dia. threaded rods and spring clips.

.2 Support 2 or more cables or conduits on channels supported by 6 mm dia. threaded rod hangers where direct fastening to building construction is impractical.

.6 Shot driven pins may only be used with written approval of the structural engineer.

.7 Use round or pan head screws for fastening straps, boxes, etc.

.8 Do not support heavy loads from the bottom chord of open web steel joists.

.9 Support outlet boxes, junction boxes, panel tubs, etc., independent of conduits running to them. Support conduits within 600 mm of outlet boxes. Support surface mounted panel tubs with a minimum of four 6 mm fasteners.

.10 For surface mounting of two or more conduits use channels at 1.5 m oc spacing.

.11 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.12 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.13 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of the Departmental Representative.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 01 50 – General Instructions

.2 Section 26 05 00 - Common Work

1.2 REFERENCES

.1 CSA C22.1-12.

.2 Canadian Standards Association (CSA) CAN/CSA C22.2.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 01 01 50.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 01 50.

1.5 SCOPE OF WORK

.1 Provide any additional and new conduit as required to meet the intent and operation of the electrical and mechanical systems as shown.

.2 Drawings do not show all conduits. Those shown are in diagrammatic form only.

.3 Conceal all conduits in finished areas. Conduits may be surface mounted either only where indicated or in service areas accessible only to authorized personnel.

.4 Note particular requirements for routing of conduits where detailed.

.5 Provide polypropylene pull cord in all “empty” conduits.

.6 Conduits and boxes penetrating rated fire walls, ceilings and floors shall be properly firestopped and sealed for fire and smoke travel.

Part 2 Products

2.1 CONDUITS

.1 Rigid metal conduit: to CSA C22.2 No.45 Galvanized Steel.

.2 Electrical Metallic Tubing (EMT): to CSA C22.2 No.83.

.3 Flexible conduits: to CSA C22.2 No. 56.

.4 Minimum conduit size in the project to be 21mm (3/4') diameter (for power as well as low tension services).

2.2 CONDUIT FASTENINGS

.1 One hole steel straps to secure surface conduits 27 mm and smaller. Use two hole steel straps to conduits larger than 27 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits.

.4 10 mm threaded rods to support suspended channels.

2.3 CONDUIT FITTINGS

.1 Fittings manufactured for use with conduits specified. Coating same as conduit.

.2 Provide factory "ells" where 90 degree bends are required for 35 mm and larger conduits.

.3 EMT couplings and connectors shall be steel. Regular die-cast alloy fittings and couplings are not acceptable. Provide plastic bushings (insulated throat) for all connectors unless there is no chance of burrs. Provide water-tight connectors in damp or wet locations and for surface equipment (e.g. Panelboards, MCC's, etc) in rooms that are fire sprinkler protected.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

.1 Weatherproof expansion fittings with internal bonding assembly suitable linear expansion.

.2 Water-tight expansion fittings: with integral bonding jumper, suitable for linear expansion and 19 mm deflection in all directions.

.3 Weatherproof expansion fittings for linear expansion at entry to panel as required.

2.5 RIGID P.V.C. CONDUIT

.1 Conduit: rigid non-metallic conduit of unplasticized polyvinyl chloride as manufactured C.G.E. "Sceptre" Schedule 40.

.2 Fittings: threaded male or female solvent weld connectors and solvent weld couplings, as supplied by conduit manufacturer.

.3 Solvent: as recommended by conduit manufacturer.

2.6 OUTLET AND CONDUIT BOXES IN GENERAL

.1 Size boxes in accordance with CSA C22.1.

.2 102 mm square or larger outlet boxes as required for special devices.

.3 Gang boxes where wiring devices are grouped. Do not use sectional boxes.

.4 Blank cover plates for boxes without wiring devices.

.5 Combination boxes with barriers where outlets for more than one system are grouped.

.6 Bushing and connectors with nylon insulated throats.

.7 Knock-out fillers to prevent entry of foreign materials.

.8 Conduit outlet bodies for conduit up to 35 mm. Use pull boxes for larger conduits.

.9 Double locknuts and insulated bushings on sheet metal boxes.

2.7 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. Larger 102 mm square x 54 mm deep outlet boxes (No. 52151 or 52171) to be used when more than one conduit enters one side. Provide extension and plaster rings as required.

.2 For larger boxes use GSB solid type as required.

.3 Boxes for surface mounted switches, receptacles, communications, telephone to be 100mm square No. 52151 or 52171 with Taylor 8300 series covers.

.4 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster and/or tile walls.

2.8 MASONRY BOXES

.1 Electro-galvanized steel masonry single and multi gang type MDB boxes for devices flush mounted in exposed block walls.

2.9 SURFACE CONDUIT BOXES

.1 Cast FS or FD aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacles.

Part 3 Execution

3.1 CONDUIT - GENERAL

.1 Generally use electrical metallic tubing (EMT) in the building interior and in above grade slabs except where subject to mechanical injury or where otherwise indicated.

.2 Install all conduit and wiring concealed, unless otherwise shown on the drawings. Do not recess conduit in columns, except as noted, without permission.

.3 Lay out conduit to avoid interference with other work. Maintain a minimum clearance of 150 mm from steam or hot water piping, vents, etc.

.4 At all recessed panels cap 4 - 27 mm empty conduits from panel into ceiling above for future use.

.5 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass. Set out the work and coordinate with other services prior to installation. Maintain access to junction and pull boxes.

.6 Any conduit shown exposed in finished areas is to be free of unnecessary labels and trade marks.

.7 All conduit ends to be reamed to ensure a smooth interior finish that will not damage the insulation of the wiring.

.8 Ensure grounding continuity in all conduit systems.

.9 Use rigid galvanized steel (RGS) threaded conduit where the installation is subject to mechanical injury. In any event, use RGS conduit for surface installations up to 1.5 m (5') above the finished floor.

.10 Field threads on rigid conduit shall be sufficient length to draw conduits ends together.

.11 Unless otherwise noted and where practical, all conduits to be routed through the ceiling space rather than in, or below, slabs or floor structures to facilitate future changes.

.12 Conduits in walls should typically drop (or loop) vertically from above to better facilitate future renovations. Generally conduits from below and horizontal conduits in walls and concrete structures should be avoided unless indicated.

.13 Generally use Rigid PVC conduits in or below ground level slab unless otherwise noted. Transition to RGS conduit in exposed locations: e.g. where conduits emerge from ground level slab.

.14 Conduits are not permitted in terrazo or concrete toppings.

.15 Cap turned up conduits to prevent the entrance of dirt of moisture during construction.

.16 Locate conduits more than 75 mm parallel to steam or hot water lines with a minimum of 25 mm at crossovers.

.17 Bend conduits cold, so that conduit at any point is not flattened more than 1/10th of its original diameter. Conduits bent more than this or kinked to be replaced.

.18 Provide polypropylene pull cord in empty conduits to facilitate pulling wiring in future.

.19 Where conduits become blocked, the use of corrosive agents is prohibited. Remove and replace blocked section.

.20 Damaged conduits to be repaired or replaced.

.21 Dry conduits out thoroughly before installing wiring. Swab out conduit and thoroughly clean internally before wires and cables are pulled.

.22 Conduits shall not pass through structural members except as indicated.

.23 Conduit sizes indicated on drawings are minimum only. Increase sizes as required to suit alternative wiring types or to comply with Code.

.24 Conduits and ducts crossing building expansion joints shall have approved conduit expansion fittings to suit the type of conduit used.

.25 Seal conduits with approved sealant where conduits are run between heated and unheated areas.

.26 Seal openings with approved sealant where conduits, cables, or cable trays pierce fire separations.

.27 Where conduits pass through walls, they shall be grouped and installed through openings. After all conduits shown on the drawings are installed, wall openings shall be closed with material compatible with the wall construction and/or to meet any fire separation integrity.

.28 Where drawings show conduit designations, these conduits shall be identified at each point of termination with Thomas & Betts "Ty-Rap" No. TY532M labels.

.29 Use "Condulet" fittings for power and telephone type conduit terminations in lieu of standard boxes where box support is not provided.

.30 Provide necessary roof jacks or flashing where conduits pass through roof or watertight membranes. Apply approved sealant to maintain membrane integrity.

.31 Use flexible metal conduit for connection to recessed incandescent fixtures without a prewired outlet box and connection to recessed fluorescent fixtures.

.32 Use liquid tight flexible metal conduit for connection to motors, and other vibrating equipment and transformers.

.33 Use explosion proof flexible connection for connection to explosion proof motors.

.34 Install conduit-sealing fittings in hazardous areas, isolation rooms and clean rooms. Fill with compound.

3.2 SURFACE CONDUITS

.1 Surface conduits are acceptable in mechanical and electrical service rooms and in unfinished areas or where indicated.

.2 Run parallel or perpendicular to building lines.

.3 Locate conduits behind infrared or gas fired heaters with minimum 1.5 m clearance.

.4 Conduits to be run in flanged portion of structural steel.

.5 Group conduits wherever possible on suspended and/or surface channels.

.6 Surface conduits will not be accepted in finished areas unless detailed.

3.3 SPARE CONDUITS

.1 Provide spare conduits as indicated.

3.4 BOXES INSTALLATION

.1 Support boxes independently of connecting conduits.

.2 Ceiling outlet boxes to be provided for each surface mounted fixture or row of fixtures installed in other than T bar ceilings with removable tiles.

.3 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of construction material. Remove upon completion of work.

.4 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

.5 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers not to be used.

.6 All outlet boxes to be flush mounted in all areas, excluding mechanical rooms, electrical rooms, and above removable ceilings.

.7 Adjust position of outlets in finished masonry walls to suit masonry course lines. Coordinate cutting of masonry walls to achieve neat openings for all boxes. All cutting of masonry work for installation of electrical fittings to be done using rotary cutting equipment.

.8 No sectional or handy boxes to be installed.

.9 Provide vapour barrier wrap or boots behind outlets mounted in exterior walls. Maintain integrity of the vapour barrier and insulation to prevent condensation through boxes.

.10 Coordinate location and mounting heights of outlets above counters, benches, splash-backs and with respect to heating units and plumbing fixtures. Coordinate with architectural details.

.11 Outlets installed back to back in party stud walls to be off-set by one stud space.

.12 Refer to wiring device and communication specification sections and to architectural layouts for mounting heights of outlet boxes.

.13 Back-boxes for all communications systems equipment to be provided in accordance with specific manufacturer's recommendations and as specified in the communications sections of these specifications.

.14 Separate outlets located immediately alongside one another to be mounted at exactly the same height above finished floor. Similarly, outlets mounted on a wall in the same general location at varying heights to be on the same vertical centre-line unless otherwise noted.

.15 Where outlet boxes penetrate through a fire separation, ensure that the boxes are externally tightly fitted with an approved non-combustible material to prevent passage of smoke or flame in the event of a fire.

END OF SECTION

Part 1 General

1.1 INTENT

.1 Except where otherwise specified, arrange testing, adjusting, balancing and related requirements specified herein.

.2 If test results do not conform with applicable requirements, repair, replace, adjust or balance equipment and systems. Repeat testing as necessary until acceptable results are achieved.

.3 Provide all labour, materials, instruments and equipment necessary to perform the tests specified.

.4 All tests shall be witnessed by persons designated by the Departmental Representative, who shall also sign the test documentation.

1.2 RELATED WORK

.1 Section 26 05 00: Common Work

1.3 MANUFACTURER'S PRODUCTION TEST RECORDS

.1 If requested, submit copies of production test records for production tests required by EEMAC and CSA standards for manufactured electrical equipment.

1.4 SITE TESTING REPORTS

.1 Log and tabulate test results on appropriate test report forms. Submit forms to Departmental Representative for approval prior to use.

.2 Submit completed test report forms as specified, immediately after tests are performed.

1.5 REFERENCE DOCUMENTS

.1 Perform tests in accordance with:

.1 The Contract Documents

.2 Requirements of authorities having jurisdiction

.3 Manufacturer's published instructions

.4 Applicable CSA, IEEE, IPCEA, EEMAC and ASTM standards

.2 If requirements of any of the foregoing conflict, notify Departmental Representative before proceeding with test and obtain clarification.

1.6 SEQUENCING AND SCHEDULING

.1 Except where otherwise specified, perform all testing, adjusting, balancing and related requirements specified herein prior to Interim Acceptance of the Work.

.2 Perform voltage testing and adjusting after user occupancy or utilization of facility.

Part 2 Products

2.1 TEST EQUIPMENT

.1 Provide all equipment and tools necessary to perform testing, adjusting and balancing specified herein and as otherwise required.

Part 3 Execution

3.1 TESTING OF EQUIPMENT

.1 All power and control wiring shall be tested for insulation resistance value with a 1000 Volt megger. Resistance values shall be as recommended by cable manufacturer. Test results shall be properly tabulated, signed, dated and submitted with maintenance manuals.

.2 Test service grounding conductors for ground resistance.

.3 Test all wiring devices for correct operation.

.4 Prove the control devices and system integrity and operation to be same as existing.

.5 Test the operation and function of all motors and associated equipment.

END OF SECTION

APPENDIX A
EXISTING SHOP DRAWINGS

Date: February 14, 2015

BUILDING AUTOMATION SYSTEM

SUBMITTAL

Aldergrove Port Of Entry
10, HIGHWAY 13, LANGLEY, BC

Submitted To:
Canstar Mechanical Ltd
2071 Kingsway Avenue
Port Coquitlam, BC V3C 6N2

Submitted By:
Troy Bazille
Project Manager

JCI Contract: 4097-0088

Johnson Controls Inc
3680 East 2nd Avenue
Vancouver, Canada V5M 0A4
Tel: 604-707-5200
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STAMPS

Aldergrove Port of Entry DB

DRAWING INDEX		
Rev	Drawing	Description
	0.001	TITLE
	001 A	001.001(Riser Drawing)
	002 A	001.002(Main Port Ground Layout)
	003 A	001.003(Main Port Upper Floor Layout)
	004 A	001.004(Commercial Ground Layout)
	101 A	002.001(Chilled Water System-Main Bldg Control)
	101 B	002.002(Chilled Water System-Main Bldg Sequence of Operation)
	102 A	003.001(Hot Water System-Main Bldg Control)
	102 B	003.002(Hot Water System-Main Bldg Sequence of Operation)
	102 C	003.003(Hot Water System-Main Bldg Boiler Control Panel Wiring Diagram)
	102 D	004.001(Domestic HWS-Main. Bldg Control)
	201 A	005.001(Air Handling Unit-M1 Control)
	201 B	005.002(Air Handling Unit-M1 Sequence of Operation)
	201 C	005.003(Air Handling Unit-M1 SF & RF Wiring)
	202 A	006.001(HRU-M1 Control)
	202 A1	HRU-M1 SEQUENCE OF OPERATION
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	202 C	007.001(HRU-M2 Control)
	202 C1	HRU-M2 SEQUENCE OF OPERATION
	202 D	007.003(HRU-M2 SF & RF Wiring)
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	301 B	008.002(VAV-Mx-CLG WITH RP Control)
	301 C	008.003(VAV-Mx-CLG WITH RP & ZN-CO2 Control)
	301 D	008.004(VAV-Mx-CLG WITH 2 RP & ZN-CO2 Control)
	301 E	008.005(VAV-Mx-CLG WITH ZN-CO2 & ZN-H Control)
	301 F	008.006(VAV-Mx-RH Control)
	301 G	008.007(VAV-Mx-Exhaust Control)
	302 A	008.008(RP Control)
	303 A	009.001(FC-Mx Control)
	401 A	010.001(EF-M1, EF-M2 ,EF-M3, EF-M5 & EF-M6 Control)
	401 B	010.002(EF-M4 Control)
	402 A	011.001(HUH-M1 & EF-M5 Control)
	403 A	012.001(FFH-Mx Control)
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DRAWING INDEX		
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	501 A	016.001(Chilled Water System-Comm Bldg Control)
	501 B	016.002(Chilled Water System-Comm Bldg Sequence of Operation)
	501 C	016.003(Chilled Water System-Comm Bldg Chiller Control Panel Wiring Diagram_Comm)
	502 A	017.001(Hot Water System-Comm. Bldg Control)
	502 B	017.002(Hot Water System-Comm. Bldg Sequence of Operation)
	502 C	017.003(Hot Water System-Comm Bldg Boiler Control Panel Wiring Diagram)
	503 A	018.001(Domestic HWS-Comm. Bldg Control)
	601 A	019.001(Air Handling Unit-C1 Control)
	601 B	019.002(Air Handling Unit-C1 Sequence of Operation)
	601 C	019.003(Air Handling Unit-C1 SF & RF Wiring)
	602 A	020.001(HRU-C1 Control)
	602 A1	HRU-C1 SEQUENCE OF OPERATION
	602 B	020.003(HRU-C1 SF & RF Wiring)
	602 C	021.001(HRU-C2 Control)
	602 C1	HRU-C2 SEQUENCE OF OPERATION
	602 D	021.003(HRU-C2 SF & RF Wiring)
	701 A	022.001(VAV-Cx-CLG Control)
	701 B	022.002(VAV-Cx-CLG WITH RP & ZN-CO2 Control)
	701 C	022.003(VAV-Cx-CLG WITH RP, ZN-CO2 & ZN-H Control)
	701 D	022.004(VAV-Cx-CLG WITH 2 RP & ZN-CO2 Control)
	701 E	022.005(VAV-Cx-CLG WITH ZN-CO2 & ZN-H Control)
	701 F	022.006(VAV-Cx-RH Control)
	701 G	022.007(VAV-Cx EXHAUST Control)
	702 A	023.001(FC-C1 Control)
	801 A	024.001(EF-C1, EF-C2, EF-C3 Control)
	801 B	024.002(EF-C4 Control)
	802 A	025.001(HUH-Cx Control)
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	803 B	027.001(EFFH-C1 Control)
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	805 A	029.001(NATURAL GAS METER Control)
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	901 C	032.004(EF-T2 & SUMP PUMP SEQUENCE OF OPERATION)
	902 B	033.002(POWER DISTRIBUTION PANEL CONTROL).
	WD-1	034.001(WIRING DETAILS-1)
	WD-2	034.002(WIRING DETAILS-2)
	AFMS-01	AFMS SCHEDULE
	DS-1	Damper Schedule
	PS-1	4097-0088 NAE Point Schedule Working Copy.xls
	RS-01	ROOM SCHEDULE
	VS-01	VALVE SCHEDULE

LEGEND

- S 20 — Main Air Supply Tube at 20 PSIG
- D-N 15-20 — Dual Air Supply Tube at 15/20 PSIG Day=15, Night=20
- S 80 — High Pressure Air Supply Tube at 80 PSIG
- Air line or Electrical Wire
- Connected Lines or Wires
- Crossing Lines or Wires, Not Connected
- In-Line Restrictor
- 7 — Pneumatic Tube indicating Tube Number
- 2/18 — Wire Symbol indicating: number of wires and size (E.G. 2 #18 wires)
- 3 → 2/18 — Wire Symbol indicating: Cable Destination (DA-T), Cable number (3), Number of wires and size (E.G. 2 #18 wires)
- 1 — Electrical Wire Terminal with Appropriate Number
- Item Located on Panel Face
- 1 — Drawing Revision Symbol with Appropriate Number
- NO — Opposed Blade Damper
- NO — Parallel Blade Damper
- Filter
- Air Flow Measuring Station
- Humidifier
- Fan
- Pump
- H/C — Heating or Cooling Coil
- Ductwork or Piping with Flow Direction Shown
- Gage
- Device
- Bulb Type Temperature Sensing Element Located under Shield in Outside air
- Humidity Sensing Element Located under Shield in Outside air
- Bulb Type Temperature Sensing Element Located inside Separable Socket/Well
- Strap-on Bulb Type Temperature Sensing Element
- Combination Bulb Type Temperature Sensing Element and Humidity Sensor (Duct Mount)
- Bulb Type Temperature Sensing Element
- Pressure Sensing Device
- Paddle Type Flow Switch
- Vapor Tension Temperature Sensing Element (Hi Limit)
- Vapor Tension Temperature Sensing Element (Low Limit)
- Current Sensing Switch or Combination Current Sensing switch & Command Relay
- Duct Detector (Smoke, CO, CO2)
- 2-Way Valve with Actuator — NC
- 3-Way Valve with Actuator — C, NC, NO

Johnson Controls

Creating a better climate for business.

- [x] Environmental Control System
- [x] Facility Management System
- [ ] Air and Water System Balancing
- [ ] Fire Management System
- [ ] Security System
- [ ] Lighting Services
- [ ] Instrumentation System Installation
- [ ] Building Operations Management
- [ ] Energy Conservation Control
- [ ] Training Programs
- [ ] Performance Contracting
- [ ] Planned Service Agreements

Air Conditioning
Heating
Diagnostic Services
Coil Cleaning
Refrigeration
Automatic Temperature Controls
Facility Management Systems
Fire Management
Security Management
Building Operations and Management
Water Treatment
Electrical Equipment
Emergency Generator / Lighting Equipment
Industrial Controls / Recording / Indication Equipment

PROJECT TITLE

Aldergrove Port Of Entry
LANGLEY, BC

ARCHITECT

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Phone: 604-684-5995

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ELECTRICAL CONTRACTOR

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	4	As-built		11/21/2015	TK
	3	Resubmitted for approval		10/30/15	JYC
	2	SUBMITTAL		10/19/15	JYC
	1	SUBMITTAL		1/20/15	CoEE

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SALES ENGINEER	PROJECT MANAGER	APPLICATION ENGINEER	DATE	CONTRACT NUMBER
Cansin Yang	Troy Bazille	CoEE	03/23/2015	4097-0088

Tertiary Building

FEC (2)

Wireless Comms

Main Port Building

FEC (9)

VMA (2)

Boiler (1)

BTU meter (2)

AHU VFD (2)

Chiller (2)

HRU VFD (2)

NAE45

Metasys Server

HUB OR SWITCH

LAN / WAN

Mech Room (upper)

FEC (1)

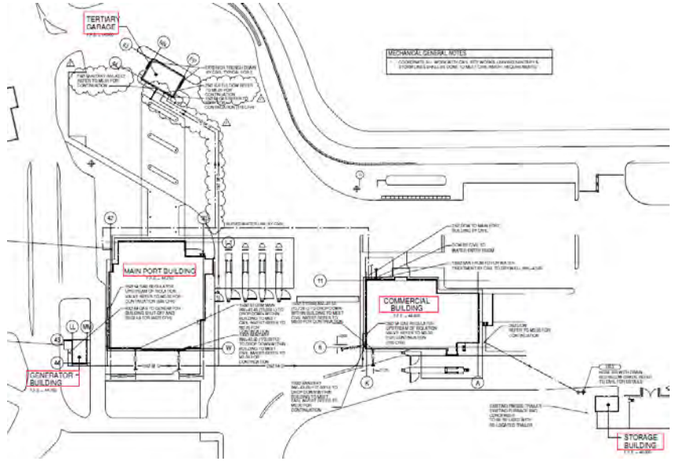
VMA (16)

Main Floor

Wireless Comms

FEC (1)

Generator Building



Commercial Building

LAN / WAN

HUB OR SWITCH

NAE45

FEC (8)

VMA (2)

BTU meter (2)

GAS meter (2)

Chiller (2)

HRU VFD (1)

AHU VFD (2)

Boiler (1)

Mech Room (upper)

FEC (1)

VMA (11)

Main Floor

Wireless Comms

FEC (1)

Storage Building

Drawing Title						
001.001(Riser Drawing)						
		1	As-built		11/21/2015	TK
	REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY

Sales Engineer	Project Manager	Application Engineer	DRAWN		APPROVED	
Cansin Yang	Troy Bazille	CoEE	BY	DATE	BY	DATE

Project Title

Aldergrove Port of Entry DB

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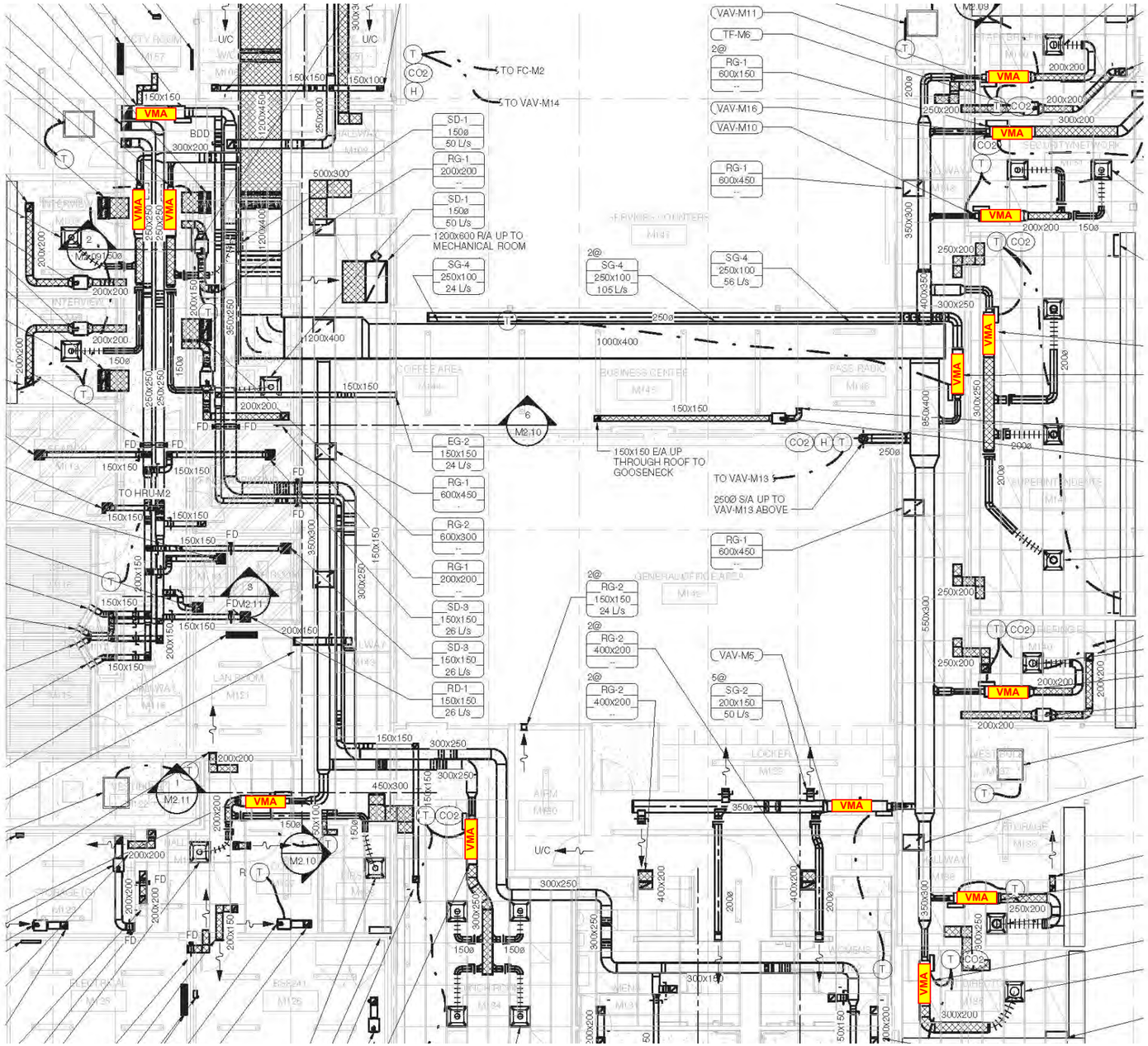
CONTRACT NUMBER

40970088

DRAWING NUMBER

001 A



Drawing Title						
001.002(Main Port Ground Layout)						
		1	As-built		11/21/2015	TK
	REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	Sales Engineer: Cansin Yang; Project Manager: Troy Bazille; Application Engineer: CoEE		DRAWN BY / DATE		APPROVED BY / DATE	
Project Title						
Aldergrove Port of Entry DB						

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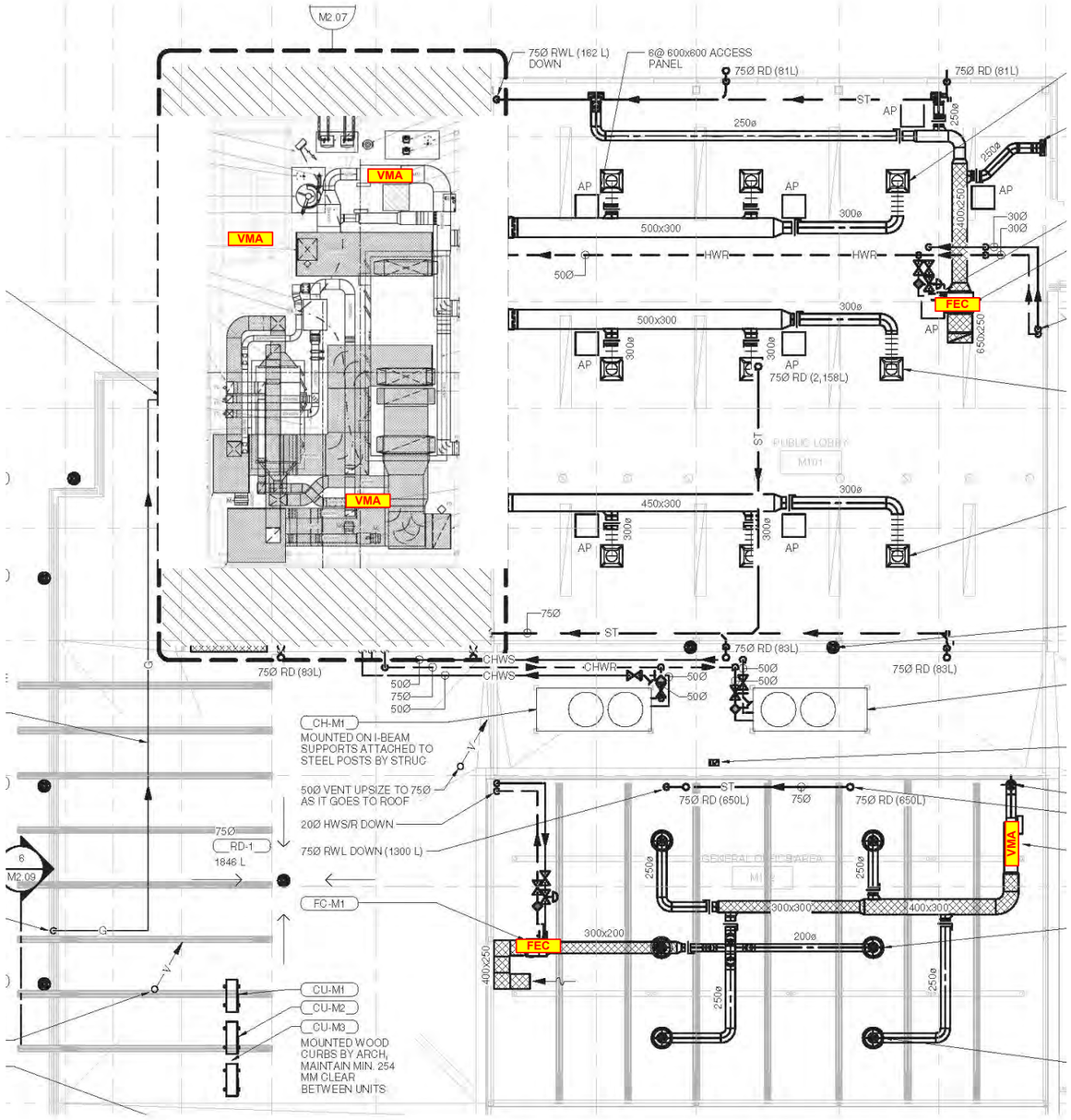
CONTRACT NUMBER **40970088**

DRAWING NUMBER **002 A**



Drawing Title: **001.003(Main Port Upper Floor Layout)**						
		1	As-built		11/21/2015	TK
	REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY

Sales Engineer	Project Manager	Application Engineer	DRAWN		APPROVED	
Cansin Yang	Troy Bazille	CoEE	BY	DATE	BY	DATE

Project Title: **Aldergrove Port of Entry DB**

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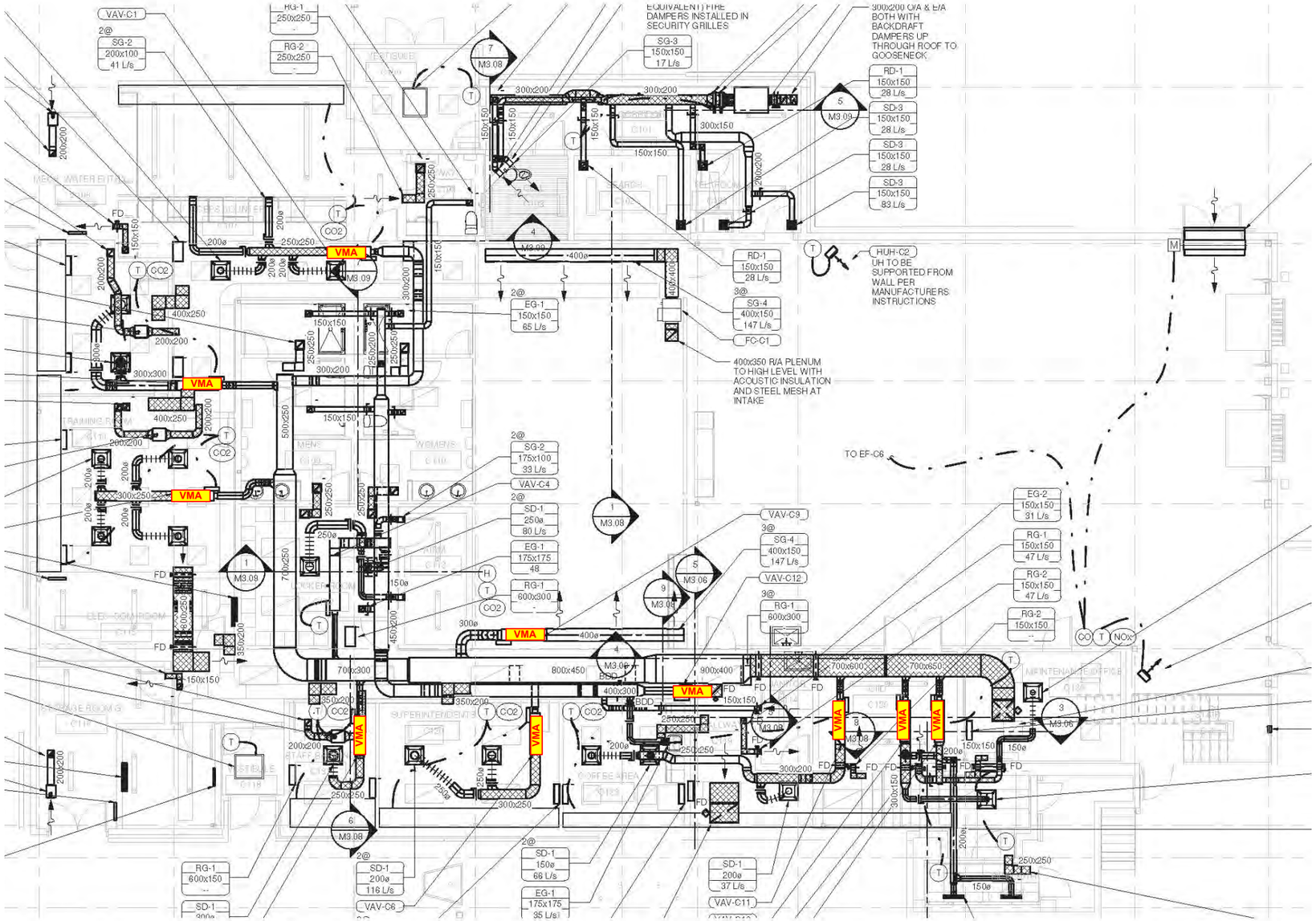
CONTRACT NUMBER: **40970088**

DRAWING NUMBER: **003 A**



Drawing Title **001.004(Commercial Ground Layout)**						
	1	As-built		11/21/2015	TK	
REFERENCE DRAWING	NO.	REVISION-LOCATION		ECN	DATE	BY

Sales Engineer	Project Manager	Application Engineer	DRAWN		APPROVED	
Cansin Yang	Troy Bazille	CoEE	BY	DATE	BY	DATE

Project Title
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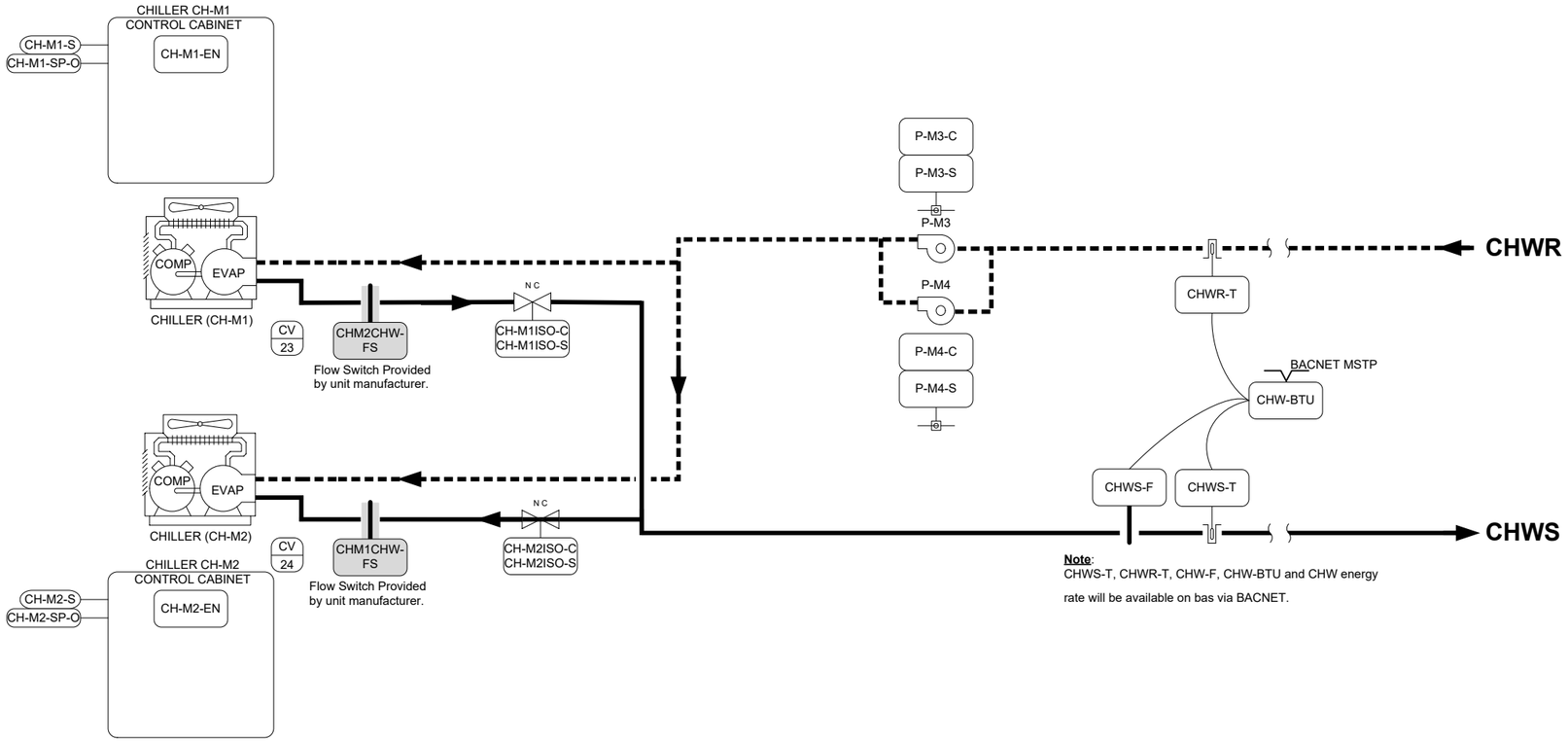
CONTRACT NUMBER
40970088

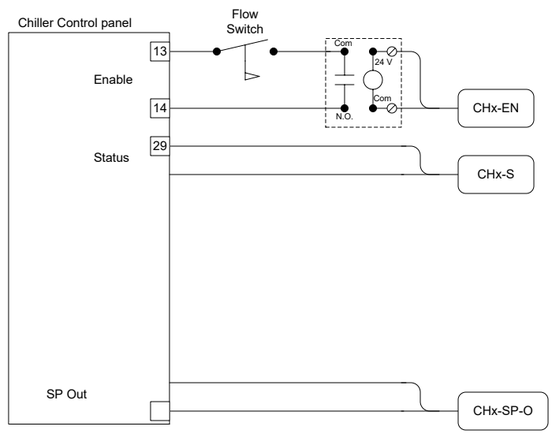
DRAWING NUMBER
004 A



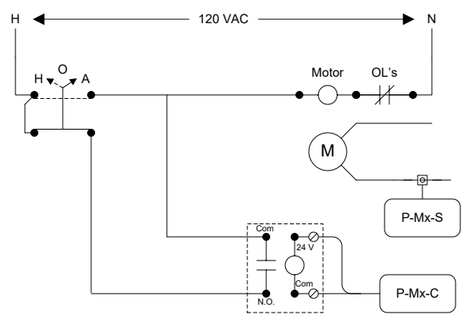
Note:
CHWS-T, CHWR-T, CHW-F, CHW-BTU and CHW energy rate will be available on bas via BACNET.

BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
CHW-BTU	1	F-STD-INSTL1	INSTALL KIT, STD, 1.25-72 - STEEL PIPE.
	1	SYSTEM-10-BAC	BTU METER, BACNET
CHWR-T	1	TE-6300W-101	T-WELL 6" BRASS DIR MNT
	1	TE-631AM-2	WELL TEMP SEN 6" 1K NI
CHWS-F	1	F-1100	FLOW METER, SINGLE TURB, FREQ OUT
CHWS-T	1	TE-6300W-101	T-WELL 6" BRASS DIR MNT
	1	TE-631AM-2	WELL TEMP SEN 6" 1K NI
P-Mx-S	2	CSD-SA1E0-1	SLD/ADJ LED 1A W/O RELAY
Panel Devices:			
CH-Mx-EN	2	RH2B-UAC24-L	DPDT,10A,HC=24 VAC,
	2	SH2B-05	DPDT RELAY BASE FOR RH2B
CP-CHWS-M1	1	MS-FEC2611-0	FEC2611-0,FEC17
	1	MS-IOM3721-0	MS-IOM3721-0,IN/PUT
	4	PAN-96VAXFR-U	PANEL TRANSFORMER KIT-UL
	1	PAN-ENC3648WDP	36X48X9.25 ENC+DOOR+PANEL
	1	PAN-PWRSP	PANEL POWER SUPPLY 96VA
P-Mx-C	2	RH2B-UAC24-L	DPDT,10A,HC=24 VAC,
	2	SH2B-05	DPDT RELAY BASE FOR RH2B
Other Devices:			
CH-MxISO-C,-S	2	VALVE	SEE VALVE SCHEDULE



Chiller Control Wiring (Typical Of 2)



Pump Control Wiring (Typical Of 2)

Drawing Title
002.001(Chilled Water System-Main Bldg Control)

Project Title
Aldergrove Port of Entry DB

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	3	As-built		11/21/2015	TK
	2	Re-submitted for approval		10/30/15	JYC
	1	SUBMITTAL		1/19/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

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CONTRACT NUMBER
40970088

DRAWING NUMBER
101 A

CHWS MAIN BLDG

Sequence of Operation:

General:

- The chilled water system consists of two chillers serving chilled water to the main cooling coil on the central air handling unit and a small chilled water coil on the HRU-2 system. Constant speed pumps operate to maintain flow through the chillers and cooling coils.

Run conditions:

- The chilled water systems will be enabled to run whenever the outside air temperature is greater than 15° C;
- And there is a call for cooling from one of the air handling systems.
- To prevent short cycling the chilled water systems will run for and be off for a minimum adjustable time (user definable), unless shutdown on safeties or outside air conditions.
- The chillers themselves will operate based on their own internal safeties and controls.

Chiller controls (CH-M1, CH-M2):

- Each chiller will be enabled/disabled through a BMS command.
- Once enabled, the chiller manufacturer provided control systems will operate the chillers to maintain the chilled water set point (adjustable through the BMS) originally set to 7° C.
- Main building lead/lag:
  A. The main building chillers are sized for lead/lag function.
  B. One chiller will be enabled to operate when the run conditions are satisfied.
  C. If one chiller is no longer capable of maintaining the CHWS temperature set point for more than 15 minutes (adjustable), then the BMS will enable the second chiller to operate.
- If two chillers are operating each with one compressor and the chilled water temperature starts to fall below the set point for more than 15 minutes, then cycle off one of the chillers.

Lead/lag/standby chillers:

- The BMS will rotate the lead chiller based on operating hours. After 100 hours of operation, the lead chiller will be changed.

Circulating pumps (P-M3, M4):

- The pumps will be operated to maintain a constant flow sized to 50% of the total load.
- When the first chiller is enabled, then the isolation control valve for the associated chiller will open.
- Once the isolation valve is proven open, then the first pump will start.
- When the second chiller is enabled, then the second pump will start (this is to ensure that the first chiller does not starve for flow while waiting for the pump to start).
- At the same time the pump is starting, the second control valve for the associated chiller will open.
- When the second chiller is disabled, then the associated control valve will close and at the same time the associated pump will turn off.
- When the first chiller is then disabled, the pump will be turned off and once no flow is detected at the associated flow switch, then close the associated chilled water isolation valve.

Alarms:

- DDC will provide an alarm when the chilled water temperature cannot maintain set point for duration of over 30 minutes.
- If pump status fails after command, generate local alarm and operate lag or standby pump.
- The BMS will take alarm points from the chiller. The following items will be monitored for alarms (typical for each chiller):
  A. Low ambient
  B. Low leaving chilled liquid temperature
  C. Low voltage
  D. Compressor 1, high discharge pressure
  E. Compressor 1, low suction pressure
  F. Compressor 2, high discharge pressure
  G. Compressor 2, low suction pressure.

Power failure:

- Chilled valves fail closed.

BTU METERS

Sequence of Operation:

General:
BTU meter monitors energy total, energy rate, flow total, flow rate, supply temperature and return temperature. See the drawings for locations and systems being metered.

BTU meter will be Connected to BMS via BACnet MSTP interface.

BTU meter:
The controller will monitor the BTU meter for the following parameters on a continual basis.these values will be made available to the system at all times.
- Energy total
- Energy rate
- Flow rate
- Supply temperature
- Return temperature

Peak demand history:
The controller will monitor and record the peak (high and low) demand readings from the BTU meter. Peak readings will be recorded on a hourly, daily, month-to-date, and year-to-date basis.

Usage history:
The controller will monitor and record BTU meter readings so as to provide an energy consumption history. Usage readings will be recorded on a hourly, daily, month-to-date, and year-to-date basis.

Alarms:
Meter failure: sensor readings indicate a loss of output from the BTU meter via software.

Fire alarm: n/a

Power failure:
BTU meter to be fed from standby power source.

Points monitored via BACNET

- Energy total
- Energy rate
- Flow rate
- Supply temperature
- Return temperature

CHILLER EFFICIENCY

Sequence of Operation:

General:
The DDC will calculate and trend the chiller efficiency. The calculation shall be as follows:
Chiller efficiency = KW/TON
- Tons cooling = BTU (as measured at BTU meter) / 12,000
- KW will be as measured at the electrical meter measuring input power to the chiller systems.
- The DDC will trend all efficiency data for the chiller systems for both the main and commercial buildings.

Graphics:
System efficiency will be displayed on the main chiller graphic.

Drawing Title
002.002(Chilled Water System-Main Bldg Sequence of Operation)

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	3	As-built		11/21/2015	TK
	2	Formal Submission		10/19/15	JYC
	1	SUBMITTAL		1/19/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Project Title
Aldergrove Port of Entry DB

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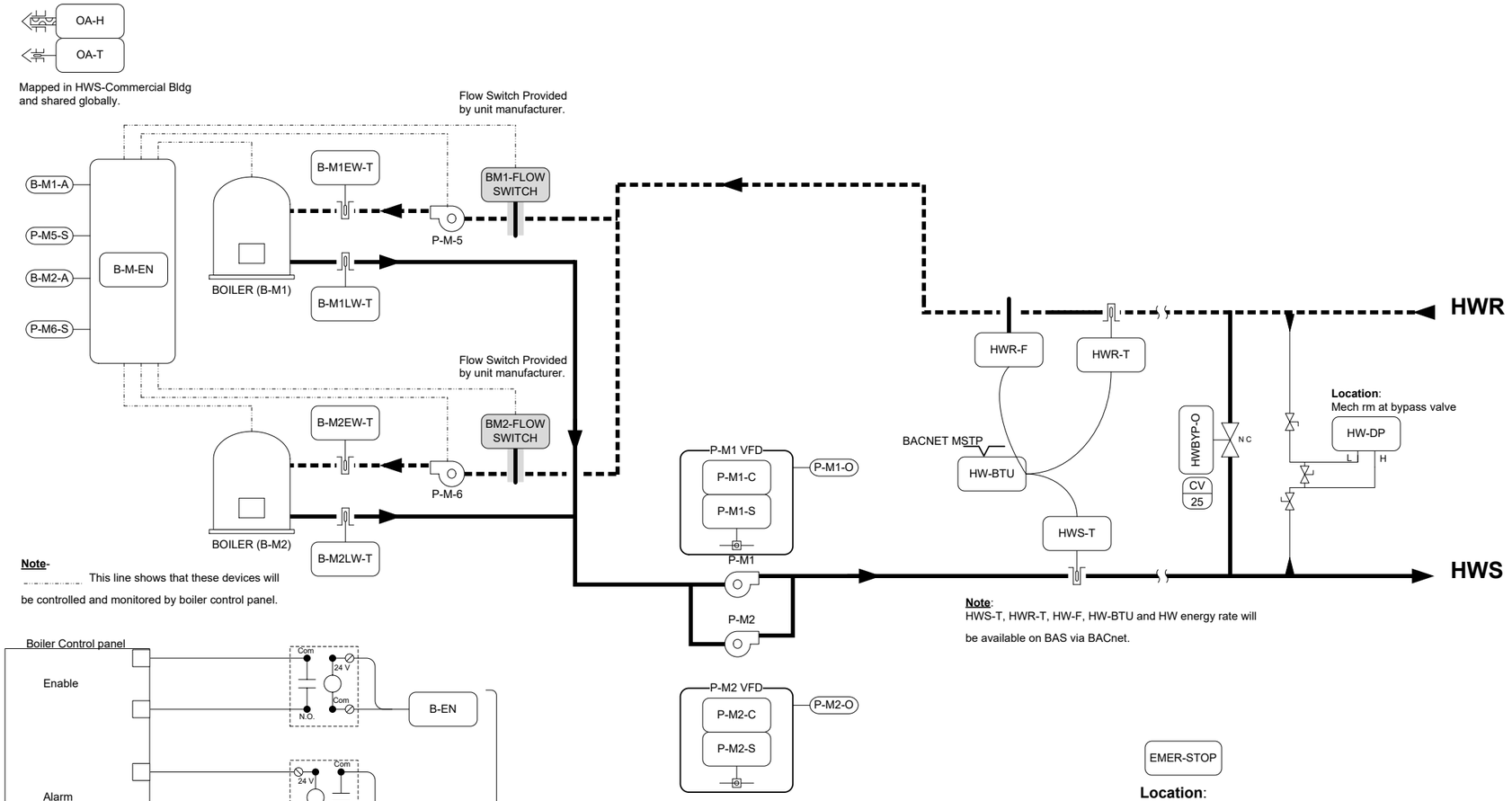
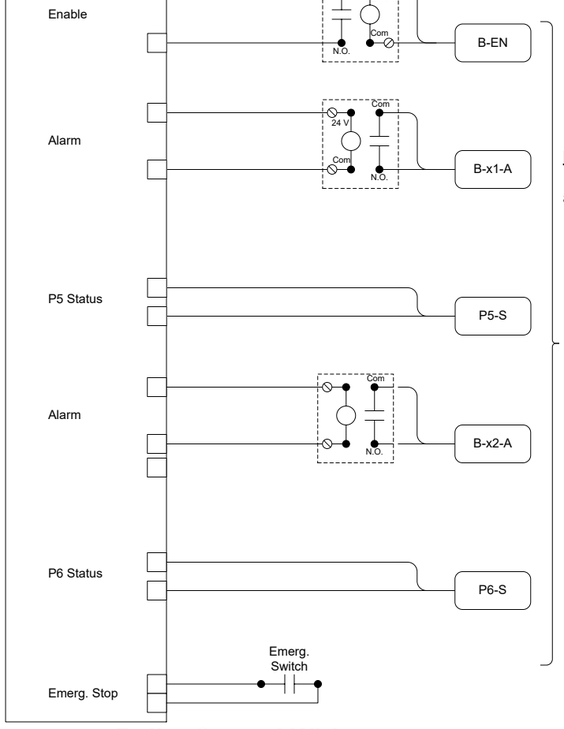
CONTRACT NUMBER
40970088

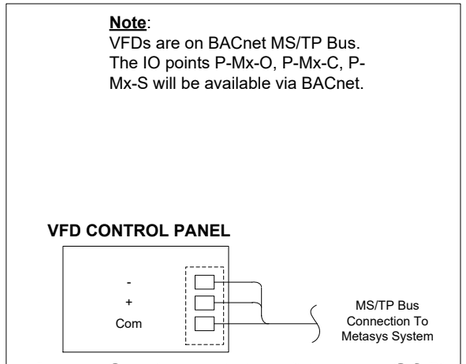
DRAWING NUMBER
101 B





Boiler Control Wiring

Note:
IO Point Details are not available on Cut Sheets.



Pump Control Wiring (Typical Of 2)

Note:
VFDs are on BACnet MS/TP Bus. The IO points P-Mx-O, P-Mx-C, P-Mx-S will be available via BACnet.

BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
B-Mx-EN	1	RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED
B-MxEW-T	2	TE-6300W-101	T-WELL 6" BRASS DIR MNT
	2	TE-631AM-2	WELL TEMP SEN 6" 1K NI
B-MxLW-T	2	TE-6300W-101	T-WELL 6" BRASS DIR MNT
	2	TE-631AM-2	WELL TEMP SEN 6" 1K NI
EMER-STOP	2	PILNOCB	N/O CONTACT BLOCK
	1	ST120SL-N1-BS	PUSH PULL STA N1 SURFACE
HW-BTU	1	F-STD-INSTL1	INSTALL KIT, STD, 1.25-72 - STEEL PIPE.
	1	SYSTEM-10-BAC	BTU METER, BACNET
HW-DP	1	DPT2301-050D-V	PRESS SENS,DP,0-50 PSI,MA,0.25%,3-VLV
HWR-F	1	F-1100	FLOW METER, SINGLE TURB, FREQ OUT
HWR-T	1	TE-6300W-101	T-WELL 6" BRASS DIR MNT
	1	TE-631AM-2	WELL TEMP SEN 6" 1K NI
HWS-T	1	TE-6300W-101	T-WELL 6" BRASS DIR MNT
	1	TE-631AM-2	WELL TEMP SEN 6" 1K NI
P-Mx-S	2	CSD-SA1E0-1	SLD/ADJ LED 1A W/O RELAY
Panel Devices:			
B-Mx-A	2	RH2B-UAC120-L	DPDT,10A,HC=120 VAC,W/LED
	2	SH2B-05	DPDT RELAY BASE FOR RH2B
CP-1-MECH. RM.	1	MS-FEC2611-0	FEC2611-0,FEC17
	1	MS-IOM2721-0	MS-IOM2721-0, IN/OUTPUT
	1	MS-IOM4711-0	IOM4711,IOM 17 POINT,UL
P-Mx-C	2	RH2B-UAC24-L	DPDT,10A,HC=24 VAC,
	2	SH2B-05	DPDT RELAY BASE FOR RH2B
Other Devices:			
HWBYP-O	1	VALVE	SEE VALVE SCHEDULE
P-Mx-VFD	2	VS4D6112B-S0000	VSDISII,1HP/0.75KW,208V

Note: HWS controllers are enclosed in CHWS-Main. Bldg panel.

Drawing Title
003.001(Hot Water System-Main Bldg Control)

NO.	REVISION-LOCATION	ECN	DATE	BY
3	As-built		11/21/2015	TK
2	Formal Submission		10/19/15	JYC
1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Project Title
Aldergrove Port of Entry DB

Johnson Controls

Branch Information
Johnson Controls Inc
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CONTRACT NUMBER
40970088

DRAWING NUMBER
102 A

HWS-MAIN BLDG

Sequence of Operation:

General:

- The hydronic heating plant located in the mechanical room of each building will provides heating water to the various perimeter heating terminal units and air handler heating coils. The heating water is generated through two wall mounted condensing boilers with individual constant volume circulating pumps. The primary loop is separated from the secondary loop through a hydronic air and dirt separator. The secondary loop is operated with lead/standby pumps. These secondary pumps are VFD operated to maintain the requirements of control valves based on calls for heating.

Run conditions:

- The boiler system will be enabled to run whenever the outside air temperature is below 18.5° C.
- To prevent short cycling, each boiler will run for and be off for a minimum adjustable time, unless shutdown on safeties or outside air conditions.
- The boilers will be operated subject to its own internal safeties and controls.

Boiler control description:

- The boiler systems will be operated through manufacturer provided controls that will operate to maintain a supply water temperature of 65.5° C (adjustable).
- The supply water temperature will be reset based on the outside air temperature. As the outside air temperature rises from -8° C to 18° C, the hot water supply temperature will reset downwards by subtracting 0° C to 20° C (adjustable) from the current boiler set point.
- The boiler control systems will operate the primary circulating pumps to be on when the boilers are in operation.

Boiler lead/lag operation:

- The designated lead boiler will rotate based upon a boiler runtime (to be determined on site and based on manufacturer's recommendations).

Secondary pump variable speed control:

A. Run conditions:

- The secondary pumps will operate at any time that the boiler systems have been enabled.

B. Normal operation:

- The two secondary heating pumps are operated in a lead/standby fashion. The lead pump will be rotated based on a runtime of 200 hours. After a total of 200 hours of runtime the lead pump will be changed.
- When lead pump is in operation, it will start at minimum flow and ramp up in response to two conditions:
  A. The differential pressure set point as determined by the balancing agent. Set points will be field adjusted during the commissioning period to meet the requirements of actual field conditions.
  B. And the valve positions of the two heating coils.
  C. VFD minimum speed will be 25%.
- Both the differential pressure in the system will be monitored at all times, and the valve position of the heating coils for the AHU-1 and HC-1 units.
  A. The control systems will ensure that both of the following are met:
  I. The differential pressure is at set point – if it is below set point, then the VFD will ramp up.
  II. The valve position of both of the heating coils – if either valve is above 95% open, then the VFD will ramp up to maintain a maximum valve position of 95%.
  B. The control system will provide a graphic that clearly identifies these variables, and what the defining variable is at that moment in time.

Bypass pressure control:

- The system will operate a bypass control valve to maintain the differential pressure in the system. Differential pressure will be monitored at one of the furthest terminal units.
- The bypass valve will operate to modulate open when the bypass pressure increases above its set point (adjustable set point to be determined during the balancing and commissioning of the building - ensure coordination with the tab contractor, mechanical contractor and controls contractor). The valve will modulate through a pid loop to control the pressure set point.

Boiler alarm monitoring:

- The DDC will monitor the following boiler system alarms for each boiler:
  - Boiler alarm
  - Boiler low water level alarm

Temperature monitoring and alarms:

- The DDC will monitor the following:
  - Boiler 1 supply water temperature;
  - Boiler 1 return water temperature;
  - Boiler 2 supply water temperature;
  - Boiler 2 return water temperature;
  - system supply water temperature;
  - system return water temperature.
- General alarm will be provided when status of equipment does not match the command.
- Alarms will be provided for high and low supply water temperature - if the temperature is 10°C below set point for more than 60 seconds (adjustable), and if the temperature is higher than set point by 10° C for more than 30 seconds (adjustable).
- Alarms will be provided for high/low differential pressure - if pressure is +- 25% from set point.

Boiler emergency shut off:

- An emergency shut off button will be installed outside of the mechanical room and will cut power to the boilers when pressed. This will be a hard wired interlock.

BTU METERS

Sequence of Operation:

General:

BTU meter monitors energy total, energy rate, flow total, flow rate, supply temperature and return temperature. See the drawings for locations and systems being metered.

BTU meter will be Connected to BMS via BACnet MSTP interface.

BTU meter:

The controller will monitor the BTU meter for the following parameters on a continual basis.these values will be made available to the system at all times.
- Energy total
- Energy rate
- Flow rate
- Supply temperature
- Return temperature

Peak demand history:

The controller will monitor and record the peak (high and low) demand readings from the BTU meter. Peak readings will be recorded on a hourly, daily, month-to-date, and year-to-date basis.

Usage history:

The controller will monitor and record BTU meter readings so as to provide an energy consumption history. Usage readings will be recorded on a hourly, daily, month-to-date, and year-to-date basis.

Alarms:

Meter failure: sensor readings indicate a loss of output from the BTU meter via software.

Fire alarm: n/a

Power failure:

BTU meter to be fed from standby power source.

Points monitored via BACNET

- Energy total
- Energy rate
- Flow rate
- Supply temperature
- Return temperature

Drawing Title
003.002(Hot Water System-Main Bldg Sequence of Operation)

NO.	REVISION-LOCATION	ECN	DATE	BY
1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Project Title
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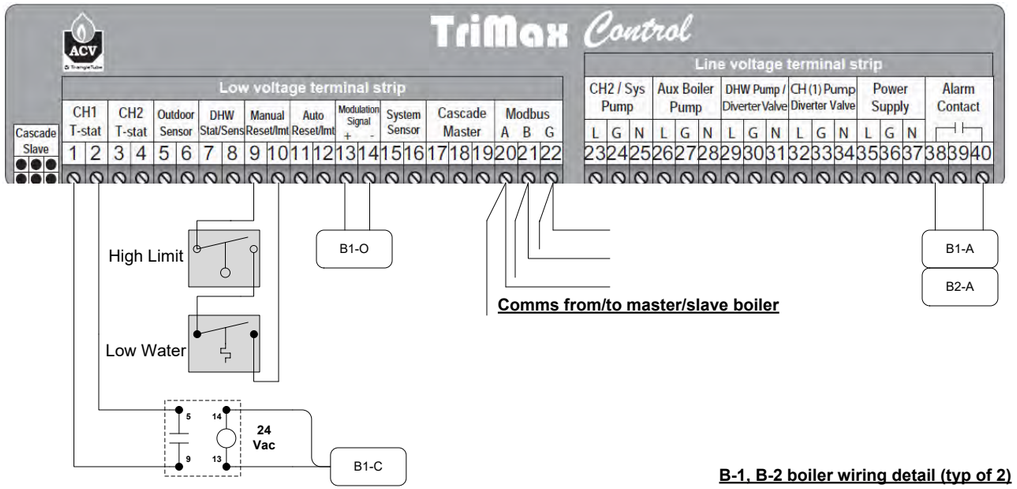
Fax: 604-707-5201

CONTRACT NUMBER
40970088

DRAWING NUMBER
102 B



B-1, B-2 boiler wiring detail (typ of 2)

Drawing Title
003.003(Hot Water System-Main Bldg Boiler Control Panel Wiring Diagram)

Project Title
Aldergrove Port of Entry DB

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	2	As-built		11/21/2015	TK
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

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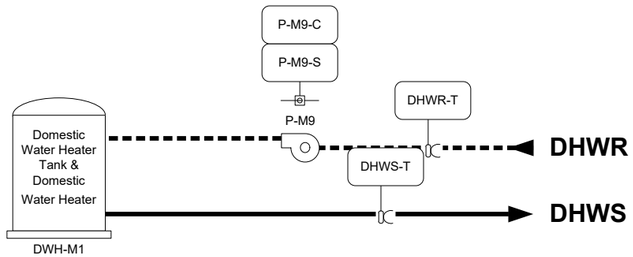
CONTRACT NUMBER
40970088

DRAWING NUMBER
102 C

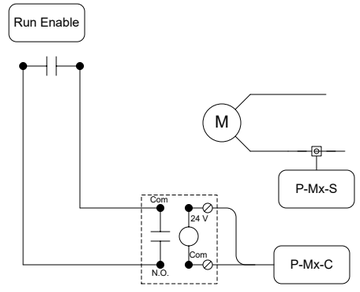
BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
DHWR-T	1	TE-6300-615	CABLE TIE MOUNTING KIT, 11"MAX.
	1	TE-631S-1	TEMPERATURE SENSOR
P-M9-S	1	CSD-SA1E0-1	SLD/ADJ LED 1A W/O RELAY
Panel Devices:			
P-M9-C	1	RH2B-UAC24-L	DPDT,10A,HC=24 VAC,
	1	SH2B-05	DPDT RELAY BASE FOR RH2B



Note:

IO points are mapped in HWS - Main Bldg. Controller.



Pump Control Wiring

DHWS- MAIN BLDG

Sequence of Operation:

General:

- The domestic hot water system for each building is served by one high efficiency gas fired DHW tank (DHWT-M1) with integral controls. Each system has a re-circulation pump that provides domestic hot water temperature maintenance.

Run condition for re-circulation pumps:

- The pump will run continuously.

Normal operation of DHW systems:

- Gas fired DWH heaters have internal controls to maintain internal tank water temperature. Initial setting is to be for 60° C (140°F).
- The DDC system will operate the re-circulation pumps based off of an aqua stat temperature in the re-circulation line. The pump will turn on when the re-circulation temperature is below 48° C (adjustable), and will turn off when the temperature rises above 55° C (adjustable).

Alarms:

If pump status fails after command.

Drawing Title

004.001(Domestic HWS-Main. Bldg Control)

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	2	As-built		11/21/2015	TK
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Project Title

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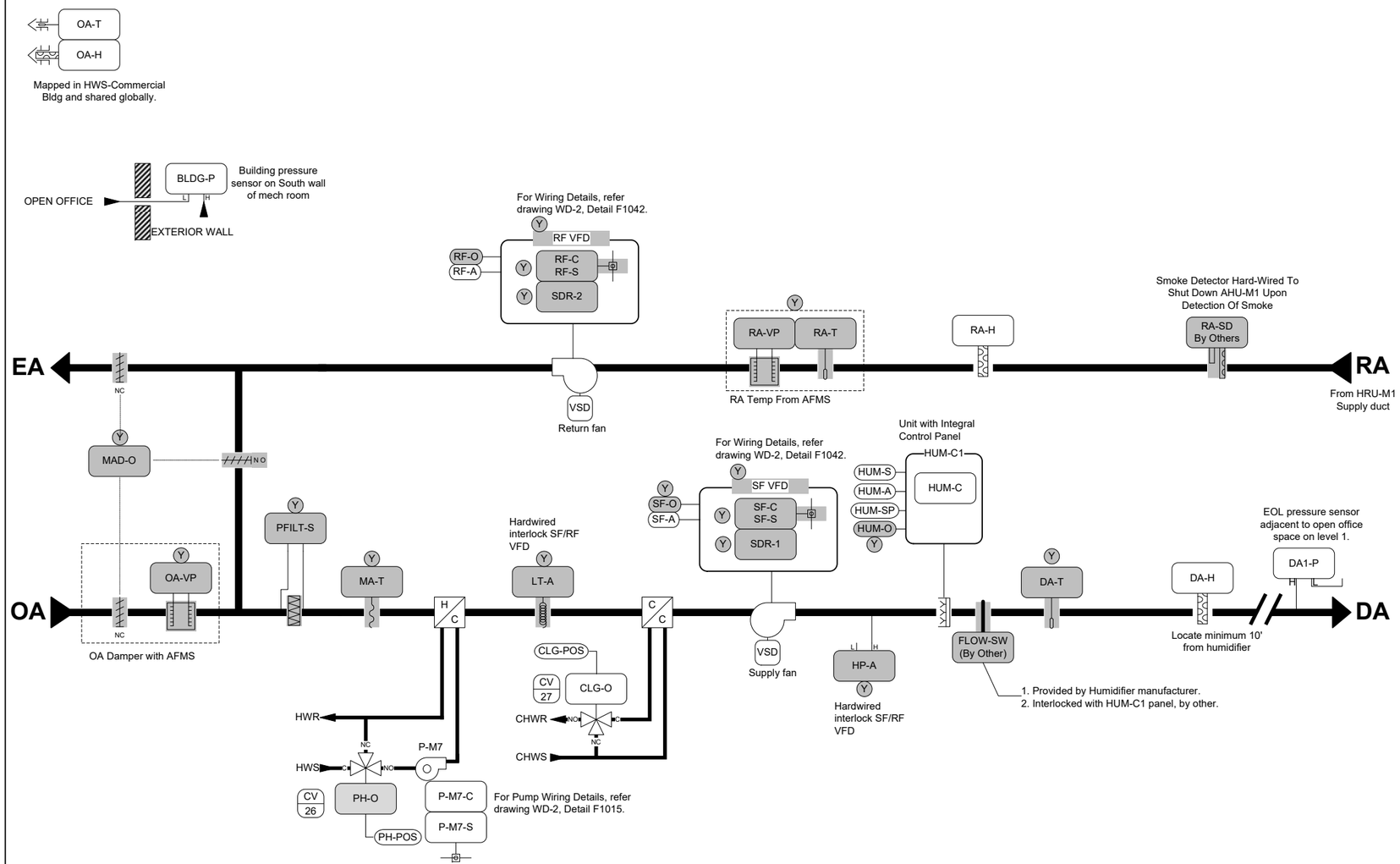
CONTRACT NUMBER

40970088

DRAWING NUMBER

102 D



BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
DA-H	1	HT-6703-0N00P	HUM SENS DUCT,4-20MA 0-10V W/JUMPER,3%RH
DA1-P	1	DPT2641-005D-1	DP TRANS, DIF, 0 TO 5
	1	FTG18A-600R	REMOTE MTD PROBE
RA-H	1	HT-6703-0N00P	HUM SENS DUCT,4-20MA 0-10V W/JUMPER,3%RH
Panel Devices:			
HUM-C	1	RH2B-UAC24-L	DPDT,10A,HC=24 VAC,
	1	SH2B-05	DPDT RELAY BASE FOR RH2B
Other Devices:			
CLG-O	1	VALVE	SEE VALVE SCHEDULE
PH-O	1	VALVE	SEE VALVE SCHEDULE
Additional Field Devices:			
BLDG-P	1	A-306-K	OUTDOOR AIR STATIC
	1	DPT2641-R25B-1	DP TRANS, DIF, -0.25 TO
	1	RPS	STAINLESS STEEL RM PRESS SENSOR 1/4 BARB
	1	SD-01	SURGE DAMPENER
P-M7-S	1	CSD-SA1E0-1	SLD/ADJ LED 1A W/O RELAY
Additional Panel Devices:			
CP-AHUM1-ADD	1	PAKFJJ002AH0	FEC1611/IOM4711,20X24
P-M7-C	1	RH2B-UAC24-L	DPDT,10A,HC=24 VAC,
	1	SH2B-05	DPDT RELAY BASE FOR RH2B

YORK FACTORY DEVICES- BILL OF MATERIALS

Designation	Qty	Part Number	Description
Factory Devices:			
DA-T	1	YDA-TN	TEMPERATURE SENSOR DUCT TE-6311M-1
HP-A	1	YHP-A	PRESSURE SWITCH AIR MANUAL AFS-460
LT-A	2	YLT-A	TEMPERATURE SWITCH LOW LIMIT A11B-1C
	1	YLT-S	TEMPERATURE SWITCH LOW LIMIT RIB24P
MA-T	1	YMA-TN	TEMPERATURE SENSOR DUCT TE-6316M-1
MAD-O	3	M9220-GGA-YK10	OUTSIDE AIR ACTUATOR
OA-VP	1	YOA-VPV	PRESSURE SENSOR AIR DPT2640-XXX
CP-AHU-M1	1	YPAKGJL002AH0	
PFILT-S	1	YPFILT-A	PRESSURE SWITCH AIR P32AC-2C
RA-T	1	YRA-TN	TEMPERATURE SENSOR DUCT TE-6311M-1
RA-VP	1	YRA-VPV	PRESSURE SENSOR AIR DPT2640-XXX
RF VFD	1	YRF-O	VARIABLE SPEED DRIVE
RF-C,-S	1	YRF-C	RELAY 24VAC RIBU1C
	1	YRF-S	CURRENT SWITCH W RELAY CSD-SA1E1-1
SDR-1	1	YSDR-1	RELAY 24VAC RIBU1C
SDR-2	1	YSDR-2	RELAY 24VAC RIBU1C
SF VFD	1	YSF-O	VARIABLE SPEED DRIVE
SF-C,-S	1	YSF-C	RELAY 24VAC RIBU1C
	1	YSF-S	CURRENT SWITCH W RELAY CSD-SA1E1-1

Note:

1. These gray devices will be York devices or provided by others.
2. (Y) These "Y" devices are York devices.
3. Above BOM is for all system.

Drawing Title
005.001(Air Handling Unit-M1 Control)

Project Title
Aldergrove Port of Entry DB

NO.	REVISION-LOCATION	ECN	DATE	BY
3	As-built		11/21/2015	TK
2	Formal Submission		10/6/15	JYC
1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

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Phone: 604-707-5200
Fax: 604-707-5201

CONTRACT NUMBER
40970088

DRAWING NUMBER
201 A

Sequence of Operation (Factory package):

SUPPLY FAN CONTROL:

The variable speed supply fan (SF-C) will be started based on occupancy schedule (OCC-SCHEDULE). When the supply fan status (SF-S) indicates the fan started, the control sequence will be enabled. The supply fan (SF-O) will modulate to maintain the discharge static pressure (DA-P) at setpoint (DAP-SP). Upon a loss of airflow (SF-S), the system will attempt to automatically restart until positive status is received. When the supply fan frequency converter fault input (SF-A) is activated, the system will shutdown. When the fault condition clears, the system shall restart as required.

RETURN FAN CONTROL:

After the supply fan has been started, the variable speed return fan will be started. The return fan (RF-O) will modulate in conjunction with the supply fan. The return fan will lag the supply fan by a percentage differential. When the return fan frequency converter fault input (RF-A) is activated, the system will shutdown. When the fault condition clears, the system shall restart as required.

ECONOMIZER CONTROL:

When the outdoor air (OA-T) is cooler than the economizer setpoint, the economizer will act as the initial stage of cooling, working in sequence with the cooling coil.

TEMPERATURE CONTROL:

The unit will control to maintain a constant discharge air temperature (DA-T).

OCCUPIED MODE:

The occupancy mode will be controlled via a network input (OCC-SCHEDULE). The occupancy mode can also be overridden by a network input (OCC-OVERRIDE).

UNOCCUPIED MODE:

The unit will remain off during unoccupied periods.

PREHEAT COIL:

The preheat (PH-O) will modulate to maintain the temperature setpoint. When the unit is shutdown, the preheat coil will be commanded to a preset position should the outdoor air temperature (OAT) fall below the low outdoor air temperature setpoint (OALT-SP). Upon a loss of airflow (SF-S), the preheat coil will be commanded to a preset position should the outdoor air temperature (OA-T) fall below the low outdoor air temperature setpoint (OALT-SP).

COOLING COIL:

The cooling coil (CLG-O) will modulate to maintain the temperature setpoint. When the unit is shutdown, the cooling coil will be commanded to a preset position should the outdoor air temperature (OA-T) fall below the low outdoor air temperature setpoint (OALT-SP). Upon a loss of airflow (SF-S), the cooling coil will be off.

HUMIDIFICATION:

The humidifier will be enabled (HUM-C) and modulate (HUM-O) to maintain the return air relative humidity setpoint (HUM-SP) as sensed by the return air relative humidity sensor (RA-H).

UNIT PROTECTION:

- Low Temperature Alarm (LT-A) - When in "Alarm", the control sequence will stop running, the valve(s) will open and the fan(s) will be disabled via a hard wired shutdown circuit.
- Return Air Smoke Detector (RA-SD) - Disables the fan(s) via a hard wired shutdown circuit.

ADDITIONAL POINTS MONITORED BY THE FMS:

- Outdoor Air Velocity Pressure (OA-VP)
- Mixed Air Temperature (MA-T)
- Discharge Air Humidity (DA-H)
- Return Fan Status (RF-S)
- Return Air Temperature (RA-T)
- Return Air Velocity Pressure (RA-VP)
- Prefilter Status (PFILT-S)
- Humidifier Status (HUM-S)

Sequence of Operation (Other than Factory package):

Pre Heat Coil Circulation Pump:

On a call for preheat, the coil pump (P-M7-C) will be started. Upon a loss of preheat coil pump status (P-M7-S), the pump will attempt to automatically restart until positive status is received. When the unit is shutdown, the preheat coil will be commanded to a preset position should the outdoor air temperature (OAT) fall below the low outdoor air temperature setpoint (OALT-SP). Upon a loss of airflow (SF-S), the preheat coil will be commanded to a preset position should the outdoor air temperature (OA-T) fall below the low outdoor air temperature setpoint (OALT-SP).

Drawing Title
005.002(Air Handling Unit-M1 Sequence of Operation)

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	2	As-built		11/21/2015	TK
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Project Title
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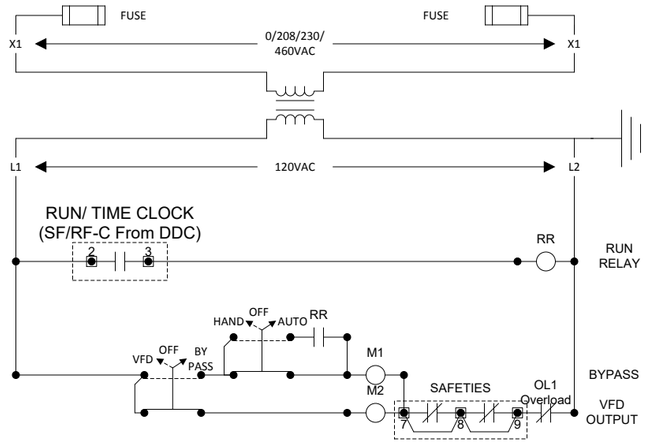
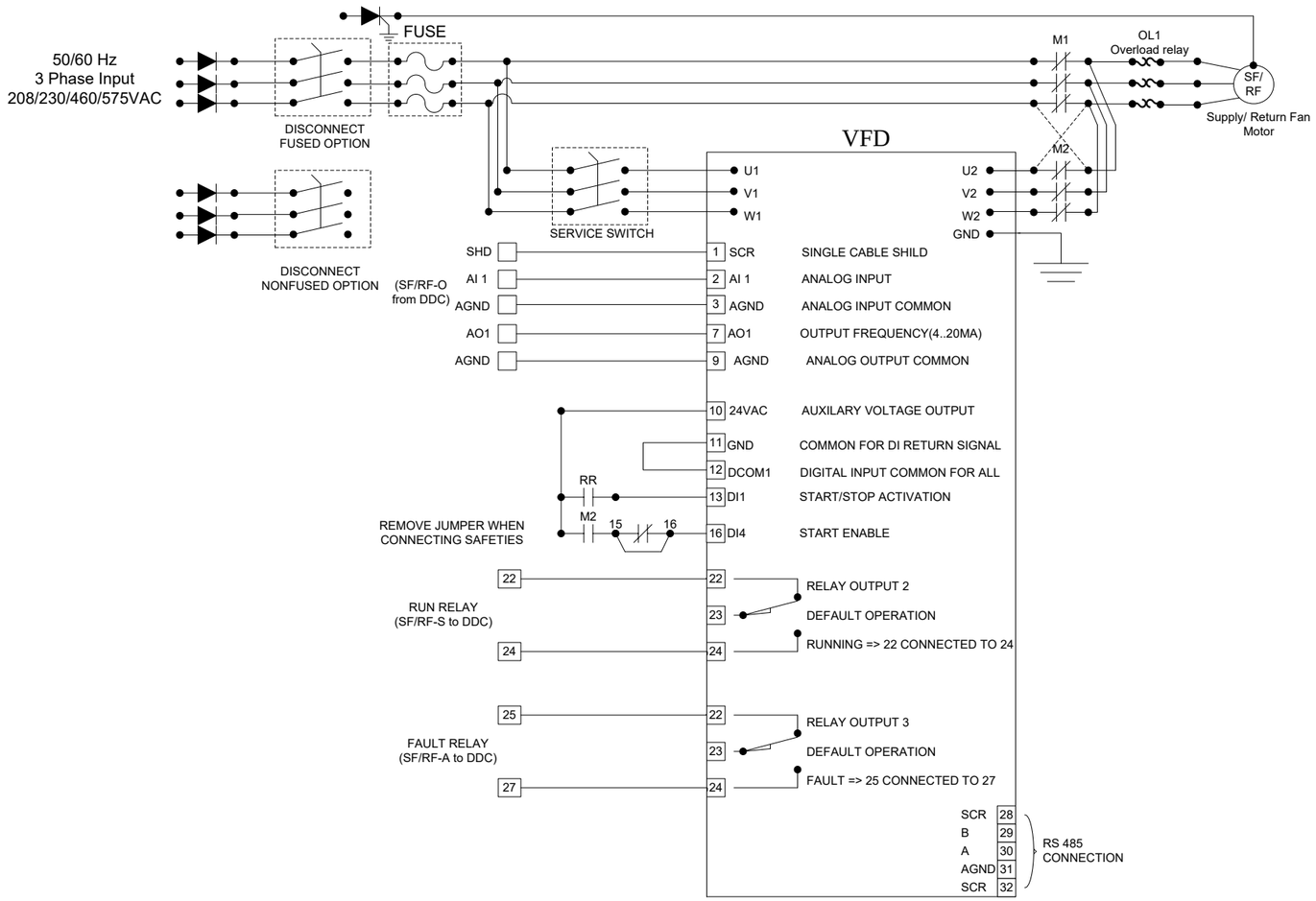
CONTRACT NUMBER
40970088

DRAWING NUMBER
201 B





Drawing Title
005.003(Air Handling Unit-M1 SF & RF Wiring)

NO.	REVISION-LOCATION	ECN	DATE	BY
1	As-built		11/21/2015	TK

Sales Engineer	Project Manager	Application Engineer	DRAWN BY	DRAWN DATE	APPROVED BY	APPROVED DATE
Cansin Yang	Troy Bazille	CoEE				

Project Title
Aldergrove Port of Entry DB

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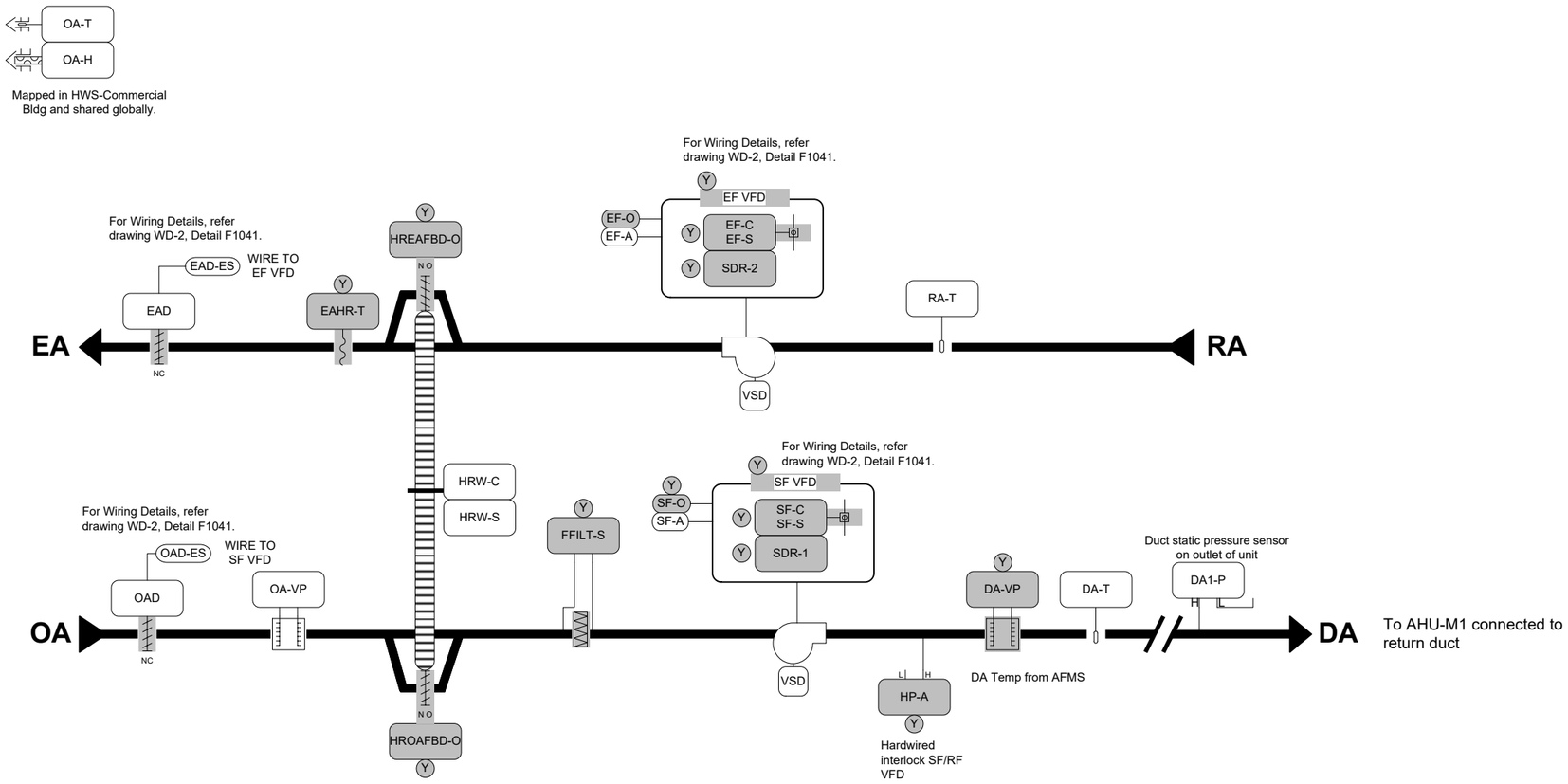
CONTRACT NUMBER
40970088

DRAWING NUMBER
201 C



BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
DA-T	1	TE-6311M-1	8" 1000 OHM NI DUCT TEMP
DA1-P	1	DPT2641-005D-1	DP TRANS, DIF, 0 TO 5
	1	FTG18A-600R	REMOTE MTD PROBE
EAD-C	1	M9220-BGC-3	20NM,SR,ACT,24V ON/OFF,2 AUX SW
OAD-C	1	M9220-BGC-3	20NM,SR,ACT,24V ON/OFF,2 AUX SW
RA-T	1	TE-6311M-1	8" 1000 OHM NI DUCT TEMP
Panel Devices:			
HRW-C	1	RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED
Additional Field Devices:			
HRW-S	1	RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED
Additional Panel Devices:			
CP-HRUC1-ADD	1	PAKF00001FH0	FEC1611,16X20
Additional Other Devices:			
OA-VP	1	AFMS	SEE AFMS SCHEDULE

YORK FACTORY DEVICES- BILL OF MATERIALS

Designation	Qty	Part Number	Description
Factory Devices:			
DA-VP	1	YDA-VPV	PRESSURE SENSOR AIR DPT2640-XXX
EAHR-T	1	YEAHR-TN	TEMPERATURE SENSOR DUCT TE-6316M-1
EF VFD	1	YEF-O	VARIABLE SPEED DRIVE
EF-C,-S	1	YEF-C	RELAY 24VAC RIBU1C
	1	YEF-S	CURRENT SWITCH W RELAY CSD-SA1E1-1
FFILT-S	1	YFFILT-A	PRESSURE SWITCH AIR P32AC-2C
HP-A	1	YHP-A	PRESSURE SWITCH AIR MANUAL AFS-460
HREAFBD-O	1	M9104-GGA-YK10	HEAT RECOVERY EA FBD OUTPUT
HROAFBD-O	1	M9104-GGA-YK10	HEAT RECOVERY OA FBD OUTPUT
SDR-1	1	YSDR-1	RELAY 24VAC RIBU1C
SDR-2	1	YSDR-2	RELAY 24VAC RIBU1C
SF VFD	1	YSF-O	VARIABLE SPEED DRIVE
SF-C,-S	1	YSF-C	RELAY 24VAC RIBU1C
	1	YSF-S	CURRENT SWITCH W RELAY CSD-SA1E1-1
Factory Panel Devices:			
CP-HRU-M1	1	YPAKGJF001AH0	PAKGJF001AH0

Note:

1. These gray devices will be York devices or provided by others.
2. (Y) These "Y" devices are York devices.
3. Above bom is for all system.

Drawing Title

006.001(HRU-M1 Control)

Project Title

Aldergrove Port of Entry DB

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	2	As-built		11/21/2015	TK
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

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Phone: 604-707-5200
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CONTRACT NUMBER

40970088

DRAWING NUMBER

202 A

HRU-M1

Sequence of Operation (Factory Package):

SUPPLY FAN CONTROL:

Upon a start command the isolation damper(s) will open. When open status is achieved, the variable speed supply fan (SF-C) will be started based on occupancy. After the start command is sent (SF-C), the outside air damper will open, and the unit will start when the damper end switch has proven open status. When the supply fan status (SF-S) indicates the fan started, the control sequence will be enabled. The supply fan (SF-O) will modulate to maintain the discharge static pressure (DA1-P) at setpoint (DAP-SP). Upon a loss of airflow (SF-C), the supply fan will attempt to automatically restart until positive status is received. . When the supply fan frequency converter fault input (SF-A) is activated, the system will shutdown. When the fault condition clears, the system shall restart as required.

EXHAUST FAN CONTROL:

After the supply fan (SF-C) has been started, the isolation damper(s) will open, and the variable speed exhaust fan (EF-C) will start when the damper end switch has proven open status. The exhaust fan (EF-O) will modulate in conjunction with the supply fan. The exhaust fan will lag the supply fan by a percentage differential. When the exhaust fan frequency converter fault input (EF-A) is activated, the system will shutdown. When the fault condition clears, the system shall restart as required.

TEMPERATURE CONTROL:

The unit will control to maintain a constant discharge air temperature (DA-T).

OCCUPIED MODE:

The occupancy mode will be controlled via a network input (OCC-SCHEDULE). The occupancy mode can also be overridden by a network input (OCC-OVERRIDE).

UNOCCUPIED MODE:

The unit will remain off during unoccupied periods.

HEAT RECOVERY:

The single speed heat recovery wheel (HRW-C) will be enabled when the absolute value of the difference between the return air temperature (RA-T) and the outdoor air temperature (OA-T) is greater than the heat recovery setpoint (HRT-SP). Heat recovery wheel bypass dampers (HREAFBD-O and HROAFBD-O) shall modulate to maintain the discharge air temperature setpoint (DAT-SP). On a drop in exhaust air temperature (EAHR-T) below the heat recovery low limit setpoint (HRLL-SP), the heat recovery loop will change modes to maintain a minimum exhaust air temperature (EAHR-T) to prevent freezing.

ADDITIONAL POINTS MONITORED BY THE FMS:

- Discharge Air Velocity Pressure (DA-VP)
- Prefilter Status (PFILT-S)
- Exhaust Fan Status (EF-S)

Drawing Title
HRU-M1 SEQUENCE OF OPERATION

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	2	As-built		11/21/2015	TK
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Project Title
Aldergrove Port of Entry DB

Johnson Controls

Branch Information
Johnson Controls Inc
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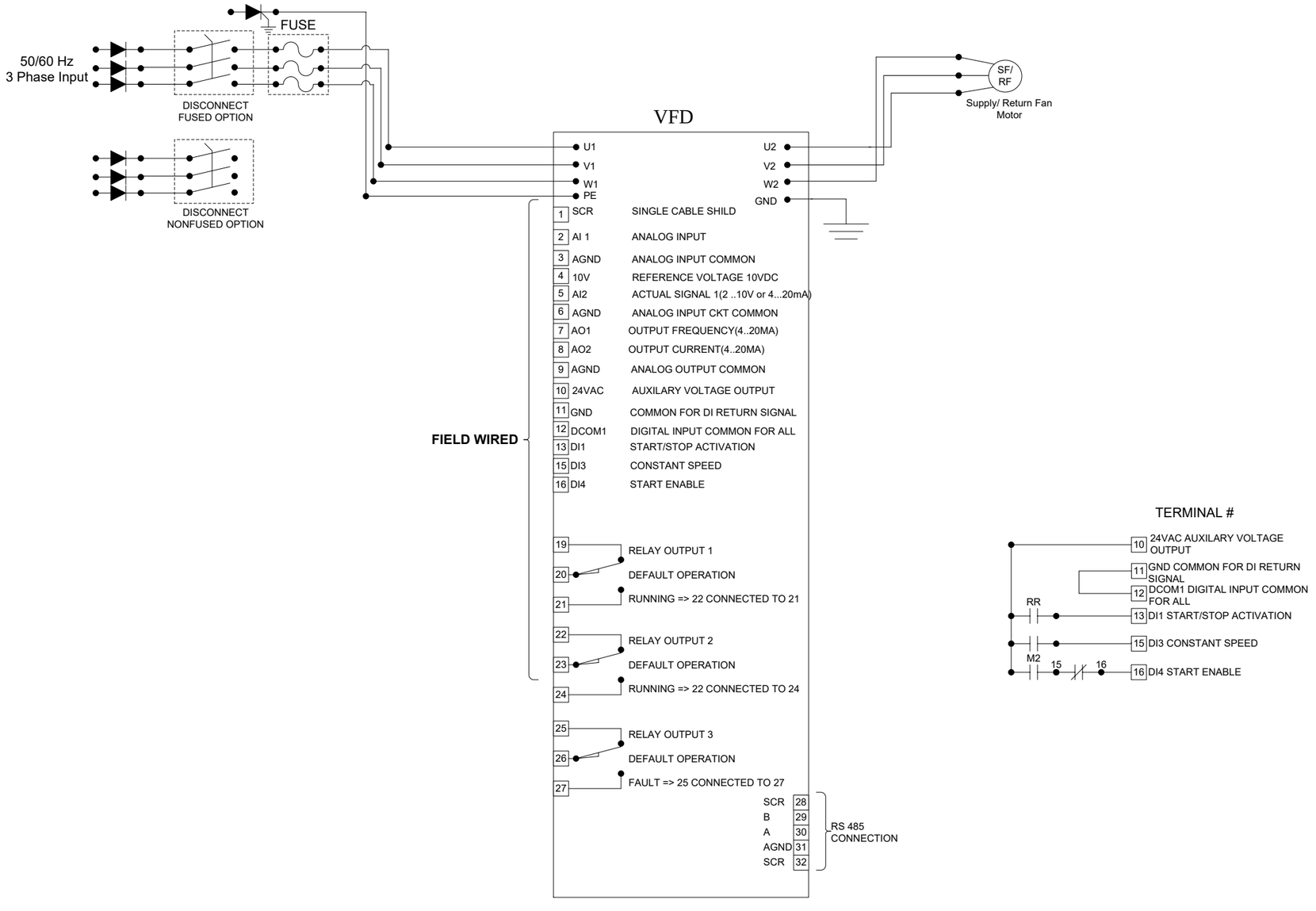
Phone: 604-707-5200
Fax: 604-707-5201

CONTRACT NUMBER
40970088

DRAWING NUMBER
202 A1



Drawing Title

006.003(HRU-M1 SF & RF Wiring)

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	1	As-built		11/21/2015	TK

Sales Engineer	Project Manager	Application Engineer	DRAWN		APPROVED	
			BY	DATE	BY	DATE
Cansin Yang	Troy Bazille	CoEE				

Project Title

Aldergrove Port of Entry DB
LANGLEY, BC

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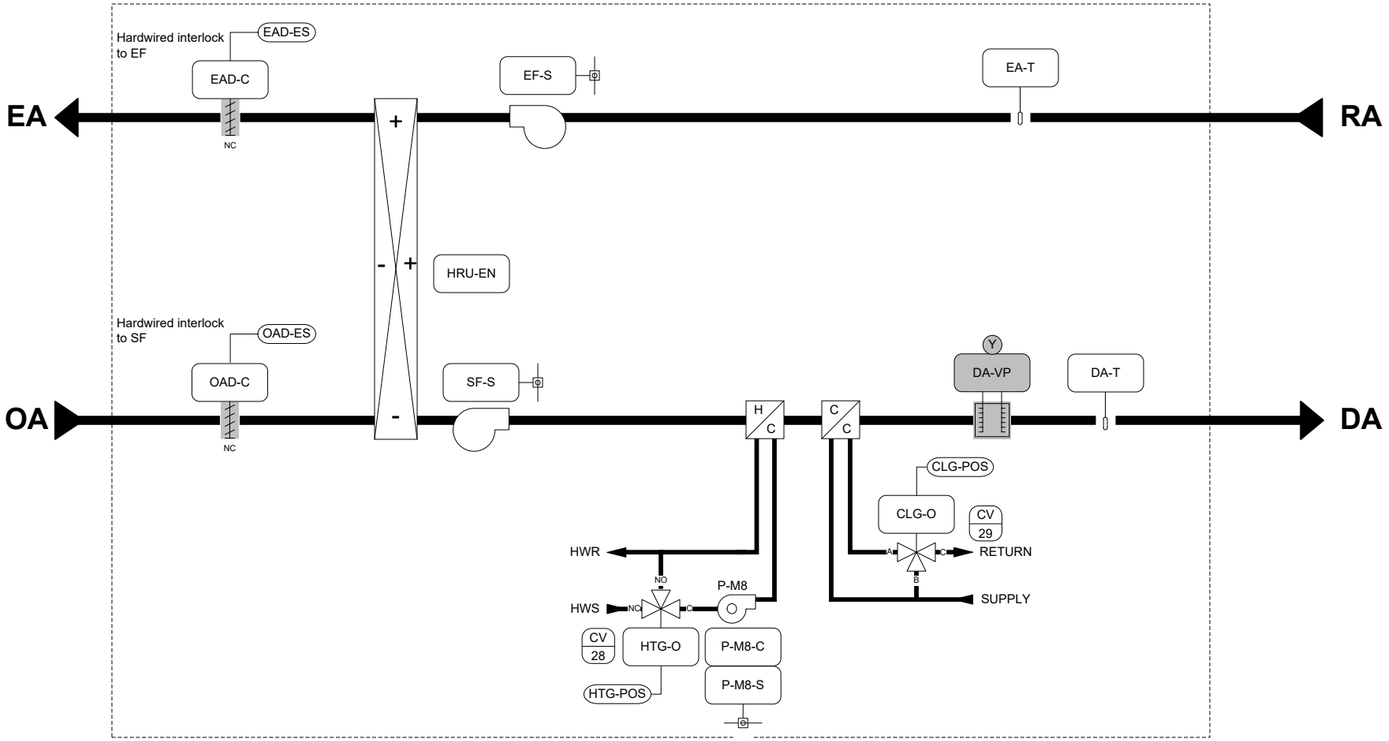
CONTRACT NUMBER

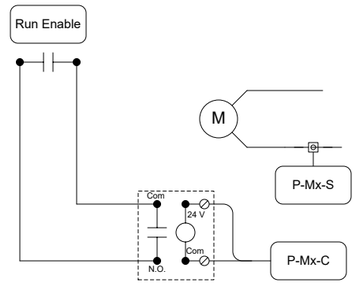
40970088

DRAWING NUMBER

202 B

Note-
1. Supply & Exhaust Fan will be controlled by manufacturer controller.
2. OA Damper will be interlocked with SF & EA Damper will be interlocked with EF.





Pump Control Wiring

BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
DA-T	1	TE-6311M-1	8" 1000 OHM NI DUCT TEMP
EA-T	1	TE-6311M-1	8" 1000 OHM NI DUCT TEMP
EAD-C,-ES	1	M9220-BGC-3	20NM,SR,ACT,24V ON/OFF,2 AUX SW
	1	RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED
EF-S	1	CSD-SA1E0-1	SLD/ADJ LED 1A W/O RELAY
OAD-C,-ES	1	M9220-BGC-3	20NM,SR,ACT,24V ON/OFF,2 AUX SW
	1	RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED
P-M8-S	1	CSD-SA1E0-1	SLD/ADJ LED 1A W/O RELAY
SF-S	1	CSD-SA1E0-1	SLD/ADJ LED 1A W/O RELAY
Panel Devices:			
CP-HRU-M2	1	PAKGJF001AH0	FEC2611/IOM1711,20X24
HRU-EN	1	RH2B-UAC24-L	DPDT,10A,HC=24 VAC,
	1	SH2B-05	DPDT RELAY BASE FOR RH2B
P-M8-C	1	RH2B-UAC24-L	DPDT,10A,HC=24 VAC,
	1	SH2B-05	DPDT RELAY BASE FOR RH2B
Other Devices:			
CLG-O,POS	1	VALVE	SEE VALVE SCHEDULE
HTG-O,POS	1	VALVE	SEE VALVE SCHEDULE

Drawing Title
007.001(HRU-M2 Control)

NO.	REVISION-LOCATION	ECN	DATE	BY
3	As-built		11/21/2015	TK
2	Formal Submission		10/19/15	JYC
1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Project Title
Aldergrove Port of Entry DB

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CONTRACT NUMBER
40970088

DRAWING NUMBER
202 C

HRU-M2

Sequence of Operation

HRU Operation – HRU-M2:
The HRU is a stand-alone unit that is provided with manufacturer controls to operate both the supply and exhaust fans.
The BMS will only provide an enable control to the HRU and will monitor the supply and exhaust fan status points through current switches.

General:
The secure areas of both the main and commercial buildings are designed to be heated and cooled through a small heat recovery unit with duct mounted heating and cooling coils. The HRU will supply constant airflow to all associated spaces to maintain the space temperature setpoint.

Run conditions:
- The HRU will operate continuously during occupied times as defined by a user defined schedule.
- During unoccupied times, the unit will cycle on to maintain the nighttime setback temperature setpoint.
- In order to prevent excessive cycling, the unit will be on for a minimum of 15 minutes (adjustable), and off for a minimum of 10 minutes (adjustable).

Start-up:
During start-up of the HRU, the following will happen.
- Upon a call to start the unit, the outside air and exhaust air dampers will open.
- Once both dampers are proven open, then the BMS will enable the HRU to start.

Shut-down:
During shut down of the HRU or associated fans, the following will happen.
- Upon a call to shut the unit down, the BMS will disable the HRU.
- Once it is confirmed that the unit is off, then the outside air and exhaust air dampers will close.

Supply air temperature:
- The heating and cooling coils will operate in sequence to maintain the supply air temperature setpoint.
- Heating coil: in heating mode, the heating coil circulating pump will turn on to circulate water through the coil at a constant speed. Once the pump is operating the 3-way control valve will modulate through a PID control logic to maintain the supply air temperature at setpoint (initially set to 30°C – adjustable).
- Cooling coil: in cooling mode, the 3-way control valve will modulate through a PID control logic to maintain the supply air temperature at setpoint (initially set to 13°C – adjustable).

Monitoring:
The BMS will monitor the exhaust air temperature through a duct mounted sensor located in the duct main. This sensor will be used to measure the average room temperature in the secure areas to provide feedback to the BMS.

Alarms:
- Provide general alarms if system status does not match command.
- A high and low supply air temperature alarm will be generated when the supply air setpoint is +/- 10°C from the setpoint for more than 5 minutes.
- If the unit is enabled and status of supply and exhaust fans is not detected within 30 second (adjustable), then a mismatch alarm will be generated at BMS

Drawing Title
HRU-M2 SEQUENCE OF OPERATION

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	2	As-built		11/21/2015	TK
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Project Title
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CONTRACT NUMBER
40970088

DRAWING NUMBER
202 C1

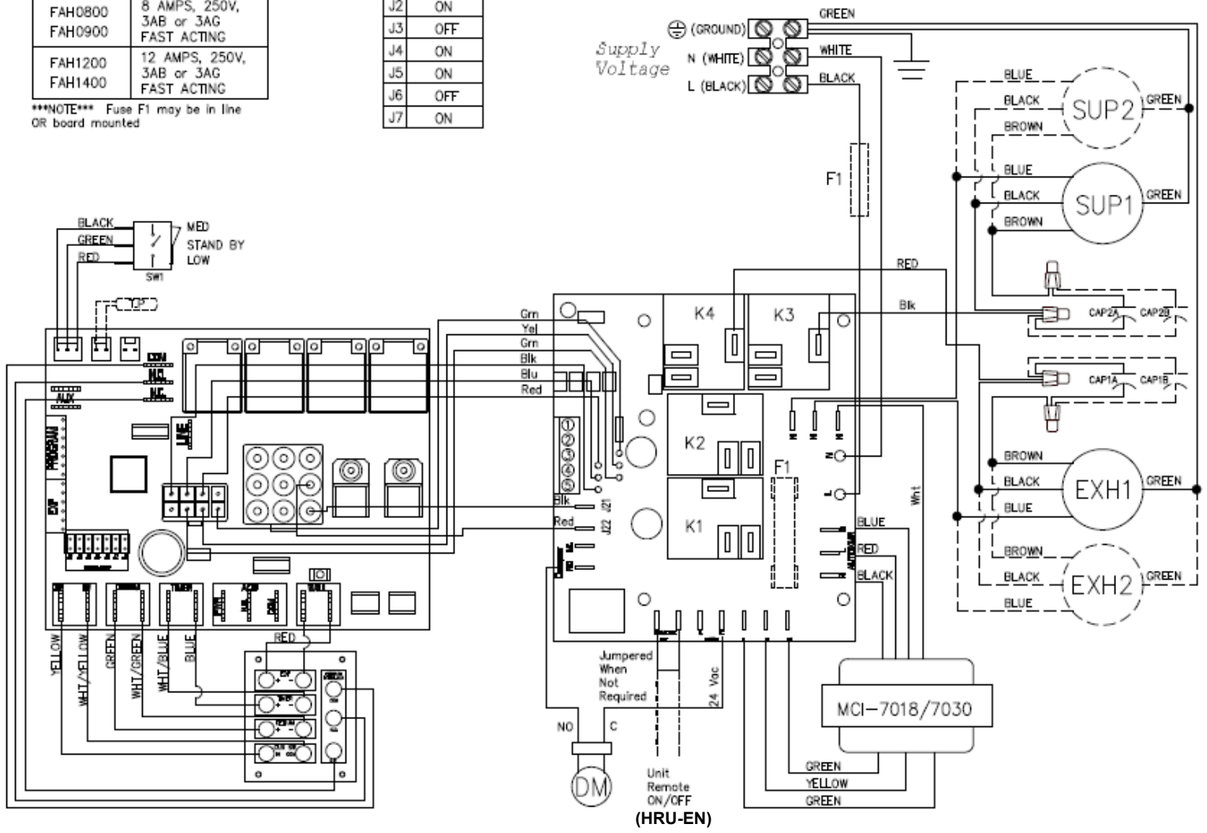
HCE PCB REPLACEMENT FUSE SPECIFICATION

TYPE	FUSE RATING
FAH0800 FAH0900	8 AMPS, 250V, 3AB or 3AG FAST ACTING
FAH1200 FAH1400	12 AMPS, 250V, 3AB or 3AG FAST ACTING

NOTE Fuse F1 may be in line OR board mounted

UNI-CTRL JUMPER SETTINGS

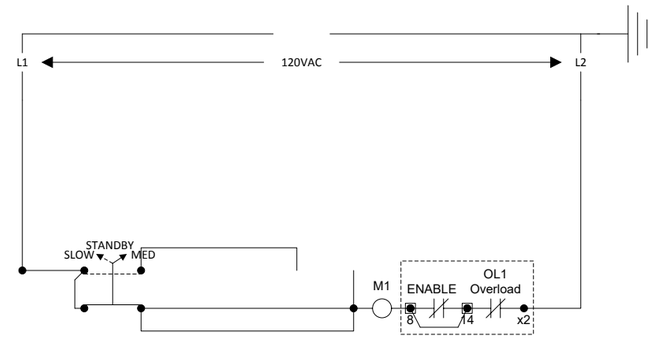
J1	OFF
J2	ON
J3	OFF
J4	ON
J5	ON
J6	OFF
J7	ON



(HRU-EN)

----INDICATES OPTIONAL COMPONENTS DEPENDING ON MODEL

—··—INDICATES CONTROL WIRING (BY OTHERS)



Drawing Title

007.003(HRU-M2 SF & RF Wiring)

Project Title

Aldergrove Port of Entry DB
LANGLEY, BC

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	1	As-built		11/21/2015	TK

Sales Engineer	Project Manager	Application Engineer	DRAWN		APPROVED	
Cansin Yang	Troy Bazille	CoEE	BY	DATE	BY	DATE

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CONTRACT NUMBER **40970088**

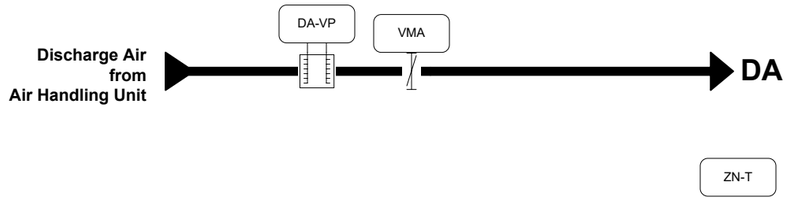
DRAWING NUMBER **202 D**

BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
VMA	4	MS-VMA1615-0	VMA 3 UI & 2BO
ZN-T	4	NS-BTN7003-0	3X4.5.T.TB.ADDRESSABLE

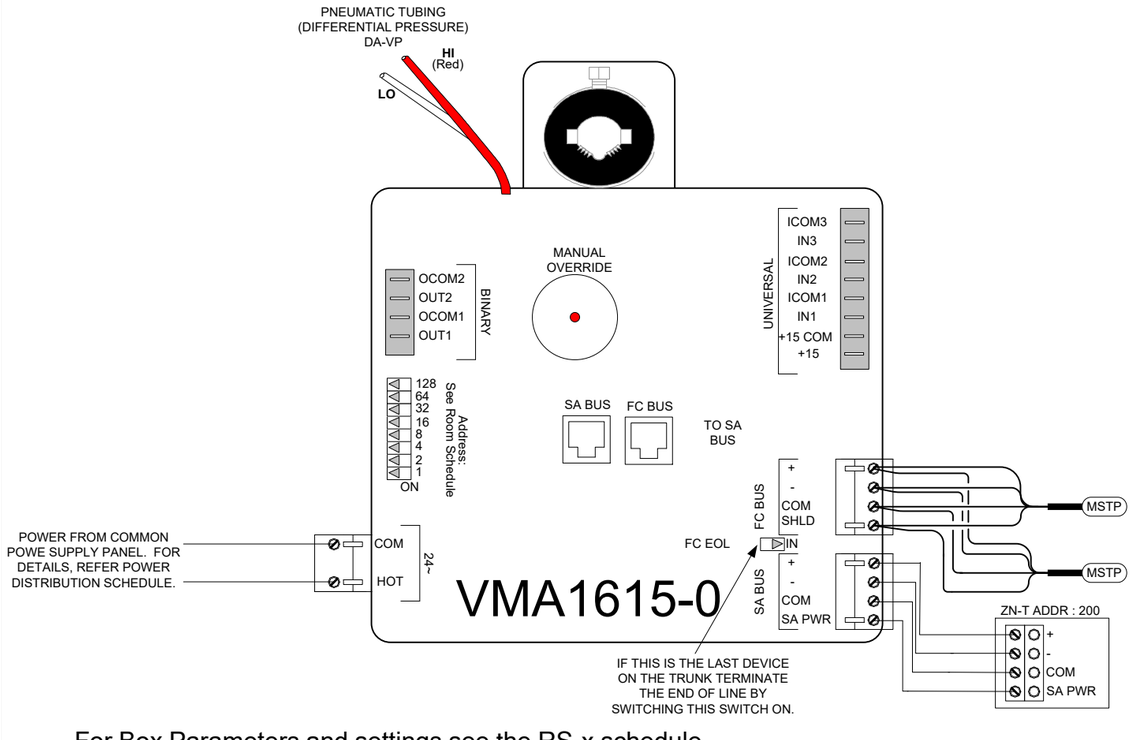
Note-

1) Above BOM is for all systems.



ZN-T SCHEDULE					
SR.NO.	FLOOR	ROOM NO.	ROOM NAME	VAV TAG	REMARK
1	Main	M110	Hallw ay	VAV-M2	
2	Main	M128	First AID	VAV-M3	
3	Main	M145	Business Center	VAV-M12	
4	Main	M152	Pill Booth	VAV-M16	

Note-
Refer Room Schedule for IO points of other systems, if mapped in VAV controller.



For Box Parameters and settings see the RS-x schedule

VAV-MX-CLG

Sequence of Operation:

General:

- System is a single duct variable air volume box providing primary cooling and ventilation to the zone from the central air handling unit system.
- A digital controller will be provided for the control of each VAV box to maintain air flow and to maintain the room temperature set-point (heating season 20 deg C; cooling season 24 deg C) (adjustable)
- The zone will have a wall mounted thermostat to provide feedback to the VAV system

Cooling mode:
During cooling mode the VAV box will module the airflow damper from the minimum position up to the maximum position through a PID loop to maintain the room temperature at set point.

Alarms:

- Low room temperature – if the room temperature is below 10°C (adjustable)
- High room temperature – if the room is 10 deg c above set point (adjustable)
- High airflow limit – if the zone airflow rises above the set point by 25% (adjustable)
- Low airflow limit – if the zone airflow falls below the set point by 25% (adjustable)

Drawing Title
008.001(VAV-Mx-CLG Control)
Typical of 4

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	3	As-built		11/21/2015	TK
	2	Formal Submission		10/19/15	JYC
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Project Title
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CONTRACT NUMBER
40970088

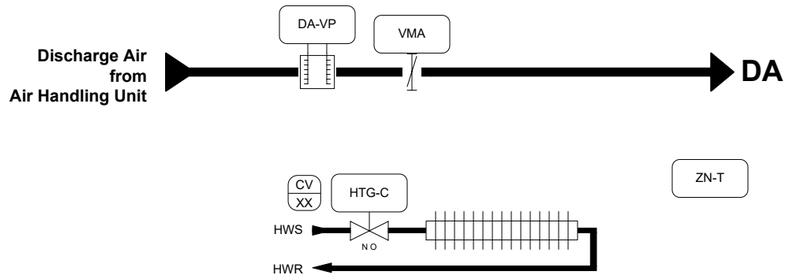
DRAWING NUMBER
301 A

BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
VMA	2	MS-VMA1615-0	VMA 3 UI & 2BO
ZN-T	2	NS-BTN7003-0	3X4.5.T.TB.ADDRESSABLE
Other Devices:			
HTG-C	2	VALVE	SEE VALVE SCHEDULE

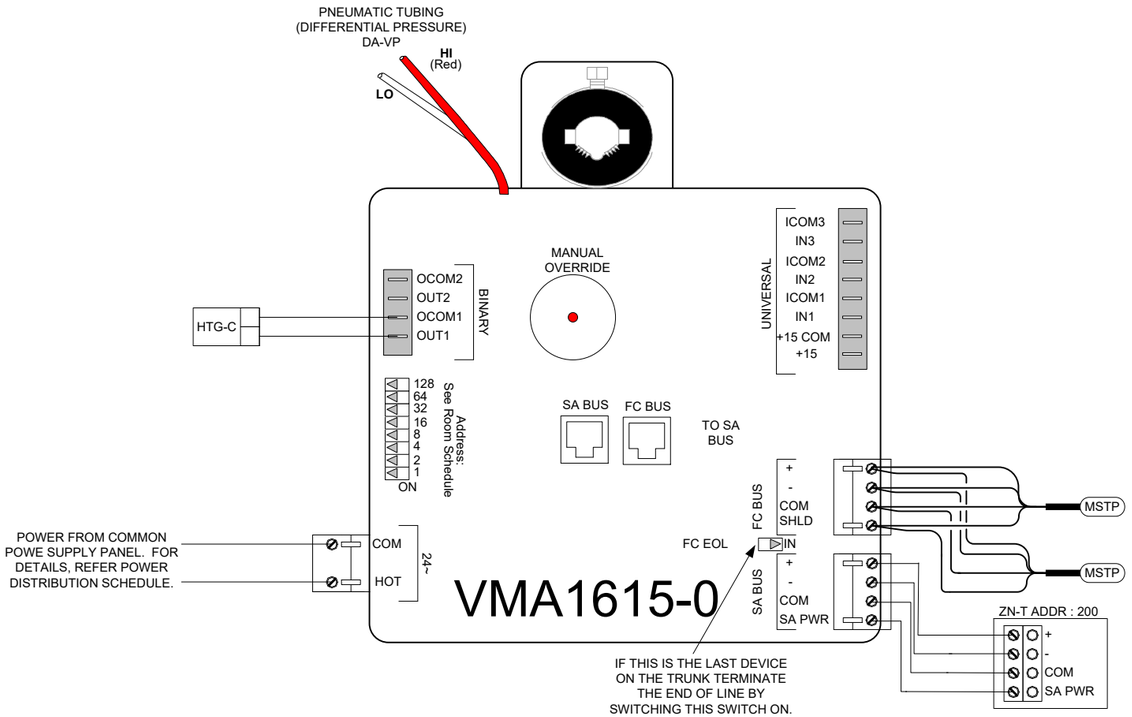
Note-

1) Above BOM is for one systems.



ZN-T and RP SCHEDULE					
SR. NO.	FLOOR	ROOM NO.	ROOM NAME	VAV TAG	RP TAG
1	Main	M111	Interview	VAV-M1	RP-3-M111
2	Main	M138	Hallway	VAV-M7	RP-5-M138

Note-
Refer Room Schedule for IO points of other systems, if mapped in VAV controller.



For Box Parameters and settings see the RS-x schedule

VAV-Mx-CLG WITH RP

Sequence of Operation

General:

- System is a single duct variable air volume box providing primary cooling and ventilation to the zone from the central air handling unit system.
- A digital controller will be provided for the control of each VAV box to maintain air flow and to maintain the room temperature set-point (heating season 20 deg C; cooling season 24 deg C) (adjustable)
- The zone will have a wall mounted thermostat to provide feedback to the VAV system
- System is to provide terminal heating to various areas in both the main and commercial buildings during the heating season. These units will not be operational during the cooling and dead band control as defined by the control for that room.

Run condition:

A. The heaters will only operate when both of the following are achieved:

- The room thermostat is in heating mode;
- The associated room VAV box is in its minimum position (see VAV without re-heat control sequence).

Cooling mode:

During cooling mode the VAV box will module the airflow damper from the minimum position up to the maximum position through a PID loop to maintain the room temperature at set point.

Heating mode:

- When the room thermostat calls for heating, the heating control valve will open.
- When the room has reached set point the heating water control valve will close.

Alarms:

- Low room temperature – if the room temperature is below 10°C (adjustable)
- High room temperature – if the room is 10 deg c above set point (adjustable)
- High airflow limit – if the zone airflow rises above the set point by 25% (adjustable)
- Low airflow limit – if the zone airflow falls below the set point by 25% (adjustable)
- Alarm when space temperature deviates from set point by more than 5 deg c for more than 10 minutes.

Drawing Title
008.002(VAV-Mx-CLG WITH RP Control)

Project Title
Aldergrove Port of Entry DB

NO.	REVISION-LOCATION	ECN	DATE	BY
2	As-built		11/21/2015	TK
1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

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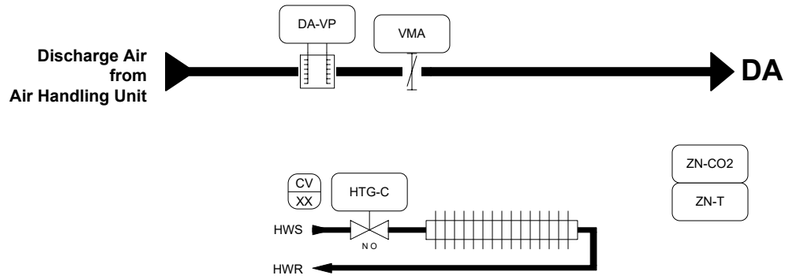
DRAWING NUMBER
301 B



BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
VMA	5	MS-VMA1615-0	VMA 3 UI & 2BO
ZN-CO2	5	CD-W00-00-1	CO2 WALL MNT
ZN-T	5	NS-BTN7003-0	3X4.5.T.TB.ADDRESSABLE
Other Devices:			
HTG-C	5	VALVE	SEE VALVE SCHEDULE

Note-

1) Above BOM is for all systems.

ZN-T,ZN-CO2 and RP SCHEDULE					
SR.NO.	FLOOR	ROOM NO.	ROOM NAME	VAV TAG	RP TAG
1	Main	M134	Lunch Room	VAV-M4	RP-5-M134
2	Main	M140	Staff Briefing B	VAV-M8	RP-5-M140
3	Main	M141	Superintendents	VAV-M9	RP-4-M141
4	Main	M151	Security/Netw ork	VAV-M10	RP-3-M151
5	Main	M150	Staff Briefing A	VAV-M11	RP-5-M150

Note-
Refer Room Schedule for IO points of other systems, if mapped in VAV controller.

For Box Parameters and settings see the RS-x schedule

VAV-Mx-CLG WITH RP & ZN-CO2

Sequence of Operation

General:

- System is a single duct variable air volume box providing primary cooling and ventilation to the zone from the central air handling unit system.
- A digital controller will be provided for the control of each VAV box to maintain air flow and to maintain the room temperature set-point (heating season 20 deg C; cooling season 24 deg C) (adjustable).
- The zone will have a wall mounted thermostat to provide feedback to the VAV system
- System is to provide terminal heating to various areas in both the main and commercial buildings during the heating season. These units will not be operational during the cooling and dead band control as defined by the control for that room.

Run condition:

A. The heaters will only operate when both of the following are achieved:

- The room thermostat is in heating mode;
- The associated room VAV box is in its minimum position (see VAV without re-heat control sequence).

Cooling mode:

During cooling mode the VAV box will module the airflow damper from the minimum position up to the maximum position through a PID loop to maintain the room temperature at set point.

Heating mode:

- When the room thermostat calls for heating, the heating control valve will open.
- When the room has reached set point the heating water control valve will close.

Alarms:

- Low room temperature – if the room temperature is below 10°C (adjustable)
- High room temperature – if the room is 10 deg c above set point (adjustable)
- High airflow limit – if the zone airflow rises above the set point by 25% (adjustable)
- Low airflow limit – if the zone airflow falls below the set point by 25% (adjustable)
- Alarm when space temperature deviates from set point by more than 5 deg c for more than 10 minutes.

Additional point monitor by BAS

- Zone CO2 (ZN-CO2)

Drawing Title
008.003(VAV-Mx-CLG WITH RP & ZN-CO2 Control)

NO.	REVISION-LOCATION	ECN	DATE	BY
2	As-built		11/21/2015	TK
1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

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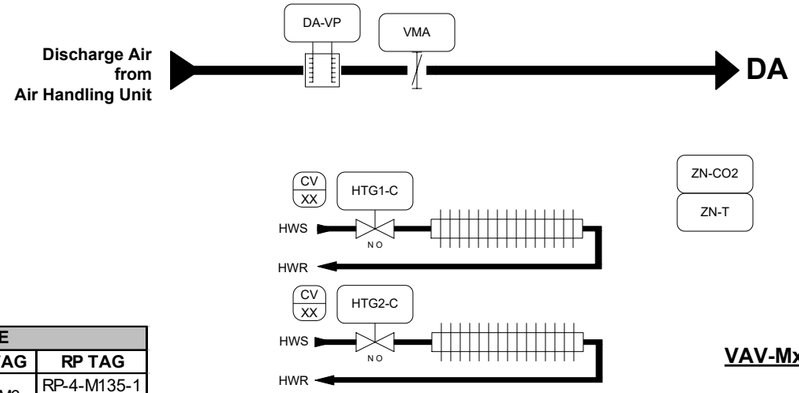
CONTRACT NUMBER
40970088

DRAWING NUMBER
301 C

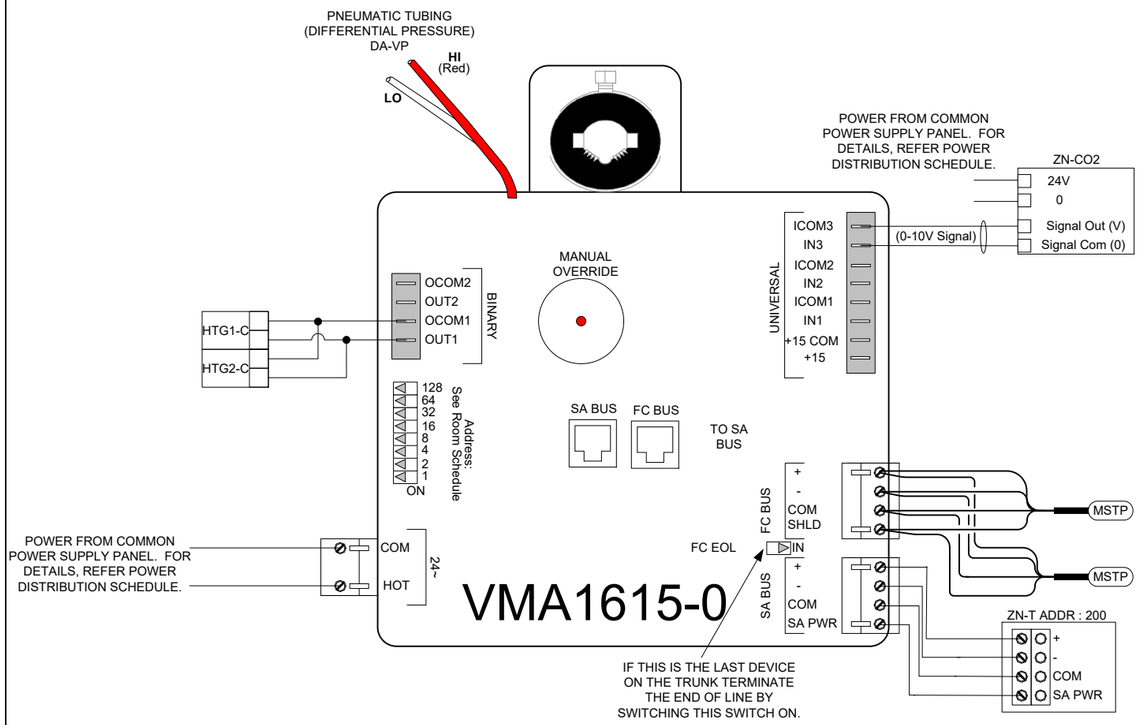
BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
R-1	1	RIB2402B	SPDT,20A,HC=24 VAC/DC,W/LED
VMA	1	MS-VMA1615-0	VMA 3 UI & 2BO
ZN-CO2	1	CD-W00-00-1	CO2 WALL MNT
ZN-T	1	NS-BTN7003-0	3X4.5.T.TB.ADDRESSABLE
Other Devices:			
HTG-C	2	VALVE	SEE VALVE SCHEDULE



ZN-T,ZN-CO2 and 2 RP SCHEDULE					
SR.NO.	FLOOR	ROOM NO.	ROOM NAME	VAV TAG	RP TAG
1	Main	M135	Port Direction	VAV-M6	RP-4-M135-1 RP-4-M135-2

Note-
Refer Room Schedule for IO points of other systems, if mapped in VAV controller.



For Box Parameters and settings see the RS-x schedule

VAV-Mx-CLG WITH 2 RP & ZN-Co2

Sequence of Operation

General:

- System is a single duct variable air volume box providing primary cooling and ventilation to the zone from the central air handling unit system.
- A digital controller will be provided for the control of each VAV box to maintain air flow and to maintain the room temperature set-point (heating season 20 deg C; cooling season 24 deg C) (adjustable) with dead band requirement of ASHRAE 90.1 – 2010 and PID algorithm requirements.
- The zone will have a wall mounted thermostat to provide feedback to the VAV system
- System is to provide terminal heating to various areas in both the main and commercial buildings during the heating season. These units will not be operational during the cooling and dead band control as defined by the control for that room.

Run condition:

A. The heaters will only operate when both of the following are achieved:

- The room thermostat is in heating mode;
- The associated room VAV box is in its minimum position (see VAV without re-heat control sequence).

Cooling mode:

During cooling mode the VAV box will module the airflow damper from the minimum position up to the maximum position through a PID loop to maintain the room temperature at set point.

Heating mode:

- When the room thermostat calls for heating, the heating control valve will open.
- When the room has reached set point the heating water control valve will close.

Alarms:

- Low room temperature – if the room temperature is below 10°C (adjustable)
- High room temperature – if the room is 10 deg c above set point (adjustable)
- High airflow limit – if the zone airflow rises above the set point by 25% (adjustable)
- Low airflow limit – if the zone airflow falls below the set point by 25% (adjustable)
- Alarm when space temperature deviates from set point by more than 5 deg c for more than 10 minutes.

Additional point monitor by BAS

- Zone CO2 (ZN-CO2)

Drawing Title
008.004(VAV-Mx-CLG WITH 2 RP & ZN-CO2 Control)

	NO.	REVISION-LOCATION	ECN	DATE	BY
	2	As-built		11/21/2015	TK
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Project Title
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Fax: 604-707-5201

CONTRACT NUMBER
40970088

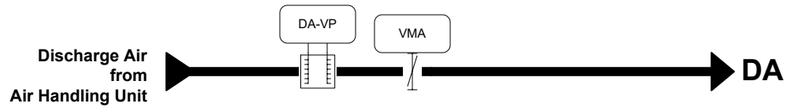
DRAWING NUMBER
301 D

BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
VMA	3	MS-VMA1615-0	VMA 3 UI & 2BO
ZN-CO2	3	CD-W00-00-1	CO2 WALL MNT
ZN-T,-H	3	NS-BHB7003-0	3X4.5 T/H D ADJ. T 3% ADR

Note-

1) Above BOM is for all systems.

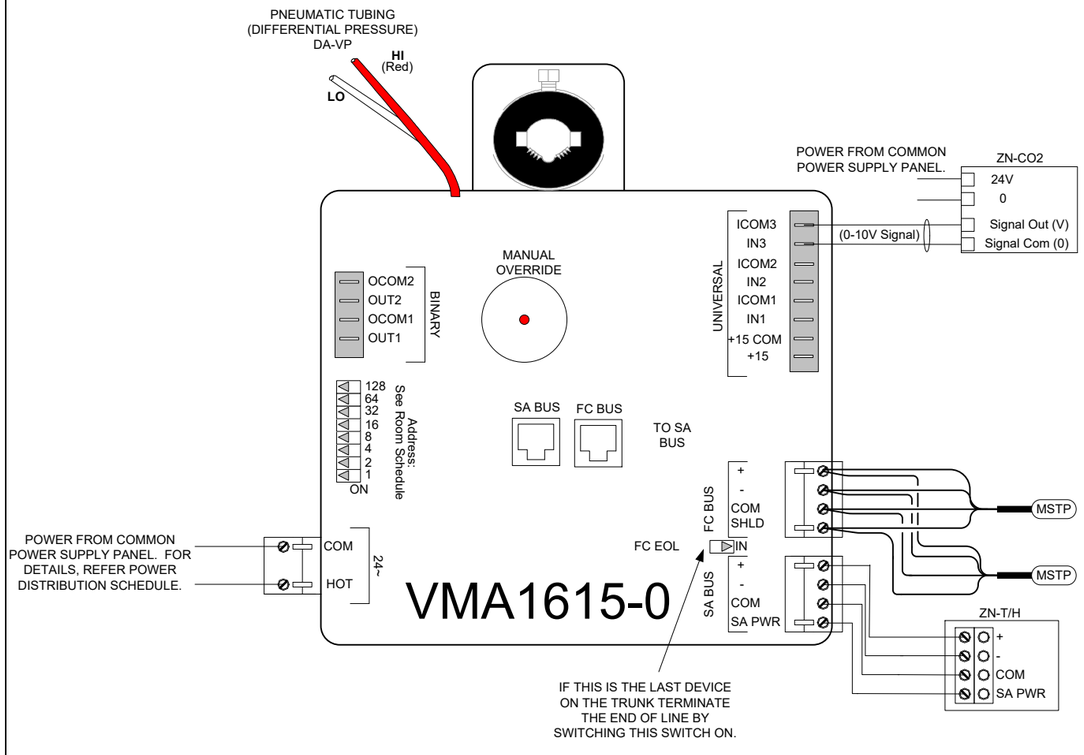


ZN-CO2

ZN-T, -H

ZN-T,ZN-H and CO2 SCHEDULE				
SR.NO.	FLOOR	ROOM NO.	ROOM NAME	VAV TAG
1	Main	M101	Public Lobby	VAV-M14
2	Main	M142	General Office Area	VAV-M15
3	Main	M142	General Office Area	VAV-M13

Note-
Refer Room Schedule for IO points of other systems, if mapped in VAV controller.



For Box Parameters and settings see the RS-x schedule

VAV-Mx-CLG WITH ZN-CO2 & ZN-H

Sequence of Operation:

General:

- System is a single duct variable air volume box providing primary cooling and ventilation to the zone from the central air handling unit system.
- A digital controller will be provided for the control of each VAV box to maintain air flow and to maintain the room temperature set-point (heating season 20 deg C; cooling season 24 deg C) (adjustable)
- The zone will have a wall mounted thermostat to provide feedback to the VAV system

Cooling mode:

During cooling mode the VAV box will module the airflow damper from the minimum position up to the maximum position through a PID loop to maintain the room temperature at set point.

Alarms:

- Low room temperature – if the room temperature is below 10°C (adjustable)
- High room temperature – if the room is 10 deg c above set point (adjustable)
- High airflow limit – if the zone airflow rises above the set point by 25% (adjustable)
- Low airflow limit – if the zone airflow falls below the set point by 25% (adjustable)

Additional points monitor by BAS

- Zone CO2 (ZN-CO2)
- Zone Humidity (ZN-H)

Drawing Title
008.005(VAV-Mx-CLG WITH ZN-CO2 & ZN-H Control)

Typical of 3

Project Title
Aldergrove Port of Entry DB

NO.	REVISION-LOCATION	ECN	DATE	BY
3	As-built		11/21/2015	TK
2	Formal Submission		10/19/15	JYC
1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

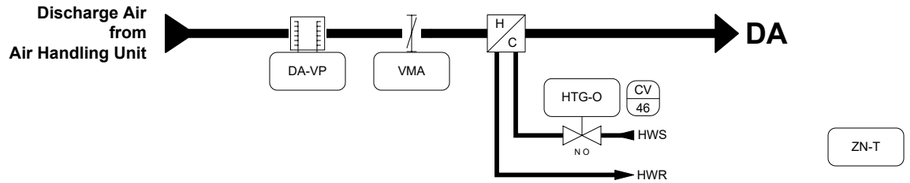
Branch Information
Johnson Controls Inc
3680 East 2nd Avenue
Vancouver, Canada
V5M 0A4
Phone: 604-707-5200
Fax: 604-707-5201

CONTRACT NUMBER
40970088

DRAWING NUMBER
301 E

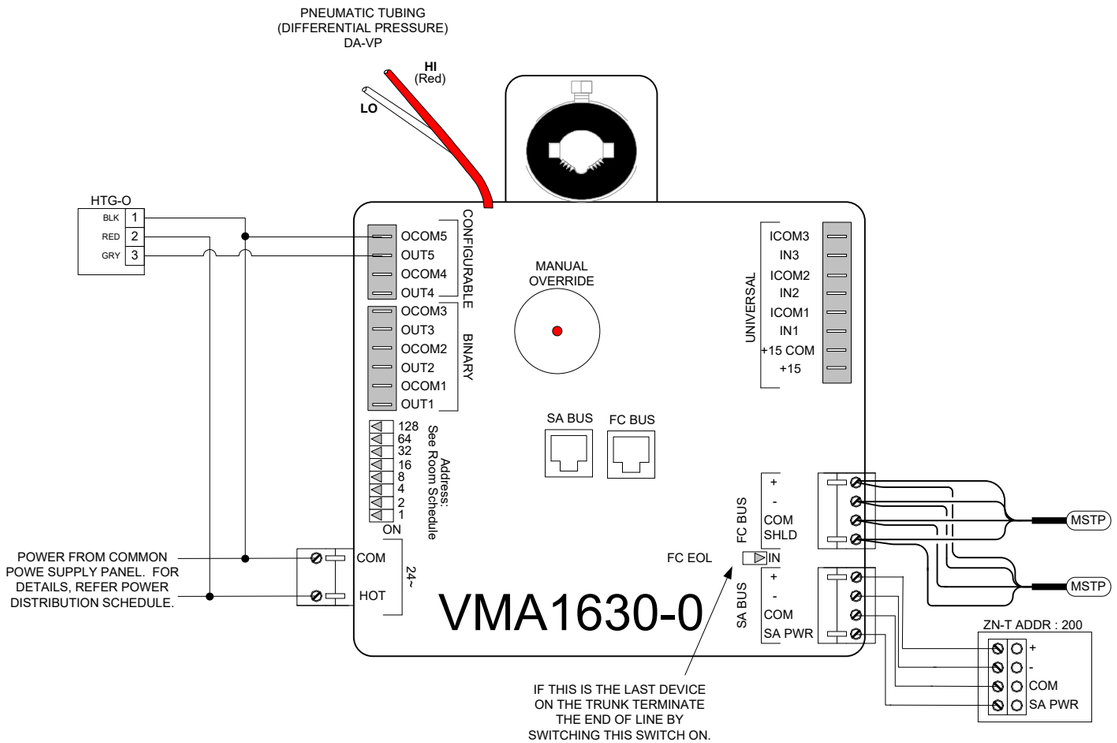
BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
VMA	1	MS-VMA1630-0	VMA 3 UI & 3 BO 2 CO
ZN-T	1	NS-BTN7003-0	3X4.5.T.TB.ADDRESSABLE
Other Devices:			
HTG-O	1	VALVE	SEE VALVE SCHEDULE



ZN-T SCHEDULE				
SR.NO.	FLOOR	ROOM NO.	ROOM NAME	VAV TAG
1	Main Floor	M132	Womens	VAV-M5

Note-
Refer Room Schedule for IO points of other systems, if mapped in VAV controller.



For Box Parameters and settings see the RS-x schedule

VAV-Mx-RH

Sequence of Operation:

General:

- System is a single duct constant air volume box with reheat coil for the central air handling unit system.
- A digital controller will be provided for the control of each VAV box to maintain air flow and provide control of the reheat coil to maintain overall control of the space temperature to maintain the room temperature set-point (heating season 20 deg c; cooling season 24 deg c) (adjustable) with dead band requirement of ASHRAE 90.1 – 2010 and PID algorithm requirements.
- The airflow will be maintained at a constant volume at all times during occupied times.
- The zone will have a wall mounted thermostat for feedback to the VAV system; refer to drawings for thermostat locations.

Cooling mode:
During cooling mode the box will be at constant airflow and the re-heat coil will be closed.

Heating mode:
During heating mode the box will be at constant airflow and the re-heat coil will modulate to maintain the room temperature set point using a PID control loop.

Alarms:

- Low room temperature – if the room temperature is below 10 deg c (adjustable)
- High room temperature – if the room is 10 deg c above set point (adjustable)
- High airflow limit – if the zone airflow rises above the set point by 25% (adjustable)
- Low airflow limit – if the zone airflow falls below the set point by 25% (adjustable).

Drawing Title
008.006(VAV-Mx-RH Control)

Project Title
Aldergrove Port of Entry DB

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	2	As-built		11/21/2015	TK
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

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Fax: 604-707-5201

CONTRACT NUMBER
40970088

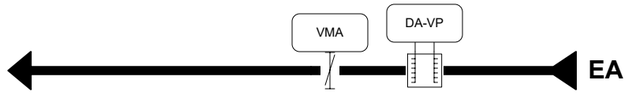
DRAWING NUMBER
301 F

BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
VMA	2	MS-VMA1615-0	VMA 3 UI & 2BO

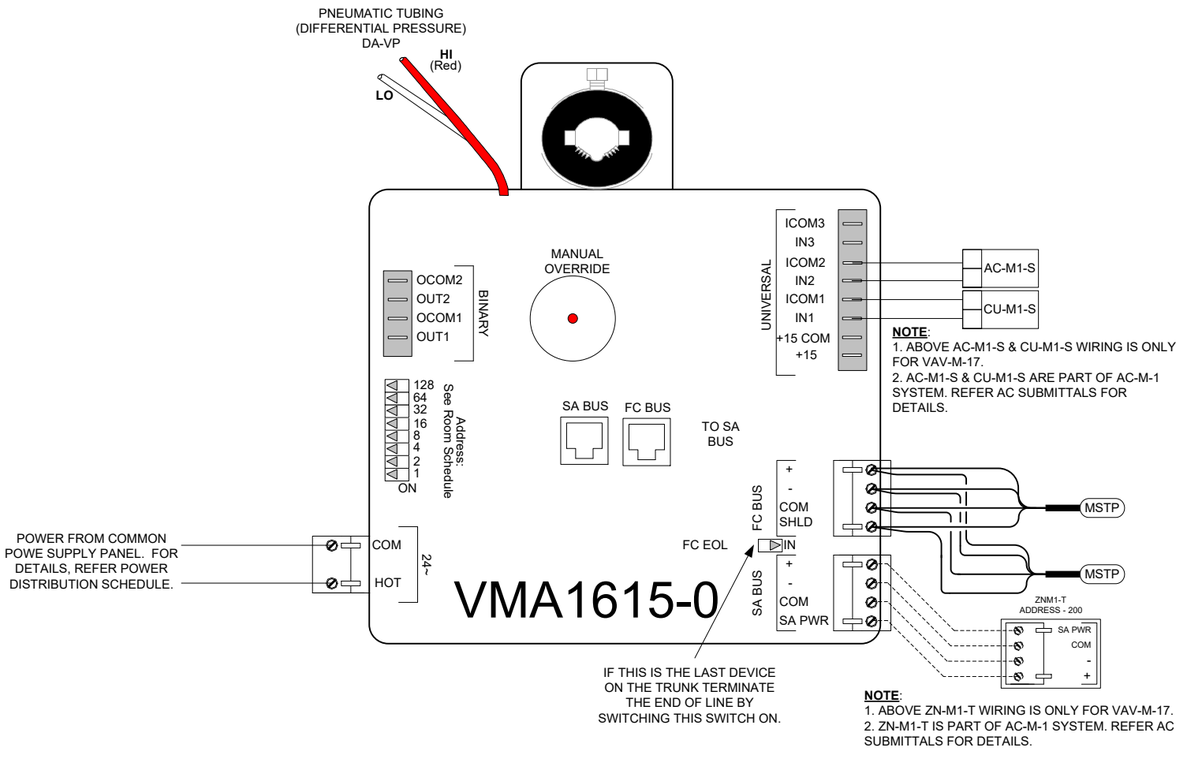
Note-

1) Above BOM is for all systems.



EXHAUST VAV SCHEDULE				
SR.NO.	FLOOR	SERVICE	LOCATION	VAV TAG
1	Main	Wash Room Exhaust	M108, Hallw ay	VAV-M17
2	Main	General Exhaust	M201, Mechanical Room	VAV-M18

Note-
Refer Room Schedule for IO points of other systems, if mapped in VAV controller.



For Box Parameters and settings see the RS-x schedule

VAV-Mx- EXHAUST

Sequence of Operation

Wash room exhaust VAV:

General:

- System is a single duct exhaust system for general washroom and janitor room exhaust airflow back to the central HRU (either HRU-M1).
- A digital controller will be provided for the control of each CAV box to maintain a constant air flow setpoint.
- Following variables will be able to be loaded/monitored at the building automation system operator station, for each of the digital VAV boxes:
  - Air volume
  - Minimum volume setting
  - Maximum volume setting
  - Damper operator command
  - No Room temperature sensor or set point adjustment
- The digital controller and actuator will be supplied by the controls contractor and mounted at the VAV box manufacturer's factory or field mounted on site. The flow sensor will be provided by the VAV manufacturer and installed in the factory.

Alarms:
High or low airflow at +/- 25% from the setpoint airflow.

General exhaust VAV:

General:

- System is a single duct variable air volume box providing general exhaust from the return air ductwork in the mechanical room. This box is meant to provide general building relief air when the AHU is operating in heat recovery mode.
- A digital controller will be provided for the control of each VAV box to maintain air flow.
- The digital controller and actuator will be supplied by the controls contractor and mounted at the VAV box manufacturer's factory or field mounted on site. The flow sensor will be provided by the VAV manufacturer and installed in the factor.

Run conditions:
The VAV box will only operate to maintain calculated airflow when the HRU is in heat recovery mode. At all other times this box will remain closed and building relief air will be through a modulated damper at the AHU.

Normal operation:
The VAV box will operate to maintain airflow.

Alarms:

Provide an alarm when the airflow drops below set point by more than 10%.

Drawing Title

008.007(VAV-Mx-Exhaust Control)

Project Title

Aldergrove Port of Entry DB

NO.	REVISION-LOCATION	ECN	DATE	BY
3	As-built		11/21/2015	TK
2	Formal Submission		10/19/15	JYC
1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Branch Information

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3680 East 2nd Avenue
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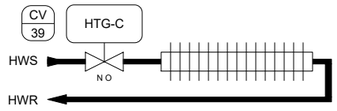
CONTRACT NUMBER **40970088**

DRAWING NUMBER **301 G**

BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
ZN-RP-T	1	NS-BTN7003-0	3X4.5.T.TB.ADDRESSABLE
Other Devices:			
HTG-C	1	VALVE	SEE VALVE SCHEDULE



ZN-RP-T

NOTE:
1. IO points of RP System is mapped in HW System.

ZN-T and RP SCHEDULE					
SR. NO.	FLOOR	ROOM NO.	ROOM NAME	RP TAG	IO POINT MAPPING DETAILS
1	Main	M102, M103	W/C	RP-2-M102	HW SYSTEM

RADIANT FLOW

Sequence Of Operation:

General:
System is to provide terminal heating to various areas in both the main and commercial buildings during the heating season. These units will not be operational during the cooling and dead band control as defined by the control for that room.

Run condition:
The heaters will only operate when both of the following are achieved:
- The room thermostat is in heating mode;

Heating mode:
- when the room thermostat calls for heating, the heating control valve will open.
- when the room has reached set point the heating water control valve will close.

Alarms:
Alarm when space temperature deviates from set point by more than 5 deg c for more than 10 minutes.

Drawing Title
008.008(RP Control)

Project Title
Aldergrove Port of Entry DB

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	2	As-built		11/21/2015	TK
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Johnson Controls

Branch Information
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Phone: 604-707-5200
Fax: 604-707-5201

CONTRACT NUMBER
40970088

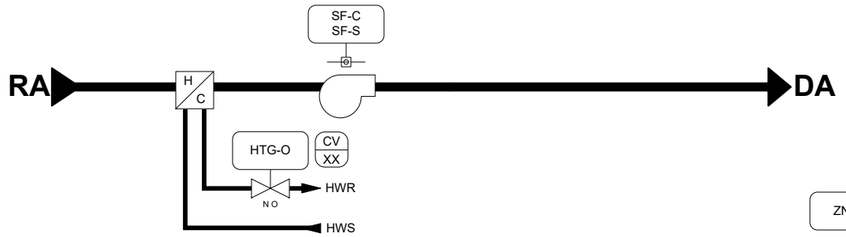
DRAWING NUMBER
302 A

BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
SF-C,-S	1	H120	CSR,N.O.,24V,FRAC HP,N.O.,SERIES
Panel Devices:			
CP-FC-Mx	1	MS-FEC1611-0	FEC1611-0, FEC9, W/O
TX-1	1	Y64T15-0	TRANSFORMER UL CLASS 2
Other Devices:			
HTG-O	1	VALVE	SEE VALVE SCHEDULE

Note-

1) Above BOM is for one system.



Note:
1. The ZN-T is common for VAV-M-15 and FC-M1 serving in the same area- General Office. ZN-T is considered in the VAV BOM/submittals.
2. The ZN-T is common for VAV-M-14 and FC-M2 serving in the same area- Public Lobby. ZN-T is considered in the VAV BOM/submittals.

FCU Schedule			
Sr. No.	**Floor**	**FCU Tag**	**Serving Room & Room**
1	Main	FCU-M1	General Office Area[M142]
2	Main	FCU-M2	Public Lobby[M101]

FAN COIL UNITS (FC-Mx)

Sequence Of Operation

General:
System is to provide terminal heating to the open office areas and lobby in the main building during the heating season. These units will not be operational during the cooling and dead band control.

Run condition:
The fan coil will only operate when both of the following are achieved:

- The room thermostat is in heating mode.

Heating mode:
When the room thermostat calls for heating, the fan will turn on and the heating coil control valve will start to open. The control valve will be operated to maintain the room temperature through a PID control loop.
When the room has reached set point the heating water control valve will close and the fan will operate for 5 minutes (adjustable) then deactivate.

Alarms:
Alarm when space temperature deviates from set point by more than 10°c for more than 15 minutes.

Drawing Title
009.001(FC-Mx Control)
Typical of 2

Project Title
Aldergrove Port of Entry DB

NO.	REVISION-LOCATION	ECN	DATE	BY
3	As-built		11/21/2015	TK
2	Formal Submission		10/19/15	JYC
1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Branch Information
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Phone: 604-707-5200
Fax: 604-707-5201

CONTRACT NUMBER
40970088

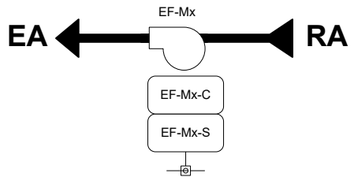
DRAWING NUMBER
303 A

BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
EF-Mx-S	4	CSD-SA1E0-1	SLD/ADJ LED 1A W/O RELAY
Panel Devices:			
CP-EF-Mx	1	PAKG00001AH0	FEC2611,20X24
EF-Mx-C	4	RH2B-UAC24-L	DPDT,10A,HC=24 VAC,
	4	SH2B-05	DPDT RELAY BASE FOR RH2B

Note:
1. Above BOM is for all system.

EF-M1, EF-M2, EF-M3 & EF-M6 Flow Diagram (Typical Of 4)



GENERAL PURPOSE EXHAUST FANS (EF-M1, EF-M2, EF-M3 & EF-M6)

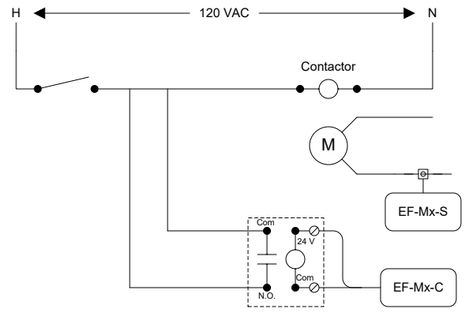
Sequence Of Operation:

General:
Units are general purpose exhaust fans for serving storage rooms and the water entry room.

Control description:
Exhaust fans will operate during a user definable occupancy schedule. Occupancy schedule will match associated ahu that serves the zone.

Alarms:
DDC will provide a local alarm when fan status does not show the unit operating during the required operating time.

EXHAUST FAN SCHEDULE					
SR.NO.	TAG	SERVING AREA	VOLT/ PH	MECH DWG	IO POINTS MAPPED IN
1	EF-M1	Janitoy-M133	120/ 1	M2.02	CP-EF-M1,2
2	EF-M2	Storage-M123	120/ 1	M2.02	CP-EF-M1,2
3	EF-M3	BSF241-M126	120/ 1	M2.02	VAV-M4
4	EF-M6	Business Center-M145	120/ 1	M2.02	VAV-M12



Exhaust Fan EF-Mx Control Wiring

Drawing Title
010.001(EF-M1, EF-M2 ,EF-M3, EF-M5 & EF-M6 Control)

NO.	REVISION-LOCATION	ECN	DATE	BY
3	As-built		11/21/2015	TK
2	SUBMITTAL		3/2/15	CoEE
1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Project Title
Aldergrove Port of Entry DB

Johnson Controls

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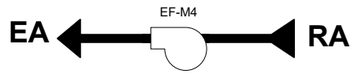
Phone: 604-707-5200
Fax: 604-707-5201

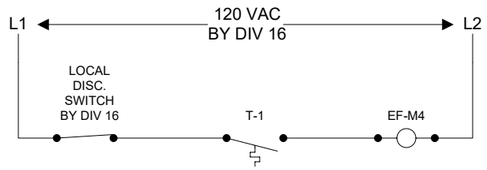
CONTRACT NUMBER
40970088

DRAWING NUMBER
401 A

BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
T-1	1	T26S-18C	SPC,BLB,SP=40-90 F(5-30 C),STG=1





NOTE-

1) DDC WILL NOT MONITOR THIS FAN.

EF-M4 SCHEDULE				
SR.NO.	**TAG**	**SERVING AREA**	**V/ PH**	**MECH DWG**
1	EF-M4	COM M127	120/ 1	M2.02

COMMUNICAIONS ROOM EXHAUST FAN (EF-M4)

Sequence Of Operation:

General:

This unit is a general purpose inline exhaust fan designed to provide cooling to the communications room in the main building. This unit will operate through a reverse acting thermostat to maintain the room temperature above the set point, initially set at 18 deg. C.

The thermostat will be a line voltage stat and these systems will not be connected to the DDC.

Drawing Title

010.002(EF-M4 Control)

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	2	As-built		11/21/2015	TK
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Project Title

Aldergrove Port of Entry DB

Johnson Controls

Branch Information

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Phone: 604-707-5200
Fax: 604-707-5201

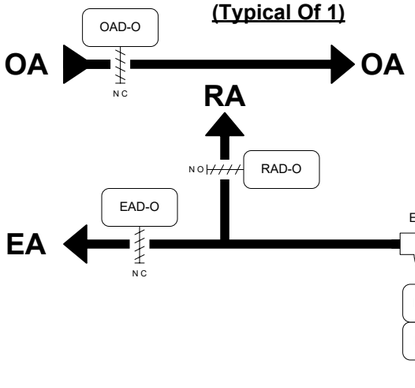
CONTRACT NUMBER

40970088

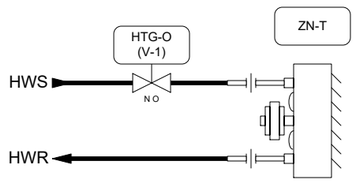
DRAWING NUMBER

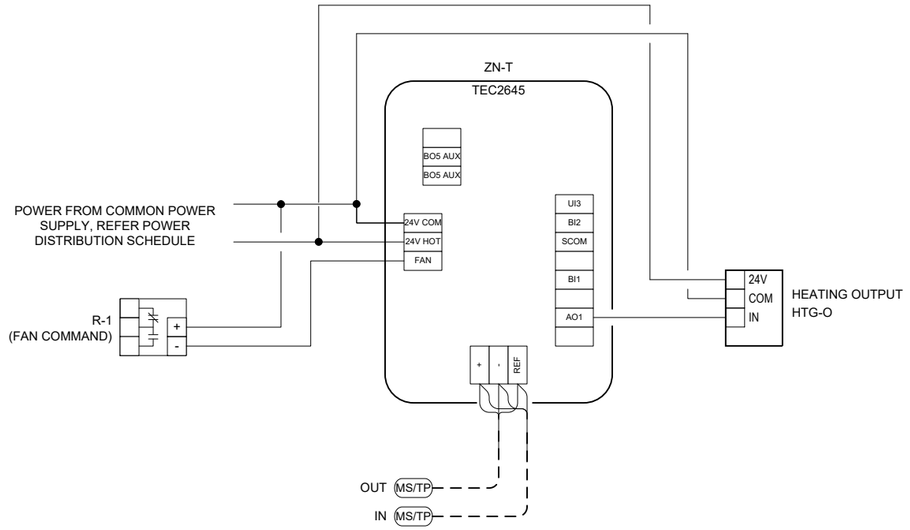
401 B

EF-M5 Flow Diagram (Typical Of 1)

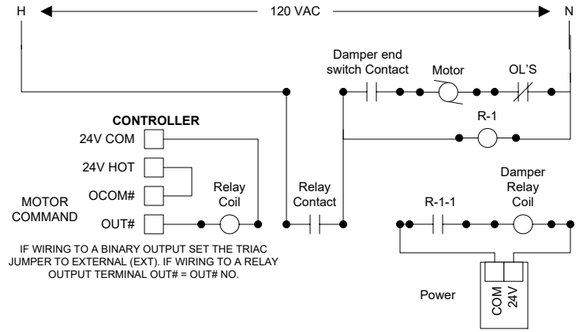


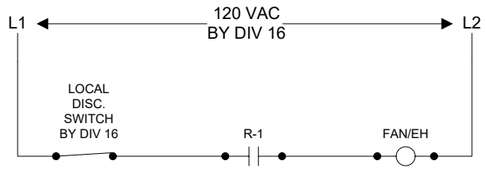
HUH-M1 FLOW DIAGRAM





Single Phase Motor Wiring With Damper





BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
EF-Mx-S	1	CSD-SA1E0-1	SLD/ADJ LED 1A W/O RELAY
R-1	1	RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED
ZN-T	1	TEC2645-4	1 PROP 1 SPD FAN
OAD, EAD, RAD	3	Damper Schedule	Damper Schedule
HTG-O	1	VALVE	SEE VALVE SCHEDULE
Panel Devices:			
EF-Mx-C	1	RH2B-UAC24-L	DPDT,10A,HC=24 VAC,
	1	SH2B-05	DPDT RELAY BASE FOR RH2B

NOTE:

1. THESE GRAY DEVICES WILL BE YORK DEVICES OR PROVIDED BY OTHERS.
2. ABOVE BOM IS FOR ALL SYSTEM.

EF-M5 SCHEDULE				
SR.NO.	TAG	SERVING AREA	MECH DWG	IO POINTS MAPPED IN
1	EF-M5	Mechanical Room M201	M2.02	CP-AHU-M1

HUH Schedule		
Tag	Location	Remark
HUH-M1	M201 - Mechanical room	Need to verify if ZN-T shared with any other system

MECHANICAL ROOM EXHAUST FAN (EF-M5):

Sequence Of Operation:

General:
Units are general purpose exhaust fans for providing ventilation and cooling for the mechanical rooms in the winter. The system is equipped with a make-up air damper, return air damper and exhaust air damper for temperature control during fan operation and to limit the requirements for heat in the winter.

Control description:
- Exhaust fans will cycle to maintain space temperature.
- When the exhaust fan is in operation, the outside air damper, return air damper and exhaust air damper will all modulate together to maintain the room temperature set point (initially set to 26°c).
- When the systems are off, the dampers will be in full return position.

Alarms:
- DDC will provide an alarm when fan status does not show the unit operating during the required operating time.
- DDC will provide an alarm when the room temperature drops below 5c.

HYDRONIC UNIT HEATER (HUH-M1)

Sequence Of Operation:

General:
System will provide heating within the mechanical room in the Main building. These units will not be operational during the cooling and dead band control.

Run condition:
The unit heater shall be enabled when the outside air temperature is below 18°c.

Heating mode:
When the room thermostat calls for heating, the fan will turn on and the heating coil control valve will start to open. The control valve will be operated to maintain the room temperature through a on/off valve.
When the room has reached set point the heating water control valve will close and the fan will operate for 5 minutes (adjustable) then deactivate.

Alarms:
Alarm when space temperature deviates from setpoint by more than 5°c.

Drawing Title
011.001(HUH-M1 & EF-M5 Control)

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	3	As-built		11/21/2015	TK
	2	Formal Submission		10/19/15	JYC
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Project Title
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CONTRACT NUMBER
40970088

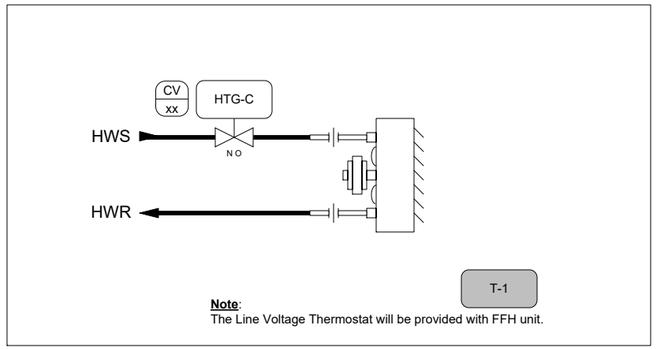
DRAWING NUMBER
402 A

BILL OF MATERIALS

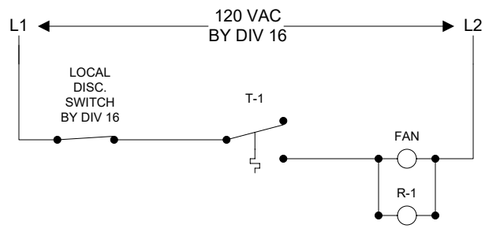
Designation	Qty	Part Number	Description
Field Devices:			
R-1	4	RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED
Other Devices:			
HTG-C	4	VALVE	SEE VALVE SCHEDULE

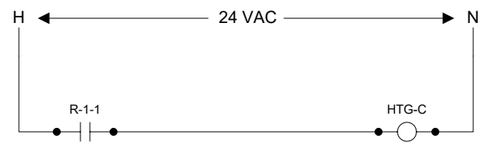
Note:

1. These gray devices will be provided by others.
2. Above BOM is for all systems.



Note:
The Line Voltage Thermostat will be provided with FFH unit.





UNIT HEATER SCHEDULE						
SR. NO.	TAG	LOCATION	LPS	HP	V/PH/HZ	REF. DWG.
1	FFH-M2	VESTIBULE-M107	66	0.13	120/1/60	M2.02
2	FFH-M3	VESTIBULE-M122	66	0.13	120/1/60	M2.02
3	FFH-M4	VESTIBULE-M137	66	0.13	120/1/60	M2.02
4	FFH-M5	VESTIBULE-M149	66	0.13	120/1/60	M2.02

FORCE FLOW HEATERS (FFH-Mx)

Sequence Of Operation:

General:
Heater is to operate to maintain the room temperature as sensed at the wall thermostat.

Heating operation:
When the associated thermostat indicates the room temperature is below thermostat setpoint the unit fan will activate and the heating water control valve will open through integral controls.
When the room has reached set point the heat water control valve will close and the fan will shut off.

Power failure:
Heating water control valve fails no valve.

Alarms:
None, these systems are not connected to BMS

Drawing Title
012.001(FFH-Mx Control)

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	3	As-built		11/21/2015	TK
	2	Formal Submission		10/19/15	JYC
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Project Title
Aldergrove Port of Entry DB

Branch Information
Johnson Controls Inc
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V5M 0A4
Phone: 604-707-5200
Fax: 604-707-5201

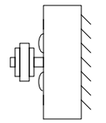
CONTRACT NUMBER
40970088

DRAWING NUMBER
403 A

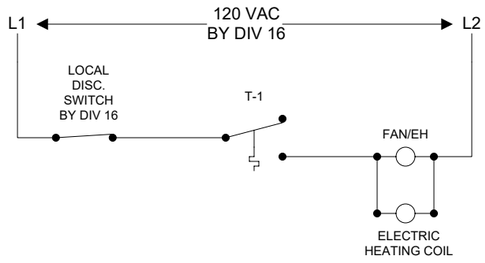
BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
T-1	6	T26S-18C	SPC,BLB,SP=40-90 F (5-30 C),STG=1

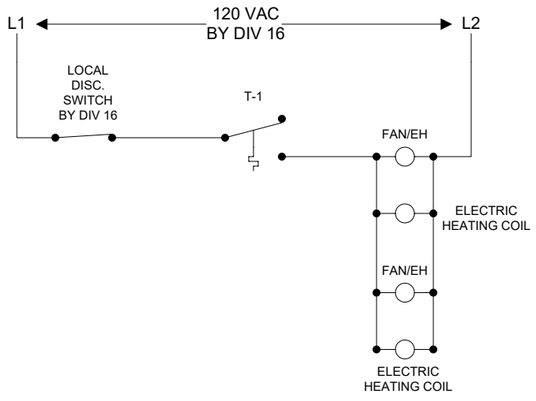
Note:
1. Above BOM is for all system.



T-1



For EFFH-M6 & EFFH-M7



ELECTRIC FORCE FLOW HEATER SCHEDULE					
SR. NO.	TAG	LOCATION	LPS	V/PH/HZ	REMARK
1	EFFH-M1	STAIR M-1	76	120/1/60	
2	EFFH-M2	STORAGE (G) - M123	76	120/1/60	
3	EFFH-M3	BSF241-M126	76	120/1/60	
4	EFFH-M4	PIL BOOTH-M152	76	575/1/60	
5	EFFH-M5	PIL BOOTH-M152	76	575/1/60	
6	EFFH-M6	VESTIBULE M100	21	208/1/60	COMMON ZN-T
7	EFFH-M7	VESTIBULE M100	21	208/1/60	

ELECTRIC FORCE FLOW HEATERS (EFFH-Mx)

Sequence Of Operation:

Heating: The fan and the electric heating coil will be energized as needed to maintain zone heating temperature setpoint.

Not interfaced with DDC systems.

Drawing Title
013.001(EFFH-Mx Control)
Typical of 7

Project Title
Aldergrove Port of Entry DB

	NO.	REVISION-LOCATION	ECN	DATE	BY
	3	As-built		11/21/2015	TK
	2	Formal Submission		10/19/15	JYC
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Branch Information
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Fax: 604-707-5201

CONTRACT NUMBER
40970088

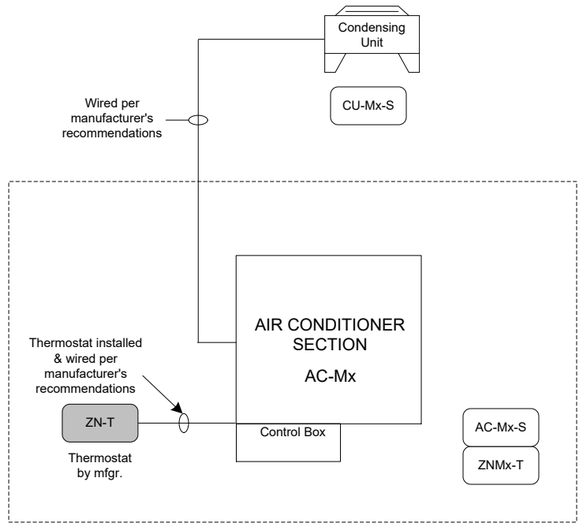
DRAWING NUMBER
403 B

BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
AC-Mx-S	1	CSD-SA1E0-1	SLD/ADJ LED 1A W/O RELAY
CU-Mx-S	1	CSD-SA1E0-1	SLD/ADJ LED 1A W/O RELAY
ZNMx-T	1	NS-BTN7003-0	3X4.5.T.TB.ADDRESSABLE

Note:

1. These gray devices will be provided by others.
2. Above BOM is for one system.



DUCTLESS SPLIT SYSTEM SCHEDULE (INDOOR UNIT)						
Sr. No.	TAG	LOCATION	LPS	V/PH/HZ	MECH DWG	IO POINTS MAPPED IN
1	AC-M1	CCTV ROOM M157	208	208/1/60	M2.02	VAV-M-17 EXHAUST VAV
2	AC-M2	LAN ROOM M121	255	208/1/60	M2.02	EF-M1,2 SUBMITTALS
3	AC-M3	ELECTRICAL ROOM M125	328	208/1/60	M2.02	EF-M1,2 SUBMITTALS

SPLIT AC SYSTEMS AC-Mx

Sequence Of Operation:

General:
These systems consist of a wall mounted evaporator within the electrical or data room and a rooftop mounted condenser unit with refrigerant lines running to and from each unit. A manufacturer provided wall mounted thermostat will be used to control the system.

Control description:

- The system will be controlled through its own remote wall mounted controller.
- The AC systems will operate through their own internal controls to cycle to maintain the room temperature setpoint.
- A separate room temperature sensor will measure the room temperature and send the signal to the DDC.

Alarms:
DDC will provide an alarm when the room temperature rises above 30°C for more than 30 minutes.

DDC graphic requirements:

- System graphic.
- AC status.
- Room temperature.

Drawing Title
014.001(SPLIT SYSTEM AC-Mx Control)

Project Title
Aldergrove Port of Entry DB

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	2	As-built		11/21/2015	TK
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

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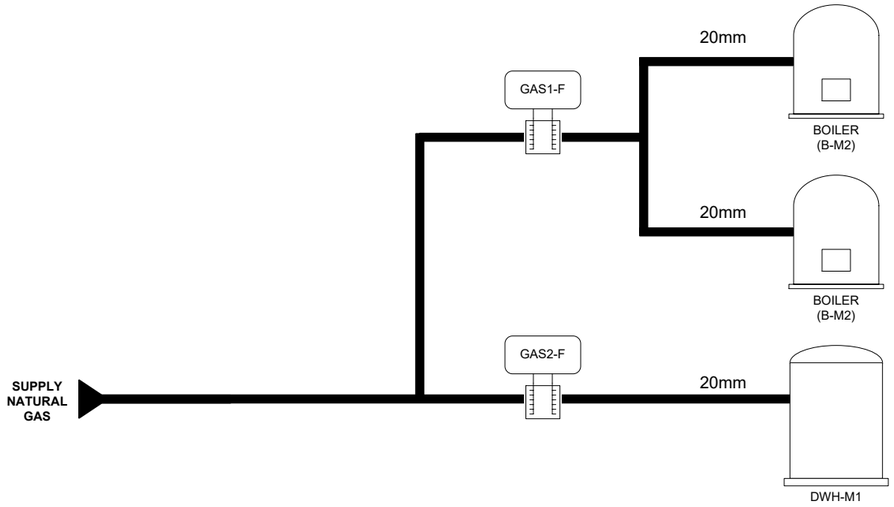
CONTRACT NUMBER
40970088

DRAWING NUMBER
404 A

BILL OF MATERIALS

Designation	Qty	Part Number	Description
Other Devices:			
GASx-F	2	FT2A-06IE2G3	KELE, NATURAL GAS FLOW METER



Note:
1. IO points are mapped in HW system.

NATURAL GAS METERS

Sequence of Operation:

Building meters are provided for general equipment which is metered at the boilers & domestic hot water heaters for the main and building systems.

Gas meter:
The controller will monitor the gas meter for gas consumption on a continual basis. These values will be made available to the system at all times.

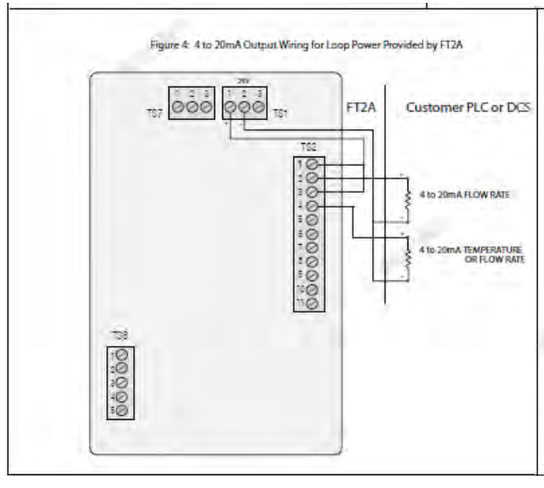
Peak demand history:
The controller will monitor and record the peak (high and low) demand readings from the gas meter. Peak readings will be recorded on an hourly, daily, month-to-date, and year-to-date basis.

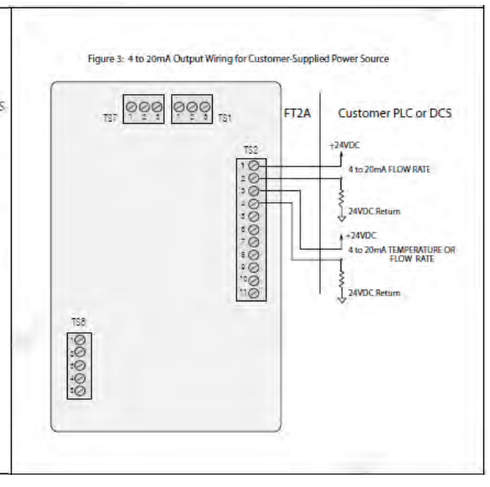
Usage history:
The controller will monitor and record gas meter readings so as to provide a gas consumption history. Usage readings will be recorded on an hourly, daily, month-to-date, and year-to-date basis.

Alarms:
Invalid reading: sensor reading indicates an invalid value from the gas meter.

Fire alarm:
N/A

Power failure:
Gas meter to be fed from standby power source.





Drawing Title
015.001(NATURAL GAS METER Control)

Project Title
Aldergrove Port of Entry DB

	NO.	REVISION-LOCATION	ECN	DATE	BY
	2	As-built		11/21/2015	TK
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

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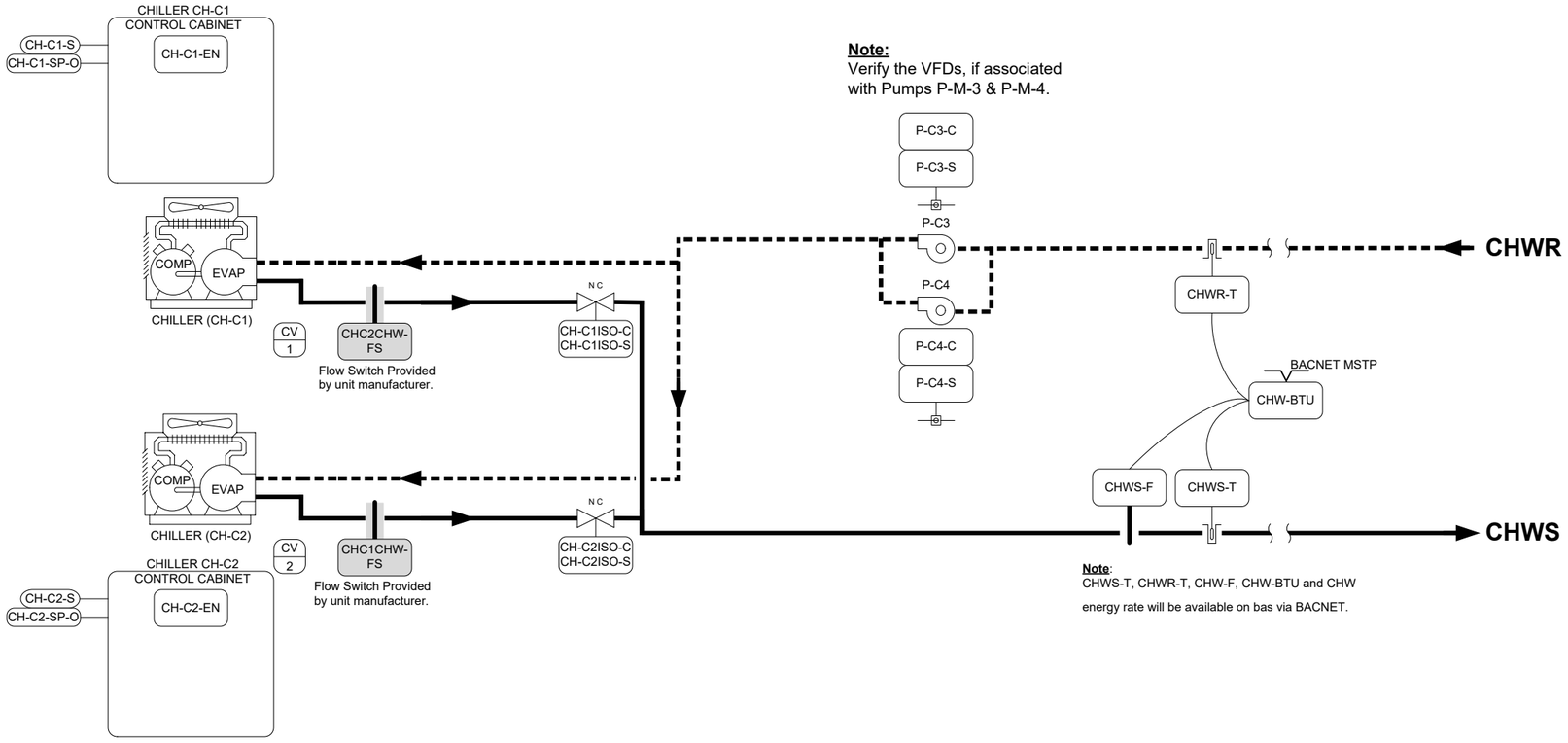
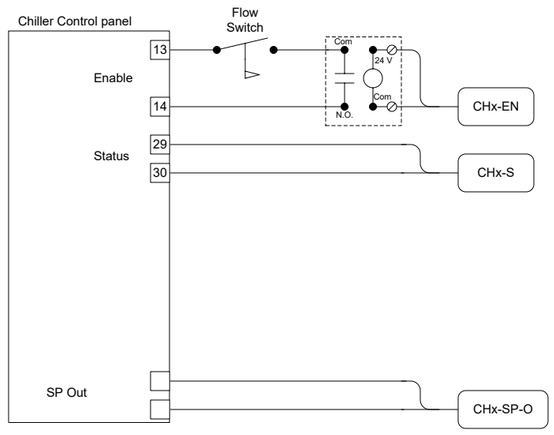
CONTRACT NUMBER
40970088

DRAWING NUMBER
405 A

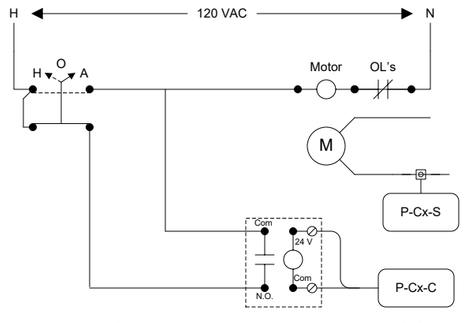


BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
CHW-BTU	1	F-STD-INSTL1	INSTALL KIT, STD, 1.25-72 - STEEL PIPE.
	1	SYSTEM-10-BAC	BTU METER, BACNET
CHWR-T	1	TE-6300W-101	T-WELL 6" BRASS DIR MNT
	1	TE-631AM-2	WELL TEMP SEN 6" 1K NI
CHWS-F	1	F-1100	FLOW METER, SINGLE TURB, FREQ OUT
CHWS-T	1	TE-6300W-101	T-WELL 6" BRASS DIR MNT
	1	TE-631AM-2	WELL TEMP SEN 6" 1K NI
P-Cx-S	2	CSD-SA1E0-1	SLD/ADJ LED 1A W/O RELAY
Panel Devices:			
CH-Cx-EN	2	RH2B-UAC24-L	DPDT,10A,HC=24 VAC,
	2	SH2B-05	DPDT RELAY BASE FOR RH2B
CP-CHWS-C1	1	MS-FEC2611-0	FEC2611-0,FEC17
	1	MS-IOM3721-0	MS-IOM3721-0,IN/PUT
	4	PAN-96VAXFR-U	PANEL TRANSFORMER KIT-UL
	1	PAN-ENC3648WDP	36X48X9.25 ENC+DOOR+PANEL
	1	PAN-PWRSP	PANEL POWER SUPPLY 96VA
P-Cx-C	2	RH2B-UAC24-L	DPDT,10A,HC=24 VAC,
	2	SH2B-05	DPDT RELAY BASE FOR RH2B
Other Devices:			
CH-CxISO-C,-S	2	VALVE	SEE VALVE SCHEDULE



Chiller Control Wiring Typical Of 2)



Pump Control Wiring (Typical Of 2)

Drawing Title
016.001(Chilled Water System-Comm Bldg Control)

Project Title
Aldergrove Port of Entry DB

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	3	As-built		11/21/2015	TK
	2	Re-submitted for approval		10/30/15	JYC
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN		APPROVED	
Cansin Yang	Troy Bazille	CoEE	BY CoEE	DATE 01/2/2015	BY	DATE

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CONTRACT NUMBER
40970088

DRAWING NUMBER
501 A

CHWS-COMMERCIAL BLDG.

Sequence of Operation:

General:

- The chilled water system consists of two chillers serving chilled water to the main cooling coil on the central air handling unit and a small chilled water coil on the HRU-2 system. Constant speed pumps operate to maintain flow through the chillers and cooling coils.

Run conditions:

- The chilled water systems will be enabled to run whenever the outside air temperature is greater than 15°c;
- And there is a call for cooling from one of the air handling systems.
- To prevent short cycling the chilled water systems will run for and be off for a minimum adjustable time (user definable), unless shutdown on safeties or outside air conditions.
- The chillers themselves will operate based on their own internal safeties and controls.

Chiller controls (CH-C1, CH-C2):

- Each chiller will be enabled/disabled through a BMS command.
- Once enabled, the chiller manufacturer provided control systems will operate the chillers to maintain the chilled water set point (adjustable through the BMS) originally set to 7°c.

Commercial building lead/standby:

- The commercial building chillers are sized for lead/standby function.
- Only the lead chiller will be enabled when the run conditions are met.
- Once NCE the lead chiller is enabled it will operate based on manufacturer provided controls to maintain a CHWS temperature.

Lead/lag/standby chillers:

- The BMS will rotate the lead chiller based on operating hours. After 100 hours of operation, the lead chiller will be changed.

Circulating pumps (P-C3, C4):

- The pumps will be operated to maintain a constant flow sized to 100% of the total required load with one pump as a standby.
- When the chiller is enabled, then the associated isolation valve is opened.
- Once the valve is proven open, the lead pump will start.
- When the chiller is disabled, then the associated pump will stop.
- Once there is no flow detected at the chiller flow switch, then the associated isolation valve can close.

Alarms:

- DDC will provide an alarm when the chilled water temperature cannot maintain set point for duration of over 30 minutes.
- If pump status fails after command, generate local alarm and operate lag or standby pump.
- The BMS will take alarm points from the chiller. The following items will be monitored for alarms (typical for each chiller):
  A. Low ambient
  B. Low leaving chilled liquid temperature
  C. Low voltage
  D. Compressor 1, high discharge pressure
  E. Compressor 1, low suction pressure
  F. Compressor 2, high discharge pressure
  G. Compressor 2, low suction pressure

Power failure:

- Chilled valves fail closed.

BTU METERS

Sequence of Operation:

General:
BTU meter monitors energy total, energy rate, flow total, flow rate, supply temperature and return temperature. See the drawings for locations and systems being metered.

BTU meter will be Connected to BMS via BACnet MSTP interface.

BTU meter:
The controller will monitor the BTU meter for the following parameters on a continual basis.these values will be made available to the system at all times.
- Energy total
- Energy rate
- Flow rate
- Supply temperature
- Return temperature

Peak demand history:
The controller will monitor and record the peak (high and low) demand readings from the BTU meter. Peak readings will be recorded on a hourly, daily, month-to-date, and year-to-date basis.

Usage history:
The controller will monitor and record BTU meter readings so as to provide an energy consumption history. Usage readings will be recorded on a hourly, daily, month-to-date, and year-to-date basis.

Alarms:
Meter failure: sensor readings indicate a loss of output from the BTU meter via software.

Fire alarm: n/a

Power failure:
BTU meter to be fed from standby power source.

Points monitored via BACNET

- Energy total
- Energy rate
- Flow rate
- Supply temperature
- Return temperature

CHILLER EFFICIENCY

Sequence of Operation:

General:
The DDC will calculate and trend the chiller efficiency. The calculation shall be as follows:
Chiller efficiency = KW/TON
- Tons cooling = BTU (as measured at BTU meter) / 12,000
- KW will be as measured at the electrical meter measuring input power to the chiller systems.
- The DDC will trend all efficiency data for the chiller systems for both the main and commercial buildings.

Graphics:
System efficiency will be displayed on the main chiller graphic.

Drawing Title
016.002(Chilled Water System-Comm Bldg Sequence of Operation)

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	3	As-built		11/21/2015	TK
	2	Formal Submission		10/6/15	JYC
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Project Title
Aldergrove Port of Entry DB

Johnson Controls

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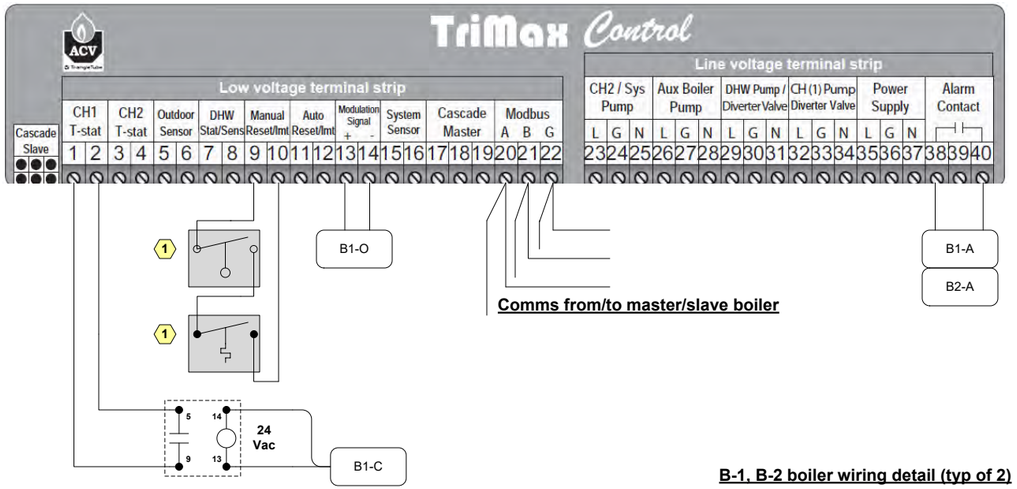
CONTRACT NUMBER
40970088

DRAWING NUMBER
501 B



B-1, B-2 boiler wiring detail (typ of 2)

Drawing Title
016.003(Chilled Water System-Comm Bldg Chiller Control Panel Wiring Diagram_Comm)

Project Title
Aldergrove Port of Entry DB

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	1	As-built		11/21/2015	TK

Sales Engineer	Project Manager	Application Engineer	DRAWN		APPROVED	
			BY	DATE	BY	DATE
Cansin Yang	Troy Bazille	CoEE				

Johnson Controls

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CONTRACT NUMBER
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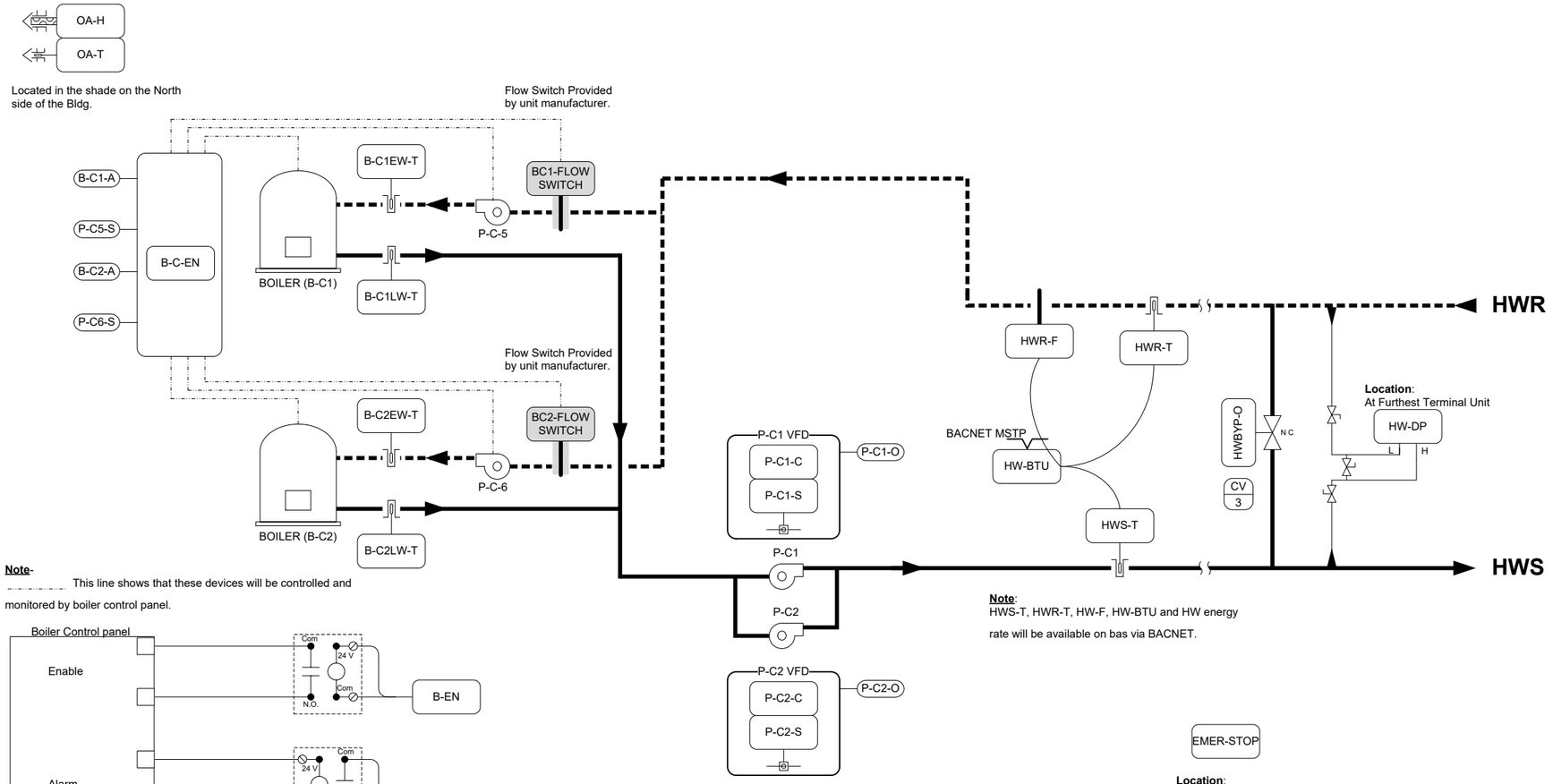
DRAWING NUMBER
501 C



Note-
This line shows that these devices will be controlled and monitored by boiler control panel.

Note:
HWS-T, HWR-T, HW-F, HW-BTU and HW energy rate will be available on bas via BACNET.

EMER-STOP

Location:
Outside Mechanical Room
(For Wiring Details also refer Drawing no. WD-2 & boiler control panel detail)

Boiler Control Wiring

Note:
VFDs are on BACnet MS/TP Bus. The IO points P-Mx-O, P-Mx-C, P-Mx-S will be available via BACnet.

VFD CONTROL PANEL

Pump Control Wiring (Typical Of 2)

BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
B-C-EN	1	RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED
B-CxEW-T	2	TE-6300W-101	T-WELL 6" BRASS DIR MNT
	2	TE-631AM-2	WELL TEMP SEN 6" 1K NI
B-CxLW-T	2	TE-6300W-101	T-WELL 6" BRASS DIR MNT
	2	TE-631AM-2	WELL TEMP SEN 6" 1K NI
EMER-STOP	2	PILNOCB	N/O CONTACT BLOCK
	1	ST120SL-N1-BS	PUSH PULL STA N1 SURFACE
HW-BTU	1	F-STD-INSTL1	INSTALL KIT, STD, 1.25-72 - STEEL PIPE.
	1	SYSTEM-10-BAC	BTU METER, BACNET
HW-DP	1	DPT2301-050D-V	PRESS SENS,DP,0-50 PSI,MA,0.25%,3-VLV
HWR-F	1	F-1100	FLOW METER, SINGLE TURB, FREQ OUT
HWR-T	1	TE-6300W-101	T-WELL 6" BRASS DIR MNT
	1	TE-631AM-2	WELL TEMP SEN 6" 1K NI
HWS-T	1	TE-6300W-101	T-WELL 6" BRASS DIR MNT
	1	TE-631AM-2	WELL TEMP SEN 6" 1K NI
OA-H	1	HE-68P3-0N000	
OA-T	1	TE-6313P-1	SENSOR,T-NI,0.1%,3IN OAT
P-Cx-S	2	CSD-SA1E0-1	SLD/ADJ LED 1A W/O RELAY
Panel Devices:			
B-Cx-A	2	RH2B-UAC120-L	DPDT,10A,HC=120 VAC,W/LED
	2	SH2B-05	DPDT RELAY BASE FOR RH2B
CP-1-MECH. RM.	1	MS-FEC2611-0	FEC2611-0,FEC17
	1	MS-IOM2721-0	MS-IOM2721-0, IN/OUTPUT
	1	MS-IOM4711-0	IOM4711,IOM 17 POINT,UL
P-Cx-C	2	RH2B-UAC24-L	DPDT,10A,HC=24 VAC,
	2	SH2B-05	DPDT RELAY BASE FOR RH2B
Other Devices:			
HWBYP-O	1	VALVE	SEE VALVE SCHEDULE
P-Cx-VFD	2	VS4D6112B-S0000	VSDISII,1HP/0.75KW,208V

Note: HWS controllers are enclosed in CHWS-Comm. Bldg panel.

Drawing Title
017.001(Hot Water System-Comm. Bldg Control)

Project Title
Aldergrove Port of Entry DB

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	3	As-built		11/21/2015	TK
	2	Formal Submission		10/6/15	JYC
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

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CONTRACT NUMBER
40970088

DRAWING NUMBER
502 A

HWS COMMERCIAL BLDG

Sequence of Operation:

General:
- The hydronic heating plant located in the mechanical room of each building will provides heating water to the various perimeter heating terminal units and air handler heating coils. The heating water is generated through two wall mounted condensing boilers with individual constant volume circulating pumps. The primary loop is separated from the secondary loop through a hydronic air and dirt separator. The secondary loop is operated with lead/standby pumps. These secondary pumps are VFD operated to maintain the requirements of control valves based on calls for heating.

Run conditions:
- The boiler system will be enabled to run whenever the outside air temperature is below 18.5° c.
- To prevent short cycling, each boiler will run for and be off for a minimum adjustable time, unless shutdown on safeties or outside air conditions.
- The boilers will be operated subject to its own internal safeties and controls.

Boiler control description:
- The boiler systems will be operated through manufacturer provided controls that will operate to maintain a supply water temperature of 65.5° c (adjustable).
- The supply water temperature will be reset based on the outside air temperature. As the outside air temperature rises from -8° c to 18° c, the hot water supply temperature will reset downwards by subtracting 0° c to 20° c (adjustable) from the current boiler set point.
- The boiler control systems will operate the primary circulating pumps to be on when the boilers are in operation.

Boiler lead/lag operation:
- The designated lead boiler will rotate based upon a boiler runtime (to be determined on site and based on manufacturer's recommendations).

Secondary pump variable speed control:
A. Run conditions:
- The secondary pumps will operate at any time that the boiler systems have been enabled.

B. Normal operation
- The two secondary heating pumps are operated in a lead/standby fashion. The lead pump will be rotated based on a runtime of 200 hours. After a total of 200 hours of runtime the lead pump will be changed.
- When lead pump is in operation, it will start at minimum flow and ramp up in response to two conditions:
  A. The differential pressure set point as determined by the balancing agent. Set points will be field adjusted during the commissioning period to meet the requirements of actual field conditions.
  B. And the valve positions of the two heating coils.
  C. VFD minimum speed will be 25%.
- Both the differential pressure in the system will be monitored at all times, and the valve position of the heating coils for the ahu-1 and hc-1 units.
  A. The control systems will ensure that both of the following are met:
  I. The differential pressure is at set point – if it is below set point, then the VFD will ramp up.
  Ii. The valve position of both of the heating coils – if either valve is above 95% open, then the VFD will ramp up to maintain a maximum valve position of 95%.
  B. The control system will provide a graphic that clearly identifies these variables, and what the defining variable is at that moment in time.

Bypass pressure control:
- The system will operate a bypass control valve to maintain the differential pressure in the system. Differential pressure will be monitored at one of the furthest terminal units.
- The bypass valve will operate to modulate open when the bypass pressure increases above its set point (adjustable set point to be determined during the balancing and commissioning of the building - ensure coordination with the tab contractor, mechanical contractor and controls contractor). The valve will modulate through a PID loop to control the pressure set point.

Boiler alarm monitoring:
- The DDC will monitor the following boiler system alarms for each boiler:
  - Boiler alarm
  - Boiler low water level alarm

Temperature monitoring and alarms:
- The DDC will monitor the following:
  - Boiler 1 supply water temperature;
  - Boiler 1 return water temperature;
  - Boiler 2 supply water temperature;
  - Boiler 2 return water temperature;
  - System supply water temperature;
  - System return water temperature.
- General alarm will be provided when status of equipment does not match the command.
- Alarms will be provided for high and low supply water temperature - if the temperature is 10°c below set point for more than 60 seconds (adjustable), and if the temperature is higher than set point by 10° c for more than 30 seconds (adjustable).
- Alarms will be provided for high/low differential pressure - if pressure is +- 25% from set point.

Boiler emergency shut off:
- An emergency shut off button will be installed outside of the mechanical room and will cut power to the boilers when pressed. This will be a hard wired interlock.

BTU METERS

Sequence of Operation:

General:
BTU meter monitors energy total, energy rate, flow total, flow rate, supply temperature and return temperature. See the drawings for locations and systems being metered.

BTU meter will be Connected to BMS via BACnet MSTP interface.

BTU meter:
The controller will monitor the BTU meter for the following parameters on a continual basis.these values will be made available to the system at all times.
- Energy total
- Energy rate
- Flow rate
- Supply temperature
- Return temperature

Peak demand history:
The controller will monitor and record the peak (high and low) demand readings from the BTU meter. Peak readings will be recorded on a hourly, daily, month-to-date, and year-to-date basis.

Usage history:
The controller will monitor and record BTU meter readings so as to provide an energy consumption history. Usage readings will be recorded on a hourly, daily, month-to-date, and year-to-date basis.

Alarms:
Meter failure: sensor readings indicate a loss of output from the BTU meter via software.

Fire alarm: n/a

Power failure:
BTU meter to be fed from standby power source.

Points monitored via BACNET

- Energy total
- Energy rate
- Flow rate
- Supply temperature
- Return temperature

Drawing Title
017.002(Hot Water System-Comm. Bldg Sequence of Operation)

NO.	REVISION-LOCATION	ECN	DATE	BY
2	As-built		11/21/2015	TK
1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

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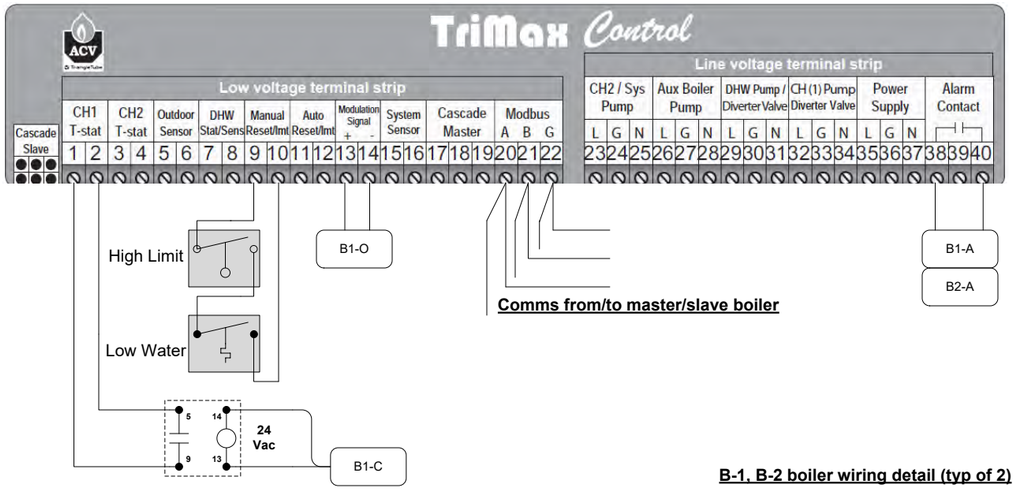
CONTRACT NUMBER
40970088

DRAWING NUMBER
502 B



B-1, B-2 boiler wiring detail (typ of 2)

Drawing Title
017.003(Hot Water System-Comm Bldg Boiler Control Panel Wiring Diagram)

Project Title
Aldergrove Port of Entry DB

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	2	As-built		11/21/2015	TK
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

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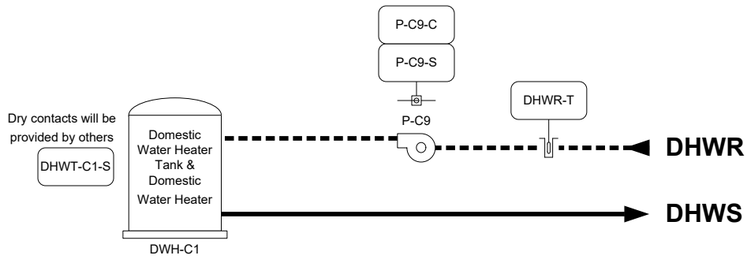
CONTRACT NUMBER
40970088

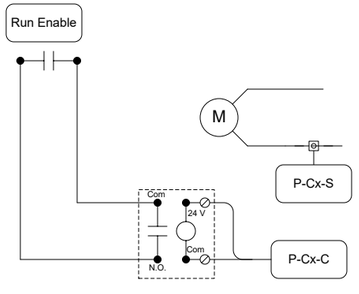
DRAWING NUMBER
502 C

BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
DHWR-T	1	TE-6300-615	CABLE TIE MOUNTING KIT, 11"MAX.
	1	TE-631S-1	TEMPERATURE SENSOR
P-C9-S	1	CSD-SA1E0-1	SLD/ADJ LED 1A W/O RELAY
Panel Devices:			
P-C9-C	1	RH2B-UAC24-L	DPDT,10A,HC=24 VAC,
	1	SH2B-05	DPDT RELAY BASE FOR RH2B



Note:
Io points are mapped in HWS - Commercial Bldg. Controller.



Pump Control Wiring

DHWS COMMERCIAL BLDG

Sequence of Operation:

General:
- The domestic hot water system for each building is served by one high efficiency gas fired DHW tank (DHWT-C1) with integral controls. Each system has a re-circulation pump that provides domestic hot water temperature maintenance.

Run condition for re-circulation pumps:
- The pump will run continuously.

Normal operation of DHW systems:
- Gas fired DWH heaters have internal controls to maintain internal tank water temperature. Initial setting is to be for 60° C (140° F).
- The DDC system will operate the re-circulation pumps based off of an aqua stat temperature in the re-circulation line. The pump will turn on when the re-circulation temperature is below 48° c (adjustable), and will turn off when the temperature rises above 55° C (adjustable).

Alarms:
If pump status fails after command.

Drawing Title
018.001(Domestic HWS-Comm. Bldg Control)

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	2	As-built		11/21/2015	TK
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Project Title
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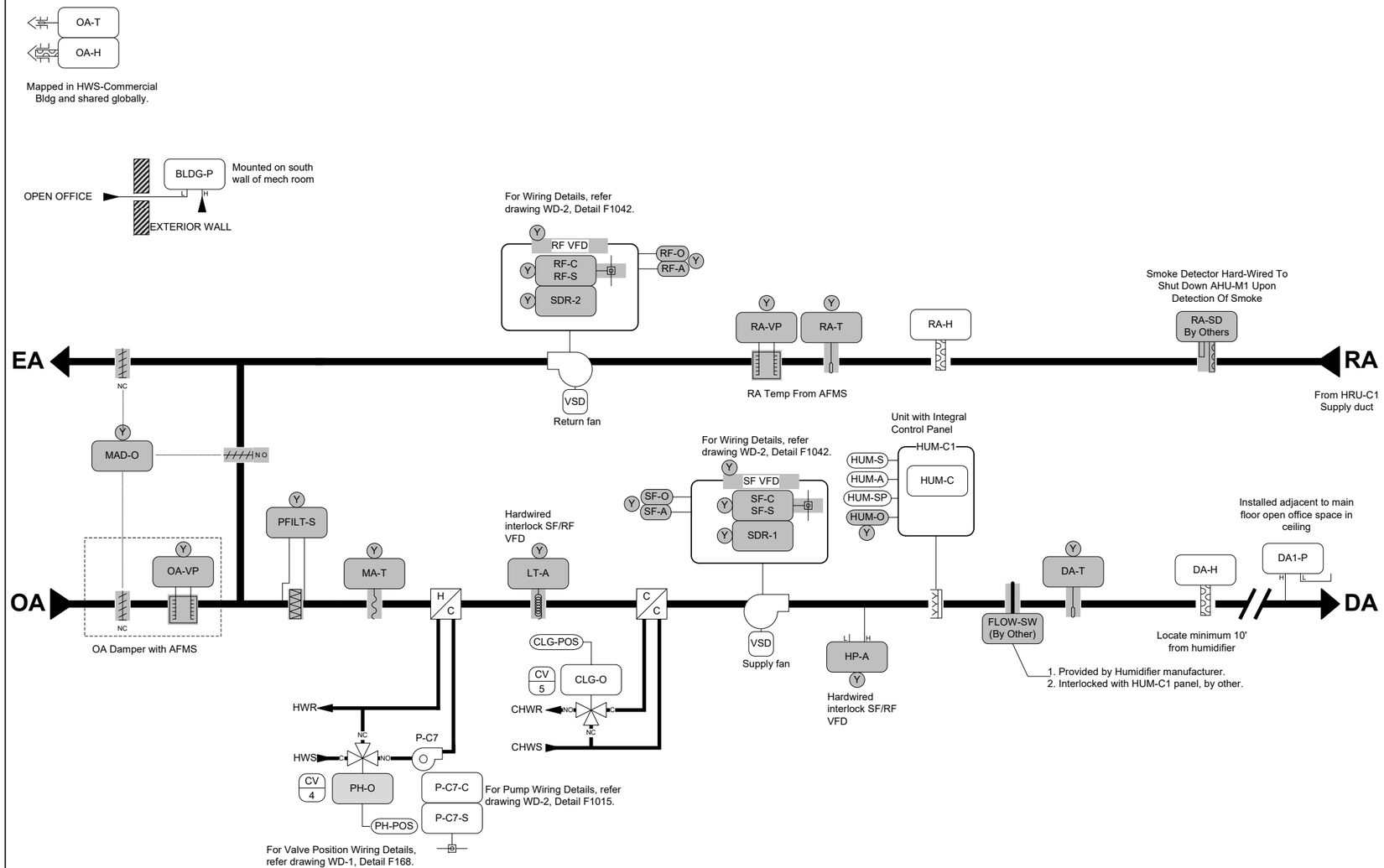
CONTRACT NUMBER
40970088

DRAWING NUMBER
503 A



BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
DA-H	1	HT-6703-0N00P	HUM SENS DUCT,4-20MA 0-10V W/JUMPER,3%RH
DA1-P	1	DPT2641-005D-1	DP TRANS, DIF, 0 TO 5
	1	FTG18A-600R	REMOTE MTD PROBE
RA-H	1	HT-6703-0N00P	HUM SENS DUCT,4-20MA 0-10V W/JUMPER,3%RH
Panel Devices:			
HUM-C	1	RH2B-UAC24-L	DPDT,10A,HC=24 VAC,
	1	SH2B-05	DPDT RELAY BASE FOR RH2B
Other Devices:			
CLG-O	1	VALVE	SEE VALVE SCHEDULE
PH-O	1	VALVE	SEE VALVE SCHEDULE
Additional Field Devices:			
BLDG-P	1	A-306-K	OUTDOOR AIR STATIC
	1	DPT2641-R25B-1	DP TRANS, DIF, -0.25 TO
	1	RPS	STAINLESS STEEL RM PRESS SENSOR 1/4 BARB
	1	SD-01	SURGE DAMPENER
P-C7-S	1	CSD-SA1E0-1	SLD/ADJ LED 1A W/O RELAY
Additional Panel Devices:			
CP-AHUC1-ADD	1	PAKFJJ002AH0	FEC1611/IOM4711,20X24
P-C7-C	1	RH2B-UAC24-L	DPDT,10A,HC=24 VAC,
	1	SH2B-05	DPDT RELAY BASE FOR RH2B

YORK FACTORY DEVICES- BILL OF MATERIALS

Designation	Qty	Part Number	Description
Factory Devices:			
DA-T	1	YDA-TN	TEMPERATURE SENSOR DUCT TE-6311M-1
HP-A	1	YHP-A	PRESSURE SWITCH AIR MANUAL AFS-460
LT-A	1	YLT-A	TEMPERATURE SWITCH LOW LIMIT A11B-1C
	1	YLT-S	TEMPERATURE SWITCH LOW LIMIT RIB24P
MA-T	1	YMA-TN	TEMPERATURE SENSOR DUCT TE-6316M-1
MAD-O	3	M9220-GGA-YK10	RETURN AIR ACTUATOR
OA-VP	1	YOA-VPV	PRESSURE SENSOR AIR DPT2640-XXX
CP-AHU-C1	1	YPAKGJL002AH0	
PFILT-S	1	YPFILT-A	PRESSURE SWITCH AIR P32AC-2C
RA-T	1	YRA-TN	TEMPERATURE SENSOR DUCT TE-6311M-1
RA-VP	1	YRA-VPV	PRESSURE SENSOR AIR DPT2640-XXX
RF VFD	1	YRF-O	VARIABLE SPEED DRIVE
RF-C,-S	1	YRF-C	RELAY 24VAC RIBU1C
	1	YRF-S	CURRENT SWITCH W RELAY CSD-SA1E1-1
SDR-1	1	YSDR-1	RELAY 24VAC RIBU1C
SDR-2	1	YSDR-2	RELAY 24VAC RIBU1C
SF VFD	1	YSF-O	VARIABLE SPEED DRIVE
SF-C,-S	1	YSF-C	RELAY 24VAC RIBU1C
	1	YSF-S	CURRENT SWITCH W RELAY CSD-SA1E1-1

Note:

1. These gray devices will be York devices or provided by others.
2. (Y) These "Y" devices are York devices.
3. Above BOM is for all system.

Drawing Title
019.001(Air Handling Unit-C1 Control)

Project Title
Aldergrove Port of Entry DB

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	2	As-built		11/21/2015	TK
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

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CONTRACT NUMBER
40970088

DRAWING NUMBER
601 A

Sequence of Operation (Factory package):

SUPPLY FAN CONTROL:

The variable speed supply fan (SF-C) will be started based on occupancy schedule (OCC-SCHEDULE). When the supply fan status (SF-S) indicates the fan started, the control sequence will be enabled. The supply fan (SF-O) will modulate to maintain the discharge static pressure (DA-P) at setpoint (DAP-SP). Upon a loss of airflow (SF-S), the system will attempt to automatically restart until positive status is received. When the supply fan frequency converter fault input (SF-A) is activated, the system will shutdown. When the fault condition clears, the system shall restart as required.

RETURN FAN CONTROL:

After the supply fan has been started, the variable speed return fan will be started. The return fan (RF-O) will modulate in conjunction with the supply fan. The return fan will lag the supply fan by a percentage differential. When the return fan frequency converter fault input (RF-A) is activated, the system will shutdown. When the fault condition clears, the system shall restart as required.

ECONOMIZER CONTROL:

When the outdoor air (OA-T) is cooler than the economizer setpoint, the economizer will act as the initial stage of cooling, working in sequence with the cooling coil.

TEMPERATURE CONTROL:

The unit will control to maintain a constant discharge air temperature (DA-T).

OCCUPIED MODE:

The occupancy mode will be controlled via a network input (OCC-SCHEDULE). The occupancy mode can also be overridden by a network input (OCC-OVERRIDE).

UNOCCUPIED MODE:

The unit will remain off during unoccupied periods.

PREHEAT COIL:

The preheat (PH-O) will modulate to maintain the temperature setpoint. When the unit is shutdown, the preheat coil will be commanded to a preset position should the outdoor air temperature (OAT) fall below the low outdoor air temperature setpoint (OALT-SP). Upon a loss of airflow (SF-S), the preheat coil will be commanded to a preset position should the outdoor air temperature (OA-T) fall below the low outdoor air temperature setpoint (OALT-SP).

COOLING COIL:

The cooling coil (CLG-O) will modulate to maintain the temperature setpoint. When the unit is shutdown, the cooling coil will be commanded to a preset position should the outdoor air temperature (OA-T) fall below the low outdoor air temperature setpoint (OALT-SP). Upon a loss of airflow (SF-S), the cooling coil will be off.

HUMIDIFICATION:

The humidifier will be enabled (HUM-C) and modulate (HUM-O) to maintain the return air relative humidity setpoint (HUM-SP) as sensed by the return air relative humidity sensor (RA-H).

UNIT PROTECTION:

- Low Temperature Alarm (LT-A) - When in "Alarm", the control sequence will stop running, the valve(s) will open and the fan(s) will be disabled via a hard wired shutdown circuit.
- Return Air Smoke Detector (RA-SD) - Disables the fan(s) via a hard wired shutdown circuit.

ADDITIONAL POINTS MONITORED BY THE FMS:

- Outdoor Air Velocity Pressure (OA-VP)
- Mixed Air Temperature (MA-T)
- Discharge Air Humidity (DA-H)
- Return Fan Status (RF-S)
- Return Air Temperature (RA-T)
- Return Air Velocity Pressure (RA-VP)
- Prefilter Status (PFILT-S)
- Humidifier Status (HUM-S)

Sequence of Operation (Other than Factory package):

Pre Heat Coil Circulation Pump:

On a call for preheat, the coil pump (P-C7-C) will be started. Upon a loss of preheat coil pump status (P-C7-S), the pump will attempt to automatically restart until positive status is received. When the unit is shutdown, the preheat coil will be commanded to a preset position should the outdoor air temperature (OAT) fall below the low outdoor air temperature setpoint (OALT-SP). Upon a loss of airflow (SF-S), the preheat coil will be commanded to a preset position should the outdoor air temperature (OA-T) fall below the low outdoor air temperature setpoint (OALT-SP).

Drawing Title
019.002(Air Handling Unit-C1 Sequence of Operation)

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	2	As-built		11/21/2015	TK
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Project Title
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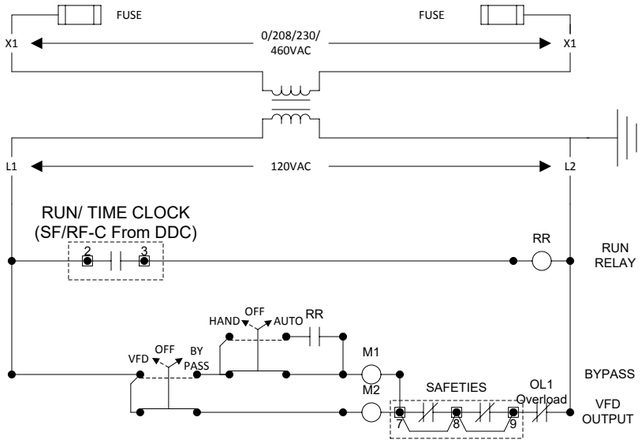
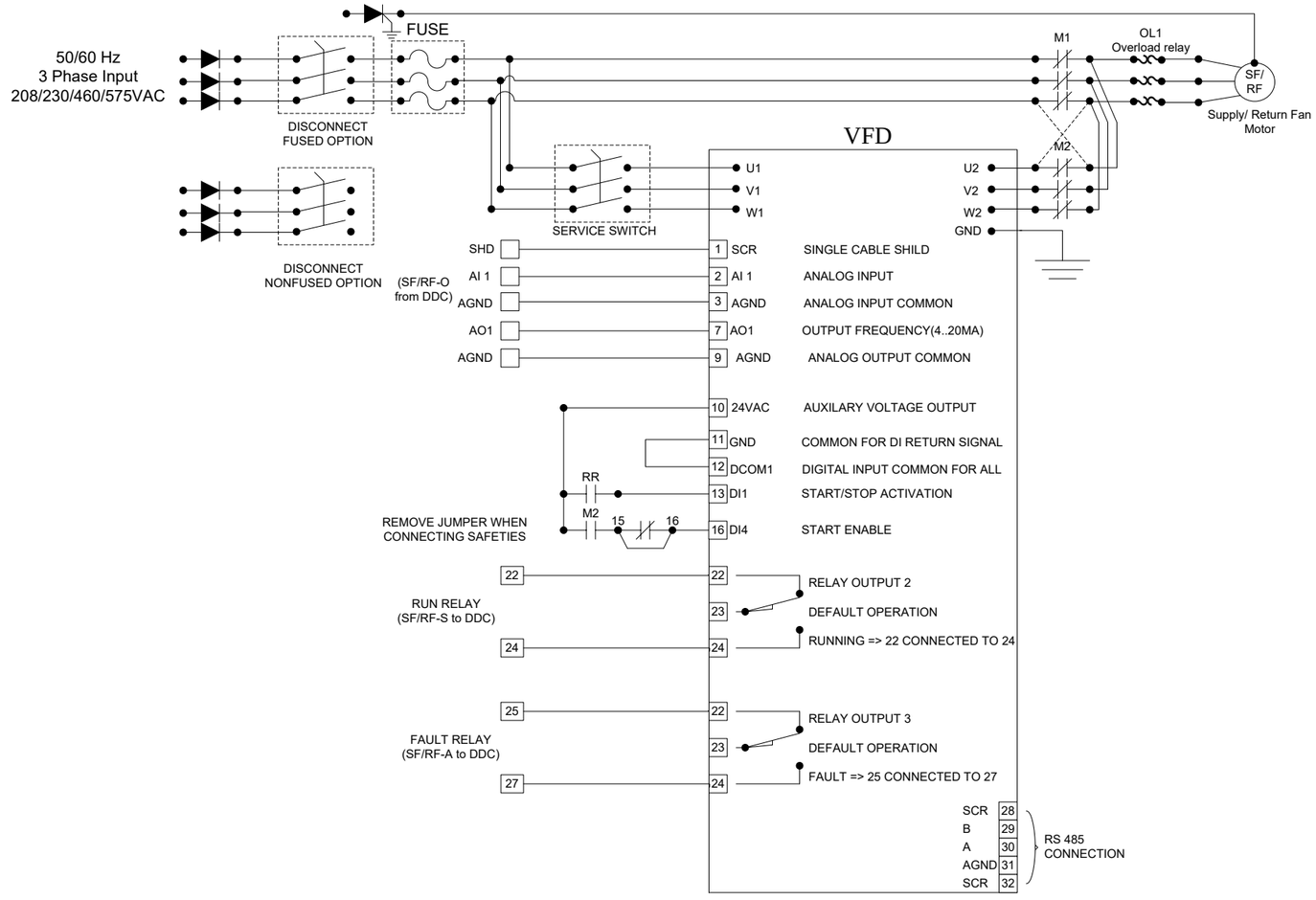
DRAWING NUMBER
601 B





Drawing Title
Air Handling Unit-C1 SF & RF Wiring

Project Title
Aldergrove Port Of Entry
LANGLEY, BC

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	1	As-built		11/21/2015	TK

Sales Engineer	Project Manager	Application Engineer	DRAWN		APPROVED	
Cansin Yang	Troy Bazille	CoEE	BY	DATE	BY	DATE

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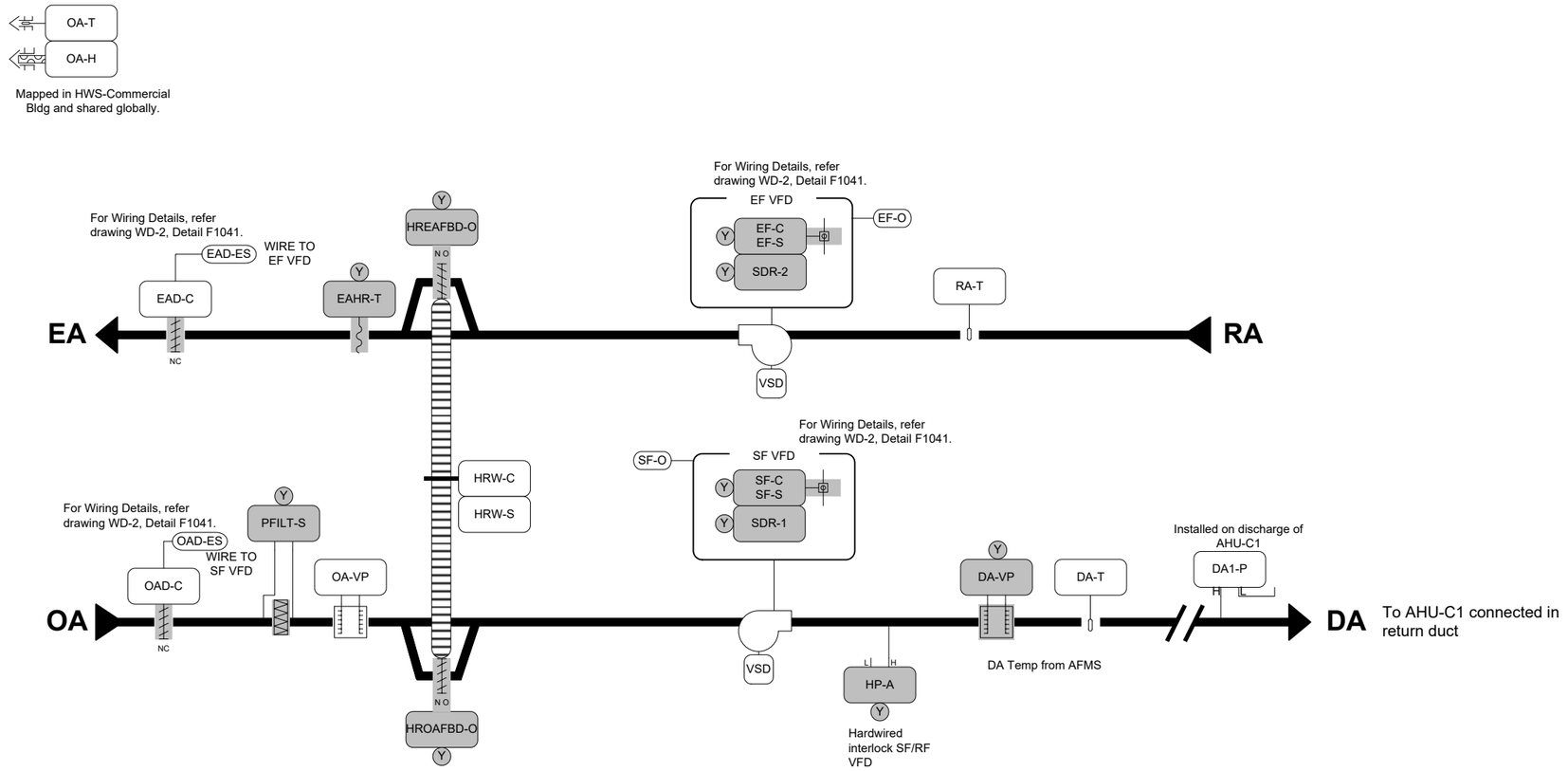
CONTRACT NUMBER
4097-0088

DRAWING NUMBER
601 C



BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
DA-T	1	TE-6311M-1	8" 1000 OHM NI DUCT TEMP
DA1-P	1	DPT2641-005D-1	DP TRANS, DIF, 0 TO 5
	1	FTG18A-600R	REMOTE MTD PROBE
EAD-C	1	M9220-BGC-3	20NM,SR,ACT,24V ON/OFF,2 AUX SW
EF VFD	1	VS003510C-N0000	VSD 3HP 575V T1 N2
OAD-C	1	M9220-BGC-3	20NM,SR,ACT,24V ON/OFF,2 AUX SW
RA-T	1	TE-6311M-1	8" 1000 OHM NI DUCT TEMP
SF VFD	1	VS003510C-N0000	VSD 3HP 575V T1 N2
Panel Devices:			
HRW-C	1	RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED
CP-HRU-C1	1	PAKLJF001AH0	ENCLOSURE 20 X 24, FAC2611, IOM1711
Additional Field Devices:			
HRW-S	1	RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED
Additional Panel Devices:			
CP-HRUC1-ADD	1	PAKF00001FH0	FEC1611,16X20
Additional Other Devices:			
OA-VP	1	AFMS	SEE AFMS SCHEDULE

YORK FACTORY DEVICES- BILL OF MATERIALS

Designation	Qty	Part Number	Description
Factory Devices:			
DA-VP	1	YDA-VPV	PRESSURE SENSOR AIR DPT2640-XXX
EAHR-T	1	YEAHR-TN	TEMPERATURE SENSOR DUCT TE-6316M-1
EF-C,-S	1	YEF-C	RELAY 24VAC RIBU1C
	1	YEF-S	CURRENT SWITCH W RELAY CSD-SA1E1-1
HP-A	1	YHP-A	PRESSURE SWITCH AIR MANUAL AFS-460
HREAFBD-O	1	M9104-GGA-YK10	HEAT RECOVERY EA FBD OUTPUT
HROAFBD-O	1	M9104-GGA-YK10	HEAT RECOVERY OA FBD OUTPUT
PFILT-S	1	YPFILT-A	PRESSURE SWITCH AIR P32AC-2C
SDR-1	1	YSDR-1	RELAY 24VAC RIBU1C
SDR-2	1	YSDR-2	RELAY 24VAC RIBU1C
SF-C,-S	1	YSF-C	RELAY 24VAC RIBU1C
	1	YSF-S	CURRENT SWITCH W RELAY CSD-SA1E1-1

Note:

1. These gray devices will be York devices or provided by others.
2. (Y) These "Y" devices are York devices.
3. Above bom is for all system.

Drawing Title

020.001(HRU-C1 Control)

Project Title

Aldergrove Port of Entry DB

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	2	As-built		11/21/2015	TK
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
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CONTRACT NUMBER

40970088

DRAWING NUMBER

602 A

HRU-C1

Sequence of Operation (Factory Package):

Start-up:
During start-up of the HRU, the following will happen (typical for both the supply and exhaust fans).
- Upon a call to start the fan, the outside or exhaust air dampers will open.
- Once the damper is proven open, then the fan VFD will start to ramp up to minimum speed.
- After a set time (initially set to 1 minute – adjustable) – the fan will then ramp up to its setpoint depending on the mode of operation.

Shut-down:
During shut down of the HRU or associated fans, the following will happen (typical for both the supply and exhaust fans).
- Upon a call to shut the fan down, the fan VFD will ramp down to 0%.
- Once it is confirmed that the fan is off, then the outside air or exhaust air damper will close.

Heat recovery mode:
- During heat recovery mode when outside air is brought in through the HRU-C1 unit, the outside air damper and return air damper on the AHU will be closed.
- The outside airflow volume will be measured at the outlet of the HRU supply through an airflow measurement station.
- The supply air fan on the HRU will ramp up and down via VFD operation to maintain the outside airflow as calculated between the v ot-min and v ot-max . This system will use a slow acting PID loop to avoid hunting.
- The HRU exhaust fan will then ramp up and down via VFD to maintain the required exhaust airflow through the washrooms/janitor rooms and general exhaust. This will be calculated as follows:
  A. Washroom/janitor room exhaust – constant at all times per design drawings = Y
  B. Total outside air volume = X
  C. General exhaust airflow – VAV box will modulate to maintain airflow to match the outside air volume = Z
  Z = X-Y
  D. The washroom exhaust airflow will be maintained through a constant volume box. For sequence see specific section for constant volume box specific to the washrooms/janitor rooms.

Heat recovery wheel:
- The single speed heat recovery wheel will be enabled when the absolute value of the difference between the return air temperature and the outdoor air temperature is greater than 5°c.
- Upon a loss of heat recovery wheel status, the heat recovery wheel will attempt to automatically restart until positive status is received.

General exhaust mode:
- When the HRU is not in heat recovery mode, the supply fan will be off and the associated outside air dampers will close.
- The exhaust fan VFD will operate to maintain the washroom exhaust airflow through the VAV box at a constant rate. Utilize a slow acting PID loop logic at the VFD to ensure that excessive hunting does not occur as the VFD and VAV boxes work in sequence to maintain flow.
- The general exhaust VAV box will be closed.

Monitoring:
The BMS will monitor the following points.
- All airflow measurement stations will provide both air temperature and flow to the BMS for monitoring.
- RA temperature.
- Mixed air temperature.

Alarms:
- Provide all general alarms when equipment status does not match the command.
- A high and low supply air temperature alarm will be generated when the supply air setpoint is +- 10c from the setpoint for more than 5 minutes.
- Differential pressure switch for AHU and HRU filters will identify “filter change required”. Set switch per manufacturer’s instructions.
- The low temperature detection device will be hardwire interlocked to shut down the respective supply and return fans and close the respective AHU outside air and exhaust air dampers whenever a supply air temperature of 3 deg. C. Or lower is sensed. Device will be manual reset. The BMS will monitor the status of the low temperature detection device and will annunciate an alarm in a low temperature condition.
- Upon detection of high duct static pressure (greater than 750 pa - adjustable), the air handler will be shut down and the exhaust and outside air dampers will be closed. Ensure that the pressure sensor is located within the mechanical room prior to the fire damper as it drops through the floor.

Drawing Title
HRU-C1 SEQUENCE OF OPERATION

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	2	As-built		11/21/2015	TK
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Project Title
Aldergrove Port of Entry DB

Johnson Controls

Branch Information
Johnson Controls Inc
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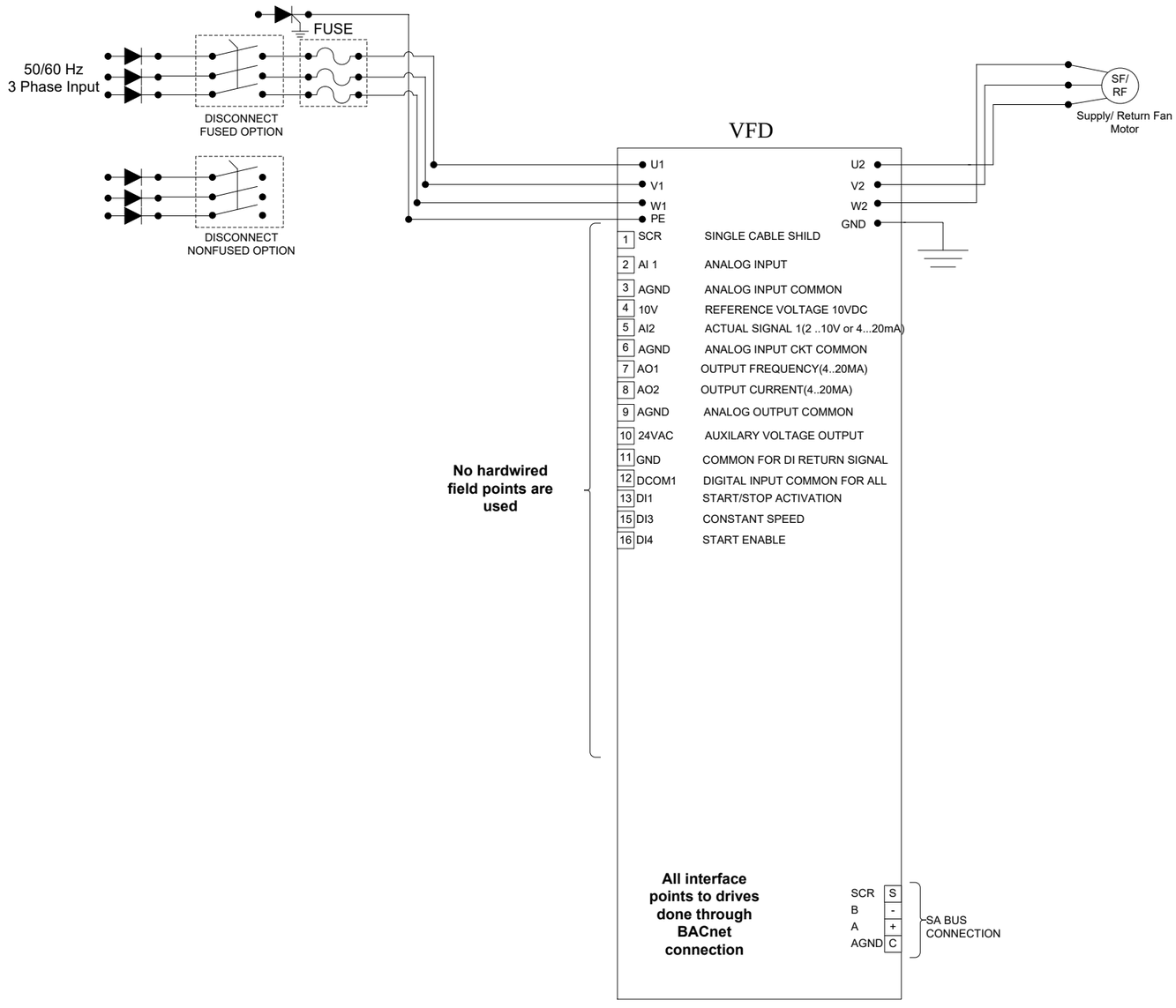
V5M 0A4
Phone: 604-707-5200
Fax: 604-707-5201

CONTRACT NUMBER
40970088

DRAWING NUMBER
602 A1



Drawing Title

020.003(HRU-C1 SF & RF Wiring)

Project Title

Aldergrove Port of Entry DB
LANGLEY, BC

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	1	As-built		11/21/2015	TK

Sales Engineer	Project Manager	Application Engineer	DRAWN		APPROVED	
			BY	DATE	BY	DATE
Cansin Yang	Troy Bazille	CoEE				

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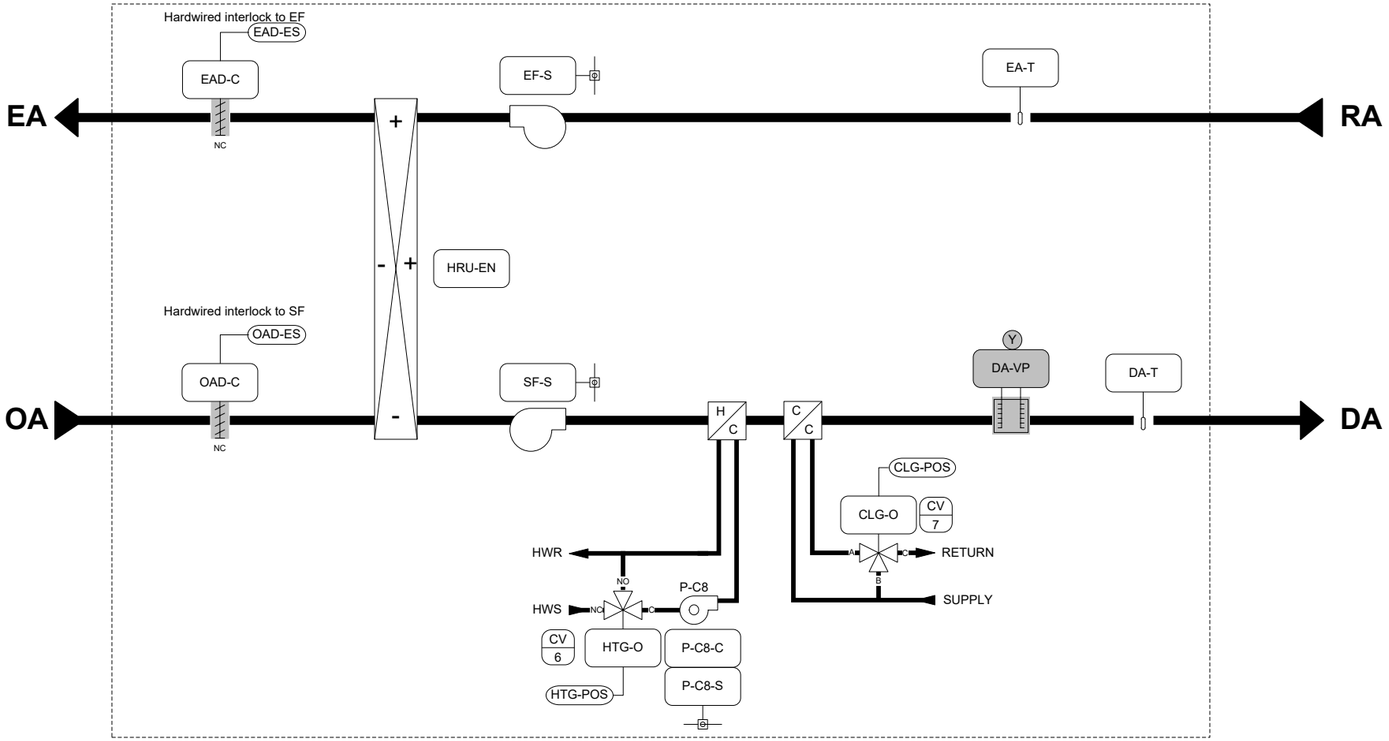
CONTRACT NUMBER

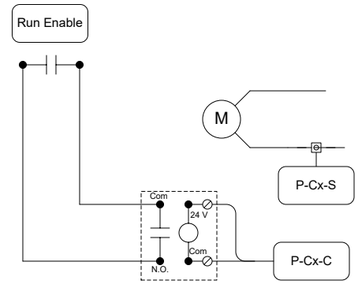
40970088

DRAWING NUMBER

602 B

Note-
1. Supply & Exhaust Fan will be controlled by manufacturer controller.
2. OA Damper will be interlocked with SF & EA Damper will be interlocked with EF.





Pump Control Wiring

BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
DA-T	1	TE-6311M-1	8" 1000 OHM NI DUCT TEMP
EA-T	1	TE-6311M-1	8" 1000 OHM NI DUCT TEMP
EAD-C,-ES	1	M9220-BGC-3	20NM,SR,ACT,24V ON/OFF,2 AUX SW
	1	RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED
EF-S	1	CSD-SA1E0-1	SLD/ADJ LED 1A W/O RELAY
OAD-C,-ES	1	M9220-BGC-3	20NM,SR,ACT,24V ON/OFF,2 AUX SW
	1	RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED
P-C8-S	1	CSD-SA1E0-1	SLD/ADJ LED 1A W/O RELAY
SF-S	1	CSD-SA1E0-1	SLD/ADJ LED 1A W/O RELAY
Panel Devices:			
CP-HRU-C2	1	PAKGJF001AH0	FEC2611/IOM1711,20X24
HRU-EN	1	RH2B-UAC24-L	DPDT,10A,HC=24 VAC,
	1	SH2B-05	DPDT RELAY BASE FOR RH2B
P-C8-C	1	RH2B-UAC24-L	DPDT,10A,HC=24 VAC,
	1	SH2B-05	DPDT RELAY BASE FOR RH2B
Other Devices:			
CLG-O,POS	1	VALVE	SEE VALVE SCHEDULE
HTG-O,POS	1	VALVE	SEE VALVE SCHEDULE

Drawing Title
021.001(HRU-C2 Control)

Project Title
Aldergrove Port of Entry DB

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	3	As-built		11/21/2015	TK
	2	Formal Submission		10/19/15	JYC
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

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CONTRACT NUMBER
40970088

DRAWING NUMBER
602 C

HRU-C2

Sequence of Operation:

HRU operation – HRU-C2:
The HRU is a stand-alone unit that is provided with manufacturer controls to operate both the supply and exhaust fans.
The BMS will only provide an enable control to the HRU and will monitor the supply and exhaust fan status points through current switches.

General:
The secure areas of both the main and commercial buildings are designed to be heated and cooled through a small heat recovery unit with duct mounted heating and cooling coils. The HRU will supply constant airflow to all associated spaces to maintain the space temperature setpoint.

Run conditions:
- The HRU will operate continuously during occupied times as defined by a user defined schedule.
- During unoccupied times, the unit will cycle on to maintain the nighttime setback temperature setpoint.
- In order to prevent excessive cycling, the unit will be on for a minimum of 15 minutes (adjustable), and off for a minimum of 10 minutes (adjustable).

Start-up:
During start-up of the HRU, the following will happen.
- Upon a call to start the unit, the outside air and exhaust air dampers will open.
- Once both dampers are proven open, then the BMS will enable the HRU to start.

Shut-down:
During shut down of the HRU or associated fans, the following will happen.
- Upon a call to shut the unit down, the BMS will disable the HRU.
- Once it is confirmed that the unit is off, then the outside air and exhaust air dampers will close.

Supply air temperature:
- The heating and cooling coils will operate in sequence to maintain the supply air temperature setpoint.
- Heating coil: in heating mode, the heating coil circulating pump will turn on to circulate water through the coil at a constant speed. Once the pump is operating the 3-way control valve will modulate through a PID control logic to maintain the supply air temperature at setpoint (initially set to 30°c – adjustable).
- Cooling coil: in cooling mode, the 3-way control valve will modulate through a PID control logic to maintain the supply air temperature at setpoint (initially set to 13°c – adjustable).

Monitoring:
The BMS will monitor the exhaust air temperature through a duct mounted sensor located in the duct main. This sensor will be used to measure the average room temperature in the secure areas to provide feedback to the BMS.

Alarms:
- Provide general alarms if system status does not match command.
- A high and low supply air temperature alarm will be generated when the supply air setpoint is +- 10°C from the setpoint for more than 5 minutes.
- If the unit is enabled and status of supply and exhaust fans is not detected within 30 second (adjustable), then a mismatch alarm will be generated at BMS

Drawing Title
HRU-C2 SEQUENCE OF OPERATION

NO.	REVISION-LOCATION	ECN	DATE	BY
2	As-built		11/21/2015	TK
1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Project Title
Aldergrove Port of Entry DB

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CONTRACT NUMBER
40970088

DRAWING NUMBER
602 C1

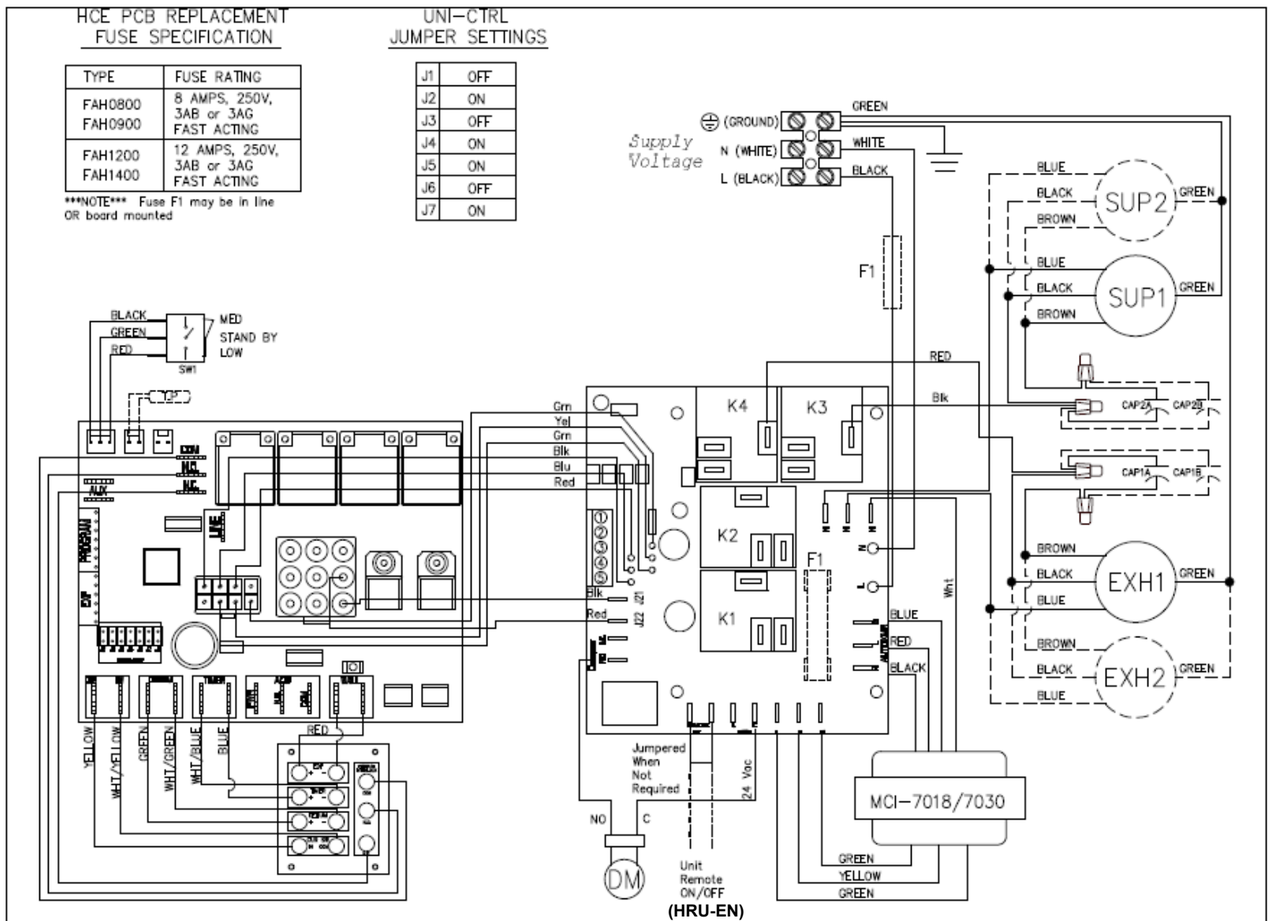
HCE PCB REPLACEMENT FUSE SPECIFICATION

TYPE	FUSE RATING
FAH0800 FAH0900	8 AMPS, 250V, 3AB or 3AG FAST ACTING
FAH1200 FAH1400	12 AMPS, 250V, 3AB or 3AG FAST ACTING

NOTE Fuse F1 may be in line OR board mounted

UNI-CTRL JUMPER SETTINGS

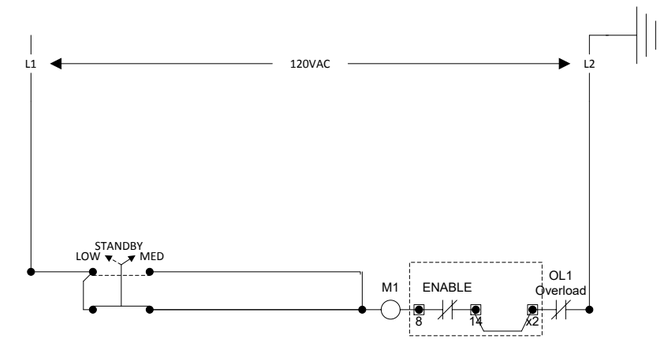
J1	OFF
J2	ON
J3	OFF
J4	ON
J5	ON
J6	OFF
J7	ON



(HRU-EN)

----INDICATES OPTIONAL COMPONENTS DEPENDING ON MODEL

—··—INDICATES CONTROL WIRING (BY OTHERS)



Drawing Title

021.003(HRU-C2 SF & RF Wiring)

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	1	As-built		11/21/2015	TK

Sales Engineer	Project Manager	Application Engineer	DRAWN BY C.E.E. DATE	APPROVED BY DATE
Cansin Yang	Troy Bazille	CoEE		

Project Title

Aldergrove Port of Entry DB
LANGLEY, BC

Branch Information
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Phone: 604-707-5200
Fax: 604-707-5201

CONTRACT NUMBER **40970088**

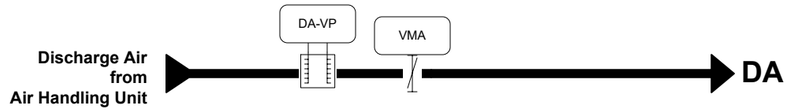
DRAWING NUMBER **602 D**

BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
VMA	1	MS-VMA1615-0	VMA 3 UI & 2BO
ZN-T	1	NS-BTN7003-0	3X4.5.T.TB.ADDRESSABLE

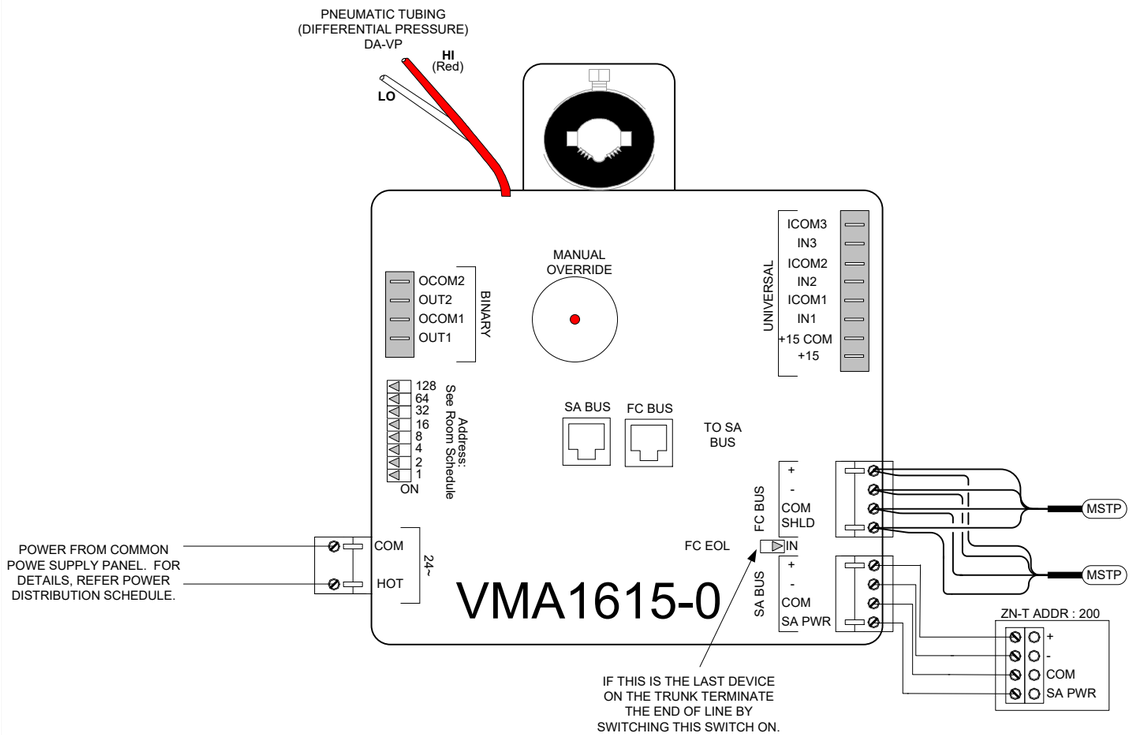
Note-

1) Above BOM is for all systems.



VAV CLG ONLY SCHEDULE					
SR.NO.	FLOOR	ROOM NO.	ROOM NAME	VAV TAG	REMARK
1	Main	C201	Mechanical Room	VAV-C8	ZN-T not Found

Note-
Refer Room Schedule for IO points of other systems, if mapped in VAV controller.



For Box Parameters and settings see the RS-x schedule

VAV-CX-CLG

Sequence of Operation:

General:

- System is a single duct variable air volume box providing ventilation to the zone from the central air handling unit system.
- A digital controller will be provided for the control of each VAV box to maintain air flow and to maintain the room temperature set-point (heating season 20 deg C; cooling season 24 deg C) (adjustable)
- The zone will have a wall mounted thermostat to provide feedback to the VAV system

Cooling mode:
During cooling mode the VAV box will module the airflow damper from the minimum position up to the maximum position through a PID loop to maintain the room temperature at set point.

Alarms:

- Low room temperature – if the room temperature is below 10°C (adjustable)
- High room temperature – if the room is 10 deg c above set point (adjustable)
- High airflow limit – if the zone airflow rises above the set point by 25% (adjustable)
- Low airflow limit – if the zone airflow falls below the set point by 25% (adjustable)

Drawing Title
022.001(VAV-Cx-CLG Control)

Project Title
Aldergrove Port of Entry DB

NO.	REVISION-LOCATION	ECN	DATE	BY
4	As-built		11/21/2015	TK
3	Re-submitted for review		10/30/15	JYC
2	Formal Submission		10/6/15	JYC
1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Johnson Controls

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CONTRACT NUMBER
40970088

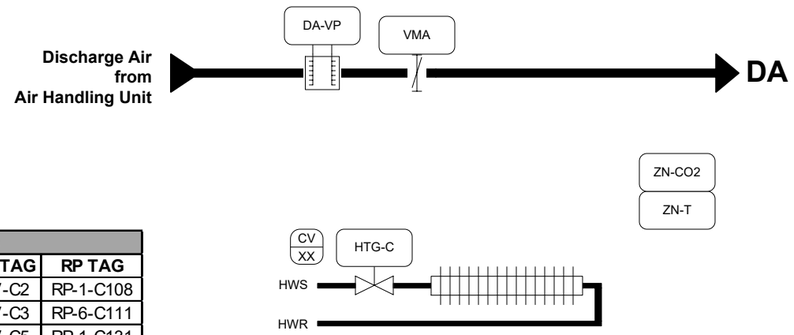
DRAWING NUMBER
701 A

BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
VMA	4	MS-VMA1615-0	VMA 3 UI & 2BO
ZN-CO2	4	CD-W00-00-1	CO2 WALL MNT
ZN-T	4	NS-BTN7003-0	3X4.5.T.TB.ADDRESSABLE
Other Devices:			
HTG-C	4	VALVE	SEE VALVE SCHEDULE

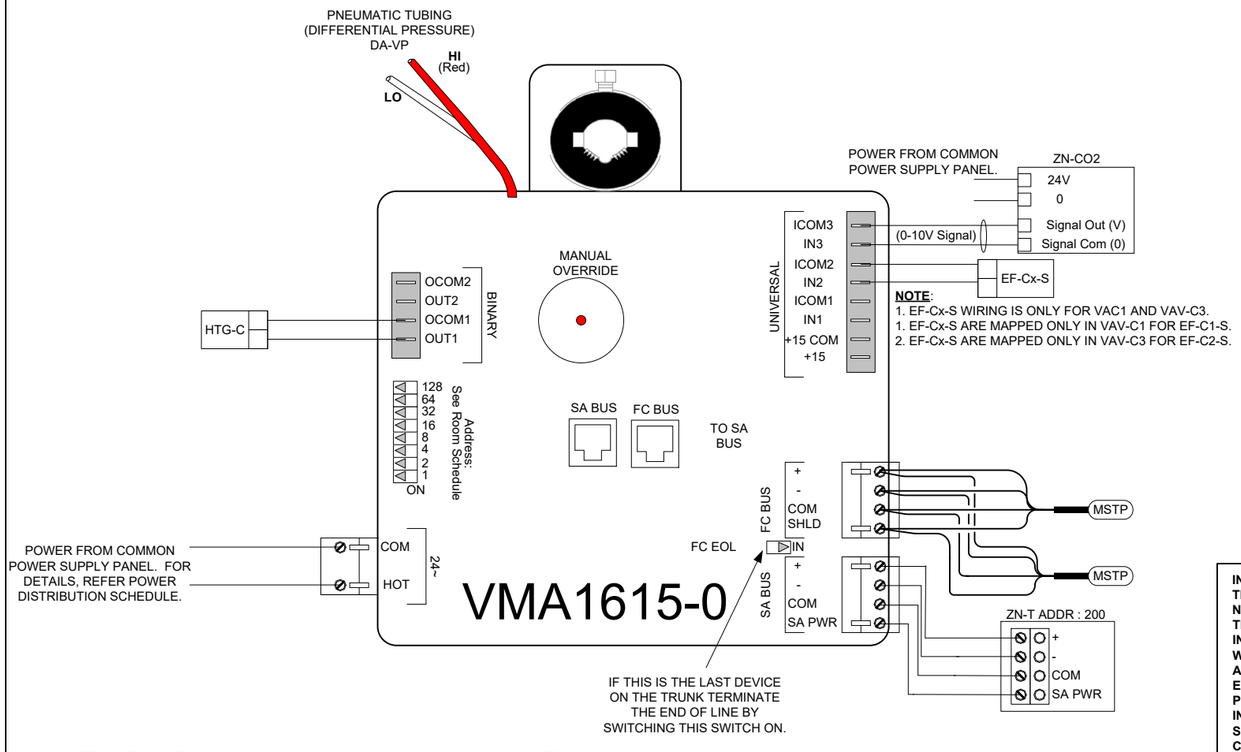
Note-

1) Above BOM is for all systems.



ZN-T, ZN-CO2 and RP SCHEDULE					
SR.NO.	FLOOR	ROOM NO.	ROOM NAME	VAV TAG	RP TAG
1	Main	C108	Meeting Room	VAV-C2	RP-1-C108
2	Main	C111	Training Room	VAV-C3	RP-6-C111
3	Main	C131	Staff Briefing	VAV-C5	RP-1-C131
4	Main	C120	Superintendents	VAV-C6	RP-5-C120

Note-
Refer Room Schedule for IO points of other systems, if mapped in VAV controller.



For Box Parameters and settings see the RS-x schedule

VAV-Cx-CLG WITH RP & ZN-CO2

Sequence of Operation

General:

- System is a single duct variable air volume box providing primary cooling and ventilation to the zone from the central air handling unit system.
- A digital controller will be provided for the control of each VAV box to maintain air flow and to maintain the room temperature set-point (heating season 20 deg C; cooling season 24 deg C) (adjustable).
- The zone will have a wall mounted thermostat to provide feedback to the VAV system
- System is to provide terminal heating to various areas in both the main and commercial buildings during the heating season. These units will not be operational during the cooling and dead band control as defined by the control for that room.

Run condition:

A. The heaters will only operate when both of the following are achieved:

- The room thermostat is in heating mode;
- The associated room VAV box is in its minimum position (see VAV without re-heat control sequence).

Cooling mode:

During cooling mode the VAV box will module the airflow damper from the minimum position up to the maximum position through a PID loop to maintain the room temperature at set point.

Heating mode:

- When the room thermostat calls for heating, the heating control valve will open.
- When the room has reached set point the heating water control valve will close.

Alarms:

- Low room temperature – if the room temperature is below 10°C (adjustable)
- High room temperature – if the room is 10 deg c above set point (adjustable)
- High airflow limit – if the zone airflow rises above the set point by 25% (adjustable)
- Low airflow limit – if the zone airflow falls below the set point by 25% (adjustable)
- Alarm when space temperature deviates from set point by more than 5 deg c for more than 10 minutes.

Additional point monitor by BAS

- Zone CO2 (ZN-CO2)

Drawing Title
022.002(VAV-Cx-CLG WITH RP & ZN-CO2 Control)
Typical of 4

NO.	REVISION-LOCATION	ECN	DATE	BY
2	As-built		11/21/2015	TK
1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Project Title
Aldergrove Port of Entry DB

Johnson Controls

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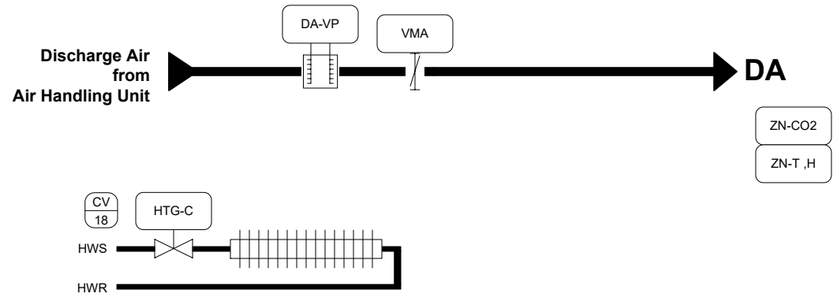
CONTRACT NUMBER
40970088

DRAWING NUMBER
701 B

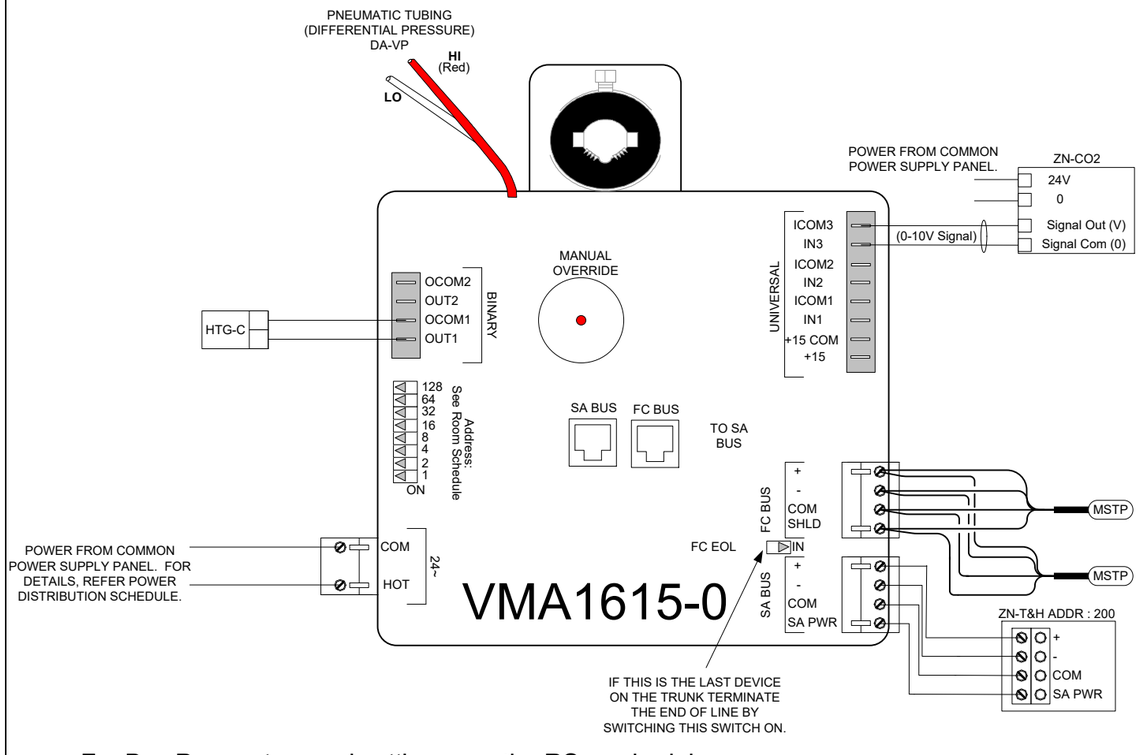


BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
VMA	1	MS-VMA1615-0	VMA 3 UI & 2BO
ZN-CO2	1	CD-W00-00-1	CO2 WALL MNT
ZN-T,-H	1	NS-BHB7003-0	3X4.5 T/H D ADJ. T 3% ADR
Other Devices:			
HTG-C	1	VALVE	SEE VALVE SCHEDULE

ZN-T, ZN-H and CO2 SCHEDULE					
SR.NO.	FLOOR	ROOM NO.	ROOM NAME	VAV TAG	RP TAG
1	Main	C107	CCEPS Counter	VAV-C1	RP-5-C107

Note-
Refer Room Schedule for IO points of other systems, if mapped in VAV controller.



For Box Parameters and settings see the RS-x schedule

VAV-Mx-CLG WITH 2 RP & ZN-Co2

Sequence of Operation

General:

- System is a single duct variable air volume box providing primary cooling and ventilation to the zone from the central air handling unit system.
- A digital controller will be provided for the control of each VAV box to maintain air flow and to maintain the room temperature set-point (heating season 20 deg C; cooling season 24 deg C) (adjustable) with dead band requirement of ASHRAE 90.1 – 2010 and PID algorithm requirements.
- The zone will have a wall mounted thermostat to provide feedback to the VAV system
- System is to provide terminal heating to various areas in both the main and commercial buildings during the heating season. These units will not be operational during the cooling and dead band control as defined by the control for that room.

Run condition:

A. The heaters will only operate when both of the following are achieved:

- The room thermostat is in heating mode;
- The associated room VAV box is in its minimum position (see VAV without re-heat control sequence).

Cooling mode:

During cooling mode the VAV box will module the airflow damper from the minimum position up to the maximum position through a PID loop to maintain the room temperature at set point.

Heating mode:

- When the room thermostat calls for heating, the heating control valve will open.
- When the room has reached set point the heating water control valve will close.

Alarms:

- Low room temperature – if the room temperature is below 10°C (adjustable)
- High room temperature – if the room is 10 deg c above set point (adjustable)
- High airflow limit – if the zone airflow rises above the set point by 25% (adjustable)
- Low airflow limit – if the zone airflow falls below the set point by 25% (adjustable)
- Alarm when space temperature deviates from set point by more than 5 deg c for more than 10 minutes.

Additional point monitor by BAS

- Zone CO2 (ZN-CO2)
- Zone Humidity (ZN-H)

Drawing Title
022.003(VAV-Cx-CLG WITH RP, ZN-CO2 & ZN-H Control)

Project Title
Aldergrove Port of Entry DB

	NO.	REVISION-LOCATION	ECN	DATE	BY
	2	As-built		11/21/2015	TK
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

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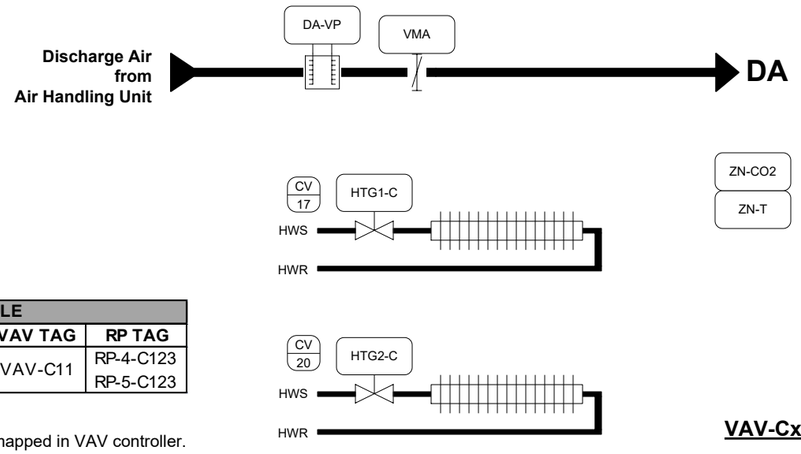
CONTRACT NUMBER
40970088

DRAWING NUMBER
701 C

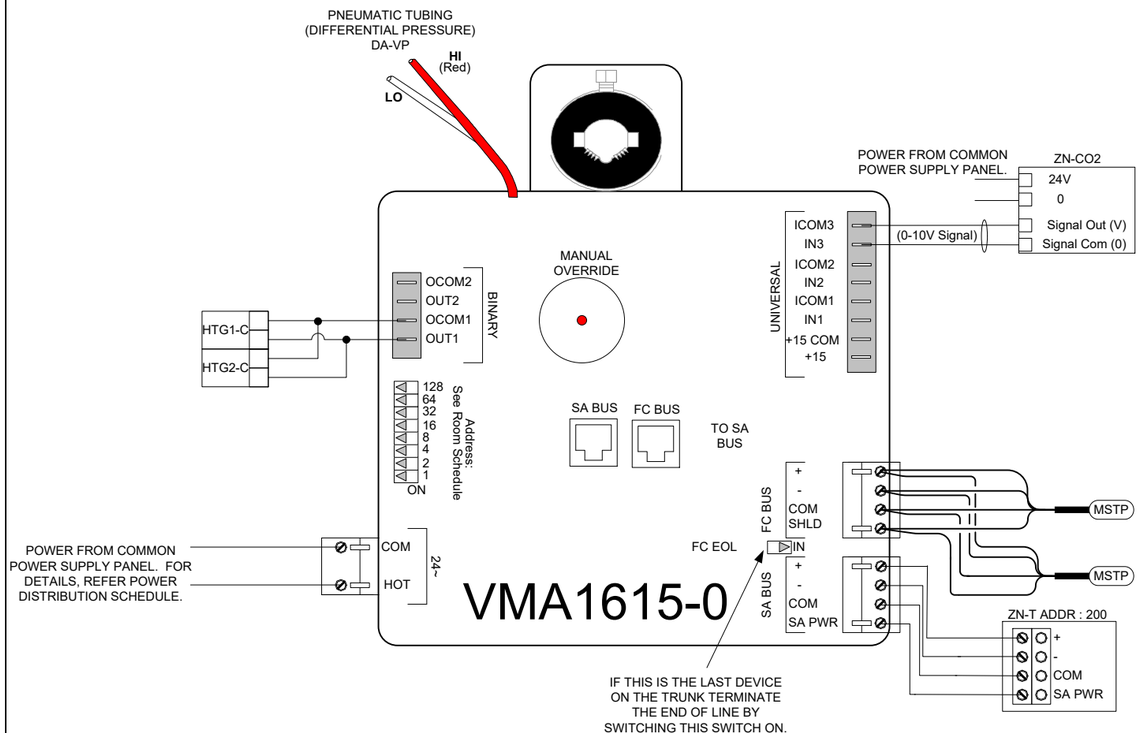


BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
R-1	1	RIB2402B	SPDT,20A,HC=24 VAC/DC,W/LED
VMA	1	MS-VMA1615-0	VMA 3 UI & 2BO
ZN-CO2	1	CD-W00-00-1	CO2 WALL MNT
ZN-T	1	NS-BTN7003-0	3X4.5.T.TB.ADDRESSABLE
Other Devices:			
HTG-C	2	VALVE	SEE VALVE SCHEDULE

ZN-T, ZN-CO2 and RP SCHEDULE					
SR.NO.	FLOOR	ROOM NO.	ROOM NAME	VAV TAG	RP TAG
1	Main	C123	Coffee Area	VAV-C11	RP-4-C123 RP-5-C123

Note-
Refer Room Schedule for IO points of other systems, if mapped in VAV controller.



For Box Parameters and settings see the RS-x schedule

VAV-Cx-CLG WITH 2 RP & ZN-Co2

Sequence of Operation

General:

- System is a single duct variable air volume box providing primary cooling and ventilation to the zone from the central air handling unit system.
- A digital controller will be provided for the control of each VAV box to maintain air flow and to maintain the room temperature set-point (heating season 20 deg C; cooling season 24 deg C) (adjustable) with dead band requirement of ASHRAE 90.1 – 2010 and PID algorithm requirements.
- The zone will have a wall mounted thermostat to provide feedback to the VAV system
- System is to provide terminal heating to various areas in both the main and commercial buildings during the heating season. These units will not be operational during the cooling and dead band control as defined by the control for that room.

Run condition:

A. The heaters will only operate when both of the following are achieved:

- The room thermostat is in heating mode;
- The associated room VAV box is in its minimum position (see VAV without re-heat control sequence).

Cooling mode:

During cooling mode the VAV box will module the airflow damper from the minimum position up to the maximum position through a PID loop to maintain the room temperature at set point.

Heating mode:

- When the room thermostat calls for heating, the heating control valve will open.
- When the room has reached set point the heating water control valve will close.

Alarms:

- Low room temperature – if the room temperature is below 10°C (adjustable)
- High room temperature – if the room is 10 deg c above set point (adjustable)
- High airflow limit – if the zone airflow rises above the set point by 25% (adjustable)
- Low airflow limit – if the zone airflow falls below the set point by 25% (adjustable)
- Alarm when space temperature deviates from set point by more than 5 deg c for more than 10 minutes.

Additional point monitor by BAS

- Zone CO2 (ZN-CO2)

Drawing Title
022.004(VAV-Cx-CLG WITH 2 RP & ZN-CO2 Control)

	NO.	REVISION-LOCATION	ECN	DATE	BY
	2	As-built		11/21/2015	TK
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Project Title
Aldergrove Port of Entry DB

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V5M 0A4
Phone: 604-707-5200
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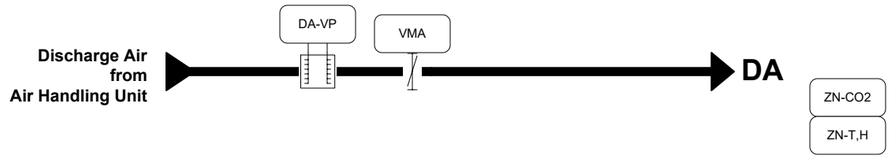
CONTRACT NUMBER
40970088

DRAWING NUMBER
701 D

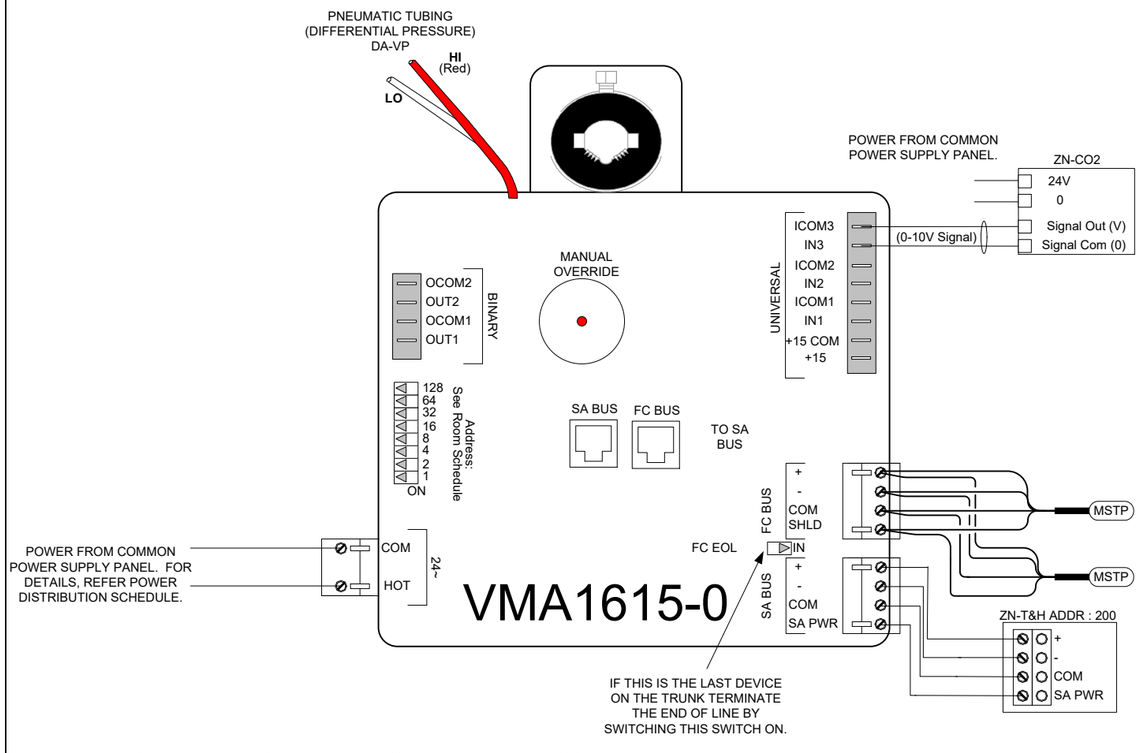
BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
VMA	1	MS-VMA1615-0	VMA 3 UI & 2BO
ZN-CO2	1	CD-W00-00-1	CO2 WALL MNT
ZN-T,-H	1	NS-BHB7003-0	3X4.5 T/H D ADJ. T 3% ADR



SR.NO.	FLOOR	ROOM NO.	ROOM NAME	VAV TAG
1	Main	C121	General Office Area	VAV-C9

Note-
Refer Room Schedule for IO points of other systems, if mapped in VAV controller.



For Box Parameters and settings see the RS-x schedule

VAV-Cx-CLG WITH ZN-CO2 & ZN-H

Sequence of Operation:

General:

- System is a single duct variable air volume box providing primary cooling and ventilation to the zone from the central air handling unit system.
- A digital controller will be provided for the control of each VAV box to maintain air flow and to maintain the room temperature set-point (heating season 20 deg C; cooling season 24 deg C) (adjustable)
- The zone will have a wall mounted thermostat to provide feedback to the VAV system

Cooling mode:
During cooling mode the VAV box will module the airflow damper from the minimum position up to the maximum position through a PID loop to maintain the room temperature at set point.

Alarms:

- Low room temperature – if the room temperature is below 10°C (adjustable)
- High room temperature – if the room is 10 deg c above set point (adjustable)
- High airflow limit – if the zone airflow rises above the set point by 25% (adjustable)
- Low airflow limit – if the zone airflow falls below the set point by 25% (adjustable)

Additional points monitor by BAS

- Zone CO2 (ZN-CO2)
- Zone Humidity (ZN-H)

Drawing Title
022.005(VAV-Cx-CLG WITH ZN-CO2 & ZN-H Control)

Project Title
Aldergrove Port of Entry DB

NO.	REVISION-LOCATION	ECN	DATE	BY
3	As-built		11/21/2015	TK
2	Formal Submission		10/19/15	JYC
1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

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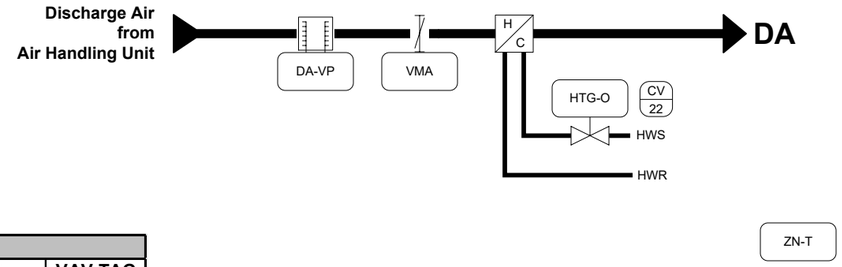
Fax: 604-707-5201

CONTRACT NUMBER
40970088

DRAWING NUMBER
701 E

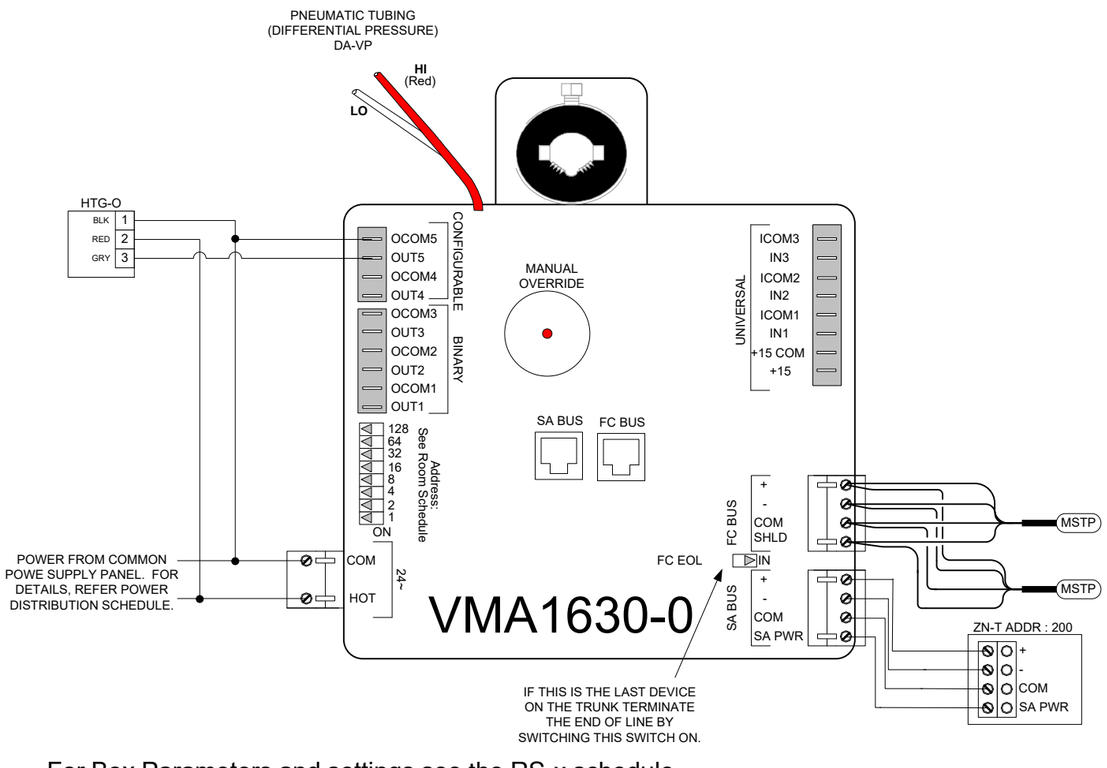
BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
VMA	1	MS-VMA1630-0	VMA 3 UI & 3 BO 2 CO
ZN-T	1	NS-BTN7003-0	3X4.5.T.TB.ADDRESSABLE
Other Devices:			
HTG-O	1	VALVE	SEE VALVE SCHEDULE



ZN-T SCHEDULE				
SR.NO.	FLOOR	ROOM NO.	ROOM NAME	VAV TAG
1	MAIN	C112	Locker Room	VAV-C4

Note-
Refer Room Schedule for IO points of other systems, if mapped in VAV controller.



For Box Parameters and settings see the RS-x schedule

VAV-Cx-RH

Sequence of Operation:

General:

- System is a single duct constant air volume box with reheat coil for the central air handling unit system.
- A digital controller will be provided for the control of each VAV box to maintain air flow and provide control of the reheat coil to maintain overall control of the space temperature to maintain the room temperature set-point (heating season 20 deg c; cooling season 24 deg c) (adjustable) with dead band requirement of ASHRAE 90.1 – 2010 and PID algorithm requirements.
- The airflow will be maintained at a constant volume at all times during occupied times.
- The zone will have a wall mounted thermostat for feedback to the VAV system; refer to drawings for thermostat locations.

Cooling mode:
During cooling mode the box will be at constant airflow and the re-heat coil will be closed.

Heating mode:
During heating mode the box will be at constant airflow and the re-heat coil will modulate to maintain the room temperature set point using a PID control loop.

Alarms:

- Low room temperature – if the room temperature is below 10 deg c (adjustable)
- High room temperature – if the room is 10 deg c above set point (adjustable)
- High airflow limit – if the zone airflow rises above the set point by 25% (adjustable)
- Low airflow limit – if the zone airflow falls below the set point by 25% (adjustable).

Drawing Title
022.006(VAV-Cx-RH Control)

Project Title
Aldergrove Port of Entry DB

NO.	REVISION-LOCATION	ECN	DATE	BY
3	As-built		11/21/2015	TK
2	Formal Submission		10/19/15	JYC
1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

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CONTRACT NUMBER
40970088

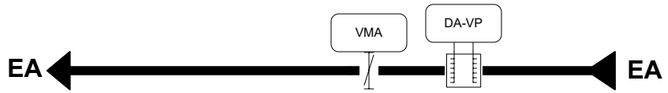
DRAWING NUMBER
701 F

BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
VMA	2	MS-VMA1615-0	VMA 3 UI & 2BO

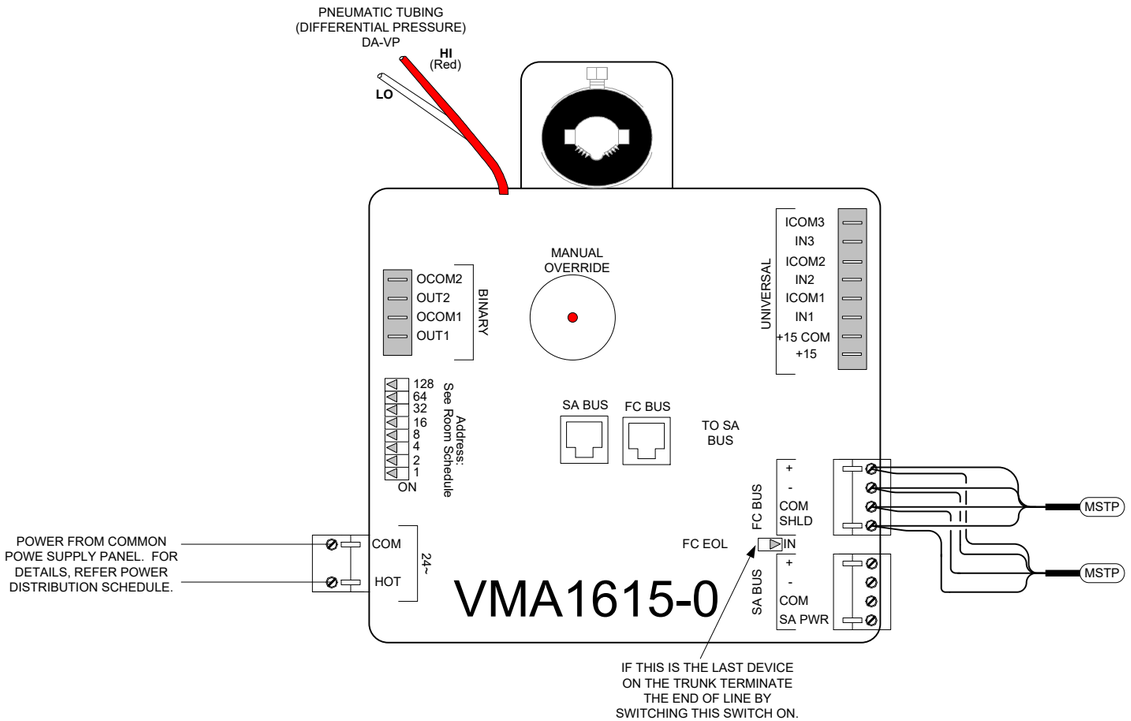
NOTE-

1) ABOVE BOM IS FOR ALL SYSTEMS.



VAV SCHEDULE				
SR.NO.	FLOOR	SERVICE	LOCATION	VAV TAG
1	Main	Wash Room Exhaust	C-119, Hallw ay	VAV-C12
2	Main	General Exhaust	C-201, Mechanical Room	VAV-C13

Note-
Refer Room Schedule for IO points of other systems, if mapped in VAV controller.



For Box Parameters and settings see the RS-x schedule

EXHAUST VAV:

Sequence of Operation

Wash room exhaust VAV:
General:

- System is a single duct exhaust system for general washroom and janitor room exhaust airflow back to the central HRU (either HRU-C1).
- A digital controller will be provided for the control of each CAV box to maintain a constant air flow setpoint.
- Following variables will be able to be loaded/monitored at the building automation system operator station, for each of the digital VAV boxes:
  - Air volume
  - Minimum volume setting
  - Maximum volume setting
  - Heating valve command
  - Damper operator command
- The digital controller and actuator will be supplied by the controls contractor and mounted at the VAV box manufacturer's factory or field mounted on site. The flow sensor will be provided by the VAV manufacturer and installed in the factory.

Alarms:
High or low airflow at +/- 25% from the setpoint airflow.

General exhaust VAV:
General:

- System is a single duct variable air volume box providing general exhaust from the return air ductwork in the mechanical room. This box is meant to provide general building relief air when the AHU is operating in heat recovery mode.
- A digital controller will be provided for the control of each VAV box to maintain air flow.
- The digital controller and actuator will be supplied by the controls contractor and mounted at the VAV box manufacturer's factory or field mounted on site. The flow sensor will be provided by the VAV manufacturer and installed in the factor.

Run conditions:
The VAV box will only operate to maintain calculated airflow when the HRU is in heat recovery mode. At all other times this box will remain closed and building relief air will be through a modulated damper at the AHU.

Normal operation:
The VAV box will operate to maintain airflow.

Alarms:
Provide an alarm when the airflow drops below set point by more than 10%.

Drawing Title
022.007(VAV-Cx EXHAUST Control)

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	2	As-built		11/21/2015	TK
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Project Title
Aldergrove Port of Entry DB

Johnson Controls

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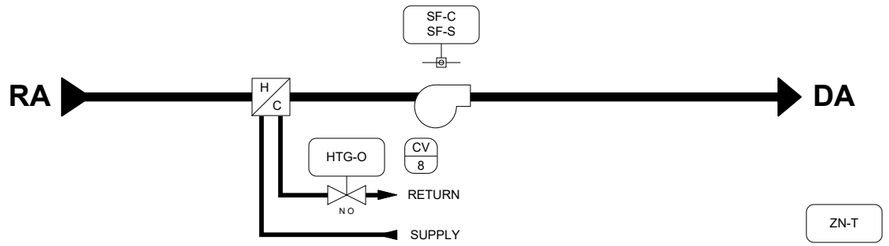
CONTRACT NUMBER
40970088

DRAWING NUMBER
701 G

BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
SF-C,-S	1	H120	CSR,N.O.,24V,FRAC HP,N.O.,SERIES
Panel Devices:			
CP-FC-C1	1	MS-FEC1611-0	FEC1611-0, FEC9, W/O
TX-1	1	Y64T15-0	TRANSFORMER UL CLASS 2
Other Devices:			
HTG-O	1	VALVE	SEE VALVE SCHEDULE



NOTE:
1. The ZN-T is common for VAV-C9 and FC-C1 serving in the same area- General Office. ZN-T is considered in the VAV BOM/Submittals.

FCU Schedule			
Sr. No.	**Floor**	**FCU Tag**	**Serving Room & Room No.**
1	Main	FCU-C1	General Office Area[M121]

FAN COIL UNIT (FC-C1)

Sequence of Operation:

General:
System is to provide terminal heating to the open office areas and lobby in both the commercial building during the heating season. These units will not be operational during the cooling and dead band control.

Run condition:
The fan coil will only operate when both of the following are achieved:

- The room thermostat is in heating mode.

Heating mode:
When the room thermostat calls for heating, the fan will turn on and the heating coil control valve will start to open. The control valve will be operated to maintain the room temperature through a PID control loop.
When the room has reached set point the heating water control valve will close and the fan will operate for 5 minutes (adjustable) then deactivate.

Alarms:
Alarm when space temperature deviates from set point by more than 10°c for more than 15 minutes.

Drawing Title
023.001(FC-C1 Control)

Project Title
Aldergrove Port of Entry DB

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	3	As-built		11/21/2015	TK
	2	Formal Submission		10/19/15	JYC
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Johnson Controls

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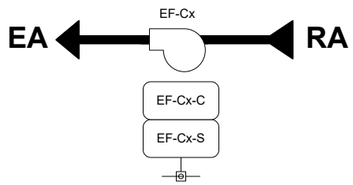
CONTRACT NUMBER
40970088

DRAWING NUMBER
702 A

EF-C1 & EF-C2 Flow Diagram (Typical Of 2)



GENERAL PURPOSE EXHAUST FANS (EF-C1, EF-C2):

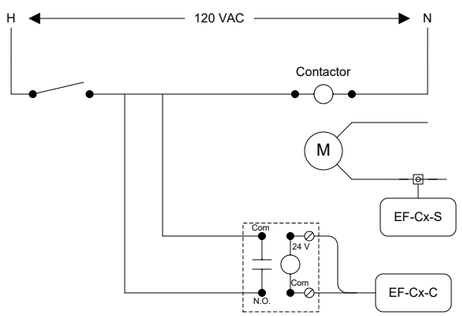
Sequence of Operation:

General:
Units are general purpose exhaust fans for serving storage rooms and the water entry room.

Control description:
Exhaust fans will operate during a user definable occupancy schedule. Occupancy schedule will match associated AHU that serves the zone.

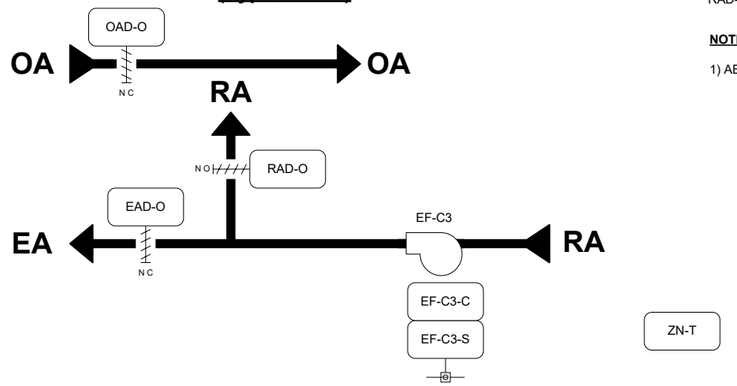
Alarms:
DDC will provide a local alarm when fan status does not show the unit operating during the required operating time.

EXHAUST FAN SCHEDULE					
SR.NO.	TAG	SERVING AREA	VOLT/ PH	IO POINTS MAPPED IN	MECH DWG
1	EF-C1	Mech Water Entry-C106	120/ 1	VAV-C1, (VAV with RP & ZN-CO2)	M3.02
2	EF-C2	Storage Room (G)-C116	120/ 1	VAV-C3, (VAV with RP & ZN-CO2)	M3.02



Exhaust Fan EF-Mx Control Wiring

EF-C3 Flow Diagram (Typical Of 1)



MECHANICAL ROOM EXHAUST FAN (EF-C3):

Sequence of Operation:

General:
Units are general purpose exhaust fans for providing ventilation and cooling for the mechanical rooms in the winter. The system is equipped with a make-up air damper, return air damper and exhaust air damper for temperature control during fan operation and to limit the requirements for heat in the winter.

Control description:
- Exhaust fans will cycle to maintain space temperature.
- When the exhaust fan is in operation, the outside air damper, return air damper and exhaust air damper will all modulate together to maintain the room temperature set point (initially set to 26°c).
- When the systems are off, the dampers will be in full return position.

Alarms:
- DDC will provide an alarm when fan status does not show the unit operating during the required operating time.
- DDC will provide an alarm when the room temperature drops below 5°c.

EF-C3 SCHEDULE				
SR.NO.	TAG	SERVING AREA	MECH DWG	IO POINTS MAPPED IN
1	EF-C3	Mechanical Room C201	M3.02	CP-AHU-C1

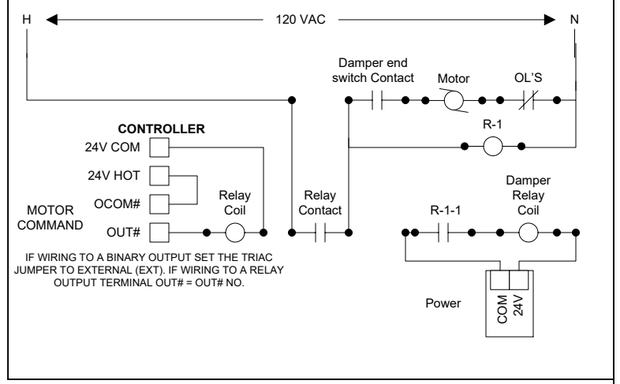
BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
EF-Cx-S	3	CSD-SA1E0-1	SLD/ADJ LED 1A W/O RELAY
ZN-T	1	NS-BTN7003-0	3X4.5.T.TB.ADDRESSABLE
Panel Devices:			
EF-Cx-C	3	RH2B-UAC24-L	DPDT,10A,HC=24 VAC,
	3	SH2B-05	DPDT RELAY BASE FOR RH2B
Other Devices:			
EAD-O	1	DAMPER	SEE DAMPER SCHEDULE
OAD-O	1	DAMPER	SEE DAMPER SCHEDULE
RAD-O	1	DAMPER	SEE DAMPER SCHEDULE

NOTE-

1) ABOVE BOM IS FOR ALL SYSTEMS.

Single Phase Motor Wiring With Damper



Drawing Title
024.001(EF-C1, EF-C2, EF-C3 Control)

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	2	As-built		11/21/2015	TK
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Project Title
Aldergrove Port of Entry DB

Johnson Controls

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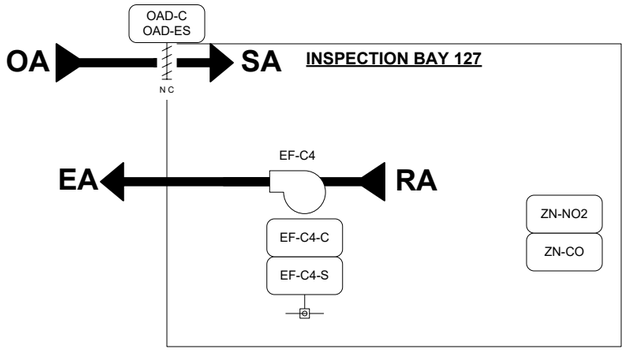
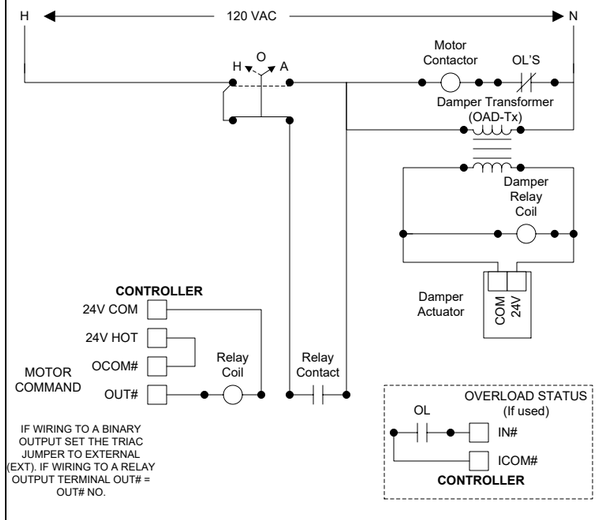
CONTRACT NUMBER
40970088

DRAWING NUMBER
801 A



TERTIARY GARAGE FAN SCHEDULE				
SR. NO.	TAG	SERVING AREA	VOLT/ PH	MECH DWG
1	EF-C4	Inspection Bay C127	120/ 1	M3.03

Starter without Safeties Wiring



BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
EF-C4-S	1	CSD-SA1E0-1	SLD/ADJ LED 1A W/O RELAY
OAD-TX	1	Y65T31-0	TRANSFORMER UL CLASS 2
ZN-CO	1	TR2000-CO	CARBON MONOXIDE, AIRTEST
ZN-NO2	1	TR3210-NO2	NO2 SENSOR, AIRTEST
Panel Devices:			
CP-EF-C4	1	PAKG00001AH0	FEC2611,20X24
EF-C4-C	1	RH2B-UAC24-L	DPDT,10A,HC=24 VAC,
	1	SH2B-05	DPDT RELAY BASE FOR RH2B
Other Devices:			
OAD-C	1	DAMPER	SEE DAMPER SCHEDULE
	1	RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED

VEHICLE EXHAUST- INSPECTION BAYS:

Sequence of Operation:

General:
System is designed as a vehicle fume exhaust fan with motorized damper make-up air. This system will operate intermittently based on CO/NO2 detection witnin the inspection bay.
CO and NO2 will be installed at approximately 1.5m above the finished floor to detect levels at the breathing zone.

Run conditions:
The exhaust fan will operate whenever:

- CO levels are detected above 25 ppm or;
- NO2 levels are detected above 0.7 ppm.

EF will run for a minimum of 5 minutes to prevent short cycling.

Normal operation:
When EF receives a call to turn on, the associated motorized outside air damper will be given a signal to open. When the motorized damper is proven open, EF will start.

Stop conditions:
EF will be disabled when:

- CO levels fall below 10 ppm; and/or
- NO2 levels fall below 0.3 ppm.

When disabled, EF will shut down and the associated motorized damper will close.

Alarms:
Provide

- High level alarm (audible and visual within inspection bay) at 200 ppm of co.
- NO2 alarm at 9 ppm or as recommended by sensor supplier
- Typical fan failure alarm if status does not match command.

Motorized damper failure alarm if status does not match command.

Drawing Title
024.002(EF-C4 Control)

Project Title
Aldergrove Port of Entry DB

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	2	As-built		11/21/2015	TK
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Branch Information
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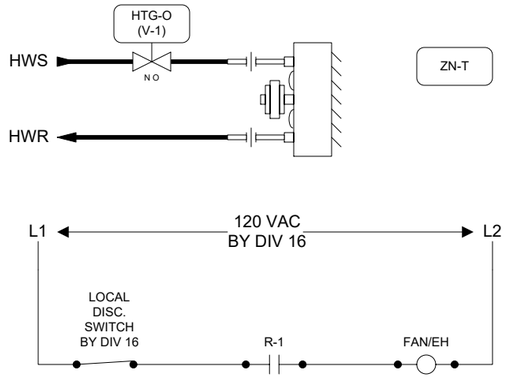
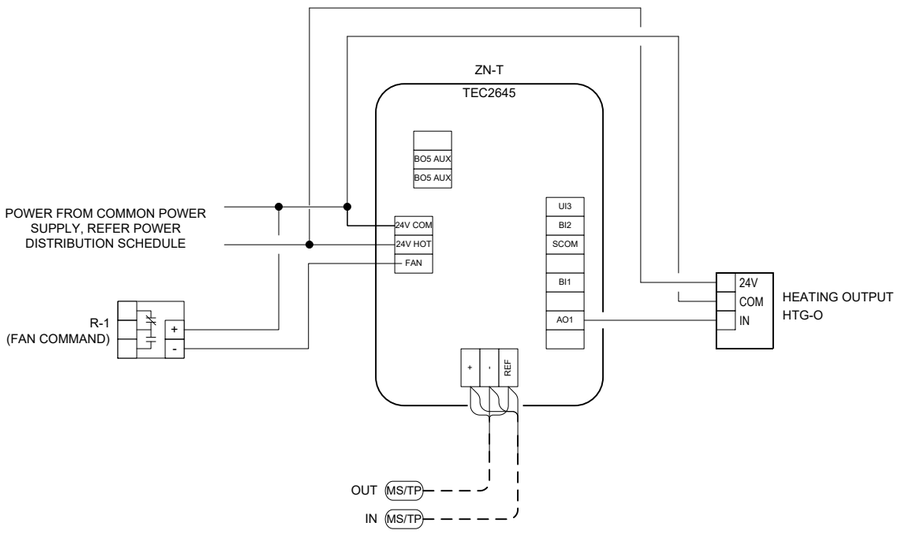
Phone: 604-707-5200
Fax: 604-707-5201

CONTRACT NUMBER
40970088

DRAWING NUMBER
801 B

HUH Schedule		
Tag	**Location**	**Remark**
HUH-C1	C127 - Inspection Bays	
HUH-C2	C127 - Inspection Bays	
HUH-C3	C201 - Mechanical room	





BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
R-1	1	RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED
ZN-T	1	TEC2645-4	1 PROP 1 SPD FAN
Other Devices:			
HTG-O	1	VALVE	SEE VALVE SCHEDULE

NOTE:

1. THESE GRAY DEVICES WILL BE YORK DEVICES OR PROVIDED BY OTHERS.
2. ABOVE BOM IS FOR ALL SYSTEM.

HYDRONIC UNIT HEATERS (HUH-Cx)

SEQUENCE OF OPERATION:

GENERAL:
SYSTEM IS TO PROVIDE HEATING WITHIN THE LOADING BAY IN THE COMMERCIAL BUILDING. THESE UNITS WILL NOT BE OPERATIONAL DURING THE COOLING AND DEADBAND CONTROL.

RUN CONDITION:
THE UNIT HEATER WILL BE ENABLED WHEN THE OUTSIDE AIR TEMPERATURE IS BELOW 18°C.

HEATING MODE:
WHEN THE ROOM THERMOSTAT CALLS FOR HEATING, THE FAN WILL TURN ON AND THE HEATING COIL CONTROL VALVE WILL START TO OPEN. THE CONTROL VALVE WILL BE OPERATED TO MAINTAIN THE ROOM TEMPERATURE THROUGH A PID CONTROL LOOP.
WHEN THE ROOM HAS REACHED SET POINT THE HEATING WATER CONTROL VALVE WILL CLOSE AND THE FAN WILL OPERATE FOR 5 MINUTES (ADJUSTABLE) THEN DEACTIVATE.

ALARMS:
ALARM WHEN SPACE TEMPERATURE DEVIATES FROM SETPOINT BY MORE THAN 5°C.

Drawing Title
025.001(HUH-Cx Control)

Project Title
Aldergrove Port of Entry DB

	NO.	REVISION-LOCATION	ECN	DATE	BY
	3	As-built		11/21/2015	TK
	2	Re-submitted for approval		10/30/15	JYC
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

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CONTRACT NUMBER
40970088

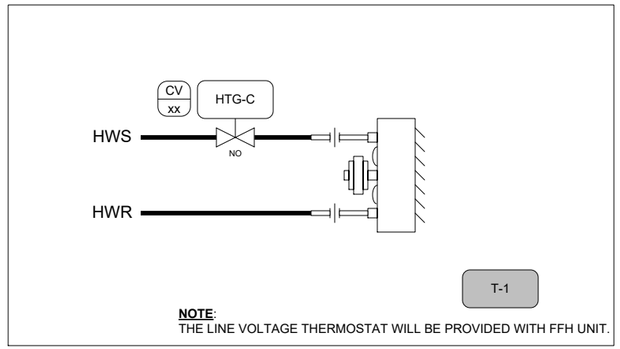
DRAWING NUMBER
802 A

BILL OF MATERIALS

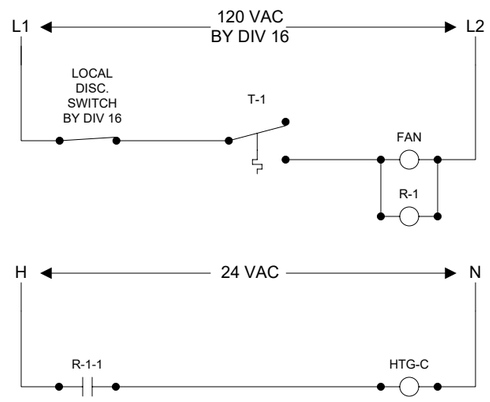
Designation	Qty	Part Number	Description
Field Devices:			
R-1	1	RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED
Other Devices:			
HTG-C	1	VALVE	SEE VALVE SCHEDULE

Note:

1. These gray devices will be provided by others.
2. Above BOM is for one system.



NOTE:
THE LINE VOLTAGE THERMOSTAT WILL BE PROVIDED WITH FFH UNIT.



UNIT HEATER SCHEDULE						
SR. NO.	TAG	LOCATION	LPS	HP	V/PH/HZ	REF. DWG.
1	FFH-C1	VESTIBULE-C100	66	0.13	120/1/60	M3.02
2	FFH-C2	VESTIBULE-C118	66	0.13	120/1/60	M3.02
3	FFH-C3	HALLWAY C128	66	0.13	120/1/60	M3.04

FORCE FLOW HEATERS (FFH-Cx)

Sequence of Operation:

General:
Heater is to operate to maintain the room temperature as sensed at the wall thermostat.

Heating operation:
When the associated thermostat indicates the room temperature is below thermostat setpoint the unit fan will activate and the heating water control valve will open through integral controls.
When the room has reached set point the heat water control valve will close and the fan will shut off.

Power failure:
Heating water control valve fails normally open.

Alarms:
None. These systems are not connected to the BMS.

Drawing Title
026.001(FFH-Cx Control)
Typical of 3

Project Title
Aldergrove Port of Entry DB

NO.	REVISION-LOCATION	ECN	DATE	BY
3	As-built		11/21/2015	TK
2	Formal Submission		10/19/15	JYC
1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

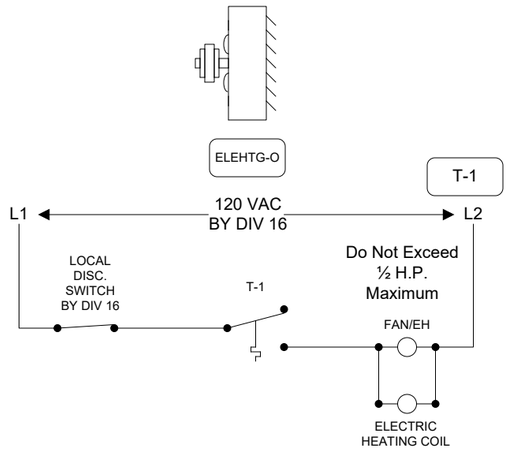
Branch Information
Johnson Controls Inc
3680 East 2nd Avenue
Vancouver, Canada
V5M 0A4
Phone: 604-707-5200
Fax: 604-707-5201

CONTRACT NUMBER
40970088

DRAWING NUMBER
803 A

BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
T-1	1	T26S-18C	SPC,BLB,SP=40-90 F (5-30 C),STG=1



ELECTRIC FORCE FLOW HEATER SCHEDULE					
SR. NO.	TAG	LOCATION	LPS	V/PH/HZ	REF. DWG.
1	EFFH-C1	STAIR C-1	76	120/1/60	M3.02

ELECTRIC FORCE FLOW HEATERS (EFFH-C1)

Sequence of Operation:

Heating: The fan and the electric heating coil will be energized as needed to maintain zone heating temperature setpoint.

Not interfaced with DDC

Drawing Title

027.001(EFFH-C1 Control)

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	3	As-built		11/21/2015	TK
	2	Formal Submission		10/19/15	JYC
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN		APPROVED	
Cansin Yang	Troy Bazille	CoEE	BY CoEE	DATE 01/2/2015	BY	DATE

Project Title

Aldergrove Port of Entry DB

Johnson Controls

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CONTRACT NUMBER

40970088

DRAWING NUMBER

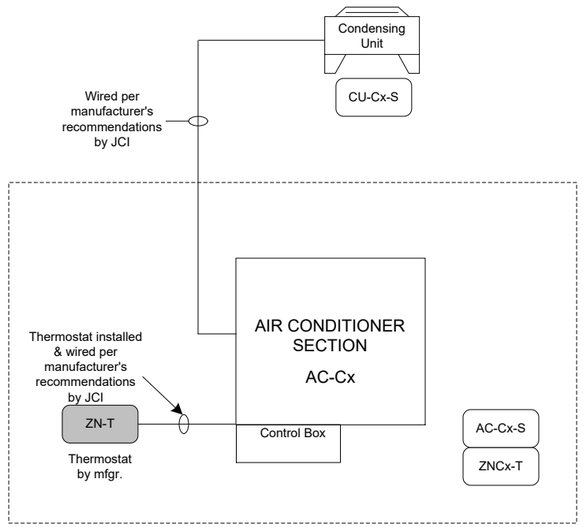
803 B

BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
AC-Cx-S	2	CSD-SA1E0-1	SLD/ADJ LED 1A W/O RELAY
CU-Cx-S	2	CSD-SA1E0-1	SLD/ADJ LED 1A W/O RELAY
ZNx-T	2	NS-BTN7003-0	3X4.5.T.TB.ADDRESSABLE

Note:

1. These gray devices will be provided by others.
2. Above BOM is for one system.



DUCTLESS SPLIT SYSTEM SCHEDULE (INDOOR UNIT)			
SR. NO.	TAG	LOCATION	MAPPED IN
1	AC-C1	ELEC/COMM ROOM C115	VAV-C4
2	AC-C2	REMOTE CABLING ROOM C117	VAV-C5

SPLIT AC SYSTEMS AC-Cx

Sequence of Operation:

General:
These systems consist of a wall mounted evaporator within the electrical or data room and a rooftop mounted condenser unit with refrigerant lines running to and from each unit. A manufacturer provided wall mounted thermostat will be used to control the system.

Control description:
- The system will be controlled through its own remote wall mounted controller.
- The AC systems will operate through their own internal controls to cycle to maintain the room temperature setpoint.
- A separate room temperature sensor will measure the room temperature and send the signal to the DDC.

Alarms:
- DDC will provide an alarm when the room temperature rises above 30°C for more than 30 minutes.

DDC graphic requirements:
- System graphic.
- AC status
- Room temperature.

Drawing Title
028.001(SPLIT SYSTEM AC-Cx Control)

Project Title
Aldergrove Port of Entry DB

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	2	As-built		11/21/2015	TK
	1	SUBMITTAL		1/20/15	CoEE

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CONTRACT NUMBER
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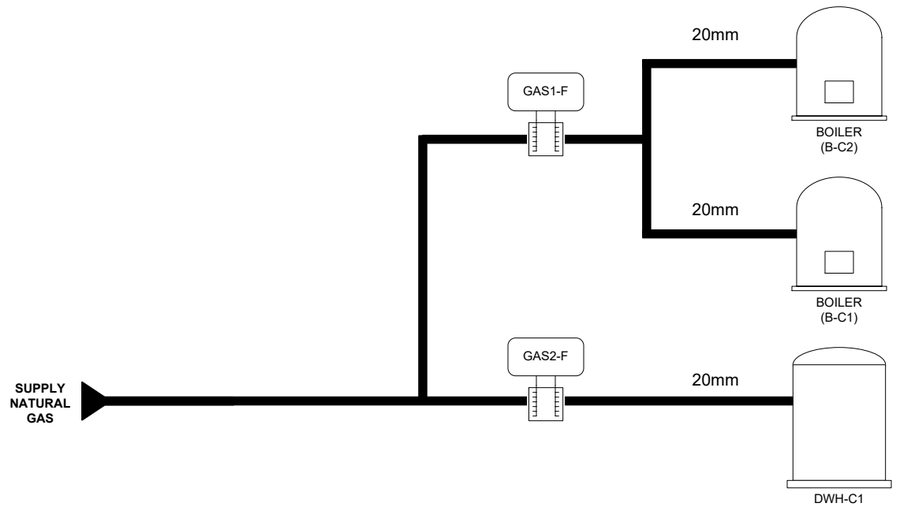
DRAWING NUMBER
804 A

BILL OF MATERIALS

Designation	Qty	Part Number	Description
Other Devices:			
GASx-F	2	FT2A-06IE2G3	KELE, NATURAL GAS FLOW METER

Note:
1. IO points are mapped in HW system.



NATURAL GAS METERS

Sequence of Operation:

Building meters are provided for general equipment which is metered at the boilers & domestic hot water heaters for the commercial building systems. See the drawings for exact locations and system requirements.

Gas meter:
The controller will monitor the gas meter for gas consumption on a continual basis. These values will be made available to the system at all times.

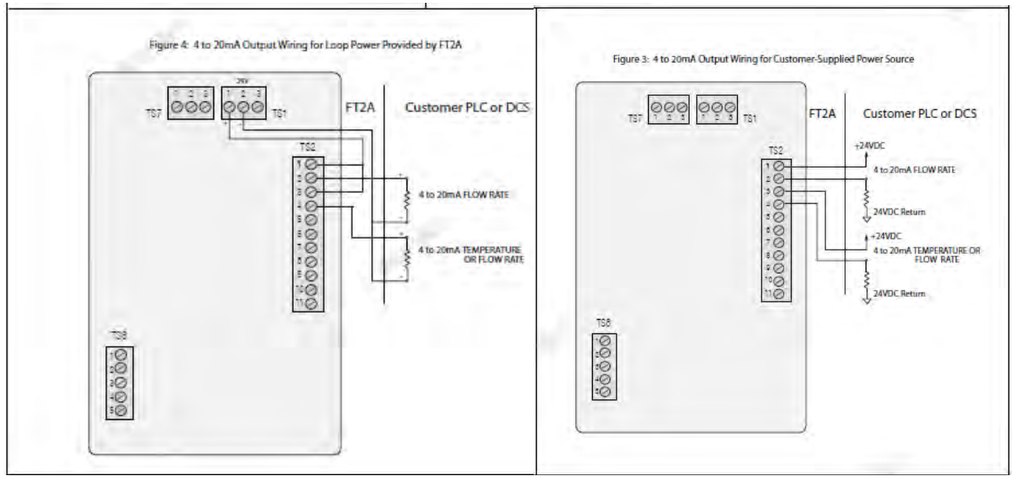
Peak demand history:
The controller will monitor and record the peak (high and low) demand readings from the gas meter. Peak readings will be recorded on an hourly, daily, month-to-date, and year-to-date basis.

Usage history:
The controller will monitor and record gas meter readings so as to provide a gas consumption history. Usage readings will be recorded on an hourly, daily, month-to-date, and year-to-date basis.

Alarms:
Invalid reading: sensor reading indicates an invalid value from the gas meter.

Fire alarm:
N/A

Power failure:
Gas meter to be fed from standby power source.



Drawing Title
029.001(NATURAL GAS METER Control)

Project Title
Aldergrove Port of Entry DB

	NO.	REVISION-LOCATION	ECN	DATE	BY
	3	As-built		11/21/2015	TK
	2	Formal Submission		10/19/15	JYC
	1	SUBMITTAL		1/20/15	CoEE

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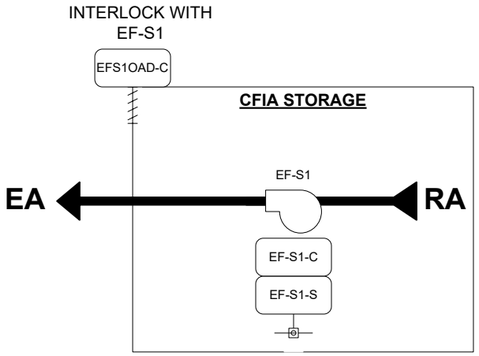
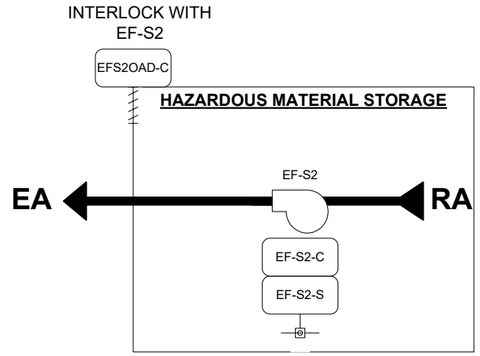




BILL OF MATERIALS

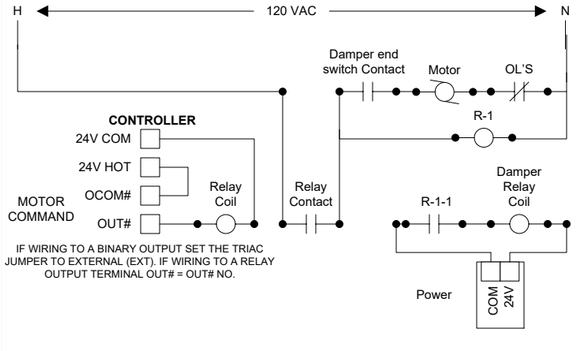
Designation	Qty	Part Number	Description
Field Devices:			
EF-Sx-S	2	CSD-SA1E0-1	SLD/ADJ LED 1A W/O RELAY
EFSxOAD-C	2	RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED
R-1	2	RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED
Panel Devices:			
CP-EF-Sx	1	PAKG00001AH0	FEC2611,20X24
EF-Sx-C	2	RH2B-UAC24-L	DPDT,10A,HC=24 VAC,
	2	SH2B-05	DPDT RELAY BASE FOR RH2B
Other Devices:			
EFSxOAD-C	2	DAMPER	SEE DAMPER SCHEDULE

Note:

1. Above BOM is for all system.

STORAGE EXHAUST FAN SCHEDULE				
SR.NO.	TAG	SERVICE AREA	VOLT/ PH	MECH DWG
1	EF-S1	CFIA Storage 102	120/ 1	M4.01
2	EF-S2	Hazardous Material 103	120/ 1	M4.01

Single Phase Motor Wiring With Damper



GENERAL PURPOSE EXHAUST FANS (EF-S1, EF-S2)

Sequence of Operation:

General:
Units are general purpose exhaust fans for serving the CFIA storage and hazardous material storage rooms in the service building.

Control description:
Damper actuator for EF-S2 within explosion proof housing.
Exhaust fans will operate during a user definable schedule, initially set to operate 24/7.
When the fan is turned on, the associated motorized outside air damper will open.
When the fan is turned off, the associated motorized outside air damper will close.

Alarms:
DDC will provide a local alarm when fan status does not show the unit operating during the required operating time.

Drawing Title
030.001(EF-Sx Control)

Project Title
Aldergrove Port of Entry DB

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	3	As-built		11/21/2015	TK
	2	Formal Submission		10/19/15	JYC
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

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CONTRACT NUMBER
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DRAWING NUMBER
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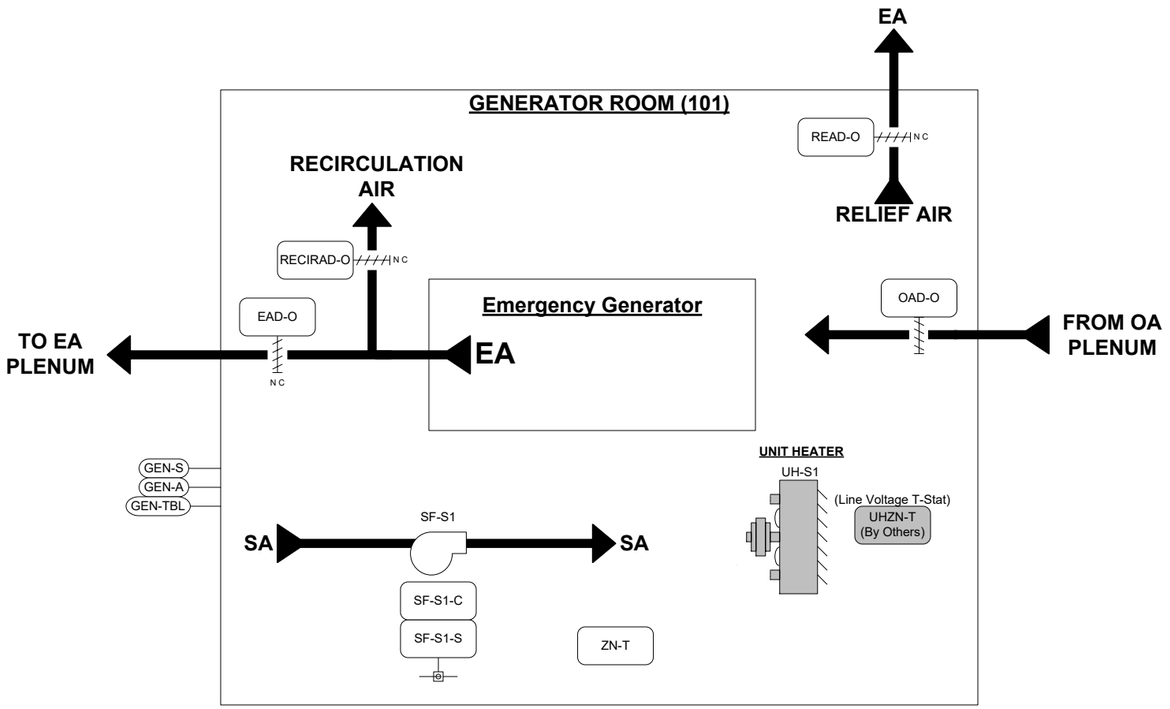


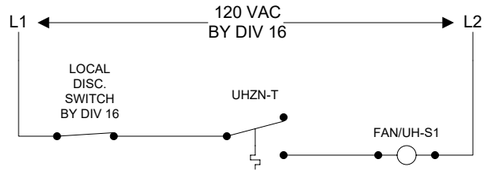
BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
SF-S1-S	1	CSD-SA1E0-1	SLD/ADJ LED 1A W/O RELAY
ZN-T	1	NS-BTN7003-0	3X4.5.T.TB.ADDRESSABLE
Panel Devices:			
CP-GEN	1	PAKG00001AH0	FEC2611,20X24
SF-S1-C	1	RH2B-UAC24-L	DPDT,10A,HC=24 VAC,
	1	SH2B-05	DPDT RELAY BASE FOR RH2B
Other Devices:			
EAD-O	1	DAMPER	SEE DAMPER SCHEDULE
OAD-O	1	DAMPER	SEE DAMPER SCHEDULE
READ-O	1	DAMPER	SEE DAMPER SCHEDULE
RECIRAD-O	1	DAMPER	SEE DAMPER SCHEDULE

Note:

1. These gray devices will be provided by others.
2. Above BOM is for all system.

SUPPLY FAN SCHEDULE				
SR.NO.	**TAG**	**SERVING AREA**	**MECH DWG.**	**VOLT/PH**
1	SF-S1	Generator Room [101]	M4.01	120/1



GENERATOR SYSTEMS

Sequence of Operation:

General:
The generator provides back up power to the site. Ductwork connected to the radiator ensures that excessive heat is rejected to the exterior along with an outside air intake connection to ensure the room does not get excessively negative in pressure.
The generator is equipped with an exhaust flue complete with silencer to expel the combustion products to the exterior.

Control description:

- The DDC will monitor the status of the generator at all times, along with the trouble and alarm conditions.
- When the generator status is on, then the outside air, return air and exhaust air dampers will all modulate in sequence to maintain the room air temperature at approximately 10-15°c (adjustable).
- When the generator is turned off, the dampers will all go into full return mode, with the outside air damper fully closed, the exhaust air damper fully closed and the return air dampers fully open.

All control systems for the generator will be on emergency power.

Heating:

- The unit heater fan & electric heating coil will be energized as needed to maintain zone heating temperature setpoint..

Alarms:

- DDC will provide an alarm when the room temperature falls below 5°C for more than 5 minutes.
- DDC will provide an alarm during trouble and alarm conditions as monitored at the generator.

Drawing Title
031.001(SF-S1 Control)

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	2	As-built		11/21/2015	TK
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Project Title
Aldergrove Port of Entry DB

Johnson Controls

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CONTRACT NUMBER
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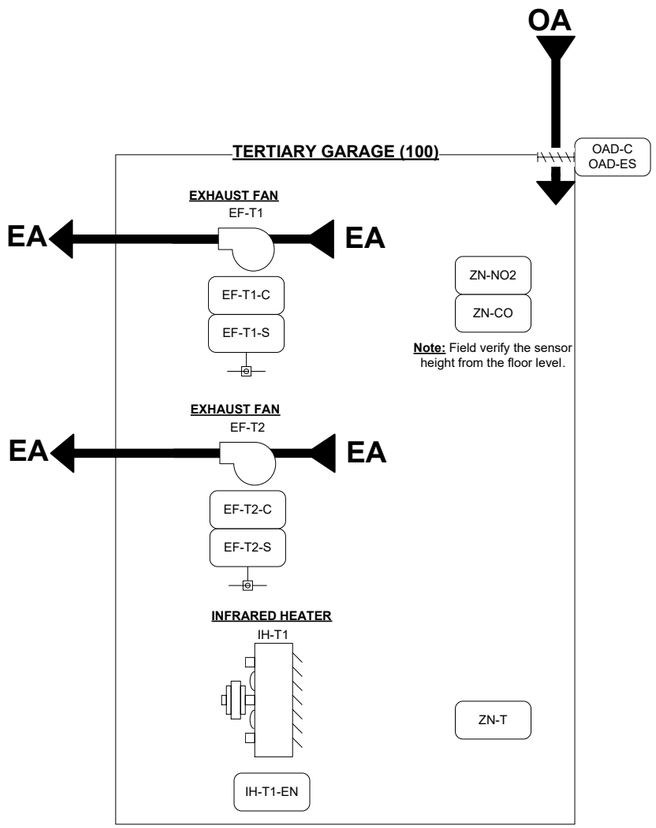
DRAWING NUMBER
807 A



NOTE: IH-T1-GAS-O FOR GAS HEATER/VALVE.

Tertiary Garage Fan Schedule				
Sr. No.	**Tag**	**Serving Area**	**Volt/Ph**	**Dwg. No.**
1	EF-T1	Tertiary Garage 100	120/ 1	M4.01
2	IH-T1	Tertiary Garage 100	120/ 1	M4.01

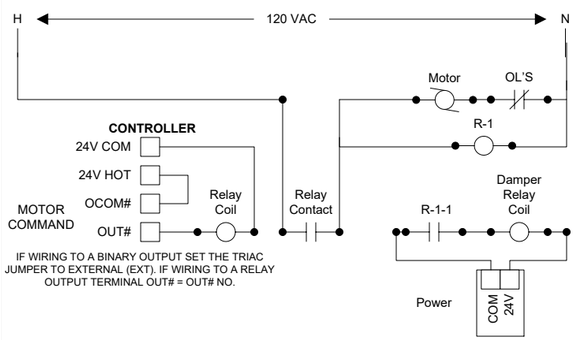
BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
EF-T1-S	1	CSD-SA1E0-1	SLD/ADJ LED 1A W/O RELAY
OAD-C,ES	1	RIBU1C	SPDT,10A,HC=10-30 VAC/DC,W/LED
ZN-CO	1	TR2000-CO	CARBON MONOXIDE, AIRTEST
ZN-NO2	1	TR3210-NO2	NO2 SENSOR, AIRTEST
ZN-T	1	NS-BTN7003-0	3X4.5.T.TB.ADDRESSABLE
Panel Devices:			
CP-EF-T1	1	PAKG00002AH0	FEC2611,20X24
EF-T1-C	2	RH2B-UAC24-L	DPDT,10A,HC=24 VAC,
EF-T2-C	2	SH2B-05	DPDT RELAY BASE FOR RH2B
IH-T1-EN	1	RH2B-UAC24-L	DPDT,10A,HC=24 VAC,
	1	SH2B-05	DPDT RELAY BASE FOR RH2B
Other Devices:			
OAD-C,ES	1	DAMPER	SEE DAMPER SCHEDULE

Note:

1. These gray devices will be provided by others.
2. Above BOM is for all system.

Single Phase Motor Wiring



IF WIRING TO A BINARY OUTPUT SET THE TRIAC JUMPER TO EXTERNAL (EXT). IF WIRING TO A RELAY OUTPUT TERMINAL OUT# = OUT# NO.

Drawing Title: **032.001(EF-T1 & IH-T1 Control)**

Project Title: **Aldergrove Port of Entry DB**

NO.	REVISION-LOCATION	ECN	DATE	BY
3	As-built		11/21/2015	TK
2	Formal Submission		10/19/15	JYC
1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

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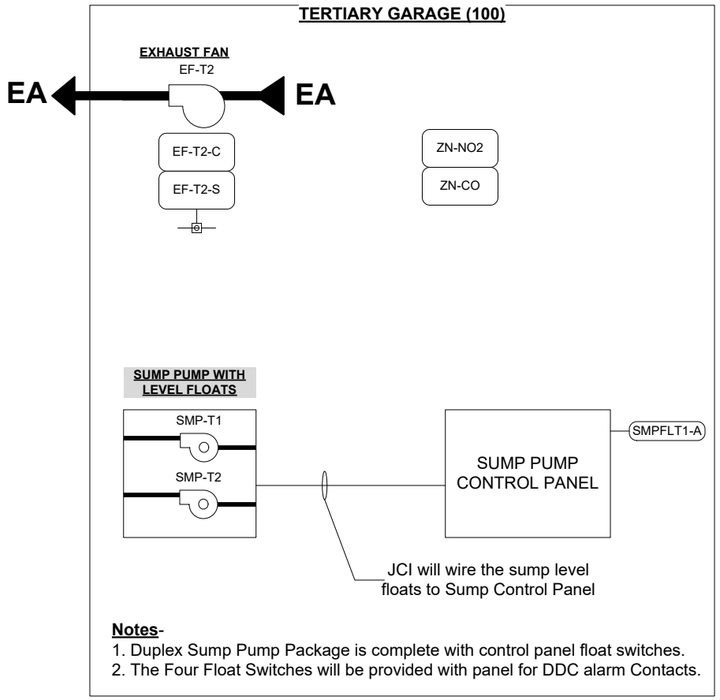
CONTRACT NUMBER: **40970088**

DRAWING NUMBER: **901 A**



Notes-
1. Duplex Sump Pump Package is complete with control panel float switches.
2. The Four Float Switches will be provided with panel for DDC alarm Contacts.

BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
EF-T2-S	1	CSD-SA1E0-1	SLD/ADJ LED 1A W/O RELAY
ZN-CO/NOx	1	EECO-END	CET, GEM-II, 2-CHANNEL INTEGRAL SENSOR, CO & NO2
	1	RSH-24	CET, GEM-II, STROBE & HORN COMBO, REMOTE
Panel Devices:			
CP-EF-T2 & SMP	1	PAKG00002AH0	FEC2611,20X24
EF-T2-C	1	RH2B-UAC24-L	DPDT,10A,HC=24 VAC,
	1	SH2B-05	DPDT RELAY BASE FOR RH2B

Note:
1. These gray devices will be provided by others.
2. Above BOM is for all system.

Drawing Title
032.003(EF-T2 & Sump Pump Control)

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	3	As-built		11/21/2015	TK
	2	SUBMITTAL		3/3/15	CoEE
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Project Title
Aldergrove Port of Entry DB

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CONTRACT NUMBER
40970088

DRAWING NUMBER
901 B

TERTIARY GARAGE: SUMP PUMP

Sequence of Operation:

Sump Pump (SMP-T1/T2):
JCI will wire the sump level floats to Sump Control Panel. The Sump Control Panel will be provided with a panel for monitoring level alarm on the DDC system.

TERTIARY GARAGE: EF-T2

Sequence of Operation:

General:
The CO & NOx sensor (Critical Environment Technologies, CET-GEMII) will be installed at 5' above floor of pit. The CO and NOx sensors will provide a local audible and visual alarm. JCI will monitor these parameters at DDC.

JCI will control start/stop of EF-T2 and monitor the status of its operation.

Run conditions:
The exhaust fan will operate whenever:
- CO levels are detected above 25 PPM or;
- NO2 levels are detected above 0.7 PPM.

EF will run for a minimum of 5 minutes to prevent short cycling.

Stop conditions:
EF will be disabled when:
- CO levels fall below 10 PPM; and/or
- NO2 levels fall below 0.3 PPM.

Alarms:
Provide
- High level alarm (audible and visual within inspection bay) at 200 PPM of O.
- NO2 alarm at 9 PPM or as recommended by sensor supplier
- Typical fan failure alarm if status does not match command.

Drawing Title
032.004(EF-T2 & SUMP PUMP SEQUENCE OF OPERATION)

Project Title
Aldergrove Port of Entry DB

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	3	As-built		11/21/2015	TK
	2	SUBMITTAL		3/3/15	CoEE
	1	SUBMITTAL		1/20/15	CoEE

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Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

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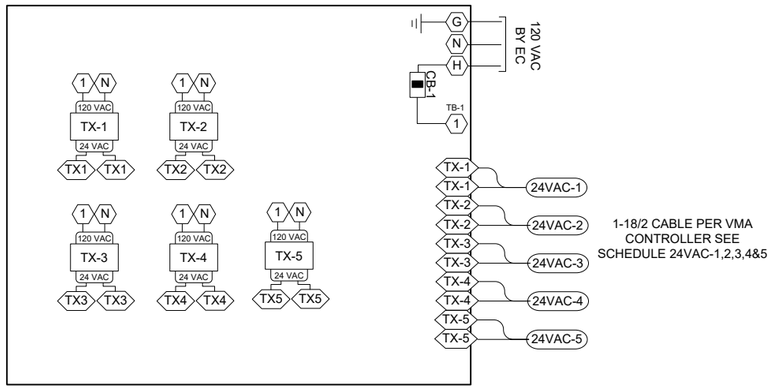
CONTRACT NUMBER
40970088

DRAWING NUMBER
901 C

PS-x
(PS-1 FOR MAIN BUILDING & PS-2 FOR COMM. BUILDING
LOCATION : 1. PS-1 : MECHANICAL ROOM- MAIN BULDING
2. PS-2 : MECHANICAL ROOM- MAIN BULDING)



BILL OF MATERIALS

Designation	Qty	Part Number	Description
Field Devices:			
PS-x	2	PSH500A	RIB 500VA 120/24VAC PWR

Note:
Above BOM is for all unit.

Note:
1. The common panel enclosure (for CHWS, HWS, DHWS), located in mechanical room will have additional power supply.
2. This power supply is used to provide the power to terminal units located in mechanical room.
3. For "Main Bld." Power will be distributed to VAV-M13, VAV-M14, VAV-M15, VAV-M18, HUH-M1 (TEC & HTG valve).
4. For "Comm. Bld." Power will be distributed to VA-C8, VAV-C13 & HUH-C3.

Main Port Building 24 VAC Power Connection Schedule							
24VAC-1	**VA**	**24VAC-2**	**VA**	**24VAC-3**	**VA**	**24VAC-4**	**VA**
VAV-M1	14	VAV-M4 /with ZN-CO2	14	VAV-M7	14	VAV-M10 /with ZN-CO2	14
RP3-M111	4.7	RP-5-M134	4.7	RP-5-M138	4.7	RP-3-M151	4.7
VAV-M2	14	VAV-M5	18.7	VAV-M8 /with ZN-CO2	14	VAV-M11 /with ZN-CO2	14
VAV-M3	14	VAV-M6 /with ZN-CO2	14	RP-5-M140	4.7	RP-5-M150	4.7
VAV-M17	14	RP-4-M135-1 RP-4-M135-2	9.4	VAV-M9 /with ZN-CO2	14	VAV-M14 /with ZN-CO2	14
RP-2-M102	4.7	FFH-M3	4.7	RP-4-M141	4.7	VAV-M15 /with ZN-CO2	14
FFH-M2	4.7	FFH-M4	4.7	VAV-M12	14	VAV-M16 /with ZN-CO2	14
						FFH-M5	4.7

Commercial Building 24 VAC Power Connection Schedule							
24VAC-1	**VA**	**24VAC-2**	**VA**	**24VAC-3**	**VA**	**24VAC-4**	**VA**
VAV-C1 /with ZN-CO2	14	VAV-C5 /with ZN-CO2	14	VAV-C9	14	HUH-C1	9.9
RP-5-C107	4.7	RP-1-C131	4.7	VAV-C10	14	HUH-C2	9.9
VAV-C2 /with ZN-CO2	14	VAV-C6 /with ZN-CO2	14	VAV-C11 /with ZN-CO2	14		
RP-1-C108	4.7	RP-5-C120	4.7	RP-5-C123	4.7		
VAV-C3 /with ZN-CO2	14	VAV-C7	14	RP-4-C123	4.7		
RP-6-C111	4.7	FFH-C1	4.7	VAV-C12	14		
VAV-C4	18.7	FFH-C2	4.7	FFH-C3	4.7		

Drawing Title
033.002(POWER DISTRIBUTION PANEL CONTROL).

Project Title
Aldergrove Port of Entry DB

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	2	As-built		11/21/2015	TK
	1	SUBMITTAL		1/20/15	CoEE

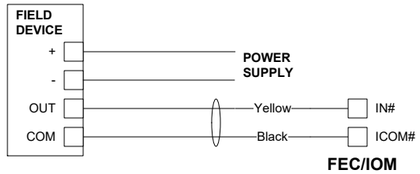
Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Branch Information
Johnson Controls Inc
3680 East 2nd Avenue
Vancouver, Canada
V5M 0A4
Phone: 604-707-5200
Fax: 604-707-5201

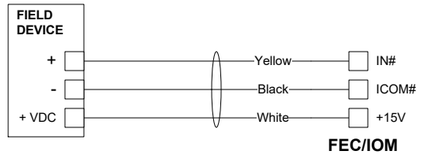
CONTRACT NUMBER
40970088

DRAWING NUMBER
902 B

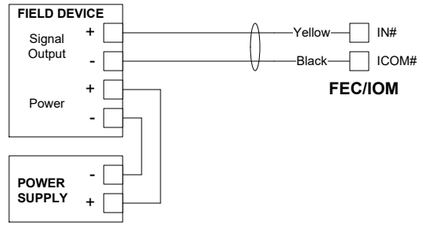
DETAIL F101 VOLTAGE INPUT - EXTERNAL SOURCE



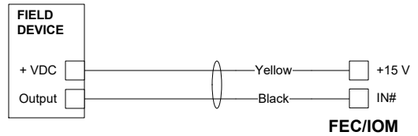
DETAIL F102 VOLTAGE INPUT - INTERNAL SOURCE



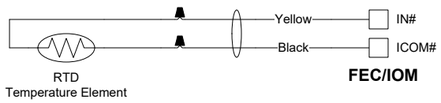
DETAIL F105 CURRENT INPUT - EXTERNAL SOURCE (Isolated)



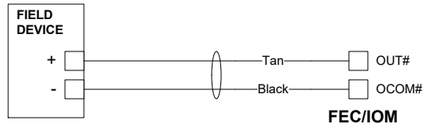
DETAIL F106 CURRENT INPUT - INTERNAL SOURCE (2 Wire)



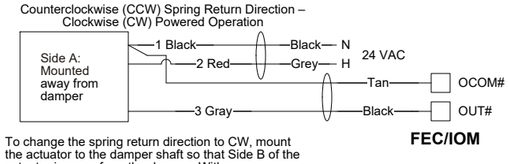
DETAIL F131 TEMPERATURE SENSOR INPUT



DETAIL F201 ANALOG OUTPUT (VOLTAGE)

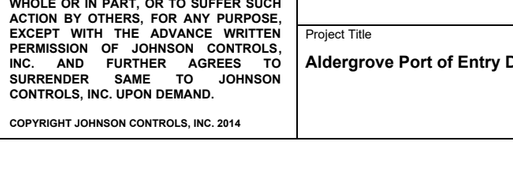


DETAIL F267 0-10VDC OUTPUT to M92xx-GGx and HGx or VA92xx-GGx and HGx

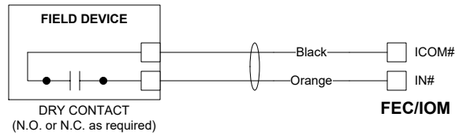


To change the spring return direction to CW, mount the actuator to the damper shaft so that Side B of the actuator is away from the damper. With power applied, the actuator now drives CCW from the 0° position, and spring returns CW.

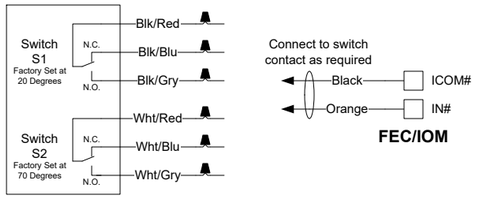
Master-Slave Application



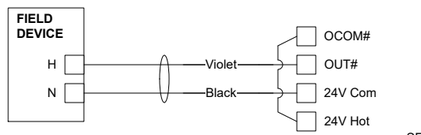
DETAIL F301 BINARY INPUT (DRY CONTACT)



DETAIL F365 BINARY INPUT from M92xx-xxx-x, and VA92xx-xxx-x



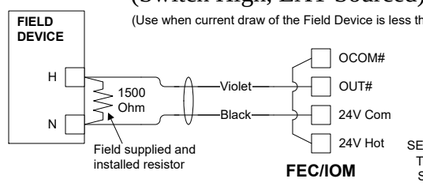
DETAIL F501 24 VAC BINARY OUTPUT (Switch High, EXT Sourced)



SET TRIAC JUMPER TO EXTERNALLY SOURCED (EXT) FOR ASSOCIATED BINARY OUTPUT(S).

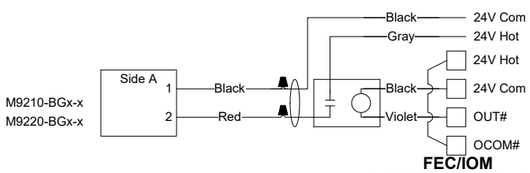
DETAIL F502 24 VAC BINARY OUTPUT to LOW CURRENT DRAW DEVICE (Switch High, EXT Sourced)

(Use when current draw of the Field Device is less than 50 mA)



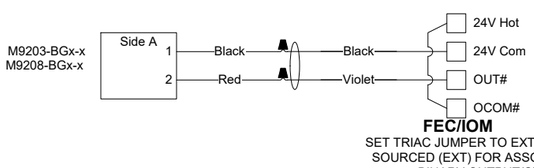
SET TRIAC JUMPER TO EXTERNALLY SOURCED (EXT) FOR ASSOCIATED BINARY OUTPUT(S).

DETAIL F578 ON-OFF CONTROL to M92xx-BGx-x and VA92xx-BGx-x (Switch High, EXT Sourced)



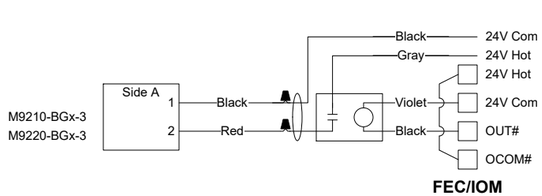
SET TRIAC JUMPER TO EXTERNALLY SOURCED (EXT) FOR ASSOCIATED BINARY OUTPUT(S).

To change the spring return direction to CW, mount the actuator to the damper shaft so that Side B of the actuator is away from the damper. With power applied, the actuator now drives CCW from the 0° position, and spring returns CW.

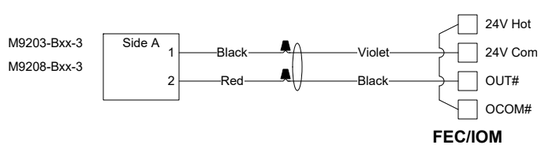


SET TRIAC JUMPER TO EXTERNALLY SOURCED (EXT) FOR ASSOCIATED BINARY OUTPUT(S).

DETAIL F978 ON-OFF CONTROL to M92xx-BGx-x and VA92xx-BGx-x (Switch High, EXT Sourced)

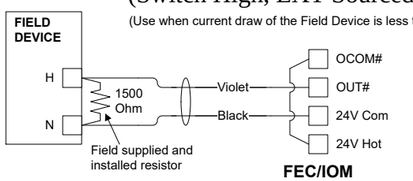


To change the spring return direction to CW, mount the actuator to the damper shaft so that Side B of the actuator is away from the damper. With power applied, the actuator now drives CCW from the 0° position, and spring returns CW.

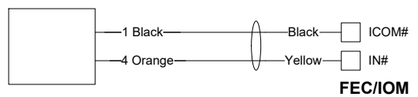


DETAIL F902 24 VAC TRIAC OUTPUT to LOW CURRENT DRAW DEVICE (Switch High, EXT Sourced)

(Use when current draw of the Field Device is less than 50 mA)



DETAIL F168 M92xx-GGx-x/HGx-x and VA92xx-GGx-x/HGx-x VOLTAGE FEEDBACK



Drawing Title

034.001(WIRING DETAILS-1)

Project Title

Aldergrove Port of Entry DB

REFERENCE DRAWING	NO.	REVISION-LOCATION	ECN	DATE	BY
	2	As-built		11/21/2015	TK
	1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Johnson Controls

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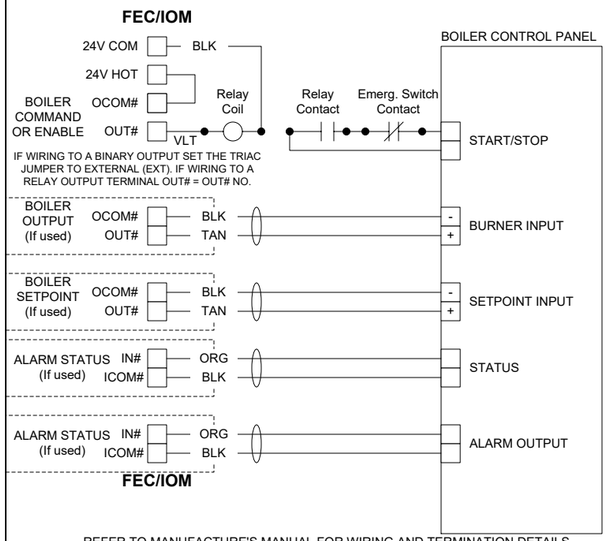
Fax: 604-707-5201

CONTRACT NUMBER **40970088**

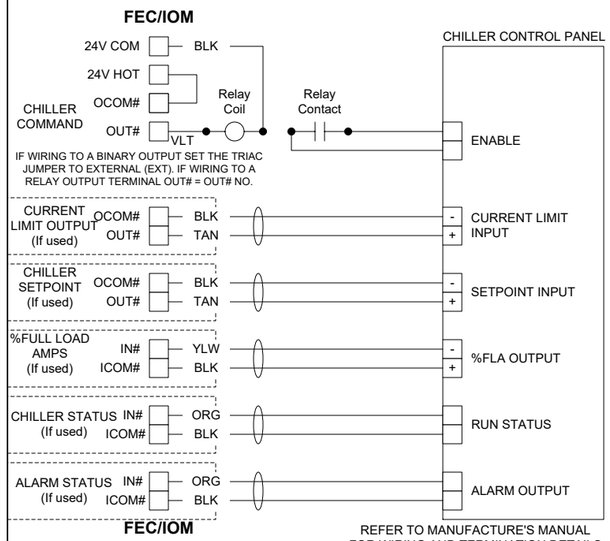
DRAWING NUMBER **WD-1**

DETAIL F1001 Boiler Control Wiring Detail



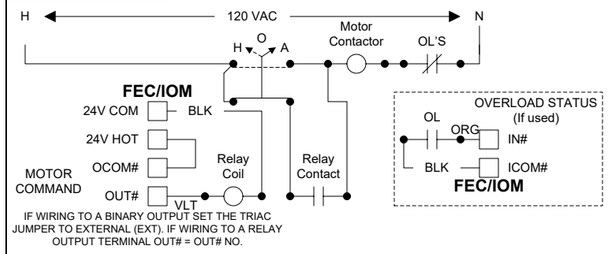
REFER TO MANUFACTURE'S MANUAL FOR WIRING AND TERMINATION DETAILS

DETAIL F1002 Chiller Control Wiring Detail



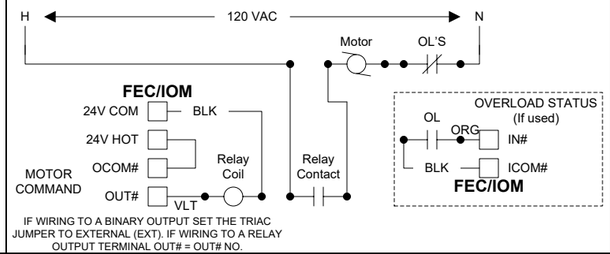
REFER TO MANUFACTURE'S MANUAL FOR WIRING AND TERMINATION DETAILS

DETAIL F1015 Starter without Safeties Wiring



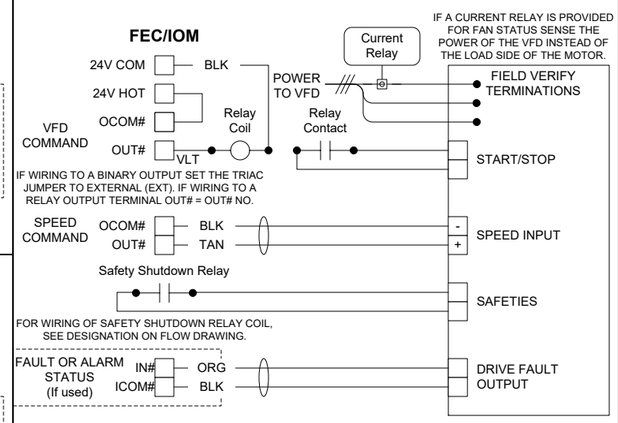
IF WIRING TO A BINARY OUTPUT SET THE TRIAC JUMPER TO EXTERNAL (EXT). IF WIRING TO A RELAY OUTPUT TERMINAL OUT# = OUT# NO.

DETAIL F1030 Single Phase Motor Wiring

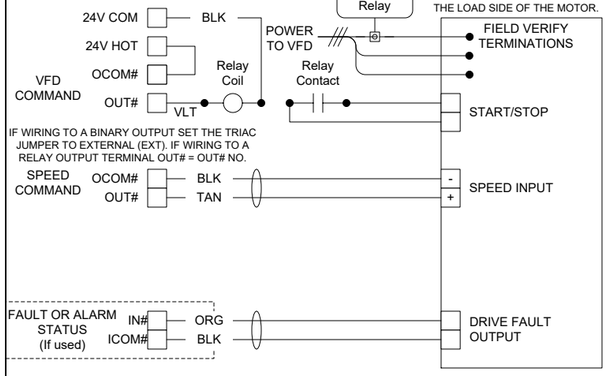


IF WIRING TO A BINARY OUTPUT SET THE TRIAC JUMPER TO EXTERNAL (EXT). IF WIRING TO A RELAY OUTPUT TERMINAL OUT# = OUT# NO.

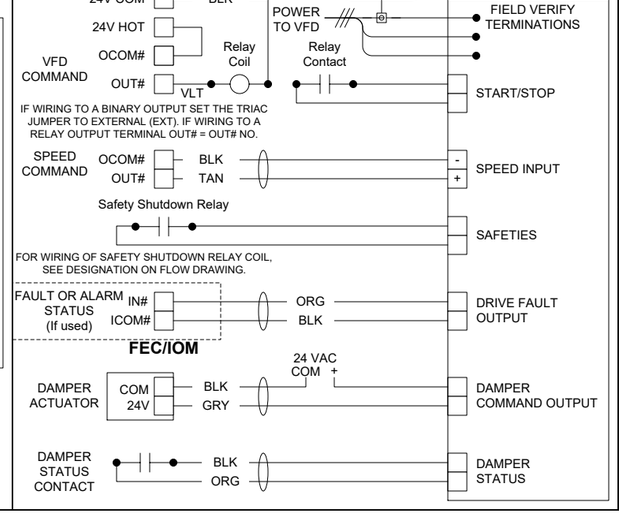
DETAIL F1042 VFD with Safeties Wiring



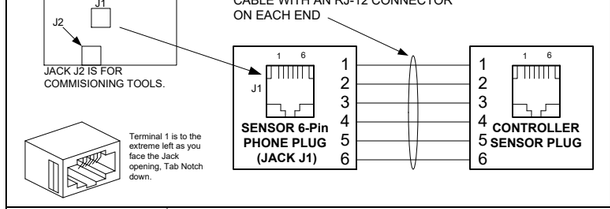
DETAIL F1043 VFD without Safeties Wiring



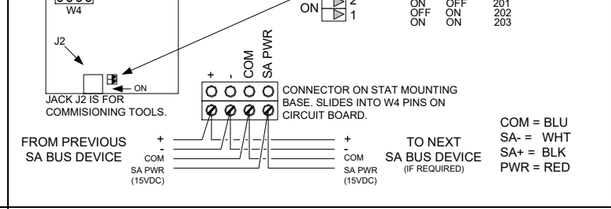
DETAIL F1041 VFD with Safeties Wiring with Damper Interlock



DETAIL NS101 NET STAT WITH PHONE JACK FIXED ADDRESS=199



DETAIL NS102 NET STAT WITH TERMINALS ADDRESSABLE



DETAIL F1099 Factory Installed Device

THIS DEVICE WILL COME INSTALLED AND WIRED BY THE FACTORY. PLEASE REFER TO THE FACTORY PACKAGED CONTROL WIRING AND UNIT WIRING DETAILS SHIPPED WITH THE UNIT FOR DEVICE WIRING DETAILS AND ANY ADDITIONAL SAFETY CONNECTION DETAILS.

Drawing Title

034.002(WIRING DETAILS-2)

Project Title

Aldergrove Port of Entry DB

NO.	REVISION-LOCATION	ECN	DATE	BY
2	As-built		11/21/2015	TK
1	SUBMITTAL		1/20/15	CoEE

Sales Engineer	Project Manager	Application Engineer	DRAWN	APPROVED
Cansin Yang	Troy Bazille	CoEE	BY CoEE DATE 01/2/2015	BY DATE

Branch Information

Johnson Controls Inc
3680 East 2nd Avenue
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CONTRACT NUMBER **40970088**

DRAWING NUMBER **WD-2**

Aldergrove Port of Entry DB
Project Number: 40970088

Air Measuring Station Schedule

Tag						Sizing Information			Airflow Measuring Station Information										Probe Location Distance (D) See Chart Below	Comments
						Duct Size											Pressure Transducer			
Item	System	Service	Ref. Dwg.	Qty.	Code Number	Diameter or W (in)	H (in)	Area (sq ft)	Design Flow Min (cfm)	Design Flow Max (cfm)	Design Velocity Min (fpm)	Design Velocity Max (fpm)	K Factor	Number of Probes	DP at Flow Min	DP at Flow Max	Range	Output		
1	HRU-M1	DA-VP	M2.07	1	ASENN-060X024	60	24	10.00					2850						34.29	
2	HRU-C1	DA-VP	M3.06	1	ASENN-048X016	48	16	5.33											24.00	

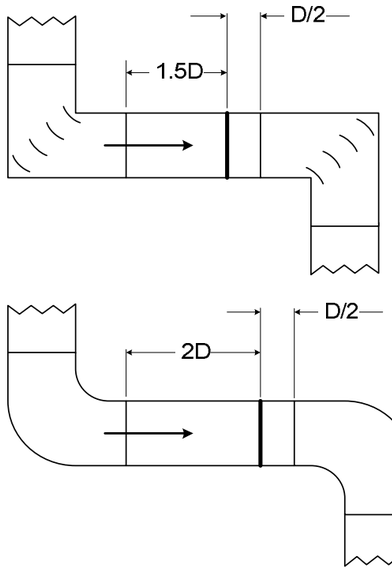
NOTE:

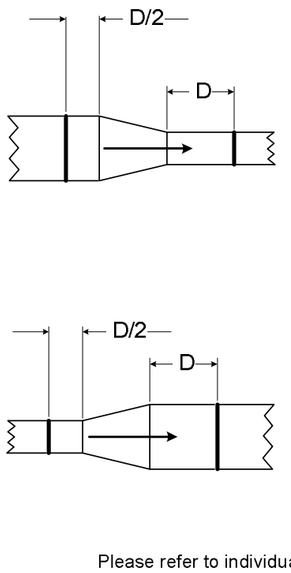
1. FIELD VARIFY THE DUCT SIZES BEFORE ORDERING THE FLOW STATION.

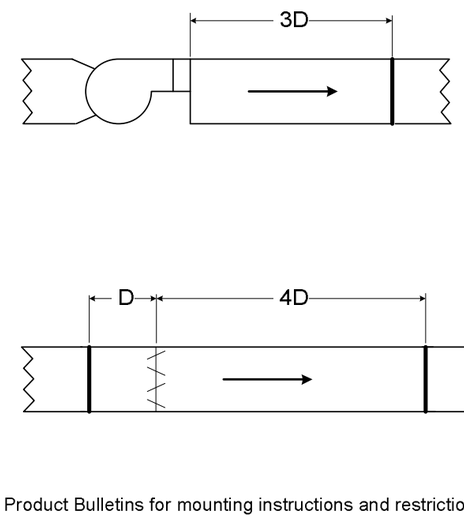
2. SUPPLY SCOPE OF THESE FLOW METERS ARE NOT CLEAR. NEED TO CONFIRM.

AHU-M1-O/A, R/A, S/A AMS c/w unit

AHU-C1-O/A, R/A, S/A AMS c/w unit

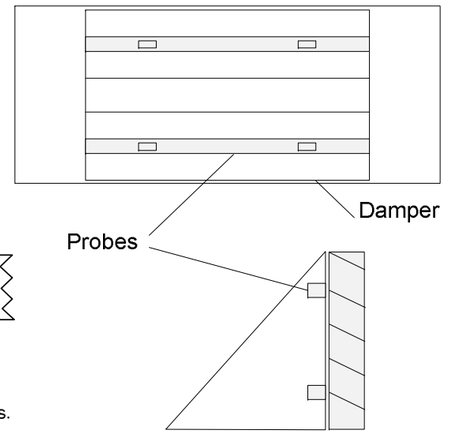






Distance (D) Rectangular = 2(Width * Height) / (Width + Height)

Distance (D) Round = Diameter



Please refer to individual Product Bulletins for mounting instructions and restrictions.

Damper Schedule

Tag					Damper Information												Actuator Information			
									Duct Size		Damper Size									
Item	System	Service	Ref. Dwg.	Qty.	Code Number	Type	Shape/Blade	Fail Position	Diameter or W (mm)	H (mm)	Diameter or W (in.)	H (in.)	Area (ft²)	Blade/Frame Type	Bearing/Seals	Qty.	Code No.	Actuator Control	Field Mtd Actuator
1	EF-M5	OAD-O	M2.07	1	VPWEN-018X010H	Class II - Low Leakage	Rectangular Parallel	Normally Closed	18	10	18	10	1.25	Single Piece/Galvanized	Bronze / Santoprene	1	M9208-GGA-3	0-10VDC PROP	Yes
2	EF-M5	RAD-O	M2.07	1	VPWEN-012X012H	Class II - Low Leakage	Rectangular Parallel	Normally Open	12	12	12	12	1.00	Single Piece/Galvanized	Bronze / Santoprene	1	M9208-GGA-3	0-10VDC PROP	Yes
3	EF-M5	EAD-O	M2.07	1	VPWEN-012X012H	Class II - Low Leakage	Rectangular Parallel	Normally Closed	12	12	12	12	1.00	Single Piece/Galvanized	Bronze / Santoprene	1	M9208-GGA-3	0-10VDC PROP	Yes
4	EF-C3	OAD-O	M3.06	1	VPWEN-014X009H	Class II - Low Leakage	Rectangular Parallel	Normally Closed	14	10	14	10	0.88	Single Piece/Galvanized	Bronze / Santoprene	1	M9208-GGA-3	0-10VDC PROP	Yes
5	EF-C3	RAD-O	M3.06	1	VPWEN-012X012H	Class II - Low Leakage	Rectangular Parallel	Normally Open	12	12	12	12	1.00	Single Piece/Galvanized	Bronze / Santoprene	1	M9208-GGA-3	0-10VDC PROP	Yes
6	EF-C3	EAD-O	M3.06	1	VPWEN-012X012H	Class II - Low Leakage	Rectangular Parallel	Normally Closed	12	12	12	12	1.00	Single Piece/Galvanized	Bronze / Santoprene	1	M9208-GGA-3	0-10VDC PROP	Yes
7	EF-C4	OAD-C	M3.02	1	VPWEN-075X020	Class II - Low Leakage	Rectangular Parallel	Normally Closed	75	20	75	20	10.42	Single Piece/Galvanized	Bronze / Santoprene	1	M9208-AGA-2	24VAC On/Off	Yes
8	EF-S1	EFS1OAD-C	M4.01	1	VPWEN-014X012H	Class II - Low Leakage	Rectangular Parallel	Normally Closed	14	12	14	12	1.17	Single Piece/Galvanized	Bronze / Santoprene	1	M9208-AGA-2	24VAC On/Off	Yes
9	EF-S2	EFS2OAD-C	M4.01	1	VPWEN-014X012H	Class II - Low Leakage	Rectangular Parallel	Normally Closed	14	12	14	12	1.17	Single Piece/Galvanized	Bronze / Santoprene	1	LF24-S / ZS-260	24VAC On/Off	Yes
10	SF-S1	OAD-O	M4.01	1	VPWEN-091X119	Class II - Low Leakage	Rectangular Parallel	Normally Closed	91	119	91	119	75.20	Single Piece/Galvanized	Bronze / Santoprene	4	M9220-GGA-3	0-10VDC PROP	Yes
11	SF-S1	EAD-O	M4.01	1	VPWEN-099X099	Class II - Low Leakage	Rectangular Parallel	Normally Closed	99	99	99	99	68.06	Single Piece/Galvanized	Bronze / Santoprene	3	M9220-GGA-3	0-10VDC PROP	Yes
12	SF-S1	RECIRAD-O	M4.01	1	VPWEN-028X095	Class II - Low Leakage	Rectangular Parallel	Normally Closed	28	95	28	95	18.47	Single Piece/Galvanized	Bronze / Santoprene	2	M9208-GGA-2	0-10VDC PROP	Yes
13	SF-S1	READ-O	M4.01	1	VPWEN-014X012H	Class II - Low Leakage	Rectangular Parallel	Normally Closed	14	12	14	12	1.17	Single Piece/Galvanized	Bronze / Santoprene	1	M9208-GGA-2	0-10VDC PROP	Yes
14	EF-T1 & IH-T	OAD-C	M4.01	1	VPWEN-040X014	Class II - Low Leakage	Rectangular Parallel	Normally Closed	40	14	40	14	3.89	Single Piece/Galvanized	Bronze / Santoprene	1	M9208-AGA-2	24VAC On/Off	Yes
	NOTE:																		
	1) VERIFY THE DUCT SIZE BEFOR ORDERING DAMPER.																		
	2) MECHANICAL DRAWING MENTIONS OA OR EA PLENUM COMING WITH MOTORIZED DAMPER. PLEASE VERIFY THE SUPPLY SCOPE.																		

Electrician/Fitter		Point Information			Controller Information							Panel Information	
Tag	Point Type	System Name	Object Name	Expanded ID	Controller Details	Trunk Type	Trunk Nbr	Trunk Addr.	Cable Destination Bay/Terminal	Module Type	Termination Out	Panel Location	Cable Number
					FEC 26xx								
					FEC 26xx	MS/TP	1	38					
	UI IN-1	AHU-M1	DA-T	Discharge Air Temperature	FEC 26xx	MS/TP	1	38	UI IN-1				-38-UI IN-1
	UI IN-2	AHU-M1	RA-T	Return Air Temperature	FEC 26xx	MS/TP	1	38	UI IN-2				-38-UI IN-2
	UI IN-3	AHU-M1	MA-T	Mixed Air Temperature	FEC 26xx	MS/TP	1	38	UI IN-3				-38-UI IN-3
	UI IN-4	AHU-M1	DA-H	Discharge Air Humidity	FEC 26xx	MS/TP	1	38	UI IN-4				-38-UI IN-4
	UI IN-5	AHU-M1	DA1-P	Discharge Air Static Pressure 1	FEC 26xx	MS/TP	1	38	UI IN-5				-38-UI IN-5
	UI IN-6	AHU-M1	HUM-S	Humidifier Status	FEC 26xx	MS/TP	1	38	UI IN-6				-38-UI IN-6
	BI IN-7	AHU-M1	SF-S	Supply Fan Status	FEC 26xx	MS/TP	1	38	BI IN-7				-38-BI IN-7
	BI IN-8	AHU-M1	RF-S	Return Fan Status	FEC 26xx	MS/TP	1	38	BI IN-8				-38-BI IN-8
	BO OUT-1	AHU-M1	SF-C	Supply Fan Command	FEC 26xx	MS/TP	1	38	BO OUT-1				-38-BO OUT-1
	BO OUT-2	AHU-M1	RF-C	Return Fan Command	FEC 26xx	MS/TP	1	38	BO OUT-2				-38-BO OUT-2
	BO OUT-3	AHU-M1	HUM-C	Humidifier Command	FEC 26xx	MS/TP	1	38	BO OUT-3				-38-BO OUT-3
	CO OUT-4	AHU-M1	RF-O	Return Fan Output	FEC 26xx	MS/TP	1	38	CO OUT-4				-38-CO OUT-4
	CO OUT-5	AHU-M1	CLG-O	Cooling Output	FEC 26xx	MS/TP	1	38	CO OUT-5				-38-CO OUT-5
	CO OUT-6	AHU-M1	PHP-C	Preheat Pump Command	FEC 26xx	MS/TP	1	38	CO OUT-6				-38-CO OUT-6
	CO OUT-7	AHU-M1	PH-O	Preheat Output	FEC 26xx	MS/TP	1	38	CO OUT-7				-38-CO OUT-7
	AO OUT-8	AHU-M1	MAD-O	Mixed Air Damper Output	FEC 26xx	MS/TP	1	38	AO OUT-8				-38-AO OUT-8
	AO OUT-9	AHU-M1	SF-O	Supply Fan Output	FEC 26xx	MS/TP	1	38	AO OUT-9				-38-AO OUT-9
		AHU-M1			IOM 2721								
		AHU-M1			IOM 2721	SA Bus	1	4					
	UI IN-1	AHU-M1	LT-A	Low Temperature Alarm	IOM 2721	SA Bus	1	4	UI IN-1				38--4-UI IN-1
	UI IN-2	AHU-M1	OA-VP	Outdoor Air Velocity Pressure	IOM 2721	SA Bus	1	4	UI IN-2				38--4-UI IN-2
	UI IN-3	AHU-M1	PFILT-S	PreFilter Status	IOM 2721	SA Bus	1	4	UI IN-3				38--4-UI IN-3
	UI IN-4	AHU-M1	HUM-A	Humidifier Alarm	IOM 2721	SA Bus	1	4	UI IN-4				38--4-UI IN-4
	UI IN-5	AHU-M1	RA-VP	Return Air Velocity Pressure	IOM 2721	SA Bus	1	4	UI IN-5				38--4-UI IN-5
	UI IN-6	AHU-M1	CLG-POS	Cooling Position	IOM 2721	SA Bus	1	4	UI IN-6				38--4-UI IN-6
	UI IN-7	AHU-M1	PHP-S	Preheat Pump Status	IOM 2721	SA Bus	1	4	UI IN-7				38--4-UI IN-7
	UI IN-8	AHU-M1	BLDG-P	Building Static Pressure	IOM 2721	SA Bus	1	4	UI IN-8				38--4-UI IN-8
	AO OUT-1	AHU-M1	HUM-O	Humidifier Output	IOM 2721	SA Bus	1	4	AO OUT-1				38--4-AO OUT-1
	AO OUT-2	AHU-M1			IOM 2721	SA Bus	1	4	AO OUT-2				38--4-AO OUT-2
		AHU-M1			IOM 4710								
		AHU-M1			IOM 4710	SA Bus	1	5					
	UI IN-1	AHU-M1	PH-POS	Preheat Position	IOM 4710	SA Bus	1	5	UI IN-1				38--5-UI IN-1
	UI IN-2	AHU-M1	RA-H	Return Air Humidity	IOM 4710	SA Bus	1	5	UI IN-2				38--5-UI IN-2
	UI IN-3	AHU-M1			IOM 4710	SA Bus	1	5	UI IN-3				38--5-UI IN-3
	UI IN-4	AHU-M1			IOM 4710	SA Bus	1	5	UI IN-4				38--5-UI IN-4
	UI IN-5	AHU-M1			IOM 4710	SA Bus	1	5	UI IN-5				38--5-UI IN-5
	UI IN-6	AHU-M1			IOM 4710	SA Bus	1	5	UI IN-6				38--5-UI IN-6
	BI IN-7	AHU-M1	RAFILT-S	Return Air Filter Status	IOM 4710	SA Bus	1	5	BI IN-7				38--5-BI IN-7
	BI IN-8	AHU-M1	EF-S	Exhaust Fan Status	IOM 4710	SA Bus	1	5	BI IN-8				38--5-BI IN-8
	BO OUT-1	AHU-M1	EF-C	Exhaust Fan Command	IOM 4710	SA Bus	1	5	BO OUT-1				38--5-BO OUT-1
	BO OUT-2	AHU-M1			IOM 4710	SA Bus	1	5	BO OUT-2				38--5-BO OUT-2
	BO OUT-3	AHU-M1			IOM 4710	SA Bus	1	5	BO OUT-3				38--5-BO OUT-3
	CO OUT-4	AHU-M1	EF5-OAD	Outside Air Damper	IOM 4710	SA Bus	1	5	CO OUT-4				38--5-CO OUT-4
	CO OUT-5	AHU-M1	EF5-EAD	Exhaust Air Damper	IOM 4710	SA Bus	1	5	CO OUT-5				38--5-CO OUT-5
	CO OUT-6	AHU-M1	EF5-RAD	Return Air Damper	IOM 4710	SA Bus	1	5	CO OUT-6				38--5-CO OUT-6

Electrician/Fitter		Point Information			Controller Information							Panel Information	
Tag	Point Type	System Name	Object Name	Expanded ID	Controller Details	Trunk Type	Trunk Nbr	Trunk Addr.	Cable Destination Bay/Terminal	Module Type	Termination Out	Panel Location	Cable Number
	CO OUT-7	AHU-M1			IOM 4710	SA Bus	1	5	CO OUT-7				38--5-CO OUT-7
	AO OUT-8	AHU-M1			IOM 4710	SA Bus	1	5	AO OUT-8				38--5-AO OUT-8
	AO OUT-9	AHU-M1			IOM 4710	SA Bus	1	5	AO OUT-9				38--5-AO OUT-9
		AHU-M1			IOM 1710								
		AHU-M1			IOM 1710	SA Bus	1	6					
	BI IN-1	AHU-M1			IOM 1710	SA Bus	1	6	BI IN-1				38--6-BI IN-1
	BI IN-2	AHU-M1			IOM 1710	SA Bus	1	6	BI IN-2				38--6-BI IN-2
	BI IN-3	AHU-M1			IOM 1710	SA Bus	1	6	BI IN-3				38--6-BI IN-3
	BI IN-4	AHU-M1			IOM 1710	SA Bus	1	6	BI IN-4				38--6-BI IN-4
		AHU-M1			IOM 2721								
		AHU-M1			IOM 2721	SA Bus	1	7					
	UI IN-1	AHU-M1	CHWE-T	Chilled Water Entering Temper	IOM 2721	SA Bus	1	7	UI IN-1				38--7-UI IN-1
	UI IN-2	AHU-M1	CHWL-T	Chilled Water Leaving Temper	IOM 2721	SA Bus	1	7	UI IN-2				38--7-UI IN-2
	UI IN-3	AHU-M1	PHWE-T	Preheat Entering Water Tempe	IOM 2721	SA Bus	1	7	UI IN-3				38--7-UI IN-3
	UI IN-4	AHU-M1	PHWL-T	Preheat Leaving Water Tempe	IOM 2721	SA Bus	1	7	UI IN-4				38--7-UI IN-4
	UI IN-5	AHU-M1	DA-VP	Discharge Air Velocity Pressur	IOM 2721	SA Bus	1	7	UI IN-5				38--7-UI IN-5
	UI IN-6	AHU-M1			IOM 2721	SA Bus	1	7	UI IN-6				38--7-UI IN-6
	UI IN-7	AHU-M1			IOM 2721	SA Bus	1	7	UI IN-7				38--7-UI IN-7
	UI IN-8	AHU-M1	DAPHI-A	Discharge Air High Duct Press	IOM 2721	SA Bus	1	7	UI IN-8				38--7-UI IN-8
	AO OUT-1	AHU-M1			IOM 2721	SA Bus	1	7	AO OUT-1				38--7-AO OUT-1
	AO OUT-2	AHU-M1			IOM 2721	SA Bus	1	7	AO OUT-2				38--7-AO OUT-2
		AHU-M1			NET STAT								
		AHU-M1			NET STAT	SA Bus	1	203					
	STAT	AHU-M1	ZN-T	Zone Temperature	NET STAT	SA Bus	1	203	STAT				38--203-STAT
					FEC 26xx								
					FEC 26xx	MS/TP	1	42					
	UI IN-1	HRU-M1	DA-T	Discharge Air Temperature	FEC 26xx	MS/TP	1	42	UI IN-1				-42-UI IN-1
	UI IN-2	HRU-M1	DA1-P	Discharge Air Static Pressure 1	FEC 26xx	MS/TP	1	42	UI IN-2				-42-UI IN-2
	UI IN-3	HRU-M1	DA-VP	Discharge Air Velocity Pressur	FEC 26xx	MS/TP	1	42	UI IN-3				-42-UI IN-3
	UI IN-4	HRU-M1	EA-T	Exhaust Air Temperature	FEC 26xx	MS/TP	1	42	UI IN-4				-42-UI IN-4
	UI IN-5	HRU-M1	EAHR-T	Exhaust Air Heat Recovery Te	FEC 26xx	MS/TP	1	42	UI IN-5				-42-UI IN-5
	UI IN-6	HRU-M1	DAPHI-A	Discharge Air High Duct Press	FEC 26xx	MS/TP	1	42	UI IN-6				-42-UI IN-6
	BI IN-7	HRU-M1	SF-S	Supply Fan Status	FEC 26xx	MS/TP	1	42	BI IN-7				-42-BI IN-7
	BI IN-8	HRU-M1	EF-S	Exhaust Fan Status	FEC 26xx	MS/TP	1	42	BI IN-8				-42-BI IN-8
	BO OUT-1	HRU-M1	SF-C	Supply Fan Command	FEC 26xx	MS/TP	1	42	BO OUT-1				-42-BO OUT-1
	BO OUT-2	HRU-M1	EF-C	Exhaust Fan Command	FEC 26xx	MS/TP	1	42	BO OUT-2				-42-BO OUT-2
	BO OUT-3	HRU-M1	HRW-C	Heat Recovery Wheel Comma	FEC 26xx	MS/TP	1	42	BO OUT-3				-42-BO OUT-3
	CO OUT-4	HRU-M1	HREAFBD-O	Heat Recovery EA FBD Output	FEC 26xx	MS/TP	1	42	CO OUT-4				-42-CO OUT-4
	CO OUT-5	HRU-M1	HROAFBD-O	Heat Recovery OA FBD Outpu	FEC 26xx	MS/TP	1	42	CO OUT-5				-42-CO OUT-5
	CO OUT-6	HRU-M1	OAD-C	Outdoor Air Damper Command	FEC 26xx	MS/TP	1	42	CO OUT-6				-42-CO OUT-6
	CO OUT-7	HRU-M1	EAD-C	Exhaust Air Damper Command	FEC 26xx	MS/TP	1	42	CO OUT-7				-42-CO OUT-7
	AO OUT-8	HRU-M1	EF-O	Exhaust Fan Output	FEC 26xx	MS/TP	1	42	AO OUT-8				-42-AO OUT-8
	AO OUT-9	HRU-M1	SF-O	Supply Fan Output	FEC 26xx	MS/TP	1	42	AO OUT-9				-42-AO OUT-9
		HRU-M1			IOM 1710								
		HRU-M1			IOM 1710	SA Bus	1	4					
	BI IN-1	HRU-M1	PFILT-S	PreFilter Status	IOM 1710	SA Bus	1	4	BI IN-1				42--4-BI IN-1
	BI IN-2	HRU-M1	OAD-S	Outdoor Air Damper Status	IOM 1710	SA Bus	1	4	BI IN-2				42--4-BI IN-2

Electrician/Fitter		Point Information			Controller Information							Panel Information	
Tag	Point Type	System Name	Object Name	Expanded ID	Controller Details	Trunk Type	Trunk Nbr	Trunk Addr.	Cable Destination Bay/Terminal	Module Type	Termination Out	Panel Location	Cable Number
	BI IN-3	HRU-M1	HRW-S	Heat Recovery Wheel Status	IOM 1710	SA Bus	1	4	BI IN-3				42--4-BI IN-3
	BI IN-4	HRU-M1	EAD-S	Exhaust Air Damper Status	IOM 1710	SA Bus	1	4	BI IN-4				42--4-BI IN-4
					FEC 26xx								
					FEC 26xx	MS/TP	1	46					
	UI IN-1	HRU-M2	DA-T	Discharge Air Temperature	FEC 26xx	MS/TP	1	46	UI IN-1				-46-UI IN-1
	UI IN-2	HRU-M2	PHP-S	Preheat Pump Status	FEC 26xx	MS/TP	1	46	UI IN-2				-46-UI IN-2
	UI IN-3	HRU-M2	CLG-POS	Cooling Position	FEC 26xx	MS/TP	1	46	UI IN-3				-46-UI IN-3
	UI IN-4	HRU-M2	PH-POS	Preheat Position	FEC 26xx	MS/TP	1	46	UI IN-4				-46-UI IN-4
	UI IN-5	HRU-M2	EA-T	Exhaust Air Temperature	FEC 26xx	MS/TP	1	46	UI IN-5				-46-UI IN-5
	UI IN-6	HRU-M2	DPR-S	Outdoor/Exhaust Air Damper S	FEC 26xx	MS/TP	1	46	UI IN-6				-46-UI IN-6
	BI IN-7	HRU-M2	SF-S	Supply Fan Status	FEC 26xx	MS/TP	1	46	BI IN-7				-46-BI IN-7
	BI IN-8	HRU-M2	EF-S	Exhaust Fan Status	FEC 26xx	MS/TP	1	46	BI IN-8				-46-BI IN-8
	BO OUT-1	HRU-M2	PHP-C	Preheat Pump Command	FEC 26xx	MS/TP	1	46	BO OUT-1				-46-BO OUT-1
	BO OUT-2	HRU-M2	UNIT-C	Supply Fan Command	FEC 26xx	MS/TP	1	46	BO OUT-2				-46-BO OUT-2
	BO OUT-3	HRU-M2	DPR-C	Exhaust/Outside Air Damper C	FEC 26xx	MS/TP	1	46	BO OUT-3				-46-BO OUT-3
	CO OUT-4	HRU-M2			FEC 26xx	MS/TP	1	46	CO OUT-4				-46-CO OUT-4
	CO OUT-5	HRU-M2			FEC 26xx	MS/TP	1	46	CO OUT-5				-46-CO OUT-5
	CO OUT-6	HRU-M2			FEC 26xx	MS/TP	1	46	CO OUT-6				-46-CO OUT-6
	CO OUT-7	HRU-M2			FEC 26xx	MS/TP	1	46	CO OUT-7				-46-CO OUT-7
	AO OUT-8	HRU-M2	CLG-O	Cooling Output	FEC 26xx	MS/TP	1	46	AO OUT-8				-46-AO OUT-8
	AO OUT-9	HRU-M2	PH-O	Preheat Output	FEC 26xx	MS/TP	1	46	AO OUT-9				-46-AO OUT-9
					FEC 26xx								
	AO OUT-9	HRU-M2	PH-O	Preheat Output	FEC 26xx	MS/TP	1	46	AO OUT-9				-46-AO OUT-9
					FEC 26xx								
					FEC 26xx	MS/TP	1	28					
	UI IN-1	CHWS-MAIN	CH1-COMP1-S	Supply Fan Status	FEC 26xx	MS/TP	1	28	UI IN-1				-28-UI IN-1
	UI IN-2	CHWS-MAIN	CH1-A	Chiller 1 Alarm	FEC 26xx	MS/TP	1	28	UI IN-2				-28-UI IN-2
	UI IN-3	CHWS-MAIN			FEC 26xx	MS/TP	1	28	UI IN-3				-28-UI IN-3
	UI IN-4	CHWS-MAIN			FEC 26xx	MS/TP	1	28	UI IN-4				-28-UI IN-4
	UI IN-5	CHWS-MAIN			FEC 26xx	MS/TP	1	28	UI IN-5				-28-UI IN-5
	UI IN-6	CHWS-MAIN			FEC 26xx	MS/TP	1	28	UI IN-6				-28-UI IN-6
	BI IN-7	CHWS-MAIN			FEC 26xx	MS/TP	1	28	BI IN-7				-28-BI IN-7
	BI IN-8	CHWS-MAIN			FEC 26xx	MS/TP	1	28	BI IN-8				-28-BI IN-8
	BO OUT-1	CHWS-MAIN	CH1-EN	Chiller 1 Enable	FEC 26xx	MS/TP	1	28	BO OUT-1				-28-BO OUT-1
	BO OUT-2	CHWS-MAIN	CH2-EN	Chiller 2 Enable	FEC 26xx	MS/TP	1	28	BO OUT-2				-28-BO OUT-2
	BO OUT-3	CHWS-MAIN	CH1CHWISOV	Chiller 1 CHW Isolation Valve (	FEC 26xx	MS/TP	1	28	BO OUT-3				-28-BO OUT-3
	CO OUT-4	CHWS-MAIN			FEC 26xx	MS/TP	1	28	CO OUT-4				-28-CO OUT-4
	CO OUT-5	CHWS-MAIN	CH2CHWISOV	Chiller 2 CHW Isolation Valve (	FEC 26xx	MS/TP	1	28	CO OUT-5				-28-CO OUT-5
	CO OUT-6	CHWS-MAIN	PCHWP1-C	Primary CHW Pump 1 Comma	FEC 26xx	MS/TP	1	28	CO OUT-6				-28-CO OUT-6
	CO OUT-7	CHWS-MAIN	PCHWP2-C	Primary CHW Pump 2 Comma	FEC 26xx	MS/TP	1	28	CO OUT-7				-28-CO OUT-7
	AO OUT-8	CHWS-MAIN	CH1SP-O	Chiller 1 Setpoint Output	FEC 26xx	MS/TP	1	28	AO OUT-8				-28-AO OUT-8
	AO OUT-9	CHWS-MAIN	CH2SP-O	Chiller 2 Setpoint Output	FEC 26xx	MS/TP	1	28	AO OUT-9				-28-AO OUT-9
		CHWS-MAIN			IOM 3721								
		CHWS-MAIN			IOM 3721	SA Bus	1	4					
	BI IN-1	CHWS-MAIN	CH2-COMP1-S	Supply Fan Status	IOM 3721	SA Bus	1	4	BI IN-1				28--4-BI IN-1
	BI IN-2	CHWS-MAIN	CH2-A	Chiller 2 Alarm	IOM 3721	SA Bus	1	4	BI IN-2				28--4-BI IN-2
	BI IN-3	CHWS-MAIN			IOM 3721	SA Bus	1	4	BI IN-3				28--4-BI IN-3
	BI IN-4	CHWS-MAIN			IOM 3721	SA Bus	1	4	BI IN-4				28--4-BI IN-4
	BI IN-5	CHWS-MAIN			IOM 3721	SA Bus	1	4	BI IN-5				28--4-BI IN-5

Electrician/Fitter		Point Information			Controller Information							Panel Information	
Tag	Point Type	System Name	Object Name	Expanded ID	Controller Details	Trunk Type	Trunk Nbr	Trunk Addr.	Cable Destination Bay/Terminal	Module Type	Termination Out	Panel Location	Cable Number
	BI IN-6	CHWS-MAIN			IOM 3721	SA Bus	1	4	BI IN-6				28--4-BI IN-6
	BI IN-7	CHWS-MAIN	PCHWP1-S	Primary CHW Pump 1 Status	IOM 3721	SA Bus	1	4	BI IN-7				28--4-BI IN-7
	BI IN-8	CHWS-MAIN	PCHWP2-S	Primary CHW Pump 2 Status	IOM 3721	SA Bus	1	4	BI IN-8				28--4-BI IN-8
	BI IN-9	CHWS-MAIN	CH1CHWISOV	Chiller 1 CHW Isolation Valve S	IOM 3721	SA Bus	1	4	BI IN-9				28--4-BI IN-9
	BI IN-10	CHWS-MAIN	CH2CHWISOV	Chiller 2 CHW Isolation Valve S	IOM 3721	SA Bus	1	4	BI IN-10				28--4-BI IN-10
	BI IN-11	CHWS-MAIN			IOM 3721	SA Bus	1	4	BI IN-11				28--4-BI IN-11
	BI IN-12	CHWS-MAIN			IOM 3721	SA Bus	1	4	BI IN-12				28--4-BI IN-12
	BI IN-13	CHWS-MAIN			IOM 3721	SA Bus	1	4	BI IN-13				28--4-BI IN-13
	BI IN-14	CHWS-MAIN			IOM 3721	SA Bus	1	4	BI IN-14				28--4-BI IN-14
	BI IN-15	CHWS-MAIN			IOM 3721	SA Bus	1	4	BI IN-15				28--4-BI IN-15
	BI IN-16	CHWS-MAIN			IOM 3721	SA Bus	1	4	BI IN-16				28--4-BI IN-16
					FEC 26xx								
					FEC 26xx	MS/TP	1	29					
	UI IN-1	HWS-MAIN	BLR1EW-T	Boiler 1 Entering Water Tempe	FEC 26xx	MS/TP	1	29	UI IN-1				-29-UI IN-1
	UI IN-2	HWS-MAIN	BLR1LW-T	Boiler 1 Leaving Water Tempe	FEC 26xx	MS/TP	1	29	UI IN-2				-29-UI IN-2
	UI IN-3	HWS-MAIN	BLR2EW-T	Boiler 2 Entering Water Tempe	FEC 26xx	MS/TP	1	29	UI IN-3				-29-UI IN-3
	UI IN-4	HWS-MAIN	BLR2LW-T	Boiler 2 Leaving Water Tempe	FEC 26xx	MS/TP	1	29	UI IN-4				-29-UI IN-4
	UI IN-5	HWS-MAIN	HW-DP	Hot Water Differential Pressure	FEC 26xx	MS/TP	1	29	UI IN-5				-29-UI IN-5
	UI IN-6	HWS-MAIN			FEC 26xx	MS/TP	1	29	UI IN-6				-29-UI IN-6
	BI IN-7	HWS-MAIN			FEC 26xx	MS/TP	1	29	BI IN-7				-29-BI IN-7
	BI IN-8	HWS-MAIN			FEC 26xx	MS/TP	1	29	BI IN-8				-29-BI IN-8
	BO OUT-1	HWS-MAIN			FEC 26xx	MS/TP	1	29	BO OUT-1				-29-BO OUT-1
	BO OUT-2	HWS-MAIN			FEC 26xx	MS/TP	1	29	BO OUT-2				-29-BO OUT-2
	BO OUT-3	HWS-MAIN			FEC 26xx	MS/TP	1	29	BO OUT-3				-29-BO OUT-3
	CO OUT-4	HWS-MAIN			FEC 26xx	MS/TP	1	29	CO OUT-4				-29-CO OUT-4
	CO OUT-5	HWS-MAIN			FEC 26xx	MS/TP	1	29	CO OUT-5				-29-CO OUT-5
	CO OUT-6	HWS-MAIN			FEC 26xx	MS/TP	1	29	CO OUT-6				-29-CO OUT-6
	CO OUT-7	HWS-MAIN			FEC 26xx	MS/TP	1	29	CO OUT-7				-29-CO OUT-7
	AO OUT-8	HWS-MAIN			FEC 26xx	MS/TP	1	29	AO OUT-8				-29-AO OUT-8
	AO OUT-9	HWS-MAIN	BYPV-O	Bypass Valve Output	FEC 26xx	MS/TP	1	29	AO OUT-9				-29-AO OUT-9
		HWS-MAIN			IOM 2721								
		HWS-MAIN			IOM 2721	SA Bus	1	5					
	UI IN-1	HWS-MAIN			IOM 2721	SA Bus	1	5	UI IN-1				29--5-UI IN-1
	UI IN-2	HWS-MAIN			IOM 2721	SA Bus	1	5	UI IN-2				29--5-UI IN-2
	UI IN-3	HWS-MAIN			IOM 2721	SA Bus	1	5	UI IN-3				29--5-UI IN-3
	UI IN-4	HWS-MAIN			IOM 2721	SA Bus	1	5	UI IN-4				29--5-UI IN-4
	UI IN-5	HWS-MAIN			IOM 2721	SA Bus	1	5	UI IN-5				29--5-UI IN-5
	UI IN-6	DHWS-MAIN	DHWR-T	Domestic HW return temperatu	IOM 2721	SA Bus	1	5	UI IN-6				29--5-UI IN-6
	UI IN-7	DHWS-MAIN	DHWT-S	DHW Operating Status	IOM 2721	SA Bus	1	5	UI IN-7				29--5-UI IN-7
	UI IN-8	DHWS-MAIN	P-M09-S	DHW Pump Status	IOM 2721	SA Bus	1	5	UI IN-8				29--5-UI IN-8
	AO OUT-1	HWS-MAIN			IOM 2721	SA Bus	1	5	AO OUT-1				29--5-AO OUT-1
	AO OUT-2	HWS-MAIN			IOM 2721	SA Bus	1	5	AO OUT-2				29--5-AO OUT-2
		HWS-MAIN			IOM 4710								
		HWS-MAIN			IOM 4710	SA Bus	1	4					
	UI IN-1	HWS-MAIN	GAS1-FLOW	Boiler Gas Flow	IOM 4710	SA Bus	1	4	UI IN-1				29--4-UI IN-1
	UI IN-2	DHWS-MAIN	GAS2-FLOW	DHW Gas Flow	IOM 4710	SA Bus	1	4	UI IN-2				29--4-UI IN-2
	UI IN-3	HWS-MAIN			IOM 4710	SA Bus	1	4	UI IN-3				29--4-UI IN-3

Electrician/Fitter		Point Information			Controller Information							Panel Information	
Tag	Point Type	System Name	Object Name	Expanded ID	Controller Details	Trunk Type	Trunk Nbr	Trunk Addr.	Cable Destination Bay/Terminal	Module Type	Termination Out	Panel Location	Cable Number
	UI IN-4	HWS-MAIN			IOM 4710	SA Bus	1	4	UI IN-4				29--4-UI IN-4
	UI IN-5	HWS-MAIN			IOM 4710	SA Bus	1	4	UI IN-5				29--4-UI IN-5
	UI IN-6	HWS-MAIN			IOM 4710	SA Bus	1	4	UI IN-6				29--4-UI IN-6
	BI IN-7	HWS-MAIN			IOM 4710	SA Bus	1	4	BI IN-7				29--4-BI IN-7
	BI IN-8	HWS-MAIN			IOM 4710	SA Bus	1	4	BI IN-8				29--4-BI IN-8
	BO OUT-1	HWS-MAIN			IOM 4710	SA Bus	1	4	BO OUT-1				29--4-BO OUT-1
	BO OUT-2	HWS-MAIN			IOM 4710	SA Bus	1	4	BO OUT-2				29--4-BO OUT-2
	BO OUT-3	HWS-MAIN	P-M09-C	Boiler Pump 1 Command	IOM 4710	SA Bus	1	4	BO OUT-3				29--4-BO OUT-3
	CO OUT-4	HWS-MAIN			IOM 4710	SA Bus	1	4	CO OUT-4				29--4-CO OUT-4
	CO OUT-5	HWS-MAIN			IOM 4710	SA Bus	1	4	CO OUT-5				29--4-CO OUT-5
	CO OUT-6	HWS-MAIN			IOM 4710	SA Bus	1	4	CO OUT-6				29--4-CO OUT-6
	CO OUT-7	HWS-MAIN			IOM 4710	SA Bus	1	4	CO OUT-7				29--4-CO OUT-7
	AO OUT-8	HWS-MAIN			IOM 4710	SA Bus	1	4	AO OUT-8				29--4-AO OUT-8
	AO OUT-9	HWS-MAIN			IOM 4710	SA Bus	1	4	AO OUT-9				29--4-AO OUT-9
					FEC 26xx								
					FEC 26xx	MS/TP	1	4					
	UI IN-1	EF-MAIN	ZN-CO	Zone CO	FEC 26xx	MS/TP	1	4	UI IN-1				-4-UI IN-1
	UI IN-2	EF-MAIN	ZN-NO2	Zone NO2	FEC 26xx	MS/TP	1	4	UI IN-2				-4-UI IN-2
	UI IN-3	EF-MAIN	AC3-S	Supply Fan Status	FEC 26xx	MS/TP	1	4	UI IN-3				-4-UI IN-3
	UI IN-4	EF-MAIN	CU3-S	Supply Fan Status	FEC 26xx	MS/TP	1	4	UI IN-4				-4-UI IN-4
	UI IN-5	EF-MAIN	EF1-S	Exhaust Fan Status	FEC 26xx	MS/TP	1	4	UI IN-5				-4-UI IN-5
	UI IN-6	EF-MAIN	EF2-S	Exhaust Fan Status	FEC 26xx	MS/TP	1	4	UI IN-6				-4-UI IN-6
	BI IN-7	EF-MAIN	EF-M4-S	Exhaust Fan Status	FEC 26xx	MS/TP	1	4	BI IN-7				-4-BI IN-7
	BI IN-8	EF-MAIN	OAD-S	Outdoor Air Damper Status	FEC 26xx	MS/TP	1	4	BI IN-8				-4-BI IN-8
	BO OUT-1	EF-MAIN	EF-M4-C	Exhaust Fan Command	FEC 26xx	MS/TP	1	4	BO OUT-1				-4-BO OUT-1
	BO OUT-2	EF-MAIN	OAD-C	Outdoor Air Damper Command	FEC 26xx	MS/TP	1	4	BO OUT-2				-4-BO OUT-2
	BO OUT-3	EF-MAIN	EF3-C	Exhaust Fan Command	FEC 26xx	MS/TP	1	4	BO OUT-3				-4-BO OUT-3
	CO OUT-4	EF-MAIN	EF6-C	Exhaust Fan Command	FEC 26xx	MS/TP	1	4	CO OUT-4				-4-CO OUT-4
	CO OUT-5	EF-MAIN			FEC 26xx	MS/TP	1	4	CO OUT-5				-4-CO OUT-5
	CO OUT-6	EF-MAIN			FEC 26xx	MS/TP	1	4	CO OUT-6				-4-CO OUT-6
	CO OUT-7	EF-MAIN			FEC 26xx	MS/TP	1	4	CO OUT-7				-4-CO OUT-7
	AO OUT-8	EF-MAIN			FEC 26xx	MS/TP	1	4	AO OUT-8				-4-AO OUT-8
	AO OUT-9	EF-MAIN			FEC 26xx	MS/TP	1	4	AO OUT-9				-4-AO OUT-9
		EF-MAIN			NET STAT								
		EF-MAIN			NET STAT	SA Bus	1	200					
	STAT	EF-MAIN	AC-M2-T	Zone 1 Temperature	NET STAT	SA Bus	1	200	STAT				4--200-STAT
		EF-MAIN			NET STAT								
		EF-MAIN			NET STAT	SA Bus	1	201					
	STAT	EF-MAIN	AC-M3-T	Zone 2 Temperature	NET STAT	SA Bus	1	201	STAT				4--201-STAT
					FEC 26xx								
					FEC 26xx	MS/TP	1	20					
	UI IN-1	AHU-C1	DA-T	Discharge Air Temperature	FEC 26xx	MS/TP	1	20	UI IN-1				-20-UI IN-1
	UI IN-2	AHU-C1	RA-T	Return Air Temperature	FEC 26xx	MS/TP	1	20	UI IN-2				-20-UI IN-2
	UI IN-3	AHU-C1	MA-T	Mixed Air Temperature	FEC 26xx	MS/TP	1	20	UI IN-3				-20-UI IN-3
	UI IN-4	AHU-C1	DA-H	Discharge Air Humidity	FEC 26xx	MS/TP	1	20	UI IN-4				-20-UI IN-4
	UI IN-5	AHU-C1	DA1-P	Discharge Air Static Pressure	FEC 26xx	MS/TP	1	20	UI IN-5				-20-UI IN-5
	UI IN-6	AHU-C1	HUM-S	Humidifier Status	FEC 26xx	MS/TP	1	20	UI IN-6				-20-UI IN-6

Electrician/Fitter		Point Information			Controller Information							Panel Information	
Tag	Point Type	System Name	Object Name	Expanded ID	Controller Details	Trunk Type	Trunk Nbr	Trunk Addr.	Cable Destination Bay/Terminal	Module Type	Termination Out	Panel Location	Cable Number
	BI IN-7	AHU-C1	SF-S	Supply Fan Status	FEC 26xx	MS/TP	1	20	BI IN-7				-20-BI IN-7
	BI IN-8	AHU-C1	RF-S	Return Fan Status	FEC 26xx	MS/TP	1	20	BI IN-8				-20-BI IN-8
	BO OUT-1	AHU-C1	SF-C	Supply Fan Command	FEC 26xx	MS/TP	1	20	BO OUT-1				-20-BO OUT-1
	BO OUT-2	AHU-C1	RF-C	Return Fan Command	FEC 26xx	MS/TP	1	20	BO OUT-2				-20-BO OUT-2
	BO OUT-3	AHU-C1	HUM-C	Humidifier Command	FEC 26xx	MS/TP	1	20	BO OUT-3				-20-BO OUT-3
	CO OUT-4	AHU-C1	RF-O	Return Fan Output	FEC 26xx	MS/TP	1	20	CO OUT-4				-20-CO OUT-4
	CO OUT-5	AHU-C1	CLG-O	Cooling Output	FEC 26xx	MS/TP	1	20	CO OUT-5				-20-CO OUT-5
	CO OUT-6	AHU-C1	HUM-O	Humidifier Output	FEC 26xx	MS/TP	1	20	CO OUT-6				-20-CO OUT-6
	CO OUT-7	AHU-C1	PH-O	Preheat Output	FEC 26xx	MS/TP	1	20	CO OUT-7				-20-CO OUT-7
	AO OUT-8	AHU-C1	MAD-O	Mixed Air Damper Output	FEC 26xx	MS/TP	1	20	AO OUT-8				-20-AO OUT-8
	AO OUT-9	AHU-C1	SF-O	Supply Fan Output	FEC 26xx	MS/TP	1	20	AO OUT-9				-20-AO OUT-9
		AHU-C1			IOM 2721								
		AHU-C1			IOM 2721	SA Bus	1	4					
	UI IN-1	AHU-C1	LT-A	Low Temperature Alarm	IOM 2721	SA Bus	1	4	UI IN-1				20--4-UI IN-1
	UI IN-2	AHU-C1	OA-VP	Outdoor Air Velocity Pressure	IOM 2721	SA Bus	1	4	UI IN-2				20--4-UI IN-2
	UI IN-3	AHU-C1			IOM 2721	SA Bus	1	4	UI IN-3				20--4-UI IN-3
	UI IN-4	AHU-C1	RA-H	Return Air Humidity	IOM 2721	SA Bus	1	4	UI IN-4				20--4-UI IN-4
	UI IN-5	AHU-C1	RA-VP	Return Air Velocity Pressure	IOM 2721	SA Bus	1	4	UI IN-5				20--4-UI IN-5
	UI IN-6	AHU-C1	DA-VP	Discharge Air Velocity Pressur	IOM 2721	SA Bus	1	4	UI IN-6				20--4-UI IN-6
	UI IN-7	AHU-C1			IOM 2721	SA Bus	1	4	UI IN-7				20--4-UI IN-7
	UI IN-8	AHU-C1	DAPHI-A	Discharge Air High Duct Press	IOM 2721	SA Bus	1	4	UI IN-8				20--4-UI IN-8
	AO OUT-1	AHU-C1			IOM 2721	SA Bus	1	4	AO OUT-1				20--4-AO OUT-1
	AO OUT-2	AHU-C1			IOM 2721	SA Bus	1	4	AO OUT-2				20--4-AO OUT-2
		AHU-C1			IOM 4710								
		AHU-C1			IOM 4710	SA Bus	1	5					
	UI IN-1	AHU-C1	PHP-S	Preheat Pump Status	IOM 4710	SA Bus	1	5	UI IN-1				20--5-UI IN-1
	UI IN-2	AHU-C1	PH-POS	Preheat Position	IOM 4710	SA Bus	1	5	UI IN-2				20--5-UI IN-2
	UI IN-3	AHU-C1	CLG-POS	Cooling Position	IOM 4710	SA Bus	1	5	UI IN-3				20--5-UI IN-3
	UI IN-4	AHU-C1	BLDG-P	Building Static Pressure	IOM 4710	SA Bus	1	5	UI IN-4				20--5-UI IN-4
	UI IN-5	AHU-C1	PFILT-S	PreFilter Status	IOM 4710	SA Bus	1	5	UI IN-5				20--5-UI IN-5
	UI IN-6	AHU-C1			IOM 4710	SA Bus	1	5	UI IN-6				20--5-UI IN-6
	BI IN-7	AHU-C1	EF3-S	Exhaust Fan Status	IOM 4710	SA Bus	1	5	BI IN-7				20--5-BI IN-7
	BI IN-8	AHU-C1	HUM-A	Humidifier Alarm	IOM 4710	SA Bus	1	5	BI IN-8				20--5-BI IN-8
	BO OUT-1	AHU-C1	PHP-C	Preheat Pump Command	IOM 4710	SA Bus	1	5	BO OUT-1				20--5-BO OUT-1
	BO OUT-2	AHU-C1	EF3-C	Exhaust Fan Command	IOM 4710	SA Bus	1	5	BO OUT-2				20--5-BO OUT-2
	BO OUT-3	AHU-C1			IOM 4710	SA Bus	1	5	BO OUT-3				20--5-BO OUT-3
	CO OUT-4	AHU-C1	EF5-OAD	Outside Air Damper	IOM 4710	SA Bus	1	5	CO OUT-4				20--5-CO OUT-4
	CO OUT-5	AHU-C1	EF5-EAD	Exhaust Air Damper	IOM 4710	SA Bus	1	5	CO OUT-5				20--5-CO OUT-5
	CO OUT-6	AHU-C1	EF5-RAD	Return Air Damper	IOM 4710	SA Bus	1	5	CO OUT-6				20--5-CO OUT-6
	CO OUT-7	AHU-C1			IOM 4710	SA Bus	1	5	CO OUT-7				20--5-CO OUT-7
	AO OUT-8	AHU-C1			IOM 4710	SA Bus	1	5	AO OUT-8				20--5-AO OUT-8
	AO OUT-9	AHU-C1			IOM 4710	SA Bus	1	5	AO OUT-9				20--5-AO OUT-9
		AHU-C1			NET STAT								
		AHU-C1			NET STAT	SA Bus	1	203					
	STAT	AHU-C1	ZN-T	Zone Temperature	NET STAT	SA Bus	1	203	STAT				20--203-STAT
					FAC 2611								
					FAC 2611	MS/TP	1	21					

Electrician/Fitter		Point Information			Controller Information							Panel Information	
Tag	Point Type	System Name	Object Name	Expanded ID	Controller Details	Trunk Type	Trunk Nbr	Trunk Addr.	Cable Destination Bay/Terminal	Module Type	Termination Out	Panel Location	Cable Number
	UI IN-1	HRU-C1	DA-T	Discharge Air Temperature	FAC 2611	MS/TP	1	21	UI IN-1				-21-UI IN-1
	UI IN-2	HRU-C1	DA1-P	Discharge Air Static Pressure 1	FAC 2611	MS/TP	1	21	UI IN-2				-21-UI IN-2
	UI IN-3	HRU-C1	DA-VP	Discharge Air Velocity Pressur	FAC 2611	MS/TP	1	21	UI IN-3				-21-UI IN-3
	UI IN-4	HRU-C1	RA-T	Return Air Temperature	FAC 2611	MS/TP	1	21	UI IN-4				-21-UI IN-4
	UI IN-5	HRU-C1	EAHR-T	Exhaust Air Heat Recovery Te	FAC 2611	MS/TP	1	21	UI IN-5				-21-UI IN-5
	UI IN-6	HRU-C1	HRW-S	Heat Recovery Wheel Status	FAC 2611	MS/TP	1	21	UI IN-6				-21-UI IN-6
	BI IN-7	HRU-C1			FAC 2611	MS/TP	1	21	BI IN-7				-21-BI IN-7
	BI IN-8	HRU-C1			FAC 2611	MS/TP	1	21	BI IN-8				-21-BI IN-8
	BO OUT-1	HRU-C1			FAC 2611	MS/TP	1	21	BO OUT-1				-21-BO OUT-1
	BO OUT-2	HRU-C1			FAC 2611	MS/TP	1	21	BO OUT-2				-21-BO OUT-2
	BO OUT-3	HRU-C1	HRW-C	Heat Recovery Wheel Comma	FAC 2611	MS/TP	1	21	BO OUT-3				-21-BO OUT-3
	CO OUT-4	HRU-C1	HREAFBD-O	Heat Recovery EA FBD Outpu	FAC 2611	MS/TP	1	21	CO OUT-4				-21-CO OUT-4
	CO OUT-5	HRU-C1	HROAFBD-O	Heat Recovery OA FBD Outpu	FAC 2611	MS/TP	1	21	CO OUT-5				-21-CO OUT-5
	CO OUT-6	HRU-C1	EAD-C	Exhaust Air Damper Comman	FAC 2611	MS/TP	1	21	CO OUT-6				-21-CO OUT-6
	CO OUT-7	HRU-C1	OAD-C	Outdoor Air Damper Comman	FAC 2611	MS/TP	1	21	CO OUT-7				-21-CO OUT-7
	AO OUT-8	HRU-C1			FAC 2611	MS/TP	1	21	AO OUT-8				-21-AO OUT-8
	AO OUT-9	HRU-C1			FAC 2611	MS/TP	1	21	AO OUT-9				-21-AO OUT-9
		HRU-C1			IOM 1710								
		HRU-C1			IOM 1710	SA Bus	1	4					
	BI IN-1	HRU-C1	PFILT-S	PreFilter Status	IOM 1710	SA Bus	1	4	BI IN-1				21--4-BI IN-1
	BI IN-2	HRU-C1	DAPHI-A	Discharge Air High Duct Press	IOM 1710	SA Bus	1	4	BI IN-2				21--4-BI IN-2
	BI IN-3	HRU-C1	EAD-S	Exhaust Air Damper Status	IOM 1710	SA Bus	1	4	BI IN-3				21--4-BI IN-3
	BI IN-4	HRU-C1	OAD-S	Outdoor Air Damper Status	IOM 1710	SA Bus	1	4	BI IN-4				21--4-BI IN-4
					FEC 26xx								
					FEC 26xx	MS/TP	1	22					
	UI IN-1	HRU-C2	DA-T	Discharge Air Temperature	FEC 26xx	MS/TP	1	22	UI IN-1				-22-UI IN-1
	UI IN-2	HRU-C2	PHP-S	Preheat Pump Status	FEC 26xx	MS/TP	1	22	UI IN-2				-22-UI IN-2
	UI IN-3	HRU-C2	CLG-POS	Cooling Position	FEC 26xx	MS/TP	1	22	UI IN-3				-22-UI IN-3
	UI IN-4	HRU-C2	PH-POS	Preheat Position	FEC 26xx	MS/TP	1	22	UI IN-4				-22-UI IN-4
	UI IN-5	HRU-C2	EA-T	Exhaust Air Temperature	FEC 26xx	MS/TP	1	22	UI IN-5				-22-UI IN-5
	UI IN-6	HRU-C2	DPR-S	Outdoor/Exhaust Air Damper S	FEC 26xx	MS/TP	1	22	UI IN-6				-22-UI IN-6
	BI IN-7	HRU-C2	SF-S	Supply Fan Status	FEC 26xx	MS/TP	1	22	BI IN-7				-22-BI IN-7
	BI IN-8	HRU-C2	EF-S	Exhaust Fan Status	FEC 26xx	MS/TP	1	22	BI IN-8				-22-BI IN-8
	BO OUT-1	HRU-C2	PHP-C	Preheat Pump Command	FEC 26xx	MS/TP	1	22	BO OUT-1				-22-BO OUT-1
	BO OUT-2	HRU-C2	UNIT-C	Supply Fan Command	FEC 26xx	MS/TP	1	22	BO OUT-2				-22-BO OUT-2
	BO OUT-3	HRU-C2	DPR-C	Exhaust/Outside Air Damper C	FEC 26xx	MS/TP	1	22	BO OUT-3				-22-BO OUT-3
	CO OUT-4	HRU-C2			FEC 26xx	MS/TP	1	22	CO OUT-4				-22-CO OUT-4
	CO OUT-5	HRU-C2			FEC 26xx	MS/TP	1	22	CO OUT-5				-22-CO OUT-5
	CO OUT-6	HRU-C2			FEC 26xx	MS/TP	1	22	CO OUT-6				-22-CO OUT-6
	CO OUT-7	HRU-C2			FEC 26xx	MS/TP	1	22	CO OUT-7				-22-CO OUT-7
	AO OUT-8	HRU-C2	CLG-O	Cooling Output	FEC 26xx	MS/TP	1	22	AO OUT-8				-22-AO OUT-8
	AO OUT-9	HRU-C2	PH-O	Preheat Output	FEC 26xx	MS/TP	1	22	AO OUT-9				-22-AO OUT-9
		HRU-C2			NET STAT								
		HRU-C2			NET STAT	SA Bus	1	203					
	STAT	HRU-C2	ZN-T	Zone Temperature	NET STAT	SA Bus	1	203	STAT				22--203-STAT
					FEC 26xx								
					FEC 26xx	MS/TP	1	18					

Electrician/Fitter		Point Information			Controller Information							Panel Information	
Tag	Point Type	System Name	Object Name	Expanded ID	Controller Details	Trunk Type	Trunk Nbr	Trunk Addr.	Cable Destination Bay/Terminal	Module Type	Termination Out	Panel Location	Cable Number
	UI IN-1	CHWS-COMM	CH1-COMP1-S	Supply Fan Status	FEC 26xx	MS/TP	1	18	UI IN-1				-18-UI IN-1
	UI IN-2	CHWS-COMM	CH1-A	Chiller 1 Alarm	FEC 26xx	MS/TP	1	18	UI IN-2				-18-UI IN-2
	UI IN-3	CHWS-COMM			FEC 26xx	MS/TP	1	18	UI IN-3				-18-UI IN-3
	UI IN-4	CHWS-COMM			FEC 26xx	MS/TP	1	18	UI IN-4				-18-UI IN-4
	UI IN-5	CHWS-COMM			FEC 26xx	MS/TP	1	18	UI IN-5				-18-UI IN-5
	UI IN-6	CHWS-COMM			FEC 26xx	MS/TP	1	18	UI IN-6				-18-UI IN-6
	BI IN-7	CHWS-COMM			FEC 26xx	MS/TP	1	18	BI IN-7				-18-BI IN-7
	BI IN-8	CHWS-COMM			FEC 26xx	MS/TP	1	18	BI IN-8				-18-BI IN-8
	BO OUT-1	CHWS-COMM	CH1-EN	Chiller 1 Enable	FEC 26xx	MS/TP	1	18	BO OUT-1				-18-BO OUT-1
	BO OUT-2	CHWS-COMM	CH2-EN	Chiller 2 Enable	FEC 26xx	MS/TP	1	18	BO OUT-2				-18-BO OUT-2
	BO OUT-3	CHWS-COMM			FEC 26xx	MS/TP	1	18	BO OUT-3				-18-BO OUT-3
	CO OUT-4	CHWS-COMM	CH1CHWISOV	Chiller 1 CHW Isolation Valve (	FEC 26xx	MS/TP	1	18	CO OUT-4				-18-CO OUT-4
	CO OUT-5	CHWS-COMM	CH2CHWISOV	Chiller 2 CHW Isolation Valve (	FEC 26xx	MS/TP	1	18	CO OUT-5				-18-CO OUT-5
	CO OUT-6	CHWS-COMM	PCHWP1-C	Primary CHW Pump 1 Comma	FEC 26xx	MS/TP	1	18	CO OUT-6				-18-CO OUT-6
	CO OUT-7	CHWS-COMM	PCHWP2-C	Primary CHW Pump 2 Comma	FEC 26xx	MS/TP	1	18	CO OUT-7				-18-CO OUT-7
	AO OUT-8	CHWS-COMM	CH1SP-O	Chiller 1 Setpoint Output	FEC 26xx	MS/TP	1	18	AO OUT-8				-18-AO OUT-8
	AO OUT-9	CHWS-COMM	CH2SP-O	Chiller 2 Setpoint Output	FEC 26xx	MS/TP	1	18	AO OUT-9				-18-AO OUT-9
		CHWS-COMM			IOM 3721								
		CHWS-COMM			IOM 3721	SA Bus	1	4					
	BI IN-1	CHWS-COMM	CH2-COMP1-S	Supply Fan Status	IOM 3721	SA Bus	1	4	BI IN-1				18--4-BI IN-1
	BI IN-2	CHWS-COMM	CH2-A	Chiller 2 Alarm	IOM 3721	SA Bus	1	4	BI IN-2				18--4-BI IN-2
	BI IN-3	CHWS-COMM			IOM 3721	SA Bus	1	4	BI IN-3				18--4-BI IN-3
	BI IN-4	CHWS-COMM			IOM 3721	SA Bus	1	4	BI IN-4				18--4-BI IN-4
	BI IN-5	CHWS-COMM			IOM 3721	SA Bus	1	4	BI IN-5				18--4-BI IN-5
	BI IN-6	CHWS-COMM			IOM 3721	SA Bus	1	4	BI IN-6				18--4-BI IN-6
	BI IN-7	CHWS-COMM	PCHWP1-S	Primary CHW Pump 1 Status	IOM 3721	SA Bus	1	4	BI IN-7				18--4-BI IN-7
	BI IN-8	CHWS-COMM	PCHWP2-S	Primary CHW Pump 2 Status	IOM 3721	SA Bus	1	4	BI IN-8				18--4-BI IN-8
	BI IN-9	CHWS-COMM	CH1CHWISOV	Chiller 1 CHW Isolation Valve S	IOM 3721	SA Bus	1	4	BI IN-9				18--4-BI IN-9
	BI IN-10	CHWS-COMM	CH2CHWISOV	Chiller 2 CHW Isolation Valve S	IOM 3721	SA Bus	1	4	BI IN-10				18--4-BI IN-10
	BI IN-11	CHWS-COMM			IOM 3721	SA Bus	1	4	BI IN-11				18--4-BI IN-11
	BI IN-12	CHWS-COMM			IOM 3721	SA Bus	1	4	BI IN-12				18--4-BI IN-12
	BI IN-13	CHWS-COMM			IOM 3721	SA Bus	1	4	BI IN-13				18--4-BI IN-13
	BI IN-14	CHWS-COMM			IOM 3721	SA Bus	1	4	BI IN-14				18--4-BI IN-14
	BI IN-15	CHWS-COMM			IOM 3721	SA Bus	1	4	BI IN-15				18--4-BI IN-15
	BI IN-16	CHWS-COMM			IOM 3721	SA Bus	1	4	BI IN-16				18--4-BI IN-16
					FEC 26xx								
					FEC 26xx	MS/TP	1	19					
	UI IN-1	HWS-COMM	BLR1EW-T	Boiler 1 Entering Water Tempe	FEC 26xx	MS/TP	1	19	UI IN-1				-19-UI IN-1
	UI IN-2	HWS-COMM	BLR1LW-T	Boiler 1 Leaving Water Tempe	FEC 26xx	MS/TP	1	19	UI IN-2				-19-UI IN-2
	UI IN-3	HWS-COMM	BLR2EW-T	Boiler 2 Entering Water Tempe	FEC 26xx	MS/TP	1	19	UI IN-3				-19-UI IN-3
	UI IN-4	HWS-COMM	BLR2LW-T	Boiler 2 Leaving Water Tempe	FEC 26xx	MS/TP	1	19	UI IN-4				-19-UI IN-4
	UI IN-5	HWS-COMM	HW-DP	Hot Water Differential Pressure	FEC 26xx	MS/TP	1	19	UI IN-5				-19-UI IN-5
	UI IN-6	HWS-COMM	OA-H	Outdoor Air Humidity	FEC 26xx	MS/TP	1	19	UI IN-6				-19-UI IN-6
	BI IN-7	DHWS-COMM	P-M09-S	DHW Pump Status	FEC 26xx	MS/TP	1	19	BI IN-7				-19-BI IN-7
	BI IN-8	HWS-COMM			FEC 26xx	MS/TP	1	19	BI IN-8				-19-BI IN-8
	BO OUT-1	HWS-COMM			FEC 26xx	MS/TP	1	19	BO OUT-1				-19-BO OUT-1
	BO OUT-2	HWS-COMM			FEC 26xx	MS/TP	1	19	BO OUT-2				-19-BO OUT-2

Electrician/Fitter		Point Information			Controller Information							Panel Information	
Tag	Point Type	System Name	Object Name	Expanded ID	Controller Details	Trunk Type	Trunk Nbr	Trunk Addr.	Cable Destination Bay/Terminal	Module Type	Termination Out	Panel Location	Cable Number
	BO OUT-3	HWS-COMM			FEC 26xx	MS/TP	1	19	BO OUT-3				-19-BO OUT-3
	CO OUT-4	HWS-COMM			FEC 26xx	MS/TP	1	19	CO OUT-4				-19-CO OUT-4
	CO OUT-5	HWS-COMM			FEC 26xx	MS/TP	1	19	CO OUT-5				-19-CO OUT-5
	CO OUT-6	HWS-COMM			FEC 26xx	MS/TP	1	19	CO OUT-6				-19-CO OUT-6
	CO OUT-7	HWS-COMM			FEC 26xx	MS/TP	1	19	CO OUT-7				-19-CO OUT-7
	AO OUT-8	HWS-COMM			FEC 26xx	MS/TP	1	19	AO OUT-8				-19-AO OUT-8
	AO OUT-9	HWS-COMM	BYPV-O	Bypass Valve Output	FEC 26xx	MS/TP	1	19	AO OUT-9				-19-AO OUT-9
		HWS-COMM			IOM 4710								
		HWS-COMM			IOM 4710	SA Bus	1	4					
	UI IN-1	HWS-COMM	OA-T	Outdoor Air Temperature	IOM 4710	SA Bus	1	4	UI IN-1				19--4-UI IN-1
	UI IN-2	HWS-COMM	GAS1-FLOW	Boiler Gas Flow	IOM 4710	SA Bus	1	4	UI IN-2				19--4-UI IN-2
	UI IN-3	DHWS-COMM	DHWR-T	Domestic HW return temperatu	IOM 4710	SA Bus	1	4	UI IN-3				19--4-UI IN-3
	UI IN-4	DHWS-COMM	GAS2-FLOW	DHW Gas Flow	IOM 4710	SA Bus	1	4	UI IN-4				19--4-UI IN-4
	UI IN-5	DHWS-COMM	DHWS-T	Domestic HW Temperature	IOM 4710	SA Bus	1	4	UI IN-5				19--4-UI IN-5
	UI IN-6	HWS-COMM			IOM 4710	SA Bus	1	4	UI IN-6				19--4-UI IN-6
	BI IN-7	HWS-COMM	EMERG-A	Emergency Shutdown 1 Alarm	IOM 4710	SA Bus	1	4	BI IN-7				19--4-BI IN-7
	BI IN-8	HWS-COMM	DHWT-S	DHW Operating Status	IOM 4710	SA Bus	1	4	BI IN-8				19--4-BI IN-8
	BO OUT-1	HWS-COMM			IOM 4710	SA Bus	1	4	BO OUT-1				19--4-BO OUT-1
	BO OUT-2	HWS-COMM			IOM 4710	SA Bus	1	4	BO OUT-2				19--4-BO OUT-2
	BO OUT-3	DHWS-COMM	P-M09-C	Boiler Pump 1 Command	IOM 4710	SA Bus	1	4	BO OUT-3				19--4-BO OUT-3
	CO OUT-4	HWS-COMM			IOM 4710	SA Bus	1	4	CO OUT-4				19--4-CO OUT-4
	CO OUT-5	HWS-COMM			IOM 4710	SA Bus	1	4	CO OUT-5				19--4-CO OUT-5
	CO OUT-6	HWS-COMM			IOM 4710	SA Bus	1	4	CO OUT-6				19--4-CO OUT-6
	CO OUT-7	HWS-COMM			IOM 4710	SA Bus	1	4	CO OUT-7				19--4-CO OUT-7
	AO OUT-8	HWS-COMM			IOM 4710	SA Bus	1	4	AO OUT-8				19--4-AO OUT-8
	AO OUT-9	HWS-COMM			IOM 4710	SA Bus	1	4	AO OUT-9				19--4-AO OUT-9
					FEC 26xx								
					FEC 26xx	MS/TP	1	26					
	UI IN-1	EF-S1,S2			FEC 26xx	MS/TP	1	26	UI IN-1				-26-UI IN-1
	UI IN-2	EF-S1,S2			FEC 26xx	MS/TP	1	26	UI IN-2				-26-UI IN-2
	UI IN-3	EF-S1,S2			FEC 26xx	MS/TP	1	26	UI IN-3				-26-UI IN-3
	UI IN-4	EF-S1,S2			FEC 26xx	MS/TP	1	26	UI IN-4				-26-UI IN-4
	UI IN-5	EF-S1,S2			FEC 26xx	MS/TP	1	26	UI IN-5				-26-UI IN-5
	UI IN-6	EF-S1,S2			FEC 26xx	MS/TP	1	26	UI IN-6				-26-UI IN-6
	BI IN-7	EF-S1,S2	EF-S1-S	Exhaust Fan Status	FEC 26xx	MS/TP	1	26	BI IN-7				-26-BI IN-7
	BI IN-8	EF-S1,S2	EF-S2-S	Exhaust Fan Status	FEC 26xx	MS/TP	1	26	BI IN-8				-26-BI IN-8
	BO OUT-1	EF-S1,S2	EF-S1-C	Exhaust Fan Command	FEC 26xx	MS/TP	1	26	BO OUT-1				-26-BO OUT-1
	BO OUT-2	EF-S1,S2	EF-S2-C	Exhaust Fan Command	FEC 26xx	MS/TP	1	26	BO OUT-2				-26-BO OUT-2
	BO OUT-3	EF-S1,S2			FEC 26xx	MS/TP	1	26	BO OUT-3				-26-BO OUT-3
	CO OUT-4	EF-S1,S2	OAD-S1-C	Outdoor Air Damper Command	FEC 26xx	MS/TP	1	26	CO OUT-4				-26-CO OUT-4
	CO OUT-5	EF-S1,S2	OAD-S2-C	Outdoor Air Damper Command	FEC 26xx	MS/TP	1	26	CO OUT-5				-26-CO OUT-5
	CO OUT-6	EF-S1,S2			FEC 26xx	MS/TP	1	26	CO OUT-6				-26-CO OUT-6
	CO OUT-7	EF-S1,S2			FEC 26xx	MS/TP	1	26	CO OUT-7				-26-CO OUT-7
	AO OUT-8	EF-S1,S2			FEC 26xx	MS/TP	1	26	AO OUT-8				-26-AO OUT-8
	AO OUT-9	EF-S1,S2			FEC 26xx	MS/TP	1	26	AO OUT-9				-26-AO OUT-9
					FEC 26xx								
					FEC 26xx	MS/TP	1	47					

Electrician/Fitter		Point Information			Controller Information							Panel Information	
Tag	Point Type	System Name	Object Name	Expanded ID	Controller Details	Trunk Type	Trunk Nbr	Trunk Addr.	Cable Destination Bay/Terminal	Module Type	Termination Out	Panel Location	Cable Number
	UI IN-1	GENERATOR RM	GEN-S	Generator Status	FEC 26xx	MS/TP	1	47	UI IN-1				-47-UI IN-1
	UI IN-2	GENERATOR RM	GEN-A	Generator Alarm	FEC 26xx	MS/TP	1	47	UI IN-2				-47-UI IN-2
	UI IN-3	GENERATOR RM	GEN-TBL	Generator Trouble Status	FEC 26xx	MS/TP	1	47	UI IN-3				-47-UI IN-3
	UI IN-4	GENERATOR RM			FEC 26xx	MS/TP	1	47	UI IN-4				-47-UI IN-4
	UI IN-5	GENERATOR RM			FEC 26xx	MS/TP	1	47	UI IN-5				-47-UI IN-5
	UI IN-6	GENERATOR RM			FEC 26xx	MS/TP	1	47	UI IN-6				-47-UI IN-6
	BI IN-7	GENERATOR RM	SF-S	Supply Fan Status	FEC 26xx	MS/TP	1	47	BI IN-7				-47-BI IN-7
	BI IN-8	GENERATOR RM			FEC 26xx	MS/TP	1	47	BI IN-8				-47-BI IN-8
	BO OUT-1	GENERATOR RM	SF-C	Supply Fan Command	FEC 26xx	MS/TP	1	47	BO OUT-1				-47-BO OUT-1
	BO OUT-2	GENERATOR RM			FEC 26xx	MS/TP	1	47	BO OUT-2				-47-BO OUT-2
	BO OUT-3	GENERATOR RM			FEC 26xx	MS/TP	1	47	BO OUT-3				-47-BO OUT-3
	CO OUT-4	GENERATOR RM			FEC 26xx	MS/TP	1	47	CO OUT-4				-47-CO OUT-4
	CO OUT-5	GENERATOR RM			FEC 26xx	MS/TP	1	47	CO OUT-5				-47-CO OUT-5
	CO OUT-6	GENERATOR RM	RECIRC-O	Return Air Damper Output	FEC 26xx	MS/TP	1	47	CO OUT-6				-47-CO OUT-6
	CO OUT-7	GENERATOR RM	RAD-O	Relief Air Damper Output	FEC 26xx	MS/TP	1	47	CO OUT-7				-47-CO OUT-7
	AO OUT-8	GENERATOR RM	OAD-O	Outdoor Air Damper Output	FEC 26xx	MS/TP	1	47	AO OUT-8				-47-AO OUT-8
	AO OUT-9	GENERATOR RM	EAD-O	Exhaust Air Damper Output	FEC 26xx	MS/TP	1	47	AO OUT-9				-47-AO OUT-9
		GENERATOR RM			NET STAT								
		GENERATOR RM			NET STAT	SA Bus	1	203					
	STAT	GENERATOR RM	ZN-T	Zone Temperature	NET STAT	SA Bus	1	203	STAT				47--203-STAT
					FEC 26xx								
					FEC 26xx	MS/TP	1	49					
					FEC 26xx	MS/TP	1	49					
	UI IN-1	EF-T1	ZN-CO	Zone CO	FEC 26xx	MS/TP	1	49	UI IN-1				-49-UI IN-1
	UI IN-2	EF-T1	ZN-NO2	Zone NO2	FEC 26xx	MS/TP	1	49	UI IN-2				-49-UI IN-2
	UI IN-3	EF-T1	OAD-POS	Outdoor Air Damper Position	FEC 26xx	MS/TP	1	49	UI IN-3				-49-UI IN-3
	UI IN-4	EF-T1			FEC 26xx	MS/TP	1	49	UI IN-4				-49-UI IN-4
	UI IN-5	EF-T1			FEC 26xx	MS/TP	1	49	UI IN-5				-49-UI IN-5
	UI IN-6	EF-T1			FEC 26xx	MS/TP	1	49	UI IN-6				-49-UI IN-6
	BI IN-7	EF-T1	EF-T1-S	Exhaust Fan Status	FEC 26xx	MS/TP	1	49	BI IN-7				-49-BI IN-7
	BI IN-8	EF-T1			FEC 26xx	MS/TP	1	49	BI IN-8				-49-BI IN-8
	BO OUT-1	EF-T1	EF-T1-C	Exhaust Fan Command	FEC 26xx	MS/TP	1	49	BO OUT-1				-49-BO OUT-1
	BO OUT-2	EF-T1	OAD-C	Outdoor Air Damper Command	FEC 26xx	MS/TP	1	49	BO OUT-2				-49-BO OUT-2
	BO OUT-3	EF-T1	IH-T1-EN	Heating Command	FEC 26xx	MS/TP	1	49	BO OUT-3				-49-BO OUT-3
	CO OUT-4	EF-T1			FEC 26xx	MS/TP	1	49	CO OUT-4				-49-CO OUT-4
	CO OUT-5	EF-T1			FEC 26xx	MS/TP	1	49	CO OUT-5				-49-CO OUT-5
	CO OUT-6	EF-T1			FEC 26xx	MS/TP	1	49	CO OUT-6				-49-CO OUT-6
	CO OUT-7	EF-T1			FEC 26xx	MS/TP	1	49	CO OUT-7				-49-CO OUT-7
	AO OUT-8	EF-T1			FEC 26xx	MS/TP	1	49	AO OUT-8				-49-AO OUT-8
	AO OUT-9	EF-T1			FEC 26xx	MS/TP	1	49	AO OUT-9				-49-AO OUT-9
		EF-T1			NET STAT								
		EF-T1			NET STAT	SA Bus	1	203					
	STAT	EF-T1	ZN-T	Zone 1 Temperature	NET STAT	SA Bus	1	203	STAT				49--203-STAT
					FEC 26xx								
					FEC 26xx	MS/TP	1	51					
	UI IN-1	EF-T2, SUMP	ZN-CO	Zone CO	FEC 26xx	MS/TP	1	51	UI IN-1				-51-UI IN-1
	UI IN-2	EF-T2, SUMP	ZN-NO2	Zone NO2	FEC 26xx	MS/TP	1	51	UI IN-2				-51-UI IN-2
	UI IN-3	EF-T2, SUMP			FEC 26xx	MS/TP	1	51	UI IN-3				-51-UI IN-3

Electrician/Fitter		Point Information			Controller Information							Panel Information	
Tag	Point Type	System Name	Object Name	Expanded ID	Controller Details	Trunk Type	Trunk Nbr	Trunk Addr.	Cable Destination Bay/Terminal	Module Type	Termination Out	Panel Location	Cable Number
	UI IN-4	EF-T2, SUMP	SUMP-A1	Sump Alarm	FEC 26xx	MS/TP	1	51	UI IN-4				-51-UI IN-4
	UI IN-5	EF-T2, SUMP			FEC 26xx	MS/TP	1	51	UI IN-5				-51-UI IN-5
	UI IN-6	EF-T2, SUMP			FEC 26xx	MS/TP	1	51	UI IN-6				-51-UI IN-6
	BI IN-7	EF-T2, SUMP			FEC 26xx	MS/TP	1	51	BI IN-7				-51-BI IN-7
	BI IN-8	EF-T2, SUMP	EF-T2-S	Exhaust Fan Status	FEC 26xx	MS/TP	1	51	BI IN-8				-51-BI IN-8
	BO OUT-1	EF-T2, SUMP	EF-T2-C	Exhaust Fan Command	FEC 26xx	MS/TP	1	51	BO OUT-1				-51-BO OUT-1
	BO OUT-2	EF-T2, SUMP			FEC 26xx	MS/TP	1	51	BO OUT-2				-51-BO OUT-2
	BO OUT-3	EF-T2, SUMP			FEC 26xx	MS/TP	1	51	BO OUT-3				-51-BO OUT-3
	CO OUT-4	EF-T2, SUMP			FEC 26xx	MS/TP	1	51	CO OUT-4				-51-CO OUT-4
	CO OUT-5	EF-T2, SUMP			FEC 26xx	MS/TP	1	51	CO OUT-5				-51-CO OUT-5
	CO OUT-6	EF-T2, SUMP			FEC 26xx	MS/TP	1	51	CO OUT-6				-51-CO OUT-6
	CO OUT-7	EF-T2, SUMP			FEC 26xx	MS/TP	1	51	CO OUT-7				-51-CO OUT-7
	AO OUT-8	EF-T2, SUMP			FEC 26xx	MS/TP	1	51	AO OUT-8				-51-AO OUT-8
	AO OUT-9	EF-T2, SUMP			FEC 26xx	MS/TP	1	51	AO OUT-9				-51-AO OUT-9

Aldergrove Port of Entry
4097-0088

Room Schedule

Box Location								Controller Information							Box Information													
	Room							Controller	Required					Sensor			Box Config	Required				Required (N2)							
Bldg./Flr.	No.	Name	System Name	Mech. Dwg.	System Serving this Box	Box Mfgr.	Mfgr Box Type	JCI Ctrl Dwg No.	Controller Part No.	NC/ NAE Addr	Trunk ID	Device Addr	PAN Offset	CSModel or Template	Code No.	Box Heat	Supplemental Heat	Config File Name	Inlet Size (Inches)	Inlet Area (Sq. Ft.)	K Factor	Clg Min Flow	Clg Max Flow	VMA Box Config	RP Unit	ZN-T	ZN-CO2	ZN-H	Comments	Generate Flag
Main Port/Main Floor	M111	Interview	VAV-M1	M2.02	AHU-M1			8.002	MS-VMA1615-0	2	1	4	x	x	x	No	Yes		4			26	87		1	Yes	x	x	With ZN-T; RP-3-M111	
Main Port/Main Floor	M110	Hallway	VAV-M2	M2.02	AHU-M1			8.001	MS-VMA1615-0	2	1	5	x	x	x	No	No		5			51	101		x	Yes	x	x	With ZN-T	
Main Port/Main Floor	M128	First AID	VAV-M3	M2.02	AHU-M1			8.001	MS-VMA1615-0	2	1	6	x	x	x	No	No		5			31	104		x	Yes	x	x	With ZN-T	
Main Port/Main Floor	M134	Lunch Room	VAV-M4	M2.02	AHU-M1			8.003	MS-VMA1615-0	2	1	7	x	x	x	No	Yes		7			74	245		1	Yes	Yes	x	With ZN-T,CO2; RP-5-M134	
Main Port/Main Floor	M132	Womens	VAV-M5	M2.02	AHU-M1			8.006	MS-VMA1630-0	2	1	8	x	x	x	Yes	No		7			253	253		x	Yes	x	x	With ZN-T	
Main Port/Main Floor	M135	Port Direction	VAV-M6	M2.02	AHU-M1			8.004	MS-VMA1615-0	2	1	9	x	x	x	No	Yes		6			47	156		2	Yes	Yes	x	With ZN-T,CO2; RP-4-M135-1 & RP-4-M135-2. Mech Dwg 2.04 shows only one Htg valve.	
Main Port/Main Floor	M138	Hallway	VAV-M7	M2.02	AHU-M1			8.002	MS-VMA1615-0	2	1	10	x	x	x	No	Yes		5			38	127		1	Yes	x	x	With ZN-T; RP-5-M138	
Main Port/Main Floor	M140	Staff Briefing B	VAV-M8	M2.02	AHU-M1			8.003	MS-VMA1615-0	2	1	11	x	x	x	No	Yes		5			49	123		1	Yes	Yes	x	With ZN-T,CO2; RP-5-M140	
Main Port/Main Floor	M141	Superintendents	VAV-M9	M2.02	AHU-M1			8.003	MS-VMA1615-0	2	1	12	x	x	x	No	Yes		7			68	227		1	Yes	Yes	x	With ZN-T,CO2; RP-4-M141	
Main Port/Main Floor	M151	Security/Network	VAV-M10	M2.02	AHU-M1			8.003	MS-VMA1615-0	2	1	13	x	x	x	No	Yes		5			30	99		1	Yes	Yes	x	With ZN-T,CO2; RP-3-M151	
Main Port/Main Floor	M150	Staff Briefing A	VAV-M11	M2.02	AHU-M1			8.003	MS-VMA1615-0	2	1	14	x	x	x	No	Yes		4			47	94		1	Yes	Yes	x	With ZN-T,CO2; RP-5-M150	
Main Port/Main Floor	M145	Business Center	VAV-M12	M2.02	AHU-M1			8.001	MS-VMA1615-0	2	1	15	x	x	x	No	No		5			43	144		x	Yes	x	x	With ZN-T	
Main Port/Main Floor	M142	General Office Area	VAV-M13	M2.02	AHU-M1			8.001	MS-VMA1615-0	2	1	20	x	x	x	No	No		10			170	566		x	??	x	x	ZN-T not found; As per VAV schedule, VAV-13 servs to M145, this room is having ZN-T,H,CO2, but with tag for VAV-M15	
Main Port/Main Floor	M101	Public Lobby	VAV-M14	M2.02	AHU-M1			8.005	MS-VMA1615-0	2	1	21	x	x	x	No	No		16			425	1416		x	Yes	Yes	Yes	With ZN-T,ZN-H,CO2	
Main Port/Main Floor	M142 (M147)	General Office Area (Services Counters)	VAV-M15	M2.02	AHU-M1			8.005	MS-VMA1615-0	2	1	22	x	x	x	No	No		10			167	555		x	Yes	Yes	Yes	With ZN-T,ZN-H,CO2; As per VAV schedule serving to M147 & ZN-T not found	
Main Port/Main Floor	M152	Pil Booth	VAV-M16	M2.02	AHU-M1			8.001	MS-VMA1615-0	2	1	16	x	x	x	No	No		6			50	165		x	Yes	Yes	x	With ZN-T,CO2	
Main Port/Main Floor	M102	Mechanical Room	VAV-M17	M2.02	AHU-M1			8.007	MS-VMA1615-0	2	1	17	x	x	x	No	No		9			435	435		x	x	x	x	Exhaust VAV.Confirm Rm Number & name(M0.02); RP-2-M102	
Main Port/Main Floor	M201	Mechanical Room	VAV-M18	M2.02	AHU-M1			8.007	MS-VMA1615-0	2	1	23	x	x	x	No	No		7			0	241		x	x	x	x	Exhaust VAV.Confirm Rm Number & name(M0.02)	
Commercial/Main Floor	C107	CCEPS Counter	VAV-C1	M3.02	AHU-C1			22.003	MS-VMA1615-0	1	1	4	x	x	x	No	Yes		6			76	189		1	Yes	Yes	???	With ZN-T,CO2; RP-5-C107; Mech Dwg M3.04 shows ZN-H. Need to confirm.	
Commercial/Main Floor	C108	Meeting Room	VAV-C2	M3.02	AHU-C1			22.002	MS-VMA1615-0	1	1	5	x	x	x	No	Yes		7			85	283		1	Yes	Yes	x	With ZN-T,CO2; RP-1-C108	
Commercial/Main Floor	C111	Training Room	VAV-C3	M3.02	AHU-C1			22.002	MS-VMA1615-0	1	1	6	x	x	x	No	Yes		7			86	286		1	Yes	Yes	x	With ZN-T,CO2; RP-6-C111	
Commercial/Main Floor	C112	Locker Room	VAV-C4	M3.02	AHU-C1			22.006	MS-VMA1630-0	1	1	7	x	x	x	Yes	No		6			212	212		x	Yes	x	x	With ZN-T	
Commercial/Main Floor	C131	Staff Briefing	VAV-C5	M3.02	AHU-C1			22.002	MS-VMA1615-0	1	1	8	x	x	x	No	Yes		7			195	224		1	Yes	Yes	x	With ZN-T,CO2; RP-1-C131	
Commercial/Main Floor	C120	Superintendents	VAV-C6	M3.02	AHU-C1			22.002	MS-VMA1615-0	1	1	9	x	x	x	No	Yes		7			69	231		1	Yes	Yes	x	With ZN-T,CO2; RP-5-C120	
Commercial/Main Floor	C126	Maintenance Office	VAV-C7	M3.02	AHU-C1			22.001	MS-VMA1615-0	1	1	10	x	x	x	No	No		4			17	57		x	Yes	x	x	With ZN-T	
Commercial/Main Floor	C201	Mechanical Room	VAV-C8	M3.02	AHU-C1			22.001	MS-VMA1615-0	1	1	19	x	x	x	No	No		6			189	189		x	???	x	x	ZN-T not found.Confirm Rm Number & name(M0.02)	
Commercial/Main Floor	C121	General Office Area	VAV-C9	M3.02	AHU-C1			22.005	MS-VMA1615-0	1	1	20	x	x	x	No	No		9			132	441		x	???	x	x	ZN-T not found.Confirm Rm Number & name(M0.02)	
Commercial/Main Floor	C125	CIID	VAV-C10	M3.02	AHU-C1			22.001	MS-VMA1615-0	1	1	11	x	x	x	No	No		5			35	118		x	Yes	x	x	With ZN-T	
Commercial/Main Floor	C123	Coffee Area	VAV-C11	M3.02	AHU-C1			22.004	MS-VMA1615-0	1	1	12	x	x	x	No	Yes		6			72	179		2	Yes	Yes	x	With ZN-T,CO2; RP-5-C123, RP-4-C123. Mech Dwg M3.04 shows only one Htg Valve	
Commercial/Main Floor	C119	Hallway	VAV-C12	M3.02	AHU-C1			22.007	MS-VMA1615-0	1	1	13	x	x	x	No	No		9			347	382		??	x	x	x	Exhaust VAV.Confirm Rm Number & name(M0.02)	
Commercial/Main Floor	C201	Mechanical Room	VAV-C13	M3.02	AHU-C1			22.007	MS-VMA1615-0	1	1	21	x	x	x	No	No		5			0	83		x	x	x	x	Exhaust VAV.Confirm Rm Number & name(M0.02)	
Main Port/Main Floor	M102, 103	W/C	RP-3-1					8.008	Mapped In HWS							No	No												

NOTE:
1. REFER COMMENT COLUMN FOR DETAILS.
2. FIELD VERIFY THESE COMMENTS.

Valve Schedule

Tag					Valve Information														Actuator Information		
Item	System	Service	Qty.	Ref. Dwg.	Code Number	Valve Family	Configuration	Fail Position	Inlet Pipe Size (in)	Valve Size (in)	Medium	Flow (l/s or kg/hr)	Design Delta P (kPa)	Valve Delta P (kPa)	Design Coefficient (Kv)	Valve Coefficient (Kv)	Valve Close Off (kPa)	Trim Material	Connection	Code Number	Actuator Control	
1	CHWS-C1	CH-C1ISO-C	1	M6.03	VG12A5HW+94NBGC	Ball Valve	2-Way	Valve Closed	3	3	30% Glycol	2.40	21.0	0.2	18.6	180.0	689.0	Stainless Steel	Flanged	M9220-BGC-3	24VAC On/Off	
2	CHWS-C1	CH-C2ISO-C	1	M6.03	VG12A5HW+94NBGC	Ball Valve	2-Way	Valve Closed	3	3	30% Glycol	2.40	21.0	0.2	18.6	180.0	689.0	Stainless Steel	Flanged	M9220-BGC-3	24VAC On/Off	
3	HWS-C1	HWBYPV-O	1	M3.06	VG1241CL+943GGA	Ball Valve	2-Way	Valve Closed	1-1/2	1	Water	0.50	21.0	6.5	3.5	6.3	1378.0	Brass	Threaded	VA9203-GGA-2Z	0-10VDC PROP	
4	AHU-C1	PH-O	1	M6.03	VG1841CN+943GGA	Ball Valve	3-Way	Normal Position	1-1/4	1	Water	0.80	21.0	8.1	6.2	10.0	1378.0	Brass	Threaded	VA9203-GGA-2Z	0-10VDC PROP	
5	AHU-C1	CLG-O	1	M6.03	VG1841EP+948GGA	Ball Valve	3-Way	Normal Position	2	1-1/2	Water	1.80	21.0	16.0	14.0	16.0	1378.0	Brass	Threaded	VA9208-GGA-2	0-10VDC PROP	
6	HRU-C2	HTG-O	1	M6.03	VG1841AD+943GGA	Ball Valve	3-Way	Normal Position	3/4	1/2	Water	0.10	21.0	18.2	0.9	1.0	1378.0	Brass	Threaded	VA9203-GGA-2Z	0-10VDC PROP	
7	HRU-C2	CLG-O	1	M6.03	VG1841AD+943GGA	Ball Valve	3-Way	Normal Position	3/4	1/2	Water	0.10	21.0	10.2	0.7	1.0	1378.0	Brass	Threaded	VA9203-GGA-2Z	0-10VDC PROP	
8	FC-C1	HTG-O	1	M3.03	VG1241AD+923GGA	Ball Valve	2-Way	Valve Open	3/4	1/2	Water	0.10	21.0	12.7	0.8	1.0	1378.0	Brass	Threaded	VA9203-GGA-2Z	0-10VDC PROP	
9	HUH-C1	HTG-O	1	M3.04	VG1241BG+923GGA	Ball Valve	2-Way	Valve Open	1-1/2	3/4	Water	0.40	21.0	12.7	3.1	4.0	1378.0	Brass	Threaded	VA9203-GGA-2Z	0-10VDC PROP	
10	HUH-C2	HTG-O	1	M3.04	VG1241AG+923GGA	Ball Valve	2-Way	Valve Open	3/4	1/2	Water	0.40	21.0	12.7	3.1	4.0	1378.0	Brass	Threaded	VA9203-GGA-2Z	0-10VDC PROP	
11	HUH-C3	HTG-O	1		VG1241AD+923GGA	Ball Valve	2-Way	Valve Open	3/4	1/2	Water	0.10	21.0	1.1	0.2	1.0	1378.0	Brass	Threaded	VA9203-GGA-2Z	0-10VDC PROP	
12	FFH-C1	HTG-C	1	M3.04	VG1241AD+923BGA	Ball Valve	2-Way	Valve Open	3/4	1/2	Water	0.10	21.0	12.7	0.8	1.0	1378.0	Brass	Threaded	VA9203-BGA-2	24VAC On/Off	
13	FFH-C2	HTG-C	1	M3.04	VG1241AD+923BGA	Ball Valve	2-Way	Valve Open	3/4	1/2	Water	0.10	21.0	12.7	0.8	1.0	1378.0	Brass	Threaded	VA9203-BGA-2	24VAC On/Off	
14	FFH-C3	HTG-C	1	M3.04	VG1241AD+923BGA	Ball Valve	2-Way	Valve Open	3/4	1/2	Water	0.10	21.0	12.7	0.8	1.0	1378.0	Brass	Threaded	VA9203-BGA-2	24VAC On/Off	
15	RP-1-C108	HTG-C	1	M3.04	VG1241AD+923BGA	Ball Valve	2-Way	Valve Open	1-1/4	1/2	Water	0.10	21.0	12.7	0.8	1.0	1378.0	Brass	Threaded	VA9203-BGA-2	24VAC On/Off	
16	RP-1-C131	HTG-C	1	M3.04	VG1241AD+923BGA	Ball Valve	2-Way	Valve Open	1-1/4	1/2	Water	0.10	21.0	12.7	0.8	1.0	1378.0	Brass	Threaded	VA9203-BGA-2	24VAC On/Off	
17	RP-4-C123	HTG-C (SI on RP-4, RP-5)	1	M3.04	VG1241AD+923BGA	Ball Valve	2-Way	Valve Open	1-1/2	1/2	Water	0.10	21.0	12.7	0.8	1.0	1378.0	Brass	Threaded	VA9203-BGA-2	24VAC On/Off	
18	RP-5-C107	HTG-C	1	M3.04	VG1241AD+923BGA	Ball Valve	2-Way	Valve Open	3/4	1/2	Water	0.10	21.0	12.7	0.8	1.0	1378.0	Brass	Threaded	VA9203-BGA-2	24VAC On/Off	
19	RP-5-C120	HTG-C	1	M3.04	VG1241AD+923BGA	Ball Valve	2-Way	Valve Open	1-1/2	1/2	Water	0.10	21.0	12.7	0.8	1.0	1378.0	Brass	Threaded	VA9203-BGA-2	24VAC On/Off	
20	RP-5-C123	HTG-C	1	M3.04	VG1241AD+923BGA	Ball Valve	2-Way	Valve Open	1-1/2	1/2	Water	0.10	21.0	12.7	0.8	1.0	1378.0	Brass	Threaded	VA9203-BGA-2	24VAC On/Off	
21	RP-6-C111	HTG-C	1	M3.04	VG1241AD+923BGA	Ball Valve	2-Way	Valve Open	1-1/4	1/2	Water	0.10	21.0	12.7	0.8	1.0	1378.0	Brass	Threaded	VA9203-BGA-2	24VAC On/Off	
22	VAV-C4	HTG-O	1	M3.04	VG1241AD+923GGA	Ball Valve	2-Way	Valve Open	1-1/4	1/2	Water	0.10	21.0	12.7	0.8	1.0	1378.0	Brass	Threaded	VA9203-GGA-2Z	0-10VDC PROP	
23	CHWS-M1	CH-M1ISO-C	1	M6.01	VG1241FT+958BGC	Ball Valve	2-Way	Valve Closed	2	2	30% Glycol	2.40	34.0	1.8	14.6	63.0	1378.0	Brass	Threaded	VA9208-BGC-3	24VAC On/Off	
24	CHWS-M1	CH-M2ISO-C	1	M6.01	VG1241FT+958BGC	Ball Valve	2-Way	Valve Closed	2	2	30% Glycol	2.40	34.0	1.8	14.6	63.0	1378.0	Brass	Threaded	VA9208-BGC-3	24VAC On/Off	
25	HWS-M1	HWBYPV-O	1	M2.07	VG1241BG+943GGA	Ball Valve	2-Way	Valve Closed	1-1/2	3/4	Water	0.40	34.0	12.7	2.4	4.0	1378.0	Brass	Threaded	VA9203-GGA-2Z	0-10VDC PROP	
26	AHU-M1	PH-O	1	M2.07	VG1841CN+943GGA	Ball Valve	3-Way	Normal Position	1-1/2	1	Water	1.00	34.0	12.4	6.0	10.0	1378.0	Brass	Threaded	VA9203-GGA-2Z	0-10VDC PROP	
27	AHU-M1	CLG-O	1	M2.07	VG1841FR+948GGA	Ball Valve	3-Way	Normal Position	3	2	Water	3.70	34.0	27.1	22.3	25.0	1378.0	Brass	Threaded	VA9208-GGA-2	0-10VDC PROP	
28	HRU-M2	HTG-O	1	M2.07	VG1841AE+943GGA	Ball Valve	3-Way	Normal Position	3/4	1/2	Water	0.20	21.0	12.7	1.2	1.6	1378.0	Brass	Threaded	VA9203-GGA-2Z	0-10VDC PROP	
29	HRU-M2	CLG-O	1	M2.07	VG1841AE+943GGA	Ball Valve	3-Way	Normal Position	3/4	1/2	Water	0.10	21.0	8.4	1.0	1.6	1378.0	Brass	Threaded	VA9203-GGA-2Z	0-10VDC PROP	
30	FC-M1	HTG-O	1	M2.03	VG1241AD+923GGA	Ball Valve	2-Way	Valve Open	3/4	1/2	Water	0.10	21.0	10.2	0.7	1.0	1378.0	Brass	Threaded	VA9203-GGA-2Z	0-10VDC PROP	
31	FC-M2	HTG-O	1	M2.03	VG1241BG+923GGA	Ball Valve	2-Way	Valve Open	1-1/4	3/4	Water	0.30	21.0	7.1	2.3	4.0	1378.0	Brass	Threaded	VA9203-GGA-2Z	0-10VDC PROP	
32	HUH-M1	HTG-O	1	M2.07	VG1241AD+923GGA	Ball Valve	2-Way	Valve Open	3/4	1/2	Water	0.10	21.0	1.1	0.2	1.0	1378.0	Brass	Threaded	VA9203-GGA-2Z	0-10VDC PROP	
33	FFH-M2	HTG-C	1	M2.04	VG1241AD+923BGA	Ball Valve	2-Way	Valve Open	3/4	1/2	Water	0.10	21.0	12.7	0.8	1.0	1378.0	Brass	Threaded	VA9203-BGA-2	24VAC On/Off	
34	FFH-M3	HTG-C	1	M2.04	VG1241AD+923BGA	Ball Valve	2-Way	Valve Open	3/4	1/2	Water	0.10	21.0	12.7	0.8	1.0	1378.0	Brass	Threaded	VA9203-BGA-2	24VAC On/Off	
35	FFH-M4	HTG-C	1	M2.04	VG1241AD+923BGA	Ball Valve	2-Way	Valve Open	3/4	1/2	Water	0.10	21.0	12.7	0.8	1.0	1378.0	Brass	Threaded	VA9203-BGA-2	24VAC On/Off	
36	FFH-M5	HTG-C	1	M2.04	VG1241AD+923BGA	Ball Valve	2-Way	Valve Open	3/4	1/2	Water	0.10	21.0	12.7	0.8	1.0	1378.0	Brass	Threaded	VA9203-BGA-2	24VAC On/Off	
37	RP-2-M102	HTG-C	1	M2.04	VG1241AD+923BGA	Ball Valve	2-Way	Valve Open	3/4	1/2	Water	0.10	21.0	12.7	0.8	1.0	1378.0	Brass	Threaded	VA9203-BGA-2	24VAC On/Off	
38	RP-3-M111	HTG-C	1	M2.04	VG1241AD+923BGA	Ball Valve	2-Way	Valve Open	3/4	1/2	Water	0.10	21.0	12.7	0.8	1.0	1378.0	Brass	Threaded	VA9203-BGA-2	24VAC On/Off	
39	RP-3-M151	HTG-C	1	M2.04	VG1241AD+923BGA	Ball Valve	2-Way	Valve Open	3/4	1/2	Water	0.10	21.0	12.7	0.8	1.0	1378.0	Brass	Threaded	VA9203-BGA-2	24VAC On/Off	
40	RP-4-M135	HTG-C (2 RPs)	2	M2.04	VG1241AD+923BGA	Ball Valve	2-Way	Valve Open	3/4	1/2	Water	0.10	21.0	12.7	0.8	1.0	1378.0	Brass	Threaded	VA9203-BGA-2	24VAC On/Off	
41	RP-4-M141	HTG-C	1	M2.04	VG1241AD+923BGA	Ball Valve	2-Way	Valve Open	3/4	1/2	Water	0.10	21.0	12.7	0.8	1.0	1378.0	Brass	Threaded	VA9203-BGA-2	24VAC On/Off	
42	RP-5-M134	HTG-C	1	M2.04	VG1241AD+923BGA	Ball Valve	2-Way	Valve Open	3/4	1/2	Water	0.10	21.0	12.7	0.8	1.0	1378.0	Brass	Threaded	VA9203-BGA-2	24VAC On/Off	
43	RP-5-M138	HTG-C	1	M2.04	VG1241AD+923BGA	Ball Valve	2-Way	Valve Open	3/4	1/2	Water	0.10	21.0	12.7	0.8	1.0	1378.0	Brass	Threaded	VA9203-BGA-2	24VAC On/Off	
44	RP-5-M140	HTG-C	1	M2.04	VG1241AD+923BGA	Ball Valve	2-Way	Valve Open	3/4	1/2	Water	0.10	21.0	12.7	0.8	1.0	1378.0	Brass	Threaded	VA9203-BGA-2	24VAC On/Off	
45	RP-5-M150	HTG-C	1	M2.04	VG1241AD+923BGA	Ball Valve	2-Way	Valve Open	3/4	1/2	Water	0.10	21.0	12.7	0.8	1.0	1378.0	Brass	Threaded	VA9203-BGA-2	24VAC On/Off	
46	VAV-M5	HTG-O	1	M2.04	VG1241AE+923GGA	Ball Valve	2-Way	Valve Open	3/4	1/2	Water	0.10	21.0	9.7	1.1	1.6	1378.0	Brass	Threaded	VA9203-GGA-2Z	0-10VDC PROP	
9	HUH-C1	HTG-O	1	M3.04	VG1241BG+923GGA	Ball Valve	2-Way	Valve Open	1-1/2	3/4	Water	0.40	21.0	12.7	3.1	4.0	1378.0	Brass	Threaded	VA9203-GGA-2Z	0-10VDC PROP;4-20mA PROP	

APPENDIX B
BGIS WORK PERMIT FORM

HEALTH AND SAFETY WORK PERMIT

PURPOSE: To increase safety and security, all work activities managed by BGIS, PSPC, or Tenants that require contractor access to any part of BGIS managed facilities must have a Work Permit.

INSTRUCTION:
1. Fill in all relevant fields completely. Permits with blank fields may be rejected.
2. E-mail the completed Permit to the email address listed for your region on the final page of this document.
3. Await authorization from BGIS prior to commencing work.
4. Retain a hard or soft copy of the authorized Work Permit. An authorized Work Permit must be available on site every day for the duration of this job or project.

NOTE: To ensure timely authorization, please submit the Work Permit **at least 2 Full Working Days** prior to the anticipated start time of work activities.
Permits are only issued for 1 week time blocks. Longer work requires multiple permits. **ANY change to work requires a new permit**
All Workers need to complete BGIS online orientation. (Available via Comply Works or through HSE Coordinator).

LOCATION OF THE WORK

Province / Territory: City:

Floor/ Room Number:

Building (Name or Address):

WORK INITIATOR (BUYER OF SERVICE)

Work Requested By (Name of Person):

Work Order # or Project # (If Applicable):

DATES OF WORK		WORK HOURS						
☐ Day Time	☐ After Hours	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Start Date								
End Date								

WORK DESCRIPTION - (Provide a detailed description of the work to be conducted. Attach a job safety plan as appropriate)

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RISK ASSESSMENT

Please note, this Risk Assessment is not intended to replace a Job Safety Assessment (JSA). "Controls" as identified are intended as prompts for the permit authorizer. The permit holder is responsible for conducting a proper JSA and safety briefing to the workers prior to the commencement of the work and implementing any additional controls that may be required specific to the work task.

	Work Consideration	Yes/No	If Yes, See Associated Control
1.	Have Building Specific OHS Documents & Hazards (including asbestos surveys/hazardous substances surveys) been reviewed by those conducting work?		A
2.	Will asbestos / other hazardous materials be disrupted during work activities?		A, B,K
3.	Will the work create dust, smoke, heat, vibration or otherwise impact the Fire Life Safety System?		C, G, H, I, J
4.	Will building systems be impacted or impaired (Fire Life Safety, HVAC, lighting, elevator, etc.)?		E
5.	Involves electrical or mechanical disruption?		B, E, H
6.	Requires energy isolation?		B, H, I
7.	Requires work from heights (excluding ladders)?		B, G, H, I
8.	Will the work involve ladders or work platforms?		L
9.	Requires access to a secure area where escort may be needed?		F
10.	Requires access to a "Confined" or "Restricted" Space?		B, G, H, I
11.	Workers have all licenses, training, and tools needed to perform task?		I
12.	Could generate noise?		K
13.	Could generate odours?		C, K, M
14.	Requires obstruction of building access or egress?		K, D, G
15.	Involves working around or with hazardous chemicals?		B, M
16.	Work taking place at heritage site?		N
17.	Workers conducting work have reviewed all BGIS Covid-19 Supplier Requirements Updates?		B, O

	Controls
A.	Review of Asbestos Survey / BGIS Document Library required.
B.	Specialized Personal Protective Equipment and Work Procedures required.
C.	System Bypass Permit.
D.	Security Coverage required.
E.	Shutdown Notice required.
F.	Additional Clearance or Authorized Escort required.
G.	Safety Barriers required.
H.	Additional High Hazard Permit required (Confined Space, LOTO, etc.).
I.	Additional License or Certifications required (Confined Space, Fall Arrest, etc.).
J.	Notify Fire Department / Fire Alarm Monitoring Company.
K.	Tenant Notification or Escort required.
L.	Ensure the Ladder/Work Platform is on a stable surface and is set up and used according to manufacture specifications.
M.	Ensure SDS are available.
N.	Conservation Plan required.
O.	Ensure Established Protocols are in place and available for Covid-19 that align with Public Health Canada Guidelines.

Permit Holder/ Contractor Details

Company Name:	
Permit Holder (Site Supervisor):	
Permit Holder Contact Number:	
Permit Holder Email:	
Names of All Workers to be on site (attach separate list if required):	

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BGIS HS REVIEW

Name of Reviewer:			
Date of Review:		Authorized:	
Comments:	We thank you for your service during this challenging time and ask that your team remain diligent with the latest health authority guidance around COVID 19 when on site, this would include maximizing the use of phone calls with our onsite maintenance Technician rather than face to face where possible. Our Maintenance teams have been asked to keep their office doors closed to reinforce social distancing while we all work through this pandemic.		

BGIS BUYER OF SERVICE REVIEW

Name of Reviewer:			
Date of Review:		Authorized:	
Comments:			

EMAIL COMPLETED WORK PERMIT TO THE ADDRESS LISTED FOR YOUR REGION

Region	Region Description	Email Address
Atlantic	Newfoundland, PEI, NB, NS	ATL-RP1workpermit@BGIS.com
Quebec	Quebec (Other Than Gatineau)	QC-RP1workpermit@BGIS.com
National Capital Area	Ottawa, Gatineau	NCA-RP1workpermit@BGIS.com
Ontario	Ontario (Other Than Ottawa)	ON-RP1workpermit@BGIS.com
Western	Manitoba, Saskatchewan, Alberta, NWT, Nunavut	WEST-RP1workpermit@BGIS.com
Pacific	British Columbia, Yukon	PAC-RP1workpermit@BGIS.com

Questions regarding the Work Permit process can be sent to the region-specific email address

APPENDIX C
PRELIMINARY HAZARD ASSESSMENT FORM

Public Works and Government Services Canada | Travaux publics et Services gouvernementaux Canada

GULF of GEORGIA CANNERY PRELIMINARY HAZARD ASSESSMENT FORM

Project Number:	R.106124.001
Location:	10 Highway 13, Aldergrove, BC, V4W 2L8
Date:	March 20, 2019
Name of Departmental Representative:	Kai Mark
Name of Client:	CBSA
Name of Client Project Co-ordinator	Michelle Copland PH: ( )- -

Site Specific Orientation Provided at Project Location ☐ **Yes**

Notice of Project Required ☐ **Yes**

NOTE:
PWGSC REQUIRES A Notice of Project FOR ALL CONSTRUCTION WORK RELATED ACTIVITIES

NOTE:
OHS law is made up of many municipal, provincial, and federal acts, regulations, bylaws and codes. There are also many other pieces of legislation in British Columbia that impose OHS obligations.

Important Notice: This hazard assessment has been prepared by PSPC for its own project planning process, and to inform the service provider of actual and potential hazards that may be encountered in performance of the work. PSPC does not warrant the completeness or adequacy of this hazard assessment for the project and the paramount responsibility for project hazard assessment rests with the service provider.

TYPES OF HAZARDS TO CONSIDER	Potential Risk for:				COMMENTS
Examples: Chemical, Biological, Natural, Physical, and Ergonomic Listed below are common construction related hazards. Your project may include pre-existing hazards that are not listed. Contact the Regional Construction Safety Coordinator for assistance should this issue arise.	**PWGSC, OGD's, or tenants**		**General Public or other contractors**		Note: When thinking about this pre-construction hazard assessment, remember a **hazard** is anything that may cause harm, such as chemicals, electricity, working from heights, etc; the **risk** is the chance, high or low, that somebody could be harmed by these and other hazards, together with an indication of how serious the harm could be.
	Yes	**No**	**Yes**	**No**	

Typical Construction Hazards					
Concealed/Buried Services (electrical, gas, water, sewer etc)	yes				
Slip Hazards or Unsound Footing	yes				
Working at Heights		no			
Working Over or Around Water		no			
Heavy overhead lifting operations, mobile cranes etc.	yes				

Canada

Marine and/or Vehicular Traffic (site vehicles, public vehicles, etc.	yes				
Fire and Explosion Hazards	yes				
High Noise Levels	yes				
Excavations		no			
Blasting		no			
Construction Equipment	yes				
Pedestrian Traffic (site personnel, tenants, visitors, public)	yes				
Multiple Employer Worksite	yes				Example: Contractor working in an occupied Federal Employee space.

Electrical Hazards					**Comments**
Contact With Overhead Wires		no			
Live Electrical Systems or Equipment	yes				
Other:					
Physical Hazards					
Equipment Slippage Due To Slopes/Ground Conditions		no			
Earthquake	yes				
Tsunami	yes				
Avalanche		no			
Forest Fires		no			
Fire and Explosion Hazards	yes				
Working in Isolation	yes				
Working Alone	yes				
Violence in the Workplace	yes				
High Noise Levels	yes				
Inclement weather	yes				
High Pressure Systems		no			
Other:					
Hazardous Work Environments					
Confined Spaces / Restricted Spaces PSPC employees do not enter confined space.		no			If available, provide the contractor with the existing confined space assessment(s) for information only. Contractor must perform their own confined space assessment as per provincial regulations.
Suspended / Mobile Work Platforms		no			
Other:					
Biological Hazards					
Mould Proliferations		no			
Accumulation of Bird or Bat Guano		no			
Bacteria / Legionella in Cooling Towers / Process Water		no			
Rodent / Insect Infestation		no			
Poisonous Plants		no			
Sharp or Potentially Infectious Objects in Wastes		no			

Wildlife	yes				
Chemical Hazards					
Asbestos Materials on Site		no			If “yes” a pre-project asbestos survey report is required. Provide Contractor with ELF Form 16 “Contractor Notification and Acknowledgement”
Designated Substance Present		no			If “yes” a pre-project designated substance survey report is required.
Chemicals Used in work		no			
Lead in paint		no			If “yes” a pre-project lead survey report is required.
Mercury in Thermostats or Switches		no			If “yes” a pre-project mercury survey report is required.
Application of Chemicals or Pesticides		no			
PCB Liquids in Electrical Equipment		no			
Radioactive Materials in Equipment		no			
Other:					
Contaminated Sites Hazards					
Hazardous Waste		no			
Hydrocarbons		no			
Metals		no			
Other:					

Security Hazards					**Comments**
Risk of Assault	yes				
Other:					
Other Hazards					

Other Compliance and Permit Requirements[1]	**YES**	**NO**	**Notes / Comments**[2]
Is a Building Permit required?	**yes**		
Is an Electrical permit required?		**no**	
Is a Plumbing Permit required?		**no**	
Is a Sewage Permit required?		**no**	
Is a Dumping Permit required?		**no**	
Is a Hot Work Permit required?	**TBD**		
Is a Permit to Work required?	**yes**		BGIS (property manager) work permet
Is a Confined Space Entry Permit required?		**no**	
Is a Confined Space Entry Log required		**no**	
Discharge Approval for treated water required	**yes**		

Notes:

(1) Does not relieve Service Provider from complying with all applicable federal, provincial, and municipal laws and regulations.

(2) TBD means To Be Determined by Service Provider.

Service Provider Acknowledgement: We confirm receipt and review of this Pre-Project Hazard Assessment and acknowledge our responsibility for conducting our own assessment of project hazards, and taking all necessary protective measures (which may exceed those cited herein) for performance of the work.			
Service Provider Name			
Signatory for Service Provider		**Date Signed**	
RETURN EXECUTED DOCUMENT TO PSPC DEPARTMENTAL REPRESENTATIVE PRIOR TO ANY WORK COMMENCING			