Public Works and Government Services Canada

Requisition No. EZ899-170635

DRAWINGS & SPECIFICATIONS
for

Mission Medium Institution
Hobby Shop Dust Extraction and HVAC Upgrade

R.076034.001

APPROVED BY:

Regional Manager, AES — Date: 2016-06-09

Construction Safety Coordinator — Date: 2016 05 30

TENDER:

Project Manager — Date: June 10, 2016

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

Discipline	**Seal / Signature / Date**
Mechanical (Prime)	PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA J.H. NG 25038 JUNE 6, 2016.
Electrical	PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA M. J. FOURIE # 21736 June 6, 2016
Structural	PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA M. C. H. KAN # 33204 June 6

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PART 1 GENERAL

1.1 SUMMARY OF WORK

.1 Work covered by Contract Documents:

.1 This Contract covers the following work at the Mission Medium Institution in Mission, BC.

.2 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 phasing. This detailed work plan shall be submitted to the Departmental Representative for review to verify that there will be no interruption of service.

.2 Do not start work until all essential equipment is delivered to the site and the work can proceed without delays.

.3 Provide as-built drawings and closeout submittals.

.4 Refer to Section 01 11 00 Summary of Work.

.3 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.

.2 Vehicular access will be restricted during the inmate "count" at breakfast, lunch and dinner hours. Confirm times with Departmental Representative. Delays may occur when entering and exiting the Institution with vehicles due to security situations and heavy traffic.

1.2 WORK RESTRICTIONS

.1 Service Interruptions

.1 Notify Departmental Representative of intended interruption of power, 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.

.2 Access & Egress: Provide for access by pedestrian and vehicular traffic on and around site where work is in progress.

.3 Use of Site and Facilities

.1 Execute work with least possible interference or disturbance. Make arrangements with Departmental Representative to facilitate work as stated.

.2 Maintain existing services where indicated and provide for personnel and vehicle access.

.3 Where security is reduced by Work, provide temporary means to maintain security.

.4 Contractor to provide sanitary facilities. Keep facilities clean.

.5 Closures: protect Work temporarily until permanent enclosures are completed.

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

.6 Hours of work:

.1 Perform work during normal working hours of the Institution 07:30 to 16:00, Monday through Friday except holidays.

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

1.3 CONSTRUCTION WORK SCHEDULE

.1 Commence work immediately upon official notification of acceptance of offer and complete the work within 22 weeks from the date of such notification.

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

.5 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.

1.4 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 Number of viewpoints: four (4), locations of viewpoints directed by Departmental Representative.

.3 Frequency: monthly, submitted on disk with monthly progress statement, sent via e-mail or as directed by Departmental Representative.

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

.3 Final Photographs:

.1 Provide digital photographs with images of minimum 3.1 mega pixel resolution and stored in Jpeg format with minimal compression. Where photos are e-mailed compression can be increased.

.2 Number of viewpoints:

.1 Each side of building for a total of 4.

.2 Interior of rooms and finishes for a total of 8.

.3 Locations of viewpoints determined by Departmental Representative.

.3 Submit final photographs in digital format on CD, before final acceptance of building.

.4 Label disks and identify with name and project number of project. Indicate exposure dates and viewpoints of each photo and photo number.

.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.

1.5 HEALTH AND SAFETY

.1 Specified in Section 01 35 33.

1.6 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.

1.7 REGULATORY REQUIREMENTS

.1 References and Codes:

.1 Perform Work in accordance with National Building Code of Canada (NBCC2010) and where applicable British Columbia Building Code (BCBC2012) 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.

1.8 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.

.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.

1.9 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.

.6 Fire Protection:

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

1.10 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.

.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.

1.11 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 CSC Property:

.1 Protect surrounding CSC 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.

1.12 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.

.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 for substitution may only be submitted after Contract award. Such request must include statements of respective costs of items originally specified and the proposed substitution.

.3 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.

.4 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.

.5 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.

1.13 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.

1.14 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.

1.15 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.

1.16 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.

1.17 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 Fire alarm verification report per CAN/ULC-S537, confirmation of proper installation of fire alarm panel to CAN/ULC-S527 signed off by the fire alarm technician and confirmation of fire alarm emergency power capacity. 24-hour battery test as described in CAN/ULC-S537, signed off by fire alarm technician.

.5 Confirmation of emergency power lighting, operating on emergency power for the required amount of time as dictated by NBCC, signed off by technician.

.6 Certificates required by Authority Having Jurisdictions for fire protection systems.

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

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

.9 Work is complete and ready for Final Inspection.

.10 Draft O&M manuals have been submitted.

.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.

1.18 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) sets of CD's in AutoCad file format (version: 2014) with all as-built information on the diskettes.

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

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

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

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

.6 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 Maintenance manual:

.1 On completion of project submit to Departmental Representative four (4) CD R/ disk copies and four (4) paper copies (in loose leaf type binder) of Operations and Maintenance Manual, made up as follows:

.1 Provide maintenance manual on CDs using pdf, 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 CSI Masterformat numbering system or other approved descriptive titles.

.3 Label disk "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.

.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 Manual specified in Clause 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.

1.19 DEMONSTRATION AND TRAINING

.1 Demonstration and Training (See Section 01 91 41):

.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.

1.20 GENERAL COMMISSIONING

.1 Commissioning (See Section 01 91 13).

.2 Commission installed systems prior to Demonstration and Training.

END OF SECTION

Part 1 General

1.1 WORK COVERED BY CONTRACT DOCUMENTS

.1 Work of this Contract includes:

.1 Demolition and/or removal of existing HVAC and dust collection systems, equipment, and related items currently serving the "Hobby Shop" and adjacent spaces.

.2 The installation of a new dust extraction system for the "Hobby Shop".

.3 The installation of a new rooftop air handling unit, pressure differential sensor and pressurization fan to serve the "Hobby Shop".

.4 The installation of a new rooftop air handling unit to serve the adjacent spaces.

.5 The installation of new exhaust fans serving the following adjacent spaces:

.1 Native Area (Smudging Room)

.2 Storage Room and Tool Storage Room

.3 Leather Room

.4 Electrical Room

.5 Barber Shop

.6 Canteen

At the Mission Medium Institution in Mission, BC and further identified as the "Work".

1.2 WORK SEQUENCE

.1 Construction period shall be determined in coordination with the Departmental Representative.

.2 Maintain fire access/control.

1.3 CONTRACTOR USE OF PREMISES

.1 Access to this site is restricted and will need to be coordinated with the facility's site officer to perform the work.

.2 Co-ordinate use of premises under direction of Departmental Representative.

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

1.4 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.

1.5 DOCUMENTS REQUIRED

.1 Maintain at job site, one copy each document as follows:

.1 Contract Drawings.

.2 Specifications.

.3 Addenda.

.4 Reviewed Shop Drawings.

.5 List of Outstanding Shop Drawings.

.6 Change Orders.

.7 Other Modifications to Contract.

.8 Field Test Reports.

.9 Copy of Approved Work Schedule.

.10 Health and Safety Plan and Other Safety Related Documents.

.11 Other documents as specified.

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

PART 1 GENERAL

1.1 Purpose

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

1.2 Purpose

.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, $25.00, and

.5 any item not described in paragraphs (a) to (d) that could jeopardize the security of a Penitentiary 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 "CSC" means Correctional Service Canada.

.5 "Director" means Director or Warden of the Institution as applicable or their representative.

.6 "Construction employees" means persons working for the general contractor, the sub-contractors, equipment operators, material suppliers, testing and inspection companies and regulatory agencies.

.7 "Departmental Representative" means the Public Works and Government Services Canada representative defined in General Conditions.

.8 "Perimeter" means the fenced or walled area of the institution that restrains the movement of the inmates.

.9 "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 institution. 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 institution's particular requirements.

.2 The Contractors' responsibilities:

.1 Ensure that all construction employees are aware of the CSC security requirements.

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

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

1.4 Construction Employees

.1 Submit CPIC form and scanned copy of government issued ID for each employee to the Departmental Representative.

.2 Allow 10 working days for processing of security clearances. Employees will not be admitted to the Institution without a valid security clearance in place and a recent picture identification such as a provincial driver's license. Security clearances obtained from other CSC institutions are not valid at this institution except as approved otherwise.

.3 The Director may require that facial photographs may be taken of construction employees and these photographs may be displayed at appropriate locations in the institution or in an electronic database for identification purposes. The Director may require that Photo ID cards be provided for all construction workers. ID cards will then be left at the designated entrance to be picked upon arrival at the institution and shall be displayed prominently on the construction employees clothing at all time while employees are at the institution.

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

.5 Any person employed on the construction site will be subject to immediate removal from Institutional Property if they:

.1 appear to be under the influence of alcohol, drugs or narcotics.

.2 behave in an unusual or disorderly manner.

.3 are in possession of contraband.

1.5 Vehicles

.1 All unattended vehicles on CSC property 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.

.2 The director may limit at any time the number and type of vehicles allowed within the Institution.

.3 Drivers of delivery vehicles for material required by the project will require security clearances and must remain with their vehicle the entire time that the vehicle is in the Institution. The director may require that these vehicles be escorted by Institutional staff or PWGSC Construction Escorts while in the Institution.

.4 If the Director permits trailers to be left inside the secure perimeter of the Institution, the trailer doors must be locked at all times. All windows must be securely locked bars when left unoccupied. Cover all windows with expanded metal mesh. When not in use lock all storage trailers located inside and outside the perimeter. All storage trailers inside and outside the perimeter must be locked when not in use.

1.6 Parking

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

1.7 Shipments

.1 To avoid confusion with the institution'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. CSC or PWGSC 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 Institution perimeter unless prior approved by the Director.

.2 The Director will ensure that approved telephones, facsimile machine and computers with Internet connections are located where they are not accessible to inmates. All computers will have an approved password protection that will stop an Internet connection to unauthorized personnel.

.3 Wireless cellular and digital telephones, including but not limited to devices for telephone messaging, pagers, Blackberries, PDAs, telephone used as 2-way radios are not permitted within the Institution unless approved by the Director. If wireless cellular telephones are permitted, the user will not permit their use by any inmate.

.4 The Director may approve but limit the use of 2-way radios.

1.9 Work Hours

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

.2 Work is not permitted during weekends and statutory holidays without the permission of the Director. 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 waved by the Director.

1.10 Overtime Work

.1 Conform to Division 1.

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

1.11 Tools and Equipment

.1 Maintain a complete list of all tools and equipment to be used during the construction project. Make this inventory available for inspection when required by the Institution.

.2 Throughout the construction project maintain up-to-date the list of tools and equipment specified above.

.3 Keep all tools and equipment under constant supervision, particularly power-driven and cartridge-driven tools, cartridges, files, saw blades, rod saws, wire, rope, ladders and any sort of jacking device.

.4 Store all tools and equipment in approved secure locations.

.5 Lock all tool boxes when not in use. Keys to remain in the possession of the employees of the contractor. Secure and lock scaffolding when not erected and when erected Secure in a manner agreed upon with the Institution designate.

.6 Report all missing or lost tools or equipment immediately to the Departmental Representative/Director.

.7 The Director will ensure that the security staff members carry out checks of the Contractor's tools and equipment against the list provided by the Contractor. These checks may be carried out at the following intervals:

.1 At the beginning and conclusion of every work day or shift upon entering and exiting the Institution.

.2 At any time when contractor is on Institution property.

.8 Certain tools/equipment such as cartridges and hacksaw blades are highly controlled items. The contractor will be given at the beginning of the day, a quantity that will permit one day's work. Used blades/cartridges will be returned to the Director's representative at the end of each day. Maintain up to date inventory of all used blades/cartridges.

.9 If propane or natural gas is used for heating the construction, the institution will require that the contractor supervise the construction site during non-working hours.

1.12 Keys

.1 Security Hardware Keys.

.1 Arrange with the security hardware supplier/installer to have the keys for the security hardware to be delivered directly to Institution, specifically the Security Maintenance Officer (SMO).

.2 The SMO will provide a receipt to the Contractor for security hardware keys.

.3 Provide a copy of the receipt to the Departmental Representative.

.2 Other Keys

.1 Use standard construction cylinders for locks for his use during the construction period.

.2 Issue instructions to employees and sub-trades, as necessary, to ensure safe custody of the construction set of keys.

.3 Upon completion of each phase of the construction, the CSC representative will, in conjunction with the lock manufacturer:

.1 Prepare an operational keying schedule

.2 Accept the operational keys and cylinders directly from the lock manufacturer.

.3 Arrange for removal and return of the construction cores and install the operational core in all locks.

.4 Upon putting operational security keys into use, the PWGSC construction escort will obtain these keys as they are required from the SMO and open doors as required by the Contractor. The Contractor shall issue instructions to his employees advising them that all security keys shall always remain with the PWGSC construction escort.

1.13 Security Hardware

.1 Turn over all removed security hardware to the Director of the Institution for disposal or for safekeeping until required for re-installation.

1.14 Prescription Drugs

.1 Employees of the contractor who are required to take prescription drugs during the workday shall obtain approval of the Director to bring a one day supply only into the Institution.

1.15 Smoking Restrictions

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

.2 Persons in violation of this policy will be requested to immediately cease smoking or dispose of any unauthorized smoking items and, if they persist will be directed to leave the Institution.

.3 Smoking is permitted outside the perimeter of a correctional facility in an area designated by the Director.

1.16 Contraband

.1 Weapons, ammunition, explosives, alcoholic beverages, drugs and narcotics are prohibited on institutional property.

.2 The discovery of contraband on the construction site and the identification of the person(s) responsible for the contraband shall be reported immediately to the Director.

.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 Institution for the duration of the construction.

.4 Presence of arms and ammunition in vehicles of contractors, sub-contractors and suppliers or employees of these will result in the immediate cancellation of security clearances for the driver of the vehicle.

1.17 Searches

.1 All vehicles and persons entering institutional property may be subject to search.

.2 When the Director suspects, on reasonable grounds, that an employee of the Contractor is in possession of contraband, he may order that person to be searched.

.3 All employees entering the Institution may be subject to screening of personal effects for traces of contraband drug residue.

1.18 Access and Removal from Institution Property

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

1.19 Movement Vehicles

.1 Construction vehicles are not to leave the Institution until an inmate count is completed. Escorted commercial vehicles will be allowed to enter or leave the institution through the vehicle access gate during the following hours:

.1 AM: 0745 hrs. to 1100 hrs.

.2 PM: 1300hrs. to 1530 hrs.

.2 The contractor will advise the Director twenty four (24) hours in advance to the arrival on the site of heavy equipment such as concrete trucks, cranes, etc.

.3 Vehicles being loaded with soil or other debris, or any vehicle considered impossible to search, must be under continuous supervision by CSC staff or PWGSC construction escorts working under the authority of the Director.

.4 Commercial vehicles will only be allowed access to institutional property when their contents are certified by the Contractor or his representative as being strictly necessary to the execution of the construction project.

.5 Vehicles will be refused access to institutional property if, in the opinion of the Director, they contain any article which may jeopardize the security of the institution. Arrange with Director for parking of contractors vehicles. .6 Private vehicles of construction employees will not be allowed within the security wall or fence without the authorization of the Director.

.7 With the approval of the Director, certain equipment may be permitted to remain on the construction site overnight or over the weekend. This equipment must be securely locked, with the battery removed. The Director may require that the equipment be secured with a chain and padlock to another solid object.

1.20 Movement of Construction Employees on Institutional Property

.1 Subject to the requirements of good security, the Director will permit the Contractor and his employees as much freedom of action and movement as is possible.

.2 However, notwithstanding paragraph above, the Director may:

.1 Prohibit or restrict access to any part of the institution.

.2 Require that in certain areas of the institution, either during the entire construction project or at certain intervals, construction employees only be allowed access when accompanied by a member of the CSC security staff or PWGSC Construction Escort Officer.

.3 During the lunch and coffee/health breaks, all construction employees will remain within the construction site. Construction employees are not permitted to eat in the Institution cafeteria and dining room.

1.21 Surveillance and Inspection

.1 Construction activities and all related movement of personnel and vehicles will be subject to surveillance and inspection by CSC security staff members to ensure that established security requirements are met.

.2 CSC staff members will ensure that an understanding of the need to carry out surveillance and inspections, as specified above, is established among construction employees and maintained throughout the construction project.

1.22 Stoppage of Work

.1 The director 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 occurring within the Institution. 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.

1.23 Contact with Inmates

.1 Unless specifically authorized, it is forbidden to come into contact with inmates, to talk with them, to receive objects from them or to give them objects. Any employee doing any of the above will be removed from the site and his security clearance revoked.

.2 Digital cameras (or any other type) are not allowed on CSC property.

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

1.24 Completion of Construction Project

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

END OF SECTION

PART 1 - GENERAL

1.1 References

.1 Government of Canada.

.1 Canada Labour Code - Part II

.2 Canada Occupational Health and Safety Regulations.

.2 National Building Code of Canada (NBC):

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

.3 Canadian Standards Association (CSA) as amended:

.1 CSA Z797-2009 (R2014) Code of Practice for Access Scaffold

.2 CSA S269.1-2016 Falsework & Framework

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

.4 National Building Code of Canada (NBCC 2010):

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

.5 American National Standards Institute (ANSI):

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

.6 Province of British Columbia:

.1 Workers Compensation Act Part 3-Occupational Health and Safety.

.2 Occupational Health and Safety Regulation

1.2 Related Sections

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

.1 Section 00 01 50 General Requirements

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 00 01 50.

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

.3 Submit the following:

.1 Health and Safety Plan.

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

.3 Copies of incident and accident reports.

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

.5 Emergency Procedures.

.4 The Departmental Representative will review the Contractor's site-specific project Health and Safety Plan and emergency procedures, and provide comments to the Contractor within 10 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 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, Territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.7 Health and Safety Coordinator

.1 The Health and Safety Coordinator (Registered Occupational Hygienist, Certified Industrial Specified Hygienist) must:

.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 Health and Safety Plan.

.3 Be on site during execution of work.

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 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.

1.10 Work Permits

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

1.11 Filing of Notice

.1 The General Contractor is to complete and submit a Notice of Project as required by Provincial authorities.

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

1.12 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 a site-specific project Health and Safety Plan based on 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.

.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.

.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 Health and Safety Plan as required, and re-submit to the Departmental Representative.

.5 Departmental Representative's review: the review of 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 Health and Safety Plan or of responsibility for meeting all requirements of construction and Contract documents.

1.13 Emergency Procedures

.1 List standard operating procedures and measures to be taken in emergency situations. Include an 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.

.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.

1.14 Hazardous Products

.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials, and regarding labeling and provision of Material 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 documents as per Section 00 01 50 General Instructions (CSC)

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

1.15 Electrical Safety Requirements

.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 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.

1.16 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.

1.17 Overloading

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

1.18 Falsework

.1 Design and construct falsework in accordance with CSA S269.1.

1.19 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 and BC Occupational Health and Safety Regulations.

1.20 Confined Spaces

.1 Carry out work in confined spaces in compliance with Provincial regulations.

1.21 Power-Actuated Devices

.1 Use power-actuated devices in accordance with ANSI A10.3 only after receipt of written permission from the Departmental Representative.

1.22 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.

1.23 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.

1.24 Fire Protection and Alarm System

.1 Do not obstruct, shut-off or leave inactive at the end of a working day or shift, the fire protection and alarm systems.

.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.

1.25 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 advise the Departmental Representative verbally and in writing.

1.26 Posted Documents

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

.1 Health and Safety Plan.

.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 are 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) 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.

.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.

1.27 Meetings

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

1.28 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 non-compliance 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".

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 performance verification of components, equipment, sub-systems, systems, and integrated systems.

.2 Related Requirements

.1 Section 01 91 41 Demonstration and Training

.2 Section 23 08 00 Mechanical Commissioning

.3 Section 26 05 00 Common Work Results for Electrical

.3 Acronyms:

.1 Cx - Commissioning

.2 CxAg – Commissioning Agent (appointed by Mech. Contractor)

.3 CxMgr – Commissioning Manager (appointed by Prime Contractor)

.4 BMS – Building Management Systems

.5 O M – Operating and Maintenance (staff)

.6 OMM - Operation and Maintenance Manuals

.7 PI - Product Information

.8 PV - Performance Verification

.9 TAB - Testing, Adjusting and Balancing.

1.2 REFERENCES

.1 CSA Standard Z320 -2011 Building Commissioning

.2 ASHRAE Standard 202-2013 Commissioning Process for Buildings and Systems

1.3 DEFINITIONS

.1 Contractor's Commissioning Agent (CxAg) – a specialist retained by the mechanical contractor to execute mechanical commissioning activities. Respectively, an electrical commissioning agent may be retained depending on the electrical project requirements.

.2 Prime Contractor's Commissioning Manager (CxMgr) – an individual appointed by the prime contractor to manage the daily commissioning activities occurring within the general contract. Typically this role is merged in with the Prime contractor's site supervisor, and relevant

commissioning activities are delegated to the mechanical commissioning agent.

.3 Commissioning Team – the group responsible for planning, implementing and executing the commissioning activities throughout the project phases. The commissioning team will typically include the Commissioning Agents, Commissioning Manager, sub-contractors, equipment suppliers, O&M personnel, Owner's Representative, and Departmental Representative.

1.4 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 OMM.

.3 Effectively train O M staff.

.2 Contractor(s) 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 operated interactively with each other as intended in accordance with Contract Documents and design criteria.

.2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.

.3 Design Criteria: as per client's requirements or determined by the design consultant, to meet the Project functional and operational requirements.

.4 Commissioning Manager and Commissioning Agent(s) shall coordinate their commissioning activities to avoid redundancy and inefficiencies.

.5 Commissioning Manager (prime contractor) shall be the main point of contact for daily management of all commissioning activities, and shall be responsible for ensuring all activities and deliverables are collected and submitted as described herein.

1.5 COMMISSIONING OVERVIEW

.1 Cx activities supplement field quality and testing procedures described in

relevant technical sections.

.2 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues which are addressed during Construction and Cx stages to ensure the built systems are 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.

.3 Commissioning is not complete until:

.1 Completed Cx documentation has been received, reviewed for suitability.

.2 Testing & Balancing is complete.

.3 Equipment, components and systems have been commissioned.

.4 O M training has been completed.

1.6 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, including related systems as deemed required 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 the Contractor. Above costs to be in form of progress payment reductions or hold-back assessments.

1.7 PRE-CX REVIEW

.1 At the early start of Construction:

.1 Review contract documents for

.1 Adequacy of provisions for Cx.

.2 Aspects of design and installation pertinent to success of Cx.

.2 During Construction:

.1 Co-ordinate provision, location and installation of provisions for Cx.

.3 Before start of Cx:

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

.2 Ensure installation of related components, equipment, sub-systems, and systems are 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 for review.

.7 Have Cx schedules up-to-date.

.8 Ensure systems have been cleaned thoroughly.

.9 Complete TAB procedures on systems, submit TAB reports for review.

.10 Ensure "As-Built" system schematics are available.

.4 Inform Consultant in writing of discrepancies and deficiencies on finished works.

1.8 CONFLICTS

.1 Report conflicts between requirements of this section and other sections before start-up and obtain clarification.

.2 Failure to report conflict and obtain clarification will result in application of most stringent requirement.

1.9 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals: in accordance with Section 00 01 50 – General Instructions (CSC).

.1 Submit no later than [2] weeks after award of Contract:

.1 Name of Contractor's Cx Agent.

.2 Draft Cx documentation.

.3 Preliminary Cx schedule.

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

.3 Submit proposed Cx procedures and obtain recommended approval at least [2] weeks prior to start of Cx.

.4 Provide supplemental support documentation relating to the Cx process as required.

1.10 COMMISSIONING DOCUMENTATION

.1 Contractor's Cx Agent shall submit their proposed Cx Forms for review prior to implementation.

.2 Provide completed and reviewed Cx documentation with the Cx Summary Report.

1.11 COMMISSIONING SCHEDULE

.1 Provide detailed Cx schedule as part of construction schedule.

.2 Provide adequate time for Cx activities prescribed in technical sections

and commissioning sections including:

.1 Review and approval of Cx reports.

.2 Verification of reported results.

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

.4 Training (Systems demonstrations).

1.12 COMMISSIONING MEETINGS

.1 Convene Cx meetings following project meetings. Minimum of [5] Cx meetings: Kickoff (60%), 75% progress, 90% progress, 100% progress and final.

.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, Cx Manager and/or Cx Agent to call a Cx kickoff 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 Meetings will be chaired by the Cx Manager and/or the Cx Agent, who will record and distribute minutes.

.7 Ensure subcontractors and relevant manufacturer representatives are present at kickoff (60%) and subsequent Cx meetings and as required.

1.13 STARTING AND TESTING

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

1.14 WITNESSING OF STARTING AND TESTING

.1 Provide [2] weeks notice prior to commencement to allow adequate presence of relevant witnesses.

.2 Notify Consultant of start-up dates, Consultant may need to witness start-up and testing.

.3 Contractor's Cx Agent to be present at tests performed and documented

by sub-trades, suppliers and equipment manufacturers.

1.15 MANUFACTURER'S INVOLVEMENT

.1 Factory testing: manufacturer to:

.1 Coordinate time and location of testing.

.2 Provide testing documentation for review and recommended approval.

.3 Arrange for tests to be witnessed by Consultant.

.4 Obtain written review of test results and documentation from Consultant before delivery to site.

.2 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and submit for review.

.1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.

.2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.

.3 Integrity of warranties:

.1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.

.2 Verify with manufacturer that testing as specified will not void warranties.

.4 Qualifications of manufacturer's personnel:

.1 Experienced in design, installation and operation of equipment and systems.

.2 Ability to interpret test results accurately.

.3 To report results in clear, concise, logical manner.

1.16 PROCEDURES

.1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.

.2 Conduct start-up and testing in following distinct phases:

.1 Included in delivery and installation:

.1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.

.2 Visual inspection of quality of installation.

.2 Start-up: follow accepted start-up procedures.

.3 Operational testing: document equipment performance.

.4 System performance verification: include repetition of tests after correcting deficiencies.

.5 Post-substantial performance verification: to include fine-tuning.

.3 Correct deficiencies before commencing to next phase.

.4 Document the required tests on performance verification forms.

.5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:

.1 Minor equipment/systems: implement corrective measures recommended by the Consultant.

.2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures recommended by the Consultant.

.3 If evaluation report concludes that major damage has occurred, Consultant shall reject equipment use.

.1 Rejected equipment to be removed from site and replace with new.

.2 Subject new equipment/systems to specified start-up procedures.

1.17 START-UP DOCUMENTATION

.1 Assemble start-up documentation and submit to Departmental Representative for approval before commencement of commissioning.

.2 Start-up documentation to include:

.1 Factory and on-site test certificates for specified equipment.

.2 Pre-start-up inspection reports.

.3 Signed installation/start-up check lists.

.4 Start-up reports,

.5 Step-by-step description of complete start-up procedures, to permit Departmental Representative to repeat start-up at any time.

1.18 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

.1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.

.2 With assistance of manufacturer develop written maintenance program and submit for review before implementation.

.3 Operate and maintain systems for length of time required for commissioning to be completed.

.4 After completion of commissioning, operate and maintain systems until issuance of certificate of interim acceptance.

1.19 TEST RESULTS

.1 If start-up, testing and/or performance verification produce unacceptable results, repair, replace or repeat specified starting and/or performance verification procedures until acceptable results are achieved.

.2 Provide manpower and materials, assume costs for re-commissioning.

1.20 START OF COMMISSIONING

.1 Notify Consultant at least [2] weeks prior to start of Cx.

.2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

1.21 INSTRUMENTS / EQUIPMENT

.1 Submit for review:

.1 Complete list of instruments proposed to be used.

.2 Listed data including, serial number, current calibration certificate, calibration date, calibration expiry date and calibration accuracy.

.2 Provide the following equipment as required:

.1 2-way radios.

.2 Ladders.

.3 Miscellaneous equipment as required to complete Cx work.

1.22 COMMISSIONING PERFORMANCE VERIFICATION

.1 Carry out Cx:

.1 Under actual and/or simulated operating conditions, over entire operating range, in all operational modes.

.2 On independent systems and interacting systems.

.2 Cx procedures to be repeatable and reported results are to be verifiable.

.3 Follow equipment manufacturer's operating instructions.

.4 EMCS trending to be available as supporting documentation for performance verification.

1.23 WITNESSING COMMISSIONING

.1 Allow Departmental Representative and/or Consultant to witness and/or

spot check activities and verify results.

1.24 AUTHORITIES HAVING JURISDICTION

.1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of authority having jurisdiction, arrange for authority to witness procedures so as to avoid duplication of tests and to facilitate expedient acceptance of facility.

.2 Obtain certificates of approval, acceptance and compliance with rules and regulation of authority having jurisdiction.

.3 Provide copies within [1] week of test and with Cx report.

1.25 COMMISSIONING CONSTRAINTS

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

1.26 EXTRAPOLATION OF RESULTS

.1 Where Cx of weather, occupancy, or seasonal-sensitive equipment or systems cannot be conducted under near-rated or near-design conditions, extrapolate part-load results to design conditions when in accordance with equipment manufacturer's instructions, using manufacturer's data, with manufacturer's assistance and using approved formulae.

1.27 EXTENT OF VERIFICATION

.1 Provide manpower and instrumentation to verify up to 75% of reported results, unless specified otherwise in other sections.

.2 Number and location to be at discretion of the Consultant.

.3 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.

.4 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.

.5 Perform additional commissioning until results are acceptable.

1.28 REPEAT VERIFICATIONS

.1 Assume costs incurred by commissioning activities for third and subsequent verifications where:

.1 Verification of reported results that fail to receive the Consultants recommended approval.

.2 Repetition of second verification again fails to receive the Consultants recommended approval.

.3 The request for second verification was premature.

1.29 SUNDRY CHECKS AND ADJUSTMENTS

.1 Make adjustments and changes which become apparent as Cx proceeds.

.2 Perform static and operational checks as applicable and as required.

1.30 DEFICIENCIES, FAULTS, DEFECTS

.1 Correct deficiencies found during start-up and commissioning.

.2 Report problems, faults or defects affecting commissioning. Pause commissioning work until problems are rectified. Then continue with commissioning once issues are resolved.

1.31 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 to be considered complete when contract Cx deliverables have been submitted and reviewed by the Consultant.

1.32 ACTIVITIES UPON COMPLETION OF COMMISSIONING

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

1.33 TRAINING / SYSTEMS DEMONSTRATION

.1 In accordance with Section 01 91 41 – Demonstration and Training.

1.34 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

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

1.35 OCCUPANCY

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

1.36 INSTALLED INSTRUMENTATION

.1 Use instruments installed under Contract for TAB and performance verification if:

.1 Accuracy complies with these specifications.

.2 Calibration certificates have been submitted.

.2 Calibrated EMCS sensors may be used to obtain performance data

provided that sensor calibration has been completed and accepted.

1.37 PERFORMANCE VERIFICATION TOLERANCES

.1 Application tolerances:

.1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. Except for special areas, to be within +/- 10% of specified values.

.2 Instrument accuracy tolerances:

.1 To be of higher order of magnitude than equipment or system being tested.

.3 Measurement tolerances during verification:

.1 Unless otherwise specified actual values to be within +/- 5% of recorded values.

1.38 OWNER'S PERFORMANCE TESTING

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

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 91 13 – Commissioning

.2 Section 23 05 00 – Common Work Results for HVAC

.3 Section 23 08 00 – Mechanical Commissioning

.4 Section 26 05 00 – Common Work Results for Electrical

1.2 DESCRIPTION

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

.2 Departmental Representative will provide list of CSC 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 in accordance with Section 23 05 93 and equipment and systems are fully operational at all operational modes.

.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 00 01 50 – General Instructions (CSC)

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 CSC 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 00 01 50 – General Instructions (CSC).

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 CSC and the Departmental Representative.

1.6 SITE CONDITIONS

.1 Review the Project Specific Hazardous Building Materials Assessment for the Mission Medium Institution with 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 CSC 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 SECTION INCLUDES

.1 Supply, installation, and removal of concrete formwork and accessories.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

- .1 CSA-A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- .2 CSA-O86-09, Engineering Design in Wood, Consolidation.
- .3 CSA O437 Series-93 (R2011), Standards for OSB and Waferboard.
- .4 CSA S269.1-1975(R2003), Falsework for Construction Purposes.
- .5 CAN/CSA-S269.3-M92(R2008), Concrete Formwork, National Standard of Canada.

.2 Underwriters' Laboratories of Canada (ULC)

- .1 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit shop drawings for formwork and falsework.

- .1 Submit drawings stamped and signed by Professional Engineer registered or licensed in Province of British Columbia, Canada.

.3 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

.4 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. Comply with CSA S269.1, for falsework drawings. Comply with CAN/CSA-S269.3 for formwork drawings.

.5 Indicate formwork design data: permissible rate of concrete placement, and temperature of concrete, in forms.

.6 Indicate sequence of erection and removal of formwork/falsework as directed by Department Representative.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling.

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

1.5 DESIGN AND CODE REQUIREMENTS

.1 Formwork and supporting falsework shall be designed and constructed in accordance with the requirements of CSA S269.3, CSA S269.1 and CSA A23.1, as applicable to the work.

.2 Contractor shall assume full responsibility for the design and for the adequacy and safety of all formwork and falsework.

.3 The design and erection of formwork and related supporting works shall comply with construction safety legislation and regulations.

.4 Engage a Professional Structural Engineer registered in the Province of British Columbia, fully qualified and experienced in the design of formwork and shoring, to be responsible for the design of formwork, falsework, scaffolding, shoring and re-shoring.

Part 2 Products

2.1 MATERIALS

.1 Formwork materials:

.1 For concrete without special architectural features, use wood and wood product formwork materials to CAN/CSA-O86 and CSA O437 Series.

.2 Rigid insulation board: to CAN/ULC-S701.

.2 Form ties:

.1 For concrete not designated 'Architectural', use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface.

.2 Use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface.

.3 Form release agent: non-toxic, biodegradable, low VOC.

.4 Form stripping agent: colourless mineral oil, non-toxic, biodegradable, low VOC, free of kerosene, with viscosity between 15 to 24 mm^2/s at 40 degrees C, flashpoint minimum 150 degrees C, open cup.

.5 Falsework materials: to CSA-S269.1.

.6 Sealant: to Section 07 92 00 - Joint Sealants.

Part 3 Execution

3.1 FABRICATION AND ERECTION

.1 Verify lines, levels and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.

.2 Obtain Department Representative's approval for use of earth forms framing openings not indicated on drawings.

.3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.

.4 Fabricate and erect falsework in accordance with CSA S269.1.

.5 Do not place shores and mud sills on frozen ground.

.6 Provide site drainage to prevent washout of soil supporting mud sills and shores.

.7 Fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1/A23.2.

.8 Align form joints and make watertight.

.1 Keep form joints to minimum.

.9 Use 20 mm chamfer strips on external corners and/or 20 mm fillets at interior corners, joints, unless specified otherwise.

.10 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.

.11 Build in anchors, sleeves, guides, angles, embedment and other inserts required to accommodate Work specified in other sections.

.1 Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.

.12 Clean formwork in accordance with CSA-A23.1/A23.2, before placing concrete. Remove cuttings, shavings and debris from within the forms. Flush the completed forms with water or air jet to remove remaining foreign matter. Ensure that water and debris drain to the exterior through the cleanout ports.

.13 Read drawings in conjunction with all other pertinent contract documents. Coordinate structural work with architectural, mechanical and electrical drawings for detailed dimensions, locations of openings, slopes, curbs, inserts, drainage, waterproofing and other items. Verify locations of mechanical openings with mechanical contractor.

3.2 REMOVAL AND RESHORING

.1 Leave formwork in place for following minimum periods of time after placing concrete.

.1 Seven (7) days for equipment pads.

.2 Remove formwork when concrete has reached 75 % of its 28 day design strength or minimum period noted above, whichever comes later, and replace immediately with adequate reshoring. Contractor shall supply evidence of concrete strength testing.

.3 Provide necessary reshoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.

.4 Space reshoring in each principal direction at not more than 3000 mm apart.

.5 Re-use formwork and falsework subject to requirements of CSA-A23.1/A23.2.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials, supply, and installation of concrete reinforcing.

1.2 REFERENCES

.1 American Concrete Institute (ACI)

.1 SP-66-04, ACI Detailing Manual 2004.

.1 ACI 315-99, Details and Detailing of Concrete Reinforcement.

.2 ACI 315R-04, Manual of Engineering and Placing Drawings for Reinforced Concrete Structures.

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM A82/A82M-07, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement

.2 ASTM A185/A185M-07, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.

.3 ASTM A497/A497M-07, Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.

.3 Canadian Standards Association (CSA International)

.1 CSA-A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.2 CSA-A23.3-04(R2010), Design of Concrete Structures.

.3 CAN/CSA-G30.18-09, Billet-Steel Bars for Concrete Reinforcement, A National Standard of Canada.

.4 CSA-G40.20/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.5 CSA W186-M1990(R2012), Welding of Reinforcing Bars in Reinforced Concrete Construction.

.4 Reinforcing Steel Institute of Canada (RSIC)

.1 RSIC-2004, Reinforcing Steel Manual of Standard Practice.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice and ACI 315.

.2 Submit shop drawings including placing of reinforcement and indicate:

.1 Bar bending details.

.2 Lists.

.3 Quantities of reinforcement.

.4 Sizes, spacings, locations of reinforcement and mechanical splices if approved by Department Representative, with identifying code marks to permit correct placement without reference to structural drawings.

.5 Indicate sizes, cover, spacings and locations of chairs, spacers and hangers.

.3 Detail lap lengths and bar development lengths to CSA-A23.3, unless otherwise indicated.

.1 Provide type B tension lap splices unless otherwise indicated.

.4 Review of the shop drawings by the Department Representative is intended to assist the Contractor and does not relieve the Contractor of responsibility for the completeness and accuracy of the work and its conformance with the contract drawings and specifications.

.5 Fabrication that commences prior to shop drawing review by the Department Representative is at the risk of the Contractor.

1.4 QUALITY ASSURANCE

.1 In accordance with PART 2 - SOURCE QUALITY CONTROL.

.1 Mill Test Report: provide Department Representative, with certified copy of mill test report of reinforcing steel, minimum 4 weeks prior to beginning reinforcing work.

.2 Submit in writing to Department Representative proposed source of reinforcement material to be supplied.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling.

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

Part 2 Products

2.1 MATERIALS

.1 Substitute different size bars only if permitted in writing by Department Representative.

.2 Reinforcing steel: billet steel, grade 400, deformed bars to CAN/CSA-G30.18, unless indicated otherwise.

.3 Reinforcing steel: weldable low alloy steel deformed bars to CAN/CSA-G30.18.

.4 Cold-drawn annealed steel wire ties: to ASTM A82/A82M

.5 Deformed steel wire for concrete reinforcement: to ASTM A497/A497M.

.6 Welded steel wire fabric: to ASTM A185/A185M.

.1 Provide in flat sheets only.

.7 Welded deformed steel wire fabric: to ASTM A497/A497M.

.1 Provide in flat sheets only.

.8 Chairs, bolsters, bar supports, spacers: to CSA-A23.1/A23.2.

.9 Plain round bars: to CSA-G40.20/G40.21.

.10 Mechanical splices: subject to approval of Department Representative.

2.2 FABRICATION

.1 Fabricate reinforcing steel in accordance with ACI 315 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.

.2 Obtain Department Representative's approval for locations of reinforcement splices other than those shown on placing drawings.

.3 Upon approval of Department Representative, weld reinforcement in accordance with CSA W186.

.4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

2.3 SOURCE QUALITY CONTROL

.1 Provide Department Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 4 weeks prior to beginning reinforcing work.

.2 Inform Department Representative of proposed source of material to be supplied.

Part 3 Execution

3.1 FIELD BENDING

.1 Do not field bend or field weld reinforcement except where indicated or authorized by Department Representative.

.2 When field bending is authorized, bend without heat, applying slow and steady pressure.

.3 Replace bars, which develop cracks or splits.

3.2 PLACING REINFORCEMENT

.1 Place reinforcing steel as indicated on placing drawings and in accordance with CSA-A23.1/A23.2.

.2 Use plain round bars as slip dowels in concrete.

.1 Paint portion of dowel intended to move within hardened concrete with one coat of asphalt paint.

.2 When paint is dry, apply thick even film of mineral lubricating grease.

.3 Prior to placing concrete, obtain Department Representative's approval of reinforcing material and placement. Notify the Department Representative at least 72 hrs prior to cast of concrete to inspect the reinforcement.

.4 Ensure cover to reinforcement is maintained during concrete pour and in accordance with CSA A23.1/A23.2 according to exposure class and conditions.

.5 Clear distances between bars, shall be not less than the nominal diameter of the bar, or 25 mm or one and one-third the maximum size of the coarse aggregate. Bars placed in two or more layers shall have a minimum clear distance between the layers of not less than 25 mm and shall be placed directly above and below each other.

.6 Reinforcement shall be adequately supported by metal chairs, spacers or hangers and secured against displacement within the tolerance permitted and in accordance with ACI 315, but not further than 1000 mm in either direction for slabs.

3.3 CLEANING

.1 All materials shall be clean and free of all form oil or deleterious materials.

.2 All deleterious material shall be removed from the surface of the reinforcing steel in a manner acceptable to the Department Representative.

.3 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.5 Waste Management: separate waste materials for recycling.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Supply and installation of cast in place concrete and accessories.

1.2 RELATED SECTIONS

.1 Section 03 10 00 - Concrete Forming and Accessories

.2 Section 03 20 00 - Concrete Reinforcing

.3 Section 03 35 00 - Concrete Finishing

1.3 REFERENCES

.1 American Concrete Institute (ACI)

.1 ACI 212.3R-10 Report on Chemical Admixtures for Concrete

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM C39/C39M-12a, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

.2 ASTM C109/C109M-11b, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 in. or 50 mm Cube Specimens)

.3 ASTM C157/C157M-8, Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete

.4 ASTM C260-10a, Standard Specification for Air-Entraining Admixtures for Concrete.

.5 ASTM C494/C494M-12, Standard Specification for Chemical Admixtures for Concrete.

.6 ASTM D1751-04(2008), Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-37.2-M88, Emulsified Asphalt, Mineral Colloid-Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings.

.2 CAN/CGSB-51.34-M86(R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

.4 Canadian Standards Association (CSA International)

.1 CSA-A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.2 CSA A283-06(R2011), Qualification Code for Concrete Testing Laboratories.

.3 CAN/CSA-A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004, and A3005).

.1 CSA-A3001-08, Cementitious Materials for Use in Concrete.

1.4 ACRONYMS AND TYPES

.1 Cement: hydraulic cement or blended hydraulic cement (XXb - where b denotes blended).

.1 Type GU or GUb - General use cement.

.2 Type HS or HSb – High sulphate resistance hydraulic cement

.2 Fly ash:

.1 Type F - CaO content in accordance with CAN/CSA-A3000.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit WHMIS MSDS - Material Safety Data Sheets.

.2 Submit testing and inspection results and reports for review by Department Representative and do not proceed without written approval when deviations from mix design or parameters are found.

.3 Concrete pours: submit accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described in PART 3 - FIELD QUALITY CONTROL.

.4 Concrete hauling time: submit for review by Department Representative deviations exceeding maximum allowable time of 120 minutes for concrete to be delivered to site of Work and discharged after batching.

.5 Supply pour sheets to Department Representative at least two days prior to concrete pour.

1.6 QUALITY ASSURANCE

.1 Submit to Department Representative, minimum 4 weeks prior to starting concrete work, valid and recognized certificate from plant delivering concrete.

.1 Provide test data and certification by qualified independent inspection and testing laboratory that materials used in concrete mix design will meet specified requirements.

.2 Minimum four (4) weeks prior to starting concrete work, submit proposed quality control procedures for review by Department Representative on following items:

.1 Falsework erection.

.2 Hot weather concrete.

.3 Cold weather concrete.

.4 Curing.

.5 Finishes.

.6 Formwork removal.

.7 Joints and locations of joints.

.8 Sequence of concrete pours.

.3 Quality Control Plan: submit written report, as described in PART 3 - VERIFICATION, to Department Representative verifying compliance that concrete in place meets performance requirements of concrete as established in PART 2 - PRODUCTS.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Concrete hauling time: maximum allowable time for concrete to be delivered to site of Work and discharged not to exceed 120 minutes after batching.

.1 Modifications to maximum time limit must be agreed to by Department Representative and concrete producer as described in CSA A23.1/A23.2.

.2 Deviations to be submitted for review by Department Representative.

.2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

.3 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling.

.2 Divert unused concrete materials from landfill to local facility approved by Department Representative.

.3 Provide an appropriate area on the job site where concrete trucks can be safely washed.

.4 Unused admixtures and additive materials must not be disposed of into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.

.5 Prevent admixtures and additive materials from entering drinking water supplies or streams. Using appropriate safety precautions collect liquid or solidify liquid with inert, non-combustible material and remove for disposal. Dispose of waste in accordance with applicable local, Provincial/Territorial and National regulations.

Part 2 Products

2.1 DESIGN CRITERIA

.1 Alternative 1 - Performance: to CSA A23.1/A23.2, and as described in MIXES of PART 2 - PRODUCTS.

2.2 MATERIALS

.1 Cement: to CAN/CSA-A3001, Type HS.

.2 Supplementary cementing materials: with maximum 25% Type F fly ash, by mass of total cementitious materials to CAN/CSA-A3001.

.3 Water: to CSA-A23.1.

.4 Aggregates: to CAN/CSA-A23.1/A23.2.

.5 Admixtures:

.1 Air entraining admixture: to ASTM C260.

.2 Chemical admixture: to ASTM C494. Department Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.

.6 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents to CSA-A23.1/A23.2.

.1 Compressive strength: 50 MPa at 28 days.

.2 Net shrinkage at 28 days: maximum 5%.

.7 Sealing and curing compounds: to Section 03 35 00 - Concrete Finishing.

.8 Pre-moulded joint fillers:

.1 Bituminous impregnated fiber board: to ASTM D1751.

.9 Epoxy Adhesive Anchors: injectable epoxy system.

2.3 MIXES

.1 Alternative 1 - Performance Method for specifying concrete: to meet DCC Representative performance criteria in accordance with CAN/CSA-A23.1/A23.2.

.1 Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as described in PART 3 - VERIFICATION.

.2 Provide concrete mix to meet following hard state requirements:

TYPE	LOCATION	28 DAY STRENGTH f'c (MPa)	CEMENT TYPE	AGGREG. MAX. (mm)	SLUMP (mm)	TOTAL AIR (%)	EXPOSURE CLASS
4.	Exterior equipment pads	32	MS	20	80 ± 30	5 - 8	C-2

.3 Maximum fly ash content as a percentage of the total cementitious material:

.1 Concrete with exposure classes C-1 and C-2: No fly ash is allowed unless it is limited to 5% and provided that the water/cement ratio is not more than 0.4.

.2 Concrete with exposure classes C-3 and F-1: Maximum 15% fly ash.

.3 Concrete with exposure classes F-2 and N: Maximum 20% fly ash.

.4 Provide quality management plan to ensure verification of concrete quality to specified performance.

.5 Concrete supplier's certification.

.2 Documentation indicating the compatibility of the water reducing admixture, the air entraining admixture, the superplasticizing admixture (if any), the silica fume (if any) and the fly ash (if any) is to be submitted upon request with the mix design for review by the Department Representative.

Part 3 Execution

3.1 PREPARATION

.1 Obtain Department Representative's approval before placing concrete.

.1 Provide a minimum 72 hours' notice prior to placing of concrete.

.2 Place concrete reinforcing in accordance with Section 03 20 00 - Concrete Reinforcing.

.3 During concreting operations:

.1 Development of cold joints not allowed.

.2 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.

.4 Pumping of concrete is permitted only after approval of equipment and mix.

.5 Ensure reinforcement and inserts are not disturbed during concrete placement.

.6 Prior to placing of concrete obtain Department Representative's approval of proposed method for protection of concrete during placing and curing in adverse weather.

.7 Protect previous Work from staining.

.8 Use cold weather concreting methods in accordance with CSA-A23.1, when the mean daily temperature falls below 5°C, and use hot weather methods when the mean temperature rises above 25°C.

.9 Clean and remove stains prior to application for concrete finishes.

.10 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.

.11 Do not place load upon new concrete until authorized by Department Representative.

3.2 CONSTRUCTION

.1 Do cast-in-place concrete work in accordance with CSA-A23.1/A23.2.

.2 Read drawings in conjunction with all other pertinent contract documents. Coordinate structural work with architectural, mechanical and electrical drawings for detailed dimensions, locations of openings, slopes, curbs, inserts, drainage, waterproofing and other items.

.3 Sleeves and inserts:

.1 Do not permit penetrations, sleeves, ducts, pipes or other openings to pass through equipment pad footing except where indicated or approved by Department Representative.

.2 Where approved by Department Representative, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere.

.3 Sleeves and openings greater than 100 x 100 mm not indicated, must be reviewed by Department Representative.

.4 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of modifications from Department Representative before placing of concrete.

.5 Confirm locations and sizes of sleeves and openings shown on drawings.

.6 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.

.4 Anchor bolts:

.1 Set anchor bolts to steel templates secured to proper supports to prevent movements, under supervision of appropriate trade prior to placing concrete.

.2 For epoxy anchors, drill holes and fill with adhesive to manufacturers' recommendations.

.3 Protect anchor bolt holes from water accumulations, snow and ice build-ups.

.5 Finishing and curing:

.1 Finish concrete in accordance with CSA-A23.1/A23.2 and Section 03 35 00 -Concrete Finishing.

.2 Use procedures as reviewed by Department Representative or those noted in CSA-A23.1/A23.2 to remove excess bleed water. Ensure surface is not damaged.

.3 Use curing compounds compatible with applied finish on concrete surfaces except for slabs. Provide written declaration that compounds used are compatible.

.4 Slabs shall be wet cured for seven days minimum according to CSA-A23.1, using one of the following methods as soon as the concrete has hardened sufficiently to prevent marring:

.1 Surface covered with canvas or other satisfactory material and kept thoroughly wet.

.2 Surface sealed with polyethylene sheeting at least 6 mils (0.15mm) thick and the concrete kept thoroughly wet.

.6 Epoxy set anchors and reinforcement dowels:

.1 Install in strict accordance with manufacturer's recommendations.

.2 Minimum anchorage requirements for reinforcement dowels and Epoxy Adhesive Anchors: as indicated.

3.3 SURFACE TOLERANCE

.1 Concrete tolerance in accordance with CSA-A23.1/A23.2.

.2 See Section 03 35 00 for floor finish tolerances.

3.4 FIELD QUALITY CONTROL

.1 Site tests: conduct the following tests.

.1 Concrete pours.

.2 Slump tests.

.3 Air content.

.2 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory designated by Contractor for review in accordance with CSA-A23.1/A23.2. Pay cost of all testing carried out under this section.

.1 Ensure testing laboratory is certified in accordance with CSA A283.

.3 Testing firm to take a minimum of three (3) test cylinders for a strength test and not less than one strength test for each 40 m^3 of concrete, or portion thereof, for each type of concrete placed and not less than one (1) test for each type of concrete placed in any one day.

.4 Testing firm to moist cure and test one (1) cylinder in seven (7) days and to moist cure and test the remaining two (2) cylinders in 28 days.

.5 Testing firm to take at least one slump test and one entrained air test for each set of test cylinders taken.

.6 Testing firm to take one additional test cylinder during cold weather concreting and cure on job site under same conditions as the concrete it represents.

.7 Testing firm is to report results of tests immediately to the Contractor and the Department Representative. The Contractor is responsible for ensuring that the concrete meets the requirements of the specifications.

.8 Testing firm is to submit to the Department Representative and Contractor copies of test results. Include the following information with the results:

.1 Name of the project.
.2 Date of sampling.
.3 Mix design, specified strength, slump and air content.
.4 Name of supplier, truck and ticket number.
.5 Time batched and time placed.
.6 Identification of sampling and testing technician.
.7 Cement type and admixtures used.
.8 Exact location in the structure of the concrete sampled.
.9 Ambient air and concrete temperatures.
.10 Nominal aggregate size.
.11 Water added and personnel authorizing additional water.
.12 Concrete density.

.9 Inspection and Testing of Grout

.1 In accordance with ASTM C109, provide at least two (2) cube tests on all types of non-shrink grout used.

.10 Ensure test results are distributed for discussion at pre-pouring concrete meeting between Contractor, testing laboratory and Department Representative.

.11 Department Representative will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.

.12 Non-Destructive Methods for Testing Concrete: in accordance with CSA-A23.1/A23.2.

.13 Inspection or testing by Department Representative will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

3.5 VERIFICATION

.1 Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established in PART 2 - PRODUCTS, by Department Representative and provide verification of compliance as described in PART 1 - QUALITY ASSURANCE.

3.6 CLEANING

.1 Waste Management: separate waste materials for reuse and recycling.

.1 Provide appropriate area on job site where concrete trucks and be safely washed.

.2 Divert unused admixtures and additive materials (pigments, fibres) from landfill to official hazardous material collections site.

.3 Do not dispose of unused admixtures and additive materials into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.

.4 Prevent admixtures and additive materials from entering drinking water supplies or streams.

.5 Using appropriate safety precautions collect liquid or solidify liquid with inert, non-combustible material and remove for disposal. Dispose of waste in accordance with applicable local, Provincial/Territorial and National regulations.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 None

1.2 REFERENCES

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

- .1 ASTM A36/A36M-08, Standard Specification for Carbon Structural Steel.
- .2 ASTM A193/A193M-11, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature or High-Pressure Service and Other Special Purpose Applications.
- .3 ASTM A307-10, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .4 ASTM A325-10, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
- .5 ASTM A325M-09, Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength[Metric].
- .6 ASTM A490M-10, Standard Specification for High-Strength Steel Structural Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints Metric.

.2 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB-85.10-99, Protective Coatings for Metals.

.3 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturers Association (CPMA).

- .1 Handbook of the Canadian Institute of Steel Construction.
- .2 CISC/CPMA Standard 2-75, Quick-Drying Primer for use on Structural Steel.

.4 Canadian Standards Association (CSA International)

- .1 CSA G40.20/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .2 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
- .3 CAN/CSA-S16-09, Limit States Design of Steel Structures.
- .4 CAN/CSA-S136-07, North American Specifications for the Design of Cold Formed Steel Structural Members.
- .5 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel.
- .6 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.
- .7 CSA W55.3-08, Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.
- .8 CSA W59-03(R2008), Welded Steel Construction (Metal Arc Welding).

.5 Master Painters Institute

.1 MPI-INT 5.1-08, Structural Steel and Metal Fabrications.

.2 MPI-EXT 5.1-08, Structural Steel and Metal Fabrications.

.6 The Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE) International

.1 NACE No. 3/SSPC SP-6-06, Commercial Blast Cleaning.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Shop Drawings:

.1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of British Columbia, Canada.

.2 Erection drawings:

.1 Submit erection drawings indicating details and information necessary for assembly and erection purposes including:

.1 Description of methods.

.2 Sequence of erection.

.3 Temporary bracings.

.3 Fabrication drawings:

.1 Submit fabrication drawings showing designed assemblies, components and connections are stamped and signed by qualified professional engineer licensed in the Province of British Columbia, Canada.

.4 Source Quality Control Submittals:

.1 Submit 3 copies of mill test reports 4 weeks prior to fabrication of structural steel.

.1 Mill test reports to show chemical and physical properties and other details of steel to be incorporated in project.

.2 Provide mill test reports certified by metallurgists qualified to practice in Province of British Columbia, Canada.

.5 Fabricator Reports:

.1 Provide structural steel fabricator's affidavit stating that materials and products used in fabrication conform to applicable material and products standards specified and indicated.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials in manufacturer's original, undamaged containers with identification labels intact.

.2 Packaging Waste Management: remove for reuse and return of pallets, crates, paddling, and packaging materials.

Part 2 Products

2.1 DESIGN REQUIREMENTS

.1 Design details and connections in accordance with requirements of CAN/CSA-S16 and CAN/CSA-S136 with CSA-S136.1 to resist forces, moments, shears and allow for movements indicated.

.2 Shear connections:

.1 Select framed beam shear connections from an industry accepted publication such as "Handbook of the Canadian Institute of Steel Construction" when connection for shear only (standard connection) is required.

.2 Select or design connections to support reaction from maximum uniformly distributed load that can be safely supported by beam in bending, provided no point loads act on beam, when shears are not indicated.

.3 Submit sketches and design calculations stamped and signed by qualified professional engineer licensed in Province of British Columbia, Canada for non-standard connections.

2.2 MATERIALS

.1 Structural steel: to CSA-G40.20/G40.21 350W Grade for rolled and HSS (class C) sections and Grade 300W for plates, bars, angles, and channels.

.2 High strength anchor bolts: to ASTM A193/A193M, Grade A.

.3 Bolts, nuts and washers: to ASTM A325M.

.4 Welding materials: to CSA W59 and certified by Canadian Welding Bureau.

.5 Shop paint primer: to CISC/CPMA2-75 solvent reducible alkyd, grey.

.6 Hot dip galvanizing: galvanize steel, where indicated, to CAN/CSA-G164, minimum zinc coating of 700 g/m2.

2.3 FABRICATION

.1 Fabricate structural steel in accordance with CAN/CSA-S16 and in accordance with reviewed shop drawings.

.2 Continuously seal members by continuous welds where indicated. Grind smooth.

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 Structural steel work: in accordance with CAN/CSA-S16.

.2 Welding: in accordance with CSA W59.

.3 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding of structural components.

3.3 CONNECTION TO EXISTING WORK

.1 Verify dimensions and condition of existing work, report discrepancies and potential problem areas to Departmental Representative for direction before commencing fabrication.

3.4 MARKING

.1 Mark materials in accordance with CSA G40.20/G40.21. Do not use die stamping. When steel is to be left in unpainted condition, place marking at locations not visible from exterior after erection.

.2 Match marking: shop mark bearing assemblies and splices for fit and match.

3.5 ERECTION

.1 Erect structural steel, as indicated and in accordance with CAN/CSA-S16 and in accordance with reviewed erection drawings.

.2 Field cutting or altering structural members: to approval of Departmental Representative.

.3 Clean with mechanical brush and touch up shop primer to bolts, rivets, welds and burned or scratched surfaces at completion of erection.

.4 Continuously seal members by continuous welds where indicated. Grind smooth.

3.6 FIELD QUALITY CONTROL

.1 Inspection and testing of materials and workmanship will be carried out by testing laboratory designated by Department Representative.

.2 Provide safe access and working areas for testing on site, as required by testing agency and as authorized by Department Representative.

.3 Submit test reports to Department Representative within 2 weeks of completion of inspection.

3.7 FIELD PAINTING

.1 Paint in accordance with the following:

.1 Touch up damaged surfaces and surfaces without shop coat with primer to NACE No.3/SSPC-SP-6 except as specified otherwise. Apply in accordance: MPI Architectural Painting Specification Manual.

.2 Repair damaged galvanizing with Galvacon in accordance to Manufacturer's specifications.

3.8 CLEANING

.1 Waste Management: separate waste materials for reuse and recycling.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Roofing Systems for Metal Decks: Mechanically fastened deck overlay, self-adhered vapour retarder, insulation in 3 layers, mechanically fastened insulation overlay in 2 layers, torch-welded base and cap modified bituminous membranes, base and cap flashings, roofing membrane control joints, and overflow scuppers.

1.2 RELATED SECTIONS

.1 Section 00 01 50 – General Instructions (CSC)

.2 Section 07 62 00 - Sheet Metal Flashing and Trim:

.3 Mechanical Drawings and Details

.4 Structural Drawings and Details

1.3 MATERIALS SUPPLIED BUT NOT INSTALLED BY THIS SECTION

.1 Supply to roofing contractor roofing vapour barrier membrane for installation under roof curbs, beams, nailers and sleepers. Vapour barrier membrane of sufficient width to allow for minimum 300 mm overlap with roofing vapour barrier to maintain continuity of vapour barrier over modified roof deck.

1.4 REFERENCES

.1 ASTM C1002 - Steel Self-Piercing, Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

.2 ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

.3 ASTM D41 - Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.

.4 ASTM D312 - Asphalt Used in Roofing.

.5 ASTM D2178 - Asphalt Glass Felt Used in Roofing and Waterproofing.

.6 ASTM D2822 - Asphalt Roof Cement.

.7 ASTM D6162 - Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements

.8 CSA A123.4 - Asphalt for Constructing Built-Up Roof Coverings and Waterproofing Systems.

.9 CGSB 37-GP-56M - Membrane Modified, Bituminous, Prefabricated, and Reinforced for Roofing.

.10 CAN/ULC S107 - Methods of Fire Tests of Roof Coverings.

.11 CAN/ULC-S704 - Thermal Insulation, Polyurethane and Polyisocyanurate, Boards Fixed.

.12 Province of British Columbia Roofing Contractors Association (RCABC) Roofing Specifications Manual.

.13 UL 790 - Test Methods for Fire Tests of Roof Coverings.

.14 CAN/CSA A123.21 - Standard Test Method for the Dynamic Wind Uplift Resistance of Mechanically Attached Membrane Roofing Systems.

.15 CCMC Technical Guide for Cladding Systems using Exterior Cement-bonded Fibrous Wood Particle Board, Masterformat number 07256, dated 02-01-04.

1.5 SYSTEM DESCRIPTION

.1 Conventional System, Reflective / High Emissivity: Assembly of components include two ply membrane system, heat-welded, with highly reflective white ceramic, synthetic, or slate flakes surface, with vapour retarder and insulation.

1.6 ADMINISTRATIVE REQUIREMENTS

.1 Section 00 01 50: General Instructions (CSC)

.1 Coordinate with other work having a direct bearing on work of this section, including the installation of

.1 associated metal flashings

.2 structural steel

.3 mechanical equipment roof curbs

.4 roof penetrations (pipe, duct, conduit)

1.7 SUBMITTALS

.1 Section 00 01 50: General Instructions (CSC)

.2 Shop Drawings: Indicate insulation fasteners and layout, setting plan for tapered insulation, layout of seams, direction of laps, base flashing details, roof accessories.

.3 Product Data: Provide product data for vapour retarder support panels, vapour retarder, membrane materials, base flashing materials, insulation, overlay board, reflective coating.

.4 Submit cold weather construction procedures and methods of protection in writing which will be initiated, provided and maintained when ambient temperature falls below 0 Deg. C, to ensure proper application of the work, per the requirements of this Section.

.5 Submit samples of materials to be used in the work if requested by the Consultant.

.6 Reports:

.1 System Certification Report: Submit a report, issued by a certified materials testing laboratory, attesting that the roofing system sustained wind uplift pressures for wind loads for building site.

.2 Manufacturer's field reports.

.3 Inspection Reports: Submit roof inspection reports as the work progresses. At completion of roofing submit to the Consultant duplicate certificates of acceptance issued by roofing inspection company. Indicate procedures followed, ambient temperatures and wind velocity during application, and precipitation.

.4 Provide to the Owner the "RCABC Roofing System Record" upon completion of the work.

.7 Maintenance Data: Provide dated and executed copy of manufacturer's warranty, and name, address and phone number of nearest manufacturer's representative, for inclusion into maintenance manual.

1.8 SUBMITTALS FOR INFORMATION

.1 Section 00 01 50: General Instructions (CSC)

.2 Manufacturer's field reports.

1.9 QUALITY ASSURANCE

.1 Perform Work in accordance with manufacturer's instructions and RCABC Policies Manual.

.2 Compatibility: ensure compatibility between components of roofing system is essential. Provide written declaration to Consultant stating that materials and components, as assembled in system, meet this requirement.

.3 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum 10 years experience.

.4 Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years experience, approved by the manufacturer and a member in good standing with the RCABC.

.5 Workmanship Standards:

.1 Conform to the latest Guarantee Standards of the Roofing Contractors Association of British Columbia Guarantee Corp. (RGC) as published in the RGC Roofing Practices Manual for a ten (10) year Guarantee, unless modified by the contract documents to exceed those minimums.

1.10 REGULATORY REQUIREMENTS

.1 Conform to applicable code for roof assembly fire hazard requirements.

.2 CAN/ULC S107: Class C Fire Hazard Classification.

1.11 DELIVERY, STORAGE, AND HANDLING

.1 Provide and maintain dry, off-ground, ventilated weatherproof storage, away from welding flame or spark and sheltered from harmful substances.

.2 Deliver and store all materials in conformance with the manufacturer's requirements described in the manufacturer's literature.

.3 Store rolls of felt in upright position. Store membrane rolls with selvage edge up. Store flashing to avoid creasing, buckling, scratches and any other possible damage.

.4 Remove from storage only in quantities required for same day use.

.5 In cold weather, store materials in heated area at +10 Deg. C minimum and remove immediately prior to installation. If rolls cannot be stored in heated environment, pre-condition prior to installation

.6 Store caulking, adhesives and emulsion-based waterproofing mastics at +5 Deg. C minimum. Store adhesives and solvent-based mastics at sufficient temperatures to ensure ease of application.

.7 Avoid material overloads which may affect the structural integrity of specific roof areas.

1.12 FIRE PROTECTION

.1 Prior to the start of work, conduct a site inspection to establish safe working practices and make sure that all procedures and proposed changes are approved to minimize the risk of fires.

.2 Respect safety measures described in the Manufacturer's specifications manual and technical data sheets, and WorkSafe BC recommendations.

.3 Fire Extinguishers: Throughout roofing installation, maintain a clean site and have one 10 lb. fire extinguisher, ULC labeled for A, B and C class protection, on roof per torch applicator, within 10 m of torch applicator.

.4 Maintain fire watch for 1 hour after each days roofing operations cease. Use an electronic thermometer to check for hot spots.

.5 Torches must never be placed near combustible or flammable products. Never apply torches directly to old and wood surfaces. Never use torches where the flame is not visible or cannot be easily controlled.

1.13 ENVIRONMENTAL REQUIREMENTS

.1 Do not apply roofing membrane during inclement weather and when

ambient temperatures below +4 degrees C or above 40 degrees C and in accordance with manufacturers' recommendations.

.2 Install roofing on dry deck, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture into roofing system.

.3 Do not apply roofing membrane to damp or frozen deck surface.

.4 Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.

.5 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labeling and provision of material safety data sheets (MSDS) acceptable to Labour Canada.

1.14 POST-INSTALLATION MEETING

.1 Convene a Post-Installation site meeting to be held upon completion of the work of this Section and before the Roofing Subcontractor departs from the site. The Contractor's representative and the roofing manufacturer's representative shall review any deficiencies that may exist. These deficiencies shall be corrected before the Roofing Contractor leaves the job site.

.2 Issue Warranty promptly to the Owner following Post-Installation Meeting.

1.15 GUARANTEE

.1 Provide the standard Roofing Contractors Association of British Columbia Guarantee Corp. (RGC) ten (10) year Guarantee.

.2 Provide manufacturer's ten (10) year material warranty.

Part 2 Products

2.1 GENERAL

.1 Conform to the RCABC "Minimum Standards" and to the appropriate CSA, CGSB, and ASTM standards for the materials used in the roofing system specified; materials to be listed in Section 2.2 of the RCABC manual.

.2 Modified membranes shall consist of a minimum of 12% styrene-butadiene-styrene.

2.2 MANUFACTURERS

.1 Acceptable Manufacturers:

.1 Soprema Waterproofing Inc.

.2 Siplast Icopal.

.3 IKO Industries Ltd.

2.3 DECK COVERING: STEEL DECKING

.1 Silicone-treated gypsum roof boards: In conformance with ASTM C1177/C1177M-04 Standard. Water resistant silicone-treated core, and embedded glass mat facing. Dimension: 1220 mm. x 2440 mm. x 16 mm thick.

.2 Acceptable Materials: GP Gypsum DensDeck RoofBoard or DensDeck Prime Roof Board, or DensDeck DuraGuard Roof Board, CGC Securock Glass-Mat Roof Board.

2.4 DECK PRIMER

.1 Deck Primer: type recommended by membrane manufacturer, applicable for substrate and application.

2.5 VAPOUR RETARDER

.1 Thermofusible vapour retarder: SBS modified bitumen membrane reinforced with fibreglass mat, both faces covered with thermofusible plastic film, complying with CAN/CGSB 37.56-M (9th draft).

.1 Thickness: 2.7 mm.

.2 Water vapour permeance: 0.22 ng/Pa*s*m2

.3 Air leakage:

.4 Acceptable Material: Soprema SopraSeal 60 F/F, or equivalent.

.2 Self-adhesive vapour retarder: self-adhesive SBS modified bitumen sheet, selvage edge, top surface slip-resistant polyethylene film; bottom surface silicone release paper.

.1 Thickness : 1 mm (40 mils) minimum.

.2 Water vapour transmission:

.3 Air leakage:

.4 Acceptable material: Soprema Sopravap'R; IKO MVP; Firestone V-Force;

.1 Cold Weather Application: Torch-on SBS modified bitumen sheet acceptable in cold weather; Soprema Elastophene SP 2.2; IKO AquaBarrier TG.

.5 Continuity strip: for installation beneath upstands, parapets, and at

wall junctions to ensure continuity of vapour retarder over building envelope. Of same material specified for roof vapour retarder, supplied by roofing Subcontractor for installation by carpentry Subcontractor.

2.6 ROOFING INSULATION

.1 Base insulation: Rigid cellular polyisocyanurate insulation (ISO): to CAN/ULC-S704, Type 3 glass fibre reinforced, coated glass fibre facers both sides.

- .1 Compressive strength 140 kPa.
- .2 RSI 1.00/25.4mm (R5.7/in).
- .3 Size: 1219 x 1219 x 76 mm thick.
- .4 Acceptable material: Soprema Sopra-Iso Plus; IKOTherm III (coated glass facer); Firestone ISO 95+ GL; Johns Manville R-Panel; Hunter H-Shield CG.

.2 Tapered shapes: Expanded polystyrene (EPS): to CAN/ULC-S701 Type 2 cut to tapered shapes for slopes indicated.

- .1 Compressive strength: 110 kPA
- .2 RSI 0.70/25 mm (R4/in).
- .3 Size: 610 x 2438 mm
- .4 Edges: shiplapped.
- .5 Acceptable material: Mansonville Plastics, Korolite EPS, PlastiSpan HD by Plasti-Fab.
- .6 Taper insulation at min. 1% to roof areas as indicated and as required.

.3 System Insulating Values:

- .1 Average insulating value: not less than RSI 5.287 (R30).

2.7 INSULATION OVERLAY

.1 Multi-ply, semi-rigid asphaltic roofing substrate board composed of a mineral fortified asphaltic core formed between two asphaltic saturated fiberglass liners. Compatible with modified bitumen roofing systems allowing modified bitumen roofing membranes to be torched directly to the board surface. Thickness 4.8 mm.

.2 Acceptable material: Soprema Sopraboard; IKO Protectoboard or equivalent.

2.8 ACCESSORY MEMBRANES

.1 Reinforcement membrane:

.1 Description: Roofing membrane with composite heavy duty reinforced and SBS modified bitumen. Both sides are covered with a thermofusible plastic film. The top face must be marked with three (3) distinctive blue chalk lines to ensure proper roll alignment.

.2 Prefabricated membrane, complies with CAN/CGSB 37-GP-56M (9th draft). Soprema Sopralene Flam 180 or equivalent.

.2 Cover Strip

.1 Description: Membrane strip 330 mm made of SBS modified bitumen and composite elastomeric bitumen reinforcement. Both faces are covered with a plastic thermofusible film.

.2 The strip ensures water-tightness in the end laps.

.3 Sopralap by Soprema Inc. or equivalent.

.3 Flexible membrane for expansion joints:

.1 Description: Waterproofing membrane manufactured by combining a polyester fabric with SBS modified bitumen and a root-repelling agent. The underface is covered with a thermofusible plastic film. The top face has an aluminum foil adhered to the centre of the membrane and is covered by a protective silicone paper to be removed during application. Nominal thickness is 4.0 mm. and width of 450 mm.

.2 Components: Polyester fabric, thermofusible elastomeric bitumen, silicone paper, and aluminum sheathing (width = 0.20 m.). Soprajoint by Soprema Inc. or equivalent.

.3 Properties:

.1	Strength at 10% elongation:	N/cm
.2	Strength at rupture:	250 N/cm
.3	Elongation at rupture:	120%
.4	Elongation at rupture at -200C:	100%
.5	Low temperature flexibility:	-300C
.6	Elasticity limit:	40%
.7	Fatigue resistance:	1000 cycles

.4 EPDM Membrane: Firestone RubberGard EPDM standard membrane 1.1 mm (0.045") or equivalent.

2.9 FLAME STOP MEMBRANE

.1 Manufacturer's recommended self-adhesive membrane composed of SBS modified bitumen and glass mat reinforcement, designed to prevent flames from penetrating into voids, cavities and openings before installing heat-welded membranes.

2.10 REFLECTIVE COATING

.1 Water-based white elastomeric acrylic latex roof coating with high Solar Reflective Index (SRI).

.2 Acceptable materials:

.1 Soprema System: Soprastar R-Nova, SRI 112.

.2 IKO System: IKO ArmourReflect Top Coat, SRI 78.

2.11 BITUMEN MATERIALS

.1 Asphalt Primer: ASTM D41.

.2 Plastic Cement: ASTM D2822, cutback asphalt type.

2.12 ACCESSORIES

.1 Roofing Nails: Galvanized, hot dipped or non-ferrous type, size as required to suit application.

.2 Fasteners:

.1 Sheathing to steel deck: No. 10 flat head, self tapping, Type A or AB, cadmium plated screws to CSA B35.3, and pressure distribution plates.

.2 Sheet metal flashing to wood: ASTM C1002 galvanized, hot dipped or non-ferrous type, of same material and finish as sheet metal, to CSA B111, ring thread roofing nails of thickness and length suitable for metal flashing application, appropriate for purpose intended and approved by system manufacturer; length required for thickness of material with washers of same material as sheet metal, 1 mm thick with rubber packings. Minimum Fastener pullout 136.1 Kg.

.3 Sealants: As recommended by membrane manufacturer.

.4 Mastic: As recommended by membrane manufacturer, conform to ASTM D4586/D4586M.

.5 Isolation Coating: alkali resistant bituminous paint.

.6 Bedding Compound: Rubber-asphalt Butyl type.

.7 Plastic Cement: Plastic cement: to CAN/CGSB 37.5.

.8 Do not use pressure-preservative treated lumber or plywood for roof curbs, nailers, sleepers or other wood in direct contact with roof membranes on roof deck.

2.13 WALKWAYS

.1 SBS modified bitumen sheet: Roofing membrane manufacturer's recommended high performance cap sheet membrane, meeting CGSB 37-GP-56M, composed of SBS modified bitumen and composite reinforcement. Surface protected by coloured granules. Underside covered with thermofusible plastic film.

.1 Dimensions: 1 m x 1.8 m x minimum 4 mm thick.

.2 Granule Colour: Contrasting colour to roofing membrane granules, as selected by Consultant.

.3 Precast concrete pavers: 600 x 600 mm x 54 mm, textured finish, mounted on adjustable pedestal system.

2.14 SPLASHPADS

.1 Precast concrete pavers: to CSA A231.1/A231.2, minimum 21MPa at 28 days, with minimum 5 percent air entrainment, 600 x 600 x 54 mm size, with slope (disked) surface, natural grey colour mounted on adjustable pedestal system.

Part 3 Execution

3.1 EXAMINATION

.1 Examine roof decks and immediately inform Consultant in writing of defects.

.2 Prior to commencement of work ensure:

.1 Decks are firm, straight, smooth, dry, free of snow, ice or frost, and swept clean of dust and debris. Use of calcium or salt is forbidden for ice or snow removal.

.2 Curbs have been built.

.3 Roof drains have been installed at proper elevations relative to finished roof surface.

.4 Plywood and lumber nailer plates have been installed to deck, walls and parapets as indicated.

3.2 GENERAL INSTALLATION

.1 Prepare surfaces and complete waterproofing work in conformance with manufacturer's requirements, and the RCABC Roofing Practices Manual.

.2 Install roofing elements on clean and dry surfaces, in conformance with manufacturer's instructions and recommendations.

.3 Roofing work must be completed in a continuous fashion as surfaces are readied and weather conditions permit.

.4 It is mandatory to seal all seams that are not covered by a cap sheet membrane in the same day. The cap sheet cannot be installed if any moisture is present at/in the base sheet seams.

.5 Whenever membranes are torch-applied, a continuous and even bead of molten bitumen must be visible as the membrane is unrolled and torched.

3.3 SITE PROTECTION

.1 Protect finished work to avoid damage during work of this Section. Assume full responsibility for any damage.

3.4 DECK COVERING

.1 Carefully screw support panels onto the metal deck's upper rib surfaces. Use a minimum of 16 screws and washers for each 1220 mm x 2440 mm board. Cut boards so edges rest on centre of upper ribs. Cut straight lines with adequate tools.

.2 Where slopes change directions, cut boards cleanly. Avoid breaking boards to acquire deck form. Place boards perpendicular to deck ribs for continuous support at extremities.

.3 Board joints will be staggered, in half-lengths, and perfectly butted.

3.5 VAPOUR RETARDER

.1 Do not commence work until other work penetrating roof deck is complete and has been reviewed by Consultant.

.2 Prime substrates and install membrane to substrate in accordance with manufacturer's instructions.

.3 Starting at low point lay sheet perpendicular to slope in longest possible lengths to reduce number of end laps. Overlap each succeeding row 50 mm shingle fashion to shed water. End laps 100 mm and staggered 300 mm between rows.

.4 Place in position without stretching, taking care to avoid air bubbles, creases and fishmounts.

.5 As installation progresses roll membrane with roller to ensure full contact with substrate.

.6 Flash and seal around openings and items penetrating roof deck such as soil stacks, vents. conduit and pipes.

.7 Seal with mastic difficult detail areas that to not allow easy installation of membrane. Make airtight.

.8 Coordinate with work of other trades for overlapping and sealing of vapour barrier with other air/vapour barriers for building envelope. Ensure

sufficient material for overlapping and sealing.

.9 Overlap and seal air barrier membrane to air/vapour barriers installed by other trades. Maintain continuity of building air/vapour barrier system over the renovated area that is being modified and connected to.

3.6 EXPOSED MEMBRANE ROOFING APPLICATION

.1 Insulation, adhesive application:

- .1 Adhere Tapered Type 2 EPS Insulation to vapour retarder using adhesive compatible with vapour retarder membrane.
- .2 Apply adhesive in continuous ribbons at 300 mm on centre.
- .3 Place boards in parallel rows with ends staggered, and in firm contact with one another. Stagger joints 150mm minimum.
- .4 Cut end pieces to suit.
- .5 Adhere two (2) layers of 76 mm Polyisocyanurate Insulation with joints staggered minimum 150 mm bonded to Tapered Type 2 EPS Insulation with cold applied adhesive. Stagger joints between layers 150 mm minimum.
- .6 Apply adhesive in continuous ribbons at 300 mm on centre.
- .7 Acrylic facer only required on top surface of Polyisocyanurate Insulation for self adhered base membrane sheet installation. All other facers - standard organic type compatible with cold applied adhesive.

.2 Overlay Board: fully adhered, adhesive application.

- .1 Adhere overlay board to insulation using adhesive.
- .2 Place boards in parallel rows with ends staggered, and in firm contact with one another. Stagger joints between layers. Stagger joints between overlay board and insulation.
- .3 Cut end pieces to suit.
- .4 Apply adhesive in continuous ribbons at 300 mm on centre.

.3 Base sheet membrane, fully-adhered, torch-on application:

- .1 Starting at low point of roof, perpendicular to slope, unroll base sheet, align and attach one end with fasteners.
- .2 Unroll and and torch base sheet onto substrate taking care not to burn membrane or its reinforcement.
- .3 Lap sheets 75 mm minimum for side and 150 mm minimum for end laps. Stagger end laps.
- .4 Application to be free of blisters, wrinkles and fishmouths.
- .5 Do membrane application in accordance with manufacturer's recommendations.

.4 Cap sheet membrane, fully adhered, torch-on application:

.1 Starting at low point on roof, perpendicular to slope, unroll cap sheet, align and reroll from both ends.

.2 Unroll and torch cap sheet onto base sheet taking care not to burn membrane or its reinforcement.

.3 Lap sheets 75 mm minimum for side laps and 150 mm minimum for end laps. Stagger end laps. Offset joints in cap sheet 300 mm minimum from those in base sheet.

.4 Stagger joints between cap sheet and base sheet.

.5 Application to be free of blisters, fishmouths and wrinkles.

.6 Do membrane application in accordance with manufacturer's recommendations.

.5 Flashings:

.1 Complete installation of flashing base sheet stripping prior to installing membrane cap sheet.

.2 Install base and cap sheet stripping onto substrate in 1 metre wide strips.

.3 Lap flashing base sheet to membrane base sheet minimum 150 mm and seal.

.4 Lap flashing cap sheet to membrane cap sheet 250 mm minimum and torch weld.

.5 Provide 75 mm minimum side lap and seal.

.6 Properly secure flashings to their support, without sags, blisters, fishmouths or wrinkles.

.7 Do work in accordance with manufacturer's recommendations.

.6 Roof penetrations.

.1 Install roof penetration flashings and seal to membrane in accordance with the manufacturer's recommendations and details.

3.7 CLEANING

.1 The work site must be routinely cleared of rubbish and other materials which may hinder roof installation, performance, or present a fire hazard.

.2 Upon completion check drains to ensure cleanliness and proper function, and remove surplus and excess materials, rubbish, tools and equipment. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their instructions.

.3 Repair or replace defaced or disfigured finishes caused by work of this section.

3.8 PROTECTION OF FINISHED WORK

.1 Do not permit work to be damaged prior to covering insulation.

.2 Protect building surfaces against damage from roofing work.

.3 Where traffic must continue over finished roof membrane, protect surfaces.

3.9 FIELD WATER TESTING

.1 Field water test the roofing system after completion to assure a watertight application. Correct all deficiencies.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 00 01 50 – General Instructions (CSC)

.2 Section 07 52 11 – SBS Modified Bitumen Membrane Roofing

1.2 REFERENCES

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

.1 ASTM A653/A653M03, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 Roofing Practices Manual as published by the Roofing Contractor's Association of British Columbia.

.3 Sheet Metal and Air Conditioning Contractor's National Association, Inc., "Architectural Sheet Metal Manual" (SMACNA).

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 00 01 50 – General Instructions (CSC)

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material for recycling in accordance with Waste Management Plan.

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

.5 Ensure emptied containers are sealed and stored safely for disposal away from children.

.6 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.

.7 Unused paint and sealant material must be disposed of at an official hazardous material collections site as approved by Departmental Representative.

.8 Unused paint and sealant material must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will

pose health or environmental hazard.

.9 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 SHEET METAL MATERIALS

.1 Zinc coated steel sheet: minimum 0.61 mm thickness, commercial quality to ASTM A653/A653M, with Z275 designation zinc coating, prefinished with PPG Duranar , custom colour as selected by the Departmental Representative.

2.2 ACCESSORIES

.1 Isolation coating: alkali resistant bituminous paint.

.2 Plastic cement: to CAN/CGSB 37.5.

.3 Self-adhered Membrane: SBS modified asphalt, minimum 40 mil thickness.

.4 Sealants: to be compatible with roof system components and rated for local weather.

.5 Cleats: of same material, and temper as sheet metal, minimum 50 mm wide. Thickness same as sheet metal being secured.

.6 Fasteners: of same material as sheet metal, to CSA B111, flat head roofing nails of length and thickness suitable for metal flashing application.

.7 Washers: of same material as sheet metal, 1 mm thick with rubber packings.

.8 Touch-up paint: as recommended by prefinished material manufacturer.

2.3 FABRICATION

.1 Fabricate metal flashings and other sheet metal work in accordance with applicable RCABC details, SMACNA details and as indicated.

.2 Form pieces in 2400 mm maximum lengths. Make allowance for expansion at joints.

.3 Hem exposed edges on underside 12 mm. Mitre and seal corners with sealant.

.4 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

.5 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

2.4 METAL FLASHINGS AND FORM SHEET METAL

.1 Form flashings, copings, cap flashings and fascias to profiles indicated of 0.61 mm thick galvanized, prefinished steel.

.2 Form roof edge metal upstands from minimum 1.22 mm thick, galvanized steel. To form roof edge metal upstands ("Sheet Metal Parapet") or other descriptions noted on drawings from minimum 1.22mm thick galvanized steel or as specified thickness on drawings.

Part 3 Execution

3.1 INSTALLATION OF SELF ADHERED MEMBRANE

.1 Inspect self-adhered membrane for damage upon delivery to site. Replace defective material.

.2 Install membrane as detailed in strict accordance with manufacturer's written directions.

.3 Prior to installation of membrane cover all exposed fasteners, sharp corners and other similar conditions detrimental to the membrane with small strips or patches of membrane to prevent sharp edges from penetrating finished membrane.

.4 Install membrane under cap flashings and over upper leg of cross cavity flashings.

3.2 INSTALLATION

.1 Install sheet metal work in accordance with RCABC details, SMACNA details and mechanical details as indicated.

.2 Use concealed fastenings except where approved before installation.

.3 Counter flash bituminous flashings at intersections of roof with vertical surfaces and curbs. Flash joints using S-lock seams forming tight fit over hook strips, as detailed.

.4 Use standing seams at corners.

.5 Lock end joints and caulk with sealant.

.6 Install surface mounted reglets true and level, and caulk top of reglet with sealant.

.7 Insert metal flashing into reglets and under cap flashings to form weather tight junction.

.8 Turn top edge of flashing into recessed reglet or mortar joint minimum of 25 mm. Lead wedge flashing securely into joint.

.9 Caulk flashing at reglet and cap flashing with sealant.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 09 29 00 - Gypsum Board: Gypsum board.

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM)

.1 ASTM A645-05 Standard For Non-Structural Steel Framing Members.

.2 ASTM A653/A653M-08, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.3 ASTM A1003-M08, Standard specification for sheet steel, carbon, metallic and non-metallic coated for cold formed framing members.

.4 ASTM C1002-07, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.40-97, Primer, Structural Steel, Oil Alkyd Type.

.2 CAN/CGSB-19.21-M87, Sealing and Bedding Compound Acoustical.

1.3 DESIGN REQUIREMENTS

.1 Include the cost of engineered design of all interior steel stud partition framing in the Contract Price.

.1 Design framing to limit deflection to L/240.

.2 Use studs having same width as shown on the drawings.

.3 Install studs at spacing not greater than that shown on the drawings.

.4 Design assemblies to resist safely and effectively all loads and effects of loads in accordance with Part 4.0 of the National Building Code for equipment, washroom accessories, fixtures, cabinets, backing plates, anchorages and similar items supported on or anchored to steel stud partitions, including work shown on the drawings, equipment supplied by the Departmental Representative to the Contractor for installation and equipment supplied and installed by the Departmental Representative. Obtain information regarding equipment loads from the Departmental Representative.

1.4 SUBMITTALS

.1 Submit engineered shop drawings for steel stud framing, prepared, signed and sealed by a structural engineer registered in the Province of British Columbia.

1.5 LETTERS OF ASSURANCE

.1 Have the engineer responsible for sealing the engineered shop drawings submit to the Departmental Representative, Schedule B-1 Assurance of Professional Design and Commitment for Field Review and Schedule B-2 Summary of Design and Field Review Requirements with the shop drawings.

.1 Engineer to provide field review of the installation and submit to the Departmental Representative Schedule C-B Assurance of Professional Field Review and Compliance upon completion of the work.

1.6 QUALITY ASSURANCE

.1 Work of this section shall conform to the Association of Wall and Ceiling Contractors (AWCC) Standards Manual.

.2 Comply with AISI's "Specification for the Design of Cold-Formed Steel Structural Members", for calculating structural characteristics of cold-formed metal framing.

.3 Manufacturer Qualifications: Company specializing in work of this section, with minimum 5 years documented experience.

.4 Installer Qualifications: Company specializing in work of this section, with minimum 3 years documented experience in commercial quality work of comparable scope.

.5 Regulatory Requirements:

.1 Comply with local and provincial codes, ordinances, and other regulatory requirements.

.2 Comply with applicable ULC or WH tested design for fire-resistive assemblies.

.6 Coordination:

.1 Conform with Product Requirements in Division 01, for coordination with related Sections.

.2 Coordinate installation of backing and bearing plates for casework, equipment, specialties, utilities, and other items required by other Sections, including Division 21 Fire Protection, Division 23 Heating, Ventilating and Air Conditioning and Division 26 Electrical.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Divert steel scraps from landfill by disposal at nearest metal recycling facility.

.1 Divert reusable materials for reuse at nearest used building materials facility or similar type facility.

.2 Divert unused primer materials from landfill through disposal at a special wastes depot.

Part 2 Products

2.1 MATERIALS

.1 Non-load bearing channel stud framing: to ASTM C 645, stud size as scheduled and detailed, roll formed from 0.91 mm thickness hot dipped galvanized steel sheet, for screw attachment of gypsum board. Knock-out service holes at 460 mm centres.

.2 Floor and ceiling tracks: to ASTM C 645, in widths to suit stud sizes, 32 mm flange height, and 50 mm flange height under structural steel framing.

.3 Metal channel stiffener: 38 x 12 mm size, 1.4 mm thick cold rolled steel, coated with rust inhibitive coating.

.4 Acoustical sealant: to CAN/CGSB-19.21.

.5 Acoustical Insulating strip: rubberized, moisture resistant 3 mm thick foam strip, 12 mm wide, with self sticking adhesive on one face, lengths as required.

.6 Security Mesh: 3/4-13F security mesh (Product No. 0700320) as supplied by PacificWest Systems Supply, telephone: 604-294-6864, or approved substitution.

Part 3 Execution

3.1 ERECTION

.1 Install steel stud tracks and studs in accordance with engineered shop drawings.

.2 Align partition tracks at floor and ceiling and secure at 600 mm o.c. maximum, unless lesser spacing prescribed on engineered shop drawings.

.3 Install damp proof course under stud shoe tracks of partitions on slabs on grade.

.4 Place studs vertically at 400 mm oc maximum and not more than 50 mm from abutting walls, and at each side of openings and corners. Position studs in tracks at floor and ceiling. Cross brace steel studs as required to provide rigid installation to manufacturer's instructions.

.5 Erect metal studding to tolerance of 1:1000.

.6 Attach studs to bottom track using screws.

.7 Install 50 mm deep ceiling tracks under structural steel framing above. Cut steel studs 12 mm short of underside of structure to allow for deflection.

.8 Co-ordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.

.9 Co-ordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other Sections.

.10 Provide two studs extending from floor to ceiling at each side of openings wider than stud centres specified. Secure studs together, 50 mm apart using column clips or other approved means of fastening placed alongside frame anchor clips.

.11 Install heavy gauge single jamb studs at openings.

.12 Erect track at head of door/window openings and sills of sidelight/window openings to accommodate intermediate studs. Secure track to studs at each end, in accordance with manufacturer's instructions. Install intermediate studs above and below openings in same manner and spacing as wall studs.

.13 Frame openings and around built-in equipment, cabinets, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.

.14 Provide 40 mm stud or furring channel secured between studs for attachment of fixtures behind lavatory basins, toilet and bathroom accessories, and other fixtures including grab bars and towel rails, attached to steel stud partitions.

.15 Install steel studs or furring channel between studs for attaching electrical and other boxes.

.16 Extend partitions to ceiling height except where noted otherwise on drawings.

.17 Install continuous insulating strips to isolate studs from uninsulated surfaces.

.18 Install two continuous beads of acoustical sealant or insulating strip under studs and tracks around perimeter of sound control partitions.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 09 22 16 – Non-structural Metal Framing.

1.2 REFERENCES

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

.1 ASTM C36/C36M-01, Specification for Gypsum Wallboard.

.2 ASTM C79/C79M-01, Standard Specification for Treated Core and Non-treated Core Gypsum Sheathing Board.

.3 ASTM C442/C442M-01, Specification for Gypsum Backing Board, Gypsum Coreboard, and Gypsum Shaftliner Board.

.4 ASTM C475-01, Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.

.5 ASTM C514-01, Specification for Nails for the Application of Gypsum Board.

.6 ASTM C630/C630M-01, Specification for Water-Resistant Gypsum Backing Board.

.7 ASTM C840-01, Specification for Application and Finishing of Gypsum Board.

.8 Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.84 mm to 2.84 mm in Thickness.

.9 ASTM C1002-01, Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

.10 ASTM C1047-99, Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.

.11 ASTM C1280-99, Specification for Application of Gypsum Sheathing Board.

.12 ASTM C1177-01, Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

.2 Association of the Wall and Ceilings Industries International (AWEI)

.3 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S102-1988(R2000), Surface Burning Characteristics of Building Materials and Assemblies.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials in original packages, containers or bundles bearing manufacturers brand name and identification.

.2 Store materials inside, level, under cover. Keep dry. Protect from weather, other elements and damage from construction operations and other causes.

.3 Handle gypsum boards to prevent damage to edges, ends or surfaces. Protect metal accessories and trim from being bent or damaged.

1.4 SITE ENVIRONMENTAL REQUIREMENTS

.1 Maintain temperature minimum 10 degrees C, maximum 21 degrees C for 48 hours prior to and during application of gypsum boards and joint treatment, and for at least 48 hours after completion of joint treatment.

.2 Apply board and joint treatment to dry, frost free surfaces.

.3 Ventilation: Ventilate building spaces as required to remove excess moisture that would prevent drying of joint treatment material immediately after its application.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated packaging material for recycling in accordance with Waste Management Plan.

.4 Divert unused gypsum from landfill to gypsum recycling facility for disposal by Departmental Representative.

.5 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.

Part 2 Products

2.1 MATERIALS

.1 Standard board: to ASTM C36/C36M regular, and Type X, 1200 mm wide x maximum practical length, ends square cut, edges beveled, thickness as detailed.

.2 Backing board and coreboard: to ASTM C442/C442M regular, and Type X, squared edges, thickness as detailed.

.3 Water-resistant board: to ASTM C630/C630M regular, and Type X, 1200 mm wide x maximum practical length, thickness as detailed.

.4 Abuse Resistant Board: Minimum Performance Levels

.1 Surface Abrasion: Level 2 Tested in accordance with ASTM C 1629 and ASTM D 4977.

.2 Indentation Resistance: Level 1 Tested in accordance with ASTM C 1629 and ASTM D 5420.

.3 Soft-body Impact: Level 1 Tested in accordance with ASTM C 1629 and ASTM E 695.

	Abrasion	Indentation	Hard Body Impact	Soft Body Impact
Category 1	15 cycles	0.15 in.	30 ft-lbs	120 ft-lbs
Category 2	30 cycles	0.13 in.	40 ft-lbs	180 ft-lbs
Category 3	100 cycles	0.10 in.	80 ft-lbs	210 ft-lbs
Category 4	500 cycles	0.08 in.	110 ft-lbs	300 ft-lbs
Category 5	1000 cycles	N/A	N/A	N/A

.4 Acceptable Product – Where Moisture and Mold Resistant GWB is specified on drawings.

.1 United States Gypsum - Fiberock® brand aqua-tough™ Gypsum Fiber Interior Panels, or equivalent. Satisfies Category 2 Criteria.

.2 Finish – USG Brand tuff-hide Primer-Surfacer, or equivalent.

.5 Acceptable Product – Where VHI GWB is specified on drawings.

.1 United States Gypsum - Fiberock® Brand VHI Abuse-Resistant Gypsum Fiber Interior Panels, or equivalent.

.2 Finish – USG Brand tuff-hide Primer-Surfacer, or equivalent.

.3 Provide control joints in walls longer than 10m.

.5 Paperless Gypsum Wallboard: to ASTM C 1177 and ASTM C 630, thickness as detailed. Acceptable Product: Georgia Pacific Dens Armor Plus, or equivalent.

.6 Glass mat gypsum substrate sheathing: to ASTM C1177/C1177M, thickness as detailed, 1200 mm wide x maximum practical length.

.7 Steel drill screws: to ASTM C1002.

.8 Casing beads, corner beads, control joints and edge trim: to ASTM C1047, metal, zinc- coated by electrolytic process, 0.5 mm base thickness, perforated flanges, one piece length per location.

.9 Joint compound: to ASTM C475, asbestos-free.

Part 3 Execution

3.1 ERECTION

.1 Do application and finishing of gypsum board in accordance with ASTM C840 except where specified otherwise.

.2 Do application of gypsum sheathing in accordance with ASTM C1280.

3.2 APPLICATION

.1 Do not apply gypsum board until bucks, anchors, blocking, sound attenuation, electrical and mechanical work are approved.

.2 Apply gypsum board to metal furring or framing using screw fasteners. Maximum spacing of screws 300 mm on centre.

.1 Single-Layer Application:

.1 Apply gypsum board on ceilings prior to application of walls in accordance with ASTM C840.

.2 Apply gypsum board vertically or horizontally, providing sheet lengths that will minimize end joints.

.2 Double-Layer Application:

.1 Install gypsum board for base layer and exposed gypsum board for face layer.

.2 Apply base layer to ceilings prior to base layer application on walls; apply face layers in same sequence. Offset joints between layers at least 250 mm.

.3 Apply base layers at right angles to supports unless otherwise indicated.

.4 Apply base layer on walls and face layers vertically with joints of base layer over supports and face layer joints offset at least 250 mm with base layer joints.

.3 Type: Refer to drawings and schedules.

.3 Install ceiling boards in direction that will minimize number of end-butt joints. Stagger end joints at least 250 mm.

.4 Install gypsum board on walls vertically to avoid end-butt joints. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs, except where local codes or fire-rated assemblies require vertical application.

.5 Install exterior gypsum sheathing board in accordance with AWCC manual, ASTM C1280 and manufacturer's printed instructions. Install sheathing with gold side out. Use maximum possible lengths to minimize number of joints. Locate edge joints parallel to and located on framing.

Stagger intermediate end joints of adjacent lengths sheets. Fixing: Single screw, screws at maximum 200 mm o.c. over supports. Set screws slightly below surface and not closer than 9 mm to edges.

.6 Do not install damaged or damp boards.

.7 Locate edge or end joints over supports. Stagger vertical joints over different studs on opposite sides of wall.

3.3 INSTALLATION

.1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure at 150 mm on centre.

.2 Install casing beads around perimeter of suspended ceilings.

.3 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated.

.4 Install access doors to electrical and mechanical fixtures specified in respective sections. Rigidly secure frames to furring or framing systems.

.5 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.

.6 Gypsum Board Finish: finish gypsum board walls and ceilings to following levels in accordance with Association of the Wall and Ceiling Industries (AWCI) International Recommended Specification on Levels of Gypsum Board Finish:

.1 Levels of finish:

.1 Level 0: No tapping, finishing or accessories required.

.2 Level 1: Embed tape for joints and interior angles in joint compound. Surfaces to be free of excess joint compound; tool marks and ridges are acceptable. Use this finish in areas where the assembly will be completely concealed from view such as in ceiling spaces and behind solid wall and ceiling finishes.

.3 Level 3: Embed tape for joints and interior angles in joint compound and apply two separate coats of joint compound over joints, angles, fastener heads and accessories; surfaces smooth and free of tool marks and ridges. Use this finish in areas where the assembly will receive a heavy or medium texture spray or heavy weight wall covering.

.4 Level 4: Embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; surfaces smooth and free of tool marks and ridges. Use this finish in areas where the assembly will be finished a flat paint finish or medium weight wall coverings are used.

.5 Level 5: Embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; apply a thin skim coat of joint compound to entire surface; surfaces smooth and free of tool marks and ridges. Use this finish in areas where the assembly will be finished in a gloss, semi-glossor egg shell paint finish. Use this finish in areas of severe lighting conditions such as long or large area walls receiving high levels of natural or artificial light.

.7 Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.

.8 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.

.9 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.

.10 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish

.11 Apply one coat of white primer sealer over surface to be textured. When dry apply textured finish in accordance with manufacturer's instructions.

.12 Mix joint compound slightly thinner than for joint taping.

.13 Apply thin coat to entire surface using trowel or drywall broadknife to fill surface texture differences, variations or tool marks.

.14 Allow skim coat to dry completely.

.15 Remove ridges by light sanding or wiping with damp cloth.

.16 Provide protection that ensures gypsum drywall work will remain without damage or deterioration at time of substantial completion.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 09 29 00 – Gypsum Board: Gypsum wallboard surfaces.

1.2 REFERENCES

.1 The Master Painters Institute (MPI) Architectural Painting Specification Manual, 1997

1.3 SUBMITTALS

.1 If requested by the Departmental Representative, provide for approval a 300 x 300 mm sample of each colour on the actual base material. Colours shall be exact shade, texture and gloss value.

.2 Submit qualification documentation indicating adherence to the Quality Assurance requirements.

1.4 QUALITY ASSURANCE

.1 The painting Subcontractor must have a minimum of five (5) years satisfactory experience in related work. Maintain a qualified crew of painters throughout the duration of the work to fully satisfy the requirements of this specification. Provide qualification documentation to the Departmental Representative when requested.

1.5 MOCK-UP

.1 Before proceeding with final paint application, finish one (1) room in each approved colour scheme in actual finish texture materials and workmanship for review by the Departmental Representative.

.2 After approval, this mock-up area to serve as the standard of quality for all work throughout the building.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING.

.1 Deliver paint materials to job site in sealed original labelled containers bearing the manufacturer's name, type of paint, brand name, colour designation and instructions for mixing and/or reducing.

.2 Store paint materials at a minimum ambient temperature of 7°C in a well ventilated and heated single designated area.

.3 Take all necessary precautionary measures to prevent fire hazards and spontaneous combustion. Maintain an operational 10 kg capacity CO2 fire extinguisher in each storage area.

.4 Where toxic materials and both toxic and explosive solvents are used, appropriate precautions and no smoking must be taken as a regular procedure.

1.7 SITE CONDITIONS

.1 Temperatures, moisture content of the surfaces, lighting and ventilation shall conform to the following:

.2 Wallboard: Maximum moisture content 12%.

.3 Concrete/Concrete Block: Maximum moisture content 12% for solvent type paint, 18% for water base paint. Masonry surfaces shall be tested for alkalinity and shall have been installed a minimum of 28 days.

.4 Wood: Maximum moisture content 15%.

.5 Temperatures: Do not execute painting work if temperatures on the surfaces, or the air in the vicinity of the painting work are below 10°C.

.6 Provide minimum of 323 lx [30 foot candles] lighting on surfaces to be painted.

.7 Provide adequate continuous ventilation and sufficient heating facilities to maintain temperatures above 10°C for 24 hours before and after paint application.

.8 Apply paint only to dry, clean, properly cured and adequately prepared surfaces in areas where dust is no longer generated by construction activities such that airborne particles will not affect the quality of finished surfaces.

1.8 SCHEDULING

.1 Schedule painting operations to prevent disruption of and by other trades

1.9 INSPECTION

.1 Provide regular inspection reports to the Departmental Representative.

.2 The cost of the inspection shall be included in the Contract Price.

.3 If the maintenance bond option is used, provide a letter of consent from a surety licensed to do business in Canada prior to award of the painting subcontract.

Part 2 Products

2.1 ACCEPTABLE MATERIALS

.1 Except as specified herein, paint, varnish, stain, enamel, lacquer, and fillers shall be of a type and brand listed under "Product Listings" as covered in the MPI Manual, latest edition, for specific uses.

.2 Paint materials such as linseed, oil, shellac, turpentine, and any of the above materials not specifically mentioned herein but required for work with the finish specified shall be highest quality product of an approved manufacturer and in accordance with CGSB standards as a minimum.

.3 Where required, paints and coatings shall meet the flame spread requirements of local authorities having jurisdiction

.4 New and Existing Concrete Block required Block Filler for areas specified for Resinous Wall Coating.

.1 Sherwin Williams heavy duty block filler B42W46, or equivalent.

.1 Application: 3 thin coats.

.2 Surface Preparation:

.1 New: refer to SSPC-SP13/NACE 6.

.2 Existing: refer to SSPC-SP13/NACE 6,Reference Section: 01 74 00 Cleaning and Special Cleaning Procedures. If Block is contaminated with oils, grease, chemicals, etc., they must be removed by cleaning with a strong detergent. Refer to ASTM D4258.

2.2 GLOSS

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

.1 Gloss Level 1: Flat or matt: max. 5 units @ 60 degrees to a maximum of 10 units@ 85 degrees.

.2 Gloss Level 2: High Sheen Flat (Velvet-like): max. 10 units @ 60 degrees to a maximum of 10 - 35 units @ 85 degrees

.3 Gloss Level 3: Eggshell: max. 10 - 25 units @ 60 degrees to a maximum of 10 - 35units @ 85 degrees.

.4 Gloss Level 4: Satin-like Finish: max. 20 - 35 units @ 60 degrees to a minimum of 35 units @ 85 degrees.

.5 Gloss Level 5: Semi-gloss Finish: max. 35 - 70 units @ 60 degrees.

.6 Gloss Level 6: Gloss Finish: max. 70 - 85 units @ 60 degrees.

.7 Gloss Level 7: High Gloss Finish: More than 85 units @ 60 degrees.

2.3 FINISHES

.1 The Departmental Representative has selected Products and colours to base final colour schemes upon. Unless otherwise approved by the Departmental Representative, paint materials shall be supplied in accordance with colour schedules provided.

.2 Mock-ups of paint finishes will be required for items scheduled to be painted prior to finishing complete areas. Make adjustments to final colour schemes as requested by the Departmental Representative. Do not mix paints until final colour schemes are approved by the Departmental Representative.

.3 Unless otherwise shown on the drawings or scheduled generally paint as follows:

.1 Paint doors, frames and door trim generally the same colour, but a different colour than walls.

.2 Paint access doors, registers, radiators and covers, prime coated butts, prime-coated door closers and exposed sprinkler and service piping, ductwork and electrical conduit and suspensions with colour, texture and sheen to match adjacent surfaces.

.3 Back prime and paint plywood service panels to match painted wall.

.4 Paint the inside of light valences gloss white.

2.4 MIXING

.1 Paints shall be ready-mixed unless otherwise specified, except that any coating in paste or powder form, or to field-catalysed shall be field-mixed in accordance with the directions of its manufacturer. Pigments shall be fully ground and shall maintain a soft paste consistency in the vehicle

during storage that can and shall be dispersed readily and uniformly by paddle to a complete homogeneous mixture.

.2 The paint shall have good flowing and brushing properties and shall dry or cure free of streaks or sags, to yield the desired finish specified.

Part 3 Execution

3.1 INSPECTION

.1 Inspect all surfaces and materials to receive painting before commencing work. Notify the Departmental Representative in writing of any defects or conditions affecting the proper application of the work of this section.

.2 Obtain necessary information from other trades on compatibility of their primers and finishes with work of this section.

.3 Do not proceed with painting work until defects have been corrected.

3.2 PREPARATION OF SURFACES

.1 Existing Surfaces to Be Re-painted: Examine existing surfaces to be re-painted to assess condition and remedial action. Prepare, clean, wash, patch and make good existing surfaces in accordance with MPI manual to suit level of surface deterioration exhibited.

.2 Refer to the MPI Manual and MPI Repaint Manual for surface preparations not included in the following:

.1 Mildew Removal: Scrub with solution of TSP and bleach, rinse with clear water and allow surface to dry completely.

.2 Drywall: Remove contamination, prime surface to show defects if any. Apply paint only after defects have been remedied.

.3 Galvanized Steel: Remove surface contamination, wash metal with xylene solvent and apply coat of an approved etching type primer.

.4 Concrete and Masonry Surfaces: Remove dirt, loose mortar, scale, powder and other foreign matter. Oil and grease to be removed by solution containing TSP, rinse and let dry. Remove concrete stains caused by weathering of corroding metals with solution of sodium metasilicate after being thoroughly wetted with water. Let dry.

.5 Structural Steel: See MPI Manual, for conditions that may apply.

.6 Wood, Plywood and Millwork: All wood surfaces shall be clean and dry with a moisture reading of less than 15%. Wipe off dust and grit prior to prime coat; knots, pitch streaks and sappy sections shall be spot coated with sealer. Fill all nail holes and fine cracks after primer has dried and sanded between coats. Back prime interior and exterior woodwork.

.7 General: Protect other surfaces from paint and damage and make good any damage caused by failure to provide suitable protection.

.8 Drop Cloths: Furnish sufficient drop cloths, shields and protective equipment to prevent spray or dropping from fouling surfaces not being painted and in particular, surfaces within the storage and preparation area.

.9 Removal of Combustible Rubbish: Place cotton waste, cloths and material which may constitute a fire hazard, in closed metal containers and removed daily from site.

.10 Hardware: Remove all electrical plates, surface hardware, fittings and fastenings, prior to painting operations. Carefully store, clean and replace on completion of work in each area. Do not use solvent to clean hardware that will mar the finish on these items.

3.3 APPLICATION

.1 Method of paint application shall be generally by the accepted trade method for the building locale and as approved by the Departmental Representative.

.2 Painting coats specified are intended to cover surfaces satisfactorily when applied in strict accordance to recommendations.

.3 For surfaces that are scheduled to receive a deep hue, provide three finish coats.

.4 Apply each coat at the proper consistency.

.5 Each coat of paint shall be slightly darker than preceding coat unless otherwise approved.

.6 Sand lightly between coats to achieve required finish.

.7 Do not apply finishes on surfaces that are not sufficiently dry.

.8 Each coat of finish should be dry and hard before a following coat is applied unless the manufacturer's directions state otherwise.

.9 Tint filler to match wood when clear finishes are specified; work filler well into the grain and before it has set, wipe the excess from the surface. Apply filler before application of finishes.

.10 Back prime interior woodwork which is to receive a paint or enamel finish upon arrival at the job site with enamel under coater paint.

.11 Top and bottom edges of metal doors shall be primed with under coater.

3.4 SCHEDULES

.1 Refer to drawings and painting schedules for the extent of finishing required and MPI Schedules.

.2 Mechanical and electrical pipes, conduit, hangers, ducts and equipment shall be finished in rooms scheduled to be painted. Pipes shall finished to colour schedule specified in Division 21, 23 and all other items painted out to match ceiling colour. Confirm extent of finishing and colour schemes for exposed ceilings with the Departmental Representative prior to application.

.3 Where space behind louvers is illuminated such as washroom valences paint space gloss white.

.4 The schedules refer to the MPI architectural painting specification manual.

.5 Where an item is shown on the drawings to be painted but the item is not specifically scheduled, the item shall be finished in accordance with the applicable MPI finishing system for premium grade work except where the schedule covers custom grade work only. In the case where there are several painting systems available for the item, use the system best suited for the intended use and consistent with other finishes used on the project.

.6 New Work- Exterior Painting and Finishing Schedule - as scheduled and specified herein. Reference Chapter 2, Section 2, MPI Manual. Refer to the Finish List and Colour Schedule and the Door and Frame Schedule for MPI Schedules.

.7 New Work - Interior Painting and Finishing Schedule - as scheduled and specified herein. Reference Chapter 3, Section 2, MPI Manual. Note for surfaces that are scheduled to receive deep hues, provide three finish coats. Refer to the Finish List and Colour Schedule and the Door and Frame Schedule for MPI Schedules.

.8 Existing Painting and Finishing Schedule:

.1 The drawings indicate the general extent of existing surfaces requiring repainting. The drawings and specifications do not necessarily indicate or describe the entire and complete extent of the work. On the basis of the general extent indicated, described or implied re-finish all work required for the proper execution and completion of the work.

.2 The MPI Repainting Manual specifies the preparation work required for existing surfaces and lists schedules applying to refinishing existing surfaces. Refinish existing surfaces using materials of the same quality and gloss as for new surfaces specified above.

.3 Interior Painting and Finishing Schedule - as scheduled, reference Chapter 3, Section 2, MPI Repaint Manual.

.9 Surface Preparation For Metal Doors and Frames:

.1 Wash with Greensolv Inc. #307, or equivalent. Spray on and saturate surface allowing 15 minutes dwell time, wipe dry with dry rag and air dry with forced air.

3.5 FIELD QUALITY CONTROL

.1 Painting surfaces will be considered to lack uniformity and soundness if any of the following defects are apparent:

.1 Runs, sags, hiding or shadowing by inefficient application methods.

.2 Evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners and re-entrant angles.

.3 Damage due to touching before paint is sufficiently dry or any other contributory cause.

.4 Damage due to contamination of paint due to airborne particles.

3.6 PROTECTION

.1 Protect all newly painted exterior surfaces from rain and snow, condensation, contamination, dust, salt spray and freezing temperatures Until paint coatings are completely dry. Curing periods shall exceed the manufacturer's recommended minimum time requirements.

.2 Erect barriers or screens and post signs to warn of or limit or direct traffic away or around work area as required.

3.7 CLEANING

.1 Promptly as the work proceeds and on completion of the work, remove all paint where spilled, splashed or spattered using methods that are not detrimental to affected surfaces.

.2 Keep the premises free from any unnecessary accumulation of tools, equipment, surplus materials and debris.

.3 Remove combustible rubbish materials and empty paint cans each day and safely dispose of same in accordance with requirements of authorities having jurisdiction.

.4 Clean equipment and dispose of wash water/solvents as well as all other cleaning and protective materials (ie. Rags, drop cloths, masking papers) paints, thinners paint removers/strippers in accordance with the safety requirements of authorities having jurisdiction.

.5 At the conclusion of the work, leave the premises neat and clean.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

.1 Submittals: in accordance with the Submittal Procedure requirements in Section 00 01 50 – General Instructions (CSC).

.2 Submit all information and data in both printed paper format and PDF electronic format. The PDF electronic format will be used for insertion into the Operating and Maintenance and Commissioning Manuals.

.3 Shop drawings to show:

.1 Mounting arrangements.

.2 Operating and maintenance clearances.

.4 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.

.5 Closeout Submittals:

.1 Provide operation and maintenance data for incorporation into manual specified in the Closeout Submittals requirements in Section 00 01 50 – General Instructions (CSC).

.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.

.6 Approvals:

.1 Submit 2 copies of draft Operation and Maintenance Manuals to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.

.2 Draft O&M Manuals submission is required prior to substantial completion.

.3 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.

.8 Site records:

.1 Departmental Representative will provide 1 set of mechanical drawings for mark up. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.

.2 Transfer information weekly to drawings, revising drawings to show work as actually installed.

.3 Use different colour 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 marked up as-built drawings with Operating and Maintenance Manuals.

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

1.2 MAINTENANCE

.1 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.

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

1.1 DELIVERY, STORAGE AND HANDLING

.1 Protect on site per paragraph 1.12.3 of section 00 01 50 General Instructions (CSC).

1.2 WASTE MANAGEMENT AND DISPOSAL:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with paragraph 1.16 of section 00 01 50 General Instructions (CSC).

Part 2 Products

2.1 DUCT AND PIPE MOUNTED CONTROL AND SENSING EQUIPMENT

.1 The following automatic control equipment will be supplied by the Division 25 (mechanical) but installed by the appropriate trade sections of the Division 23 Mechanical Contract:

.1 Automatic control valves.

.2 Temperature control wells.

.3 Pressure tappings.

.4 Flow switches.

.5 Automatic control dampers.

.6 Static pressure sensors.

Part 3 Execution

3.1 EXISTING UNDERGROUND SERVICES

.1 Protect all existing underground services encountered. Obtain instructions from Departmental Representative when existing services require relocation or modifications, other than those already indicated in the Contract Documents.

.2 Arrange work to avoid shutdowns of existing services. Where shutdowns are unavoidable, obtain the Departmental Representative's approval of the timing, and work to minimize any interruptions.

.3 Shutdowns, to permit connections, will be carried out by maintenance staff.

.4 In order to maintain existing services in operation, provide temporary relocations and/or bypasses of piping.

.5 Be responsible for any damages to existing systems by this work.

3.2 CUTTING, PATCHING, DIGGING, CANNING AND CORING

.1 Be responsible for all cutting, patching, digging, canning and coring required to accommodate the mechanical services.

.2 Openings through structural members of the building shall not be made without the approval of the Departmental Representative.

.3 Be responsible for correct location and sizing of all openings required under Division 23, including pipe sleeves and duct openings. Allow oversized openings for fire dampers and pipe penetrations where insulation is specified.

.4 Verify the location of existing service runs and steel reinforcing within existing concrete floor and walls prior to core drilling and/or cutting. Repairs to existing services and structural components damaged as a result of core drilling and cutting is included in this section of the work.

.5 All openings shall be core drilled or diamond saw cut.

3.3 SERVICE PENTRATIONS IN RATED FIRE SEPARATIONS

.1 All piping, tubing, ducts, wiring, conduits, etc. passing through rated fire separations shall be smoke and fire proofed with ULC approved materials in accordance with CAN4-S115-M85 and ASTM E814 standards and which meet the requirements of the Building code in effect. This 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.

3.4 SERVICE PENETRAIONS IN NON-RATED SEPARATIONS

.1 All piping, tubing, ducts, wiring, conduits, 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 silicon sealant to prevent the passage of smoke and/or transmission of sound. Refer to "pipe sleeve" clause in this section for packing and sealing of pipe sleeves.

3.5 PIPE SLEEVES

.1 Provide pipe sleeves for all piping passing through rated walls and floors. Sleeves to be concentric with pipe.

.2 Pipes and ducts passing through fire rated separations that have no fire resistance (non-rated separations) do not require a sleeve, but the insulation at the separation should be wrapped with 0.61mm thick galvanized sheet steel band to which to apply the flexible caulking compound to.

.3 Pipe sleeves for floors and interior walls shall be minimum 0.61mm thick galvanized sheet steel with lock seam joints.

.4 Pipe sleeves for perimeter walls and foundation walls shall be cast iron sleeve or Schedule 40 steel pipe with annular fin continuously welded at

midpoint and protruding 150 mm beyond sleeve diameter. Annular fin shall be embedded into centre of wall.

.5 Pipe sleeves for wet or washdown floor areas shall be Schedule 40 steel pipe, unless indicated otherwise.

.6 Except as otherwise noted pipe sleeves are not required for holes formed or cored in interior concrete walls or floors.

.7 Pipe sleeves shall extend 50 mm above floors in unfinished areas and wet areas and 6 mm above floors in finished areas, unless indicated otherwise.

.8 Pipe sleeves shall extend 25 mm on each side of walls in unfinished areas and 6 mm in finished areas.

.9 Pipe sleeves shall extend 25 mm beyond exterior face of building. Caulk with flexible caulking compound.

.10 Sleeve Size: 12 mm clearance all around, between sleeve and pipe or between sleeve and pipe insulation.

.11 Paint exterior surfaces of ferrous sleeves with heavy application of rust inhibiting primer.

.12 Packing of Sleeves:

.1 Where sleeves pass through foundation walls and perimeter walls the space between sleeve and pipe or between sleeve and pipe insulation shall be caulked with waterproof fire retardant non-hardening mastic.

.2 Pack future-use sleeves with mineral wool insulation and then seal with ULC approved fire stop sealant for rated fire separations.

3.6 ESCUTCHEONS AND SLEEVES

.1 Provide on pipes passing through finished walls, partitions, floors and ceilings.

.2 Plates shall be stamped steel, split type, chrome plated, or stainless steel, concealed hinge, complete with springs, suitable for external dimensions of piping/insulation. Secure to pipe or finished surface. For all pipes passing through suspended ceilings and uninsulated piping passing through walls. Outside diameter shall cover opening or sleeve.

.3 Where pipe sleeve extends above finished floor, escutcheons or plates shall clear sleeve extension.

.4 Do not install escutcheons and plates in concealed locations.

3.7 EQUIPMENT SUPPORTS

.1 Provide stands and supports for equipment and materials supplied.

.2 Lay out concrete bases and curbs required under Division 23 and structural drawings.

.3 Concrete bases shall be a minimum of 100 mm thick, or as noted and shall project at least 150 mm outside the bedplate, unless otherwise directed. Bases and curbs shall be keyed to the floor and incorporate reinforcing bars and/or steel mesh. Chamfer edges of bases at 45 degrees.

.4 Equipment with bedplates shall have metal wedges placed under the edges of the bedplates to raise them 25 mm above the base after levelling. The wedges shall be left permanently in place. Fill the space between the bedplate and the base with non-shrink grout.

.5 Construct equipment supports of structural steel or steel pipe. Securely brace. Employ only welded construction. Bolt mounting plates to the structure.

.6 Support ceiling hung equipment with rod hangers and/or structural steel.

3.8 EQUIPMENT RESTRAINT

.1 It is the 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.

.2 Refer to Section 23 05 49 - Seismic Restraint.

3.9 EQUIPMENT INSTALLATION

.1 Provide unions and flanges to permit equipment maintenance and disassembly and to minimize disturbance to piping and duct systems and without interfering with building structure or other equipment.

.2 Provide means of access for servicing equipment including permanently lubricated bearings.

.3 Pipe equipment drains to floor drains.

.4 Line up equipment, rectangular cleanouts and similar items with building walls wherever possible.

3.10 ANCHOR BOLTS AND TEMPLATES

.1 Supply anchor bolts and templates for installation by other divisions.

3.11 MISCELLANEOUS METALS

.1 Be responsible for all miscellaneous steel work relative to Division 23 of the Specifications, including but not limited to:

.1 Support of equipment

.2 Hanging, support, anchoring, guiding and relative work as it applies to piping, ductwork, heat exchangers, hot water storage tanks, expansion tanks, fans and mechanical equipment.

.3 Earthquake restraint devices - refer to Section 23 05 49 - Seismic Restraint.

.4 Pipe anchor and/or support posts.

.5 Ceiling ring bolts - secure to structure or steel supports.

.2 All steel work shall be prime and undercoat painted ready for finish under Division 9. Refer to drawings for details.

3.12 FLASHING

.1 Flash and counterflash where mechanical equipment passes through weather or water proofed walls, floors, and roofs.

.2 Flash, vent and soil pipes projecting 75 mm minimum above finished roof surface with lead worked 25 mm minimum into hub, 200 mm minimum clear on side with minimum 600 x 600 mm sheet size. For pipes through outside walls turn flange back into wall and caulk.

.3 Provide curbs for mechanical roof installations 200 mm minimum high above roof insulation. Flash and counterflash with galvanized steel, soldered and made waterproofed.

.4 Provide continuous lead or neoprene safes for built-up mop sinks, and shower stalls located above finished rooms. Solder at joints, flash into floor drains and turn up 150 mm into walls or to top of curbs and caulk into joints.

3.13 DIELECTRIC COUPLINGS

.1 On all "OPEN" systems provide wherever pipes of dissimilar metals are joined.

.2 Provide insulating unions for pipe sizes NPS 2 and under and flanges for pipe sizes over NPS 2.

.3 Provide felt or rubber gaskets to prevent dissimilar metals contact.

3.14 LUBRICATION OF EQUIPMENT

.1 Lubricate all new equipment prior to being operated, except sealed bearings, which shall be checked.

.2 Use the lubricant recommended by the manufacturer for the service for which the equipment is specified.

.3 Extend lubricating connections and sight glasses to the outside of housings, where lubricating positions are not readily accessible.

3.15 PAINTING

.1 Clean exposed bare metal surfaces supplied under Divisions 21, 23 removing all dirt, dust, grease and millscale. Apply at least one coat of corrosion resistant primer paint to all supports and equipment fabricated from ferrous metal.

.2 Repaint all marred factory finished equipment supplied under Division 21, 23, which is not scheduled to be repainted, to match the original factory finish.

.3 Natural gas and fire protection piping shall be painted for identification purposes over their entire lengths throughout all exposed areas and in the mechanical room(s) as follows:

.1	Gas:	Yellow	C.G.S.B.	505-101
.2	Fire:	Red	C.G.S.B.	509-102

.4 Painting of all equipment and materials, supplied under Division 21 and 23, installed in mechanical equipment areas and inside finished areas of the building or exposed outside the building, is included under Division 9 of the Specification.

3.16 EQUIPMENT PROTECTION AND CLEAN UP

.1 Protect equipment and material in storage, on site and after installation until final acceptance. Leave factory covers in place. Take special precautions to prevent entry of foreign material into working parts of piping and duct systems.

.2 All mechanical equipment stored on site shall be kept in a dry, heated and ventilated storage area.

.3 Thoroughly clean piping, ducts and equipment of dirt, cuttings, and other foreign material.

.4 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.

.5 Provide, install and maintain 30% efficient temporary filters to return and exhaust air openings from ceiling spaces to prevent air born dust from entering ducts, plenums and coils. Install filters to return air grilles when fans are operated and building is not at a clean condition.

3.17 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS.

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.18 DEMONSTRATION

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

.2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

.3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.

.4 Departmental Representative may record these demonstrations on video tape for future reference.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Bases, pads, hangers and supports for mechanical piping, ducting and equipment.

1.2 RELATED SECTIONS

.1 Section 23 05 49 - Seismic Restraint

1.3 REFERENCES

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

.1 ANSI/ASME B31.1-2007, Power Piping.

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM A125-1996 (R2007), Specification for Steel Springs, Helical, Heat-Treated.

.2 ASTM A307-10, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.3 ASTM A563-07a, Specification for Carbon and Alloy Steel Nuts.

.3 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)

.1 MSS SP58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.

.2 ANSI/MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.

.3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.

.4 Thermal Insulation Association of Canada (TIAC)

1.4 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 MSS SP58 and ASME B31.1.

.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 as specified Section 23 05 49 - Seismic Restraint.

1.5 SUBMITTALS

.1 Submittals: in accordance with the Submittal Procedure requirements in Section 00 01 50 – General Instructions (CSC).

.2 Submit all information and data in both printed paper format and PDF electronic format. The PDF electronic format will be used for insertion into the Building Interactive Electronic Operating and Maintenance and Commissioning Manuals.

.3 Shop drawings: submit drawings stamped and signed by Professional Engineer registered or licensed in Province of British Columbia, Canada.

.4 Submit shop drawings and product data for following items:

.1 Bases, hangers and supports.

.2 Connections to equipment and structure.

.3 Structural assemblies.

.5 Quality Control Check Sheets

.6 Closeout Submittals: Provide all applicable close-out submittals per paragraph 1.18 "Closeout Submittals" of section 00 01 50 – General Instructions (CSC).

1.6 QUALITY CONTROL

.1 General:

.1 Contractor to be responsible for quality control of the products and installation in this section.

.2 Quality Control Program Submittals:

.1 Quality Control Check Sheet

.2 Check sheets to include the following information:

.1 Pipe or ductwork system

.2 Equipment number, make and model, including weights

.3 Pipe support type and spacing

.4 Pipe support finish (corrosion protection, painted)

.5 Details of pipe attachment to structure

.6 Hanger details at pipe insulation (where applicable and specified)

.7 Comments on seismic installation

.3 For each tabulated item, state the following:

.1 Does the item comply with the specification? Yes/No/Not Applicable.

.2 Identify any areas of non compliance and the proposed action to make it compliant.

Part 2 Products

2.1 GENERAL

.1 Provide hangers and supports to secure equipment in place, prevent vibration, protect appropriate against damage from earthquake, maintain grade, provide for expansion and contraction and accommodate insulation.

.2 Provide insulation protection saddles on all insulated piping.

.3 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS-SP58.

.4 Set inserts in position in advance of concrete work. Use grid system in equipment rooms.

.5 Support from (top of) structural members. Where structural bearings do not exist or inserts are not in suitable locations, suspend hangers from steel channels or angles. Provide supplementary structural members, as necessary.

.6 Do not suspend from metal deck.

2.2 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.

2.3 WALL SUPPORTS

.1 Horizontal and Vertical pipe adjacent to wall.

.1 Exposed pipe wall support for lateral movement restraint.

.2 Galvanized or other non corrosive finish.

.3 Channel type support - Burndy, Canadian Strut, Cantruss or Unistrut, type support.

.4 Angle iron wall brackets (galvanized or other non corrosive finish) with specified hangers.

2.4 FLOOR SUPPORTS

.1 Horizontal pipe.

.1 Do not support piping from the floor unless specifically indicated.

.2 Vertical pipe.

.1 Mid-point of risers between floor slabs - adjustable fabricated steel supports. Refer to Section 23 05 49 - Seismic Restraints.

2.5 EQUIPMENT SUPPORTS

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel.

.2 Calculations shall be signed and sealed by Professional Engineer certified in BC.

2.6 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

.1 Provide templates to ensure accurate location of anchor bolts.

2.7 OTHER EQUIPMENT SUPPORTS

.1 Fabricate equipment supports from structural grade steel

.2 Submit structural calculations with shop drawings, signed and sealed by Professional Engineer certified in British Columbia.

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, and as indicated.

.3 Clamps on riser piping:

.1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.

.2 Bolt-tightening torques to industry standards.

.3 Steel pipes: install below coupling or shear lugs welded to pipe.

.4 Cast iron pipes: install below joint.

.4 Clevis plates:

.1 Attach to concrete with 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 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.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Vibration isolation materials and components, seismic control measures and their installation.

1.2 RELATED SECTIONS

.1 Section 23 05 49 - Seismic Restraints

.2 Section 23 33 00 - Air Duct Accessories

1.3 REFERENCES

.1 National Building Code of Canada (NBC) - 2010

1.4 SUBMITTALS

.1 Submittals: In accordance with the Submittal Procedure requirements in Section 00 01 50 – General Instructions (CSC).

.2 Submit all information and data in both printed paper format and PDF electronic format.

.3 Submit shop drawings in accordance with Division 01Submittal Procedures.

.1 Drawings stamped and signed by Professional Engineer registered or licensed in Province of British Columbia, Canada. Provide Letters of Assurance (Schedule-C).

.2 Provide separate shop drawings for each isolated system complete with performance and product data.

.3 Provide detailed drawings of seismic control measures for equipment and piping.

.4 Manufacturer's Reports

.5 Closeout Submittals: Provide all applicable close-out submittals per paragraph 1.18 "Closeout Submittals" of section 00 01 50 – General Instructions (CSC).

Part 2 Products

2.1 GENERAL

.1 Provide vibration isolation on all motor driven equipment with motors of 1/2 HP and greater power output (as indicated on the motor nameplate) and on piping and ductwork, as specified herein. For equipment less than 1/2 HP, provide vibration isolation grommets at the support points.

.2 Provide seismic restraint for all equipment including all seismic restraint related hardware (bolts and anchors) from point of attachment to equipment through to and including attachment to structure. The required anchors shall be indicated on the shop drawings and shall be clearly identified for the correct location and so as to be readily identified after installation. Provide clear instructions for their installation. Refer to Section 23 05 49 - Seismic Restraints.

.3 Place isolators under equipment so 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.

.4 Ensure isolation systems have a vertical natural frequency no higher than one third of the lowest forcing frequency, unless otherwise specified. Use dynamic stiffness correction factors for elastomers and do not exceed 60 durometer.

.5 Isolators and restraining devices, which are factory supplied with equipment, shall meet the requirements of this section.

.6 Provide concrete inertia bases or structural steel bases, where specified or required by equipment manufacturers, located between vibrating equipment and the vibration isolation elements, unless the equipment manufacturer certifies direct attachment capabilities.

.7 Coordinate for the provision of housekeeping pads at least 100 mm high under all isolated equipment, or greater thickness where specified. Provide at least 300 mm clearance between drilled inserts and edge of housekeeping pads. Housekeeping pads to be tied to structure with reinforcement to meet Code seismic requirements.

.8 For isolated equipment, design anchors, bolts, isolators and bases to meet Code requirements. For larger isolators, where the Code requirement cannot be met by the isolator housing, provide Type 6 seismic snubbers or Type 6P where post-disaster requirement is specified.

.9 Use ductile materials in all vibration and seismic restraint equipment.

.10 Follow structural consultant's instructions for drilled inserts re: installation of anchors.

.11 Coordinate with Section 23 33 00 - Air Duct Accessories for all ductwork connections to fans or plenums.

.12 Provide flexible connectors between equipment and piping where required by manufacturers to protect equipment from stress and reduce vibration in the piping system. Meet connector manufacturer's installation specifications as well as equipment manufacturer's requirements.

.13 Coordinate with Electrical Division 26 for the provision of a minimum 180^0 hanging loop of flexible conduit for all electrical connections to isolated equipment.

.14 Supply all isolators fully assembled and clearly labelled with full instructions for installation by the contractor.

2.2 ISOLATORS - GENERAL

.1 Supply all of the vibration isolation equipment by one approved supplier with the exception of isolators, which are factory installed and are standard equipment with the machinery. Confirm with manufacturer that these factory-installed isolators meet the seismic requirements of this specification.

.2 Select isolators at the supplier's optimum recommended loading and do not load beyond the limit specified in the manufacturer's literature.

.3 Design springs "iso-stiff" (kx/ky = 1.0 to 1.5) with a working deflection between 0.3 and 0.6 of solid deflection.

.4 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.

2.3 ISOLATORS – TYPE 1, PADS

.1 Neoprene or neoprene / steel / neoprene pad isolators. Select Type 1 pads for a minimum 2.5 mm static deflection or greater. Use hold down bolts selected for seismic loads. Isolate bolts from base of unit using neoprene hemi-grommets. Avoid over-compressing grommets. Size bolt and hemi-grommet for minimum lateral clearance. Use grommets only on light-weight equipment.

2.4 ISOLATORS – TYPE 2, RUBBER FLOOR MOUNTS

.1 Rubber/neoprene-in-shear isolators designed to meet specified seismic requirements. Select isolators for a 4 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 to oil in the mechanical room.

2.5 ISOLATORS – TYPE 3, SPRING FLOOR MOUNTS

.1 Spring mounts complete with levelling devices, selected to achieve 25 mm deflection under load. Springs to incorporate a minimum 6 mm thick neoprene sound pad or cup having a 1.3 mm minimum deflection under load. Design isolator to meet specified seismic requirements.

.2 Outdoor or moist installations: Zinc or cadmium plated springs and hardware; housings coated with rust resistant paint.

.3 Colour code springs.

2.6 ISOLATORS – TYPE 4, HANGER MOUNTS

.1 Spring hangers, c/w 6 mm thick neoprene cup/bushing sized for 1.3 mm minimum deflection, or neoprene hangers.

.2 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.

.3 Outdoor or moist installations: Zinc or cadmium plated springs and hardware; housings coated with rust resistant paint.

2.7 CLOSED CELL FOAM GASKETS/NEOPRENE GROMMETS – TYPE 7

.1 20 mm thick continuous perimeter closed cell foam gasket to isolate base of package type equipment, AHU's, exhaust fans, etc. from concrete floors / roof curbs. Select width for nominal 20 kPa loading under weight of equipment and allow for 25% compression 5mm. Increase width of curb using steel shim if necessary to accommodate gasket. For light equipment such as exhaust fans, deflection should be a minimum of 1.3 mm.

Contractor to check fire rating requirements specified for project.

2.8 PIPE RISER GUIDE/ANCHOR – TYPE 8

.1 Telescoping all direction acoustical pipe anchor consisting of two concentric steel tubes separated by 12 mm thick neoprene isolation material. Hot application isolators.

2.9 FLEXIBLE CONNECTORS – TYPE 9

.1 Twin sphere flexible connectors with floating flanges c/w control rods.

2.10 STEEL BASES

.1 Construct structural steel bases sufficiently rigid to keep deflection and misalignment within acceptable limits as determined by the equipment manufacturer.

.2 Use height saving brackets in all mounting locations to provide a base clearance of 35 mm.

.3 Bases to be furnished with built-in motor slide rails. Motor location as specified/scheduled.

.4 Steel bases supplied as integral part of equipment to be supplied meeting the above requirements.

2.11 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.

Part 3 Execution

3.1 INSTALLATION

.1 Execute the work in accordance with the specifications and, where applicable, in accordance with the manufacturer's instructions and only by 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, etc.

.3 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) anchors and/or welding.

.4 After installation and adjustment of isolators verify deflection under load to ensure loading is within specified range and isolation is being obtained.

.5 Where hold down bolts for isolators or seismic restraint equipment penetrate roofing membranes, provide "gum cups" and sealing compound to maintain waterproof integrity of roof. Ensure sealing compound is compatible with isolator components such as neoprene. Co-ordinate with roofing section of specifications and with roofing subcontractor.

.6 Under equipment mounted on Type 3 mounts, which do not meet the seismic requirement, provide Type 6 seismic snubbers.

.7 Select Type 4 spring hangers for a minimum static deflection of 25 mm for all ceiling hung fans, and air handling units, emergency generator exhaust piping and silencers, steam PRV's and any other vibrating sources.

.8 Isolate axial fans rotating at more than 1170 RPM on type 2 isolators.

.9 Use the lowest RPM scheduled for two-speed equipment in determining isolator deflection.

.10 Where ductwork, piping or boiler exhaust stacks, etc., connected to or serving noise generating equipment, is routed through walls, floors, piping chases, etc. position ductwork, piping, stacks, etc. to avoid contact with the concrete structure, future framing, drywall and other finishes which may radiate noise. Use Type 2 and Type 8 mounts. Submit proposed details to meet this requirement. This requirement includes piping from chiller and emergency generator exhaust.

.11 Provide Type 8 resilient elements in pipe anchors, where pipe anchors are within 12 m of a vibrating source or if located in pipe chases.

.12 Protect neoprene isolator components from overheating or use type 8 mounts.

.13 Be responsible for ensuring that flexible duct connections are installed with a minimum of 40 mm metal-to-metal gap. Use flanges to ensure that flexible connectors are clear of the airstream.

.14 Isolate variable frequency drive controller using isolators or soft grommets such that structure borne noise transmission to occupied space is less than airborne noise transmission. Controller supplier to provide all isolation, including wiring connections, to control flanking noise transmission. Provide isolation meeting all seismic requirements.

.15 Provide stabilizing springs limiting movement at flexible connections to 25% of fabric width under steady state conditions and 40% at start up.

.16 Floor or pier mounted equipment: Isolate all floor or pier mounted equipment on Type 3 isolators, unless otherwise specified.

.17 Slab on grade mounted equipment: For equipment mounted on a slab on grade, mount on type 2 isolators unless otherwise specified.

3.2 INSPECTIONS

.1 The supplier shall provide assistance to the contractor as necessary during the course of installation of isolation equipment.

.2 The supplier shall inspect the complete installation after system startup and establish that the isolators for each piece of equipment are properly installed and adjusted. Correct any mal-performance. The supplier shall submit a statutory declaration to the Departmental Representative stating that the complete vibration isolation installation is installed in accordance with his drawings and instructions and operates to his satisfaction.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.

.2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:

.1 After delivery and storage of Products.

.2 After preparatory work is complete but before installation commences.

.3 Once during the installation, at 50% completion stage.

.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.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Seismic restraint systems (SRS) for statically supported and vibration isolated equipment and systems; including mechanical and process equipment, mechanical and process distribution systems, fire protection, both vibration isolated and statically supported, air handling units and exhaust fans roof curb systems.

1.2 REFERENCES

.1 SMACNA – Seismic Restraint Manual – Guidelines for Mechanical Systems.

.2 Canadian Standards Association (CSA International)

.1 CSA G40.20/G40.21-04 (R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.3 National Building Code of Canada (NBC) – 2010

1.3 DEFINITIONS

.1 Priority Two (P2) Buildings: buildings in which life safety is of paramount concern. It is not necessary that P2 buildings remain operative during or after earthquake activity.

.2 SRS: acronym for Seismic Restraint System.

1.4 SCOPE OF WORK

.1 Provide restraint on all piping, ductwork, equipment and machinery, which is part of the building mechanical and process systems to prevent injury or hazard to persons and equipment and to retain equipment in its normal position in the event of an earthquake. This specification covers equipment, which is not specifically covered in SMACNA.

.2 Provide all seismic restraint related hardware, (including bolts and anchors) from point of attachment to equipment through to and including attachment to structure.

.3 When equipment is mounted on concrete housekeeping pads, and / or concrete curbs the anchor bolts shall extend through the pad into the structure.

.4 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.

.5 Seismic restraints may only be omitted where permitted by SMACNA.

.6 Designed by Professional Engineer specializing in design of SRS and registered in Province of British Columbia. Provide Letters of Assurance (Schedules B, C-B).

1.5 SUBMITTALS

.1 Submittals: in accordance with the Submittal Procedure requirements in

Section 00 01 50 – General Instructions (CSC).

.2 Submit all information and data in both printed paper format and PDF electronic format. The PDF electronic format will be used for insertion into the Building Interactive Electronic Operating and Maintenance and Commissioning Manuals.

.3 Shop drawings: submit drawings stamped and signed by Professional Engineer registered or licensed in Province of British Columbia, Canada.

.1 Note that the shop drawings must be specific to this project, with reference and drawings showing attachment to the existing or new structure.

.2 Seismic Engineer to visit site to survey the existing conditions, before submitting the shop drawings. Coordinate roof curb seismic requirements to allow for ductwork to be run within roof curbs.

.3 Generic shop drawings that do not reflect the actual site conditions, will be rejected.

.4 Submit design data including:

.1 Full details of design criteria.

.2 Working drawings (prepared to same standard of quality and size as documents forming these tender documents), materials lists, schematics, full specifications for components of each SRS to be provided.

.3 Design calculations (including restraint loads resulting from seismic forces in accordance with National Building Code, detailed work sheets, tables).

.4 Separate shop drawings for each SRS and devices for each system, equipment.

.5 Identification of location of devices.

.6 Schedules of types of SRS equipment and devices.

.7 Details of fasteners and attachments to structure, anchorage loadings, attachment methods.

.8 Installation procedures and instructions.

.9 Design calculations including restraint loads to NBC and Supplement.

.10 Detailed work sheets, tables.

.11 Detailed design of SRS including complete working drawings prepared to same standard of quality and size as Contract Documents, materials lists, design calculations, schematics, specifications.

.5 Quality assurance submittals: Submit the following in accordance with the Submittal Procedure requirements in Section 00 01 50 – General Instructions (CSC).

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

.2 Instructions: submit manufacturer's installation instructions.

.1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.

.6 Certificate of Compliance from Contractor's Seismic Engineer (refer to Clause 3.5.1).

.7 Closeout Submittals: Provide all applicable close-out submittals per paragraph 1.18 "Closeout Submittals" of section 00 01 50 – General Instructions (CSC).

Part 2 Products

2.1 SRS MANUFACTURER

.1 SRS from one manufacturer, regularly engaged in SRS production.

2.2 GENERAL

.1 SRS to provide gentle and steady cushioning action and avoid high impact loads.

.2 SRS to restrain seismic forces in every direction.

.3 Fasteners and attachment points to resist same load as seismic restraints.

.4 SRS of Piping systems compatible with:

.1 Expansion, anchoring and guiding requirements.

.2 Equipment vibration isolation and equipment SRS.

.5 SRS utilizing cast iron, threaded pipe, other brittle materials not permitted.

.6 Attachments to reinforced concrete structure:

.1 Use high strength mechanical expansion anchors.

.2 Drilled or power driven anchors not permitted.

.7 Seismic control measures not to interfere with integrity of firestopping.

2.3 SRS FOR STATIC EQUIPMENT, SYSTEMS

.1 Floor-mounted equipment, systems:

.1 Anchor equipment to equipment supports.

.2 Anchor equipment supports to structure.

.3 Use size of bolts scheduled in approved shop drawings.

.2 Suspended equipment, systems:

.1 Use one or combination of following methods:

.1 Install tight to structure.

.2 Cross-brace in every direction.

.3 Brace back to structure.

.4 Slack cable restraint system.

.2 SCS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.

.3 Hanger rods to withstand compressive loading and buckling.

2.4 SRS FOR VIBRATION ISOLATED EQUIPMENT

.1 Floor mounted equipment, systems:

.1 Use one or combination of following methods:

.1 Vibration isolators with built-in snubbers.

.2 Vibration isolators and separate snubbers.

.3 Built-up snubber system approved by Departmental Representative, consisting of structural elements and elastomeric layer.

.2 SRS to resist complete isolator unloading.

.3 SRS not to jeopardize noise and vibration isolation systems. Provide 4-8 mm clearance between seismic restraint snubbers and equipment during normal operation of equipment and systems.

.4 Cushioning action: gentle and steady by utilizing elastomeric material or other means in order to avoid high impact loads.

.2 Suspended equipment, systems:

.1 Use one or combination of following methods:

.1 Slack cable restraint system.

.2 Brace back to structure via vibration isolators and snubbers.

2.5 SLACK CABLE RESTRAINT SYSTEM (SCS)

.1 Use elastomer materials or similar to avoid high impact loads and provide gentle and steady cushioning action.

.2 SCS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.

.3 Hanger rods to withstand compressive loading and buckling.

Part 3 Execution

3.1 GENERAL

.1 It is the responsibility of the contractor to ascertain that an appropriate size device be selected for each individual piece of equipment.

.2 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

.3 The following are guidelines for some items not covered in SMACNA but certified shop drawings should still be submitted. Note that this list is not intended to cover all equipment requiring restraints.

3.2 AIR TERMINALS

.1 Where air terminals are installed in mechanical grid ceilings, provide at least two 12 ASWG galvanized steel wire seismic security bridles per air terminal tied either to the building structure or to ceiling hanger wires.

.2 Attach security bridles at opposite corners of each air terminal and in such a manner that the air terminal cannot fall.

.3 Provide all necessary brackets for attachment of security bridles to the air terminals.

3.3 NON-ISOLATED FLOOR MOUNTED EQUIPMENT

.1 Not used.

3.4 ISOLATED PIPING AND EQUIPMENT

.1 Install cables using appropriate grommets, shackles, and other hardware to ensure alignment of the restraints and to avoid bending the cables at connecting points.

.2 Connect slack cable restraints to ceiling hung equipment in such a way that the axial projection of the wires passes through the centre of gravity of the equipment.

.3 Orient restraint wires on ceiling hung equipment at approximately 90 degrees to each other (in plan), and tie back to the ceiling slab at an angle not exceeding 45 degrees to the slab.

.4 On piping systems, provide transverse slack cable restraints at a maximum spacing of 10 m and longitudinal restraints at 20 m maximum spacing, or as limited by anchor/slack cable performance. For pipes greater than NPS10, reduce transverse restraint spacings to 6.0 m.

.5 Small pipes may be rigidly tied to big pipes for restraint, but not the reverse.

.6 Transverse bracing for one pipe section may also act as longitudinal bracing for the pipe connected perpendicular to it, provided the bracing is installed within 600 mm of the elbow or T, and if the connected pipe is the same or smaller in size. Do not use branch lines to restrain main lines.

.7 Provide flexibility in piping joints or sleeves where pipes pass through building seismic or expansion joints.

.8 At vertical pipe risers, wherever possible, support the weight of the riser at a point or points above the centre of gravity of the riser. Provide lateral guides at the top and bottom of the riser, and at intermediate points not to exceed the transverse spacings discussed above for horizontal pipes, with guide clearance not exceeding 3 mm.

.9 Vary adjacent spacing of restraints on a piping run by 10% to 30% to avoid coincident resonances.

.10 Install restraints at least 50 mm clear of all other equipment and services.

.11 Adjust restraint cables such that they are not visibly slack, or such that the flexibility is approximately 40 mm under thumb pressure for a 1.5 m cable

length (equivalent ratio for other cable lengths). Adjust the clearance at cable strap/spacer piece restraints to not exceed 6 mm.

.12 Provide transverse and axial restraints as close as practical to a vertical bend.

.13 At steel trusses, connect to top chords and follow truss manufacturer's instructions.

.14 The maximum spacing between transverse and longitudinal restraints for piping and ductwork shall be 25% less than specified in SMACNA for SHL A.

3.5 FIELD QUALITY CONTROL

.1 Inspection and Certification:

.1 SRS: inspected and certified by Contractor's Seismic Engineer (who signed shop drawings) upon completion of installation.

.2 Provide written report to Departmental Representative with certificate of compliance.

.2 Commissioning Documentation:

.1 Upon completion and acceptance of certification, hand over to Departmental Representative complete set of construction documents, revised to show "as-built" conditions.

3.6 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 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.

1.2 RELATED SECTIONS

.1 Not used.

1.3 REFERENCES

.1 Canadian Gas Association (CGA)

.1 CSA/CGA B149.1-05, Natural Gas and Propane Installation Code.

1.4 SUBMITTALS

.1 Submittals in accordance with Section 00 01 50 General Instructions (CSC).

.2 Submit all information and data in both printed paper format and PDF electronic format. The PDF electronic format will be used for insertion into the Building Interactive Electronic Operating and Maintenance and Commissioning Manuals.

.3 Shop drawings to indicate the following:

.1 Legend of proposed identification details for each system.

.2 Details of proposed nameplates, labels and tags.

.4 Samples:

.1 Provide a sample of a typical nameplate, label and tag for review and approval of Departmental Representative.

.2 Provide a mock up of each type of piping identification.

.5 Quality Control Check Sheets.

.6 Closeout Submittals:

.1 Submit maintenance data for incorporation into manual.

1.5 QUALITY CONTROL

.1 General:

.1 Contractor to be responsible for quality control of the products and installation in this section.

.2 Submit all information and material required for the Quality Management System, in accordance with the Submittal Procedure requirements in Section 00 01 50 – General Instructions (CSC).

.3 Quality Control Program Submittals:

.1 Quality Control Check Sheet

.4 Quality Control Check Sheet:

.1 Prepare and maintain Quality Control Check Sheets.

.2 Check sheet to be kept on site and be made available for review by the Departmental Representative at any time.

.3 Check sheets to be filled in and submitted for review, prior to substantial completion.

.4 Tabulated check list including the following:

.1 Equipment number and type

.2 System type

.3 Equipment and system location

.4 Identification completed

.5 Spacing as specified

.6 Visible from all areas

.7 Match existing identification

.8 Corrosion resistant nameplates, tags and ties

.9 Valve schedule and identification chart

.5 For each tabulated item, state the following:

.1 Does the item comply with the specification? Yes/No/Not Applicable.

.2 Identify any areas of non compliance and the proposed action to make it compliant.

Part 2 Products

2.1 GENERAL

.1 There are areas in this project where the relative humidity levels will be high.

.2 Select an identification system that is appropriate for such an environment.

2.2 MANUFACTURER'S EQUIPMENT NAMEPLATES

.1 Lamacoid nameplate, mechanically fastened to each piece of equipment by manufacturer.

.2 Include ULC, (Underwriters' Laboratories Canada) or CSA, (Canadian Standards Association) registration logos and those of other agencies, as required by the respective agencies.

.3 Nameplates shall be located so that they are easily read. Do not insulate or paint over nameplates.

.4 Lettering and numbers raised or recessed.

.5 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.

2.3 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 (lamacoid), 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.

.5 Identify all systems and areas or zones of building being serviced.

2.4 PIPING SYSTEMS GOVERNED BY CODES

.1 Identification:

.1 Natural gas: to CSA/CGA B149.1.

.1 Paint all natural gas piping yellow.

.2 Sprinklers: to NFPA 13.

.1 Paint all sprinkler piping red.

.3 Standpipe and hose systems: to NFPA 14.

.1 Paint standpipe and hose system piping red.

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 or 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
Natural gas	to Codes	
Gas regulator vents	to Codes	

2.6 IDENTIFICATION DUCTWORK SYSTEMS

.1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.

.2 Colours: black, or co-ordinated with base colour to ensure strong contrast.

2.7 VALVES, DAMPERS, CONTROLLERS

.1 White lamacoid tags with 12 mm engraved 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.

2.8 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.

2.9 LANGUAGE

.1 Identification in English.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 TIMING

.1 Provide identification only after painting has been completed.

3.3 INSTALLATION

.1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.

.2 Provide ULC and or CSA registration plates as required by respective agency.

3.4 NAMEPLATES

.1 Locations:

.1 In conspicuous location to facilitate easy reading and identification from operating floor.

.2 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 mechanical rooms, equipment rooms, crawlspace: at not more than 15 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas, service spaces 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, 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 UV rated plastic tie wraps.

.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.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Testing, Adjusting and Balancing (TAB) is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for all HVAC, plumbing and some specific process systems in the facility.

.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 SUBMITTALS

.1 Submittals: in accordance with the Submittal Procedure requirements in Section 00 01 50 – General Instructions (CSC).

.2 Submit all information and data in both printed paper format and PDF electronic format.

.3 Qualifications of TAB Company and Personnel.

.4 Submit, prior to commencement of TAB:

.1 Proposed methodology and procedures for performing TAB if different from referenced standard.

.5 Test Reports: submit certified test reports from approved TAB Company indicating compliance with specifications for specified performance characteristics and physical properties. Include as follows:

.1 Pre-TAB review – confirmation of the adequacy of provisions of TAB (Clause 1.8.1).

.2 List of any standards or procedures that differ from specified standards (Clause 1.8.2).

.3 Preliminary TAB Report (Clause 1.14).

.4 Statutory declaration certifying that the TAB procedures have been completed (Clause 1.19.14).

.5 Fire Damper Test Report (Clause 1.22.3)

.6 Final TAB Report (Clause 1.15)

.6 Quality Control Check Sheet, itemizing all reports and certificates.

1.3 QUALIFICATIONS OF TAB COMPANY AND PERSONNEL

.1 Submit names of personnel to perform TAB to the 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-1-2002.

.2 National Environmental Balancing Bureau (NEBB), Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-2006.

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing Procedural Guide, 2003.

.4 Use TAB Standard provisions, including checklists, and report forms; submit final report at the completion of the project. Include report in the maintenance manual.

.5 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.

.6 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.

.7 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.

1.4 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 (simulate filter loading, outdoor air provision, etc).

.4 Note that there is some overlap in responsibility between this section and Section 23 08 00 - Commissioning - Mechanical Systems.

1.5 EXCEPTIONS

.1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction (such as sprinkler system, fire alarm system, etc.)

1.6 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.

1.7 PRE-TAB REVIEW

.1 Review contract documents before project construction is started and confirm in writing to the Departmental Representative the adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.

.2 Review specified standards and report to the 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.

1.8 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 seven (7) days prior to start of TAB.

.2 Start TAB when building is essentially completed, including:

.1 Pressure, leakage, other tests specified elsewhere in Division 23.

.2 Provisions for TAB installed and operational.

.3 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:

.1 Proper thermal overload protection in place for electrical equipment.

.2 Air systems:

.1 Filters in place, clean.

.2 Duct systems clean.

.3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.

.4 Correct fan rotation.

.5 Fire, volume control dampers installed and open.

.6 Coil fins combed, clean.

.7 Access doors, installed, closed.

.8 Outlets installed, volume control dampers open.

.3 Liquid systems:

.1 Flushed, filled, vented.

.2 Isolating and balancing valves installed, open.

1.10 APPLICATION TOLERANCES

.1 Do TAB to following tolerances of design values:

.1 HVAC systems: plus 5%, minus 5%.

.2 Hydronic systems: plus or minus 10 %.

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 a 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 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.

1.14 TAB REPORT

.1 Format in accordance with SMACNA Guidelines.

.2 TAB report to show results in SI units and to include:

.1 Project record drawings.

.2 System schematics.

.3 Submit 4 copies of TAB Report to Departmental Representative for verification and approval, in English in D-ring binders, complete with index and index tabs.

.4 Include final TAB report in maintenance manual.

1.15 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.

1.16 SETTINGS

.1 After TAB is completed to satisfaction of Departmental Representative, replace drive guards, close access doors, lock devices in set positions, and 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.

1.17 COMPLETION OF TAB

.1 TAB considered complete when final TAB Report received and approved by Departmental Representative.

.2 Include final TAB report in the maintenance manual.

1.18 TAB GENERAL

.1 Standard: TAB to most stringent of this section or TAB standards of SMACNA or ASHRAE.

.2 Do TAB of following systems, equipment, components, controls:

.1 Supply air system(s).

.2 Return air system(s).

.3 Exhaust air system(s).

.4 Connecting branch hydronic hot water system serving the finned wall radiator.

.3 The TAB agency shall be responsible to the Contractor but report jointly to the Departmental Representative and the Contractor. Report in writing to the Departmental Representative any lack of cooperation and any discrepancies or items not installed in accordance with the contract documents.

.4 Procedures shall be in general accordance with AABC's National Standards for Field Measurement and Instrumentation and ASHRAE Standards.

.5 The TAB agency shall agree to perform spot checks, where requested, in the presence of the Departmental Representative.

.6 Work with the TAB agency to:

.1 Ensure that all mechanical systems are complete and ready to be balanced and provide sufficient time for testing and balancing prior to substantial performance.

.2 Make corrections to achieve system balance without delay, include all corrections made during the balancing procedure on "As Built" Drawings. Mechanical Contractor to provide "As Built" information to the balancing agency before balancing commences.

.3 Adjust fan drives and change sheaves and belts as directed by the agency. Allow for the cost of the replacement sheaves and belts.

.4 Maintain all systems in full operation during the complete testing and balancing period.

.5 Employ control technicians to make adjustments to the control systems to facilitate the balancing process.

.6 Employ the journeyman millwright to check the alignment of any V-belt drives and/or shaft coupling drives if they have been adjusted during the balancing process. Belt tension correctness to be verified.

.7 Consult with the Departmental Representative to clarify the design intent where necessary or in case there are any problems foreseen as the balancing processes.

.8 Complete air balance before commencing water balance where heating/cooling coils are installed in the air system. Balancing shall not commence until systems have been cleaned and treated and the air removed from within the piping systems.

.9 This TAB agency shall remove and re-install ceiling tile to provide access to ductwork and piping. The TAB agency will make good any damage or soiling caused by his forces.

.10 Permanently mark final settings on valves, dampers and other adjustment devices. Set and lock all memory stop balancing devices.

.11 Seal all holes with snap plugs or approved alternate method, used for flow and pressure measurements.

.12 The controls contractor and TAB agency are to allow for checking and making adjustments during the 12 month warranty period, when weather conditions provide natural loads and in cases where complaints arise.

.13 Submit a draft balance report to the Departmental Representative for approval and submit approved copies to the agency preparing the O & M manuals for inclusion in each operating and maintenance manual. Provide field notes in the balancing report to clearly identify unusual conditions, problem areas and report on any cases where the specified flow rates or conditions could not be achieved by adjustment. Identify outstanding problems that cannot be corrected by the balancing team or that will not be corrected by the installing trades (e.g. in cases where additional balancing dampers are required).

.14 Submit a statutory declaration to the Departmental Representative, certifying that the testing and balancing procedures have been completed, that complete factual reports have been distributed and that directions have been given to the Contractor to correct faults and omissions and, finally, that follow-up testing, after correction of faults and omissions, has been completed and recorded. Reports to be signed by the senior member of the TAB agency.

.15 Employ the testing and balancing agency to test all fire dampers as follows:

.1 Test all fire dampers. The test shall be made by releasing the fusible link and witnessing closure of the damper. All fire dampers shall be left in the open position.

.2 A set of prints shall be marked up to show that each damper has checked for closure, accessibility and installation or provide schematic mechanical drawing showing all fire damper locations, label all fire dampers on drawing and reference made in the completed test certificate submitted to the Departmental Representative.

.16 The Balancing Agency shall include for 10 (ten) days of return visits for readjustment of systems after the building is occupied and used.

1.19 AIR SYSTEMS TAB

.1 Quality assurance: perform TAB under direction of supervisor qualified to standards of Associated Air Balance Council (AABC), National Standards for Total System Balance or National Environmental Balancing Bureau (NEBB) "Procedural Standards for Testing, Adjusting and Balancing Environmental Systems".

.2 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.

.3 Systems Data – the following information shall be provided:

.1 Air Handling Equipment:

.1 Design Data:

.1 Total air flow rate;
.2 Fan total static pressure;
.3 System static pressure;
.4 Motor kW, r/min, amps, volts, phase;
.5 Outside air flow rate L/s;
.6 Fan r/min;
.7 Fan kW;
.8 Inlet and outlet, dry and wet bulb temperatures.

.2 Installation Date:

.1 Manufacturer and model;
.2 Size;
.3 Arrangement discharge class;
.4 Motor type, kW, r/min, voltage, phase, cycles, and load amperage;
.5 Location and local identification data.

.3 Recorded Data:

.1 Air flow rate;
.2 Fan total static pressure;
.3 System static pressure;
.4 Fan r/min;
.5 Motor operating amperage;
.6 Inlet and outlet, dry and wet bulb temperatures.

.2 Duct Air Quantities: All mains supplying more than 10% of Volume, outside air and exhaust (maximum and minimum), major return air openings back to duct shafts or air handling units.
- .1 Duct sizes;
- .2 Number of pressure readings;
- .3 Sum of velocity measurements;
- .4 Average velocity;
- .5 Dust recorded air flow rate;
- .6 Duct design air flow rate.

.3 Air Inlet and Outlets:
- .1 Outlet identification location and designation;
- .2 Manufacturers catalogue identification and type;
- .3 Application factors;
- .4 Design and recorded velocities;
- .5 Design and recorded air flow rates;
- .6 Deflector vane or diffuser cone settings.

.4 Air Heating and Cooling Equipment

.1 Design Data:
- .1 Heat transfer rate;
- .2 Liquid and air flow rates;
- .3 Liquid pressure drop;
- .4 Air static pressure drop;
- .5 Entering and leaving liquid temperatures;
- .6 Entering and leaving air dry and wet bulb temperatures;
- .7 Fluid and air side pressure drops.

.2 Installation Data:
- .1 Manufacturers, model, type;
- .2 Entering and leaving fluid flow and temperatures
- .3 Entering and leaving fluid flow and temperatures
- .4 Fluid and air side pressure drops

.3 Recorded Data:
- .1 Element type and identification (location and designation);
- .2 Entering and leaving air dry and wet bulb temperatures;
- .3 Entering and leaving water temperatures;
- .4 Water pressure drop;
- .5 Air static pressure drop;
- .6 Air and water flow rates;
- .7 Adjusted temperature rise or drop.

.4 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

.5 Adjust duct and terminal balance dampers, and adjust or change drive sheaves and fan blade pitch angles to obtain design quantities (within +/- 10%) at each outlet and inlet.

.6 Use terminal balance dampers to regulate air quantities only to the extent that adjustments do not create objectional air motion or sound levels. The sheet metal sub contractor shall provide additional dampers where required by the balancing agency to achieve a satisfactory balance without creating noise problems.

.7 Make air quantity measurements in ducts by "Pitot Tube" traverse of entire cross-sectional area of duct. Provide a "Pitot Tube" traverse test sheet for each major duct branch.

.8 Measure air quantities at each air terminal.

.9 Maintain the design relationship between the supply and exhaust air system quantities.

.10 Check to ensure that supply and return air quantities provide reasonable building pressurization. Document abnormal building leakage conditions noted.

.11 Adjust the air terminals to obtain the optimum air distribution pattern.

.12 Controllers on heating coils are to be checked by the controls contractor and the commissioning agent and they shall also verify that room thermostats / sensors are cycling valves properly.

.13 Air systems shall be balanced with clean filters in place, at a total of 105% to 110% of specified total airflow rates.

.14 Where variable air volume systems are installed, take measurements at maximum and minimum flows. Record the minimum operating duct static pressure set-point for each air handling system.

.15 In conjunction with the Controls Contractor set and verify the outdoor air damper minimum position. The balancing agent shall measure the O/A volume during minimum O/A condition when the air valves/mixing boxes are at a simulated minimum system condition.

.16 Balance all air systems for 100% outdoor air and 100% relief air. Upon completion of each system balance, check to ensure that the fan motor does not overload and that the main duct pressure does not change substantially when the system is switched over to minimum O/A condition.

.17 Include in the air balance report:

.1 Date of test, Name and address of building and balancing technician's name.

.2 Range of outdoor air temperature during the balancing period.

.3 System schematics indicating damper positions, design and measured air quantities at each inlet and outlet. Show room numbers and floors.

.4 If installation permits, record both air terminals and fan discharge traverse air volumes to establish system leakage.

.5 Main branch duct traverses. Maximum and minimum outdoor air quantities.

.6 Static pressure across each component in an air handling system at full flow.

.7 Face velocities across major components such as filter or coils.

.8 Static pressure across each fan.

.9 Fan and motor speed.

.10 Motor size, starting time, amps and voltage.

.11 Burner air entering and leaving temperatures (D.B. and W.B.).

.12 Maximum and minimum zone supply air temperatures under prevailing conditions at time of test.

.13 Provide fan performance curve for each new air handling system.

.14 Pressure differences between Hobby Shop and adjacent spaces.

1.20 WALL-FINNED RADIATOR

.1 With the valve at the full open position, adjust balancing valve to achieve a minimum of 0.92 m/s (3 ft/s) hot-water velocity through the radiator pipe.

1.21 OTHER SYSTEMS

.1 Fire protection devices in air systems:

.1 Test for proper operation of all fire dampers, and smoke detectors, installed as component parts of air systems specified under Division 23.

.2 Fire Dampers:

.1 Confirm that all dampers have been installed as required on the contract drawings.

.2 Confirm installation is in accordance with ULC listing.

.3 Confirm access door at each damper.

.4 Confirm correct operation of each damper.

.5 Prepare final report listing all dampers and test results.

.6 Submit final report to Departmental Representative.

1.22 OTHER TAB REQUIREMENTS

.1 General requirements applicable to work specified this paragraph:

.1 Quality assurance: as for systems specified in this section.

.2 Building pressure conditions:

.1 Adjust HVAC systems, equipment, controls to ensure specified pressure conditions at all times.

1.23 POST-OCCUPANCY TAB

.1 Participate in systems checks twice during Warranty Period - #1 approximately 3 months after acceptance and #2 within 2 months of termination of Warranty Period.

.2 Include for two days on site for checking and system balance modifications during each visit.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and methods for pressure testing sheetmetal ducts.

.2 Scope of work includes pressure testing of the following:

.1 Dust Collection exhaust system.

1.2 REFERENCES

.1 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)

.1 SMACNA HVAC Air Duct Leakage Test Manual, 1985.

1.3 SUBMITTALS

.1 Make submittals in accordance with Section 00 01 50 – General Instructions (CSC).

.2 Submit all information and data in both printed paper format and PDF electronic format. The PDF electronic format will be used for insertion into the Operating and Maintenance Manuals.

.3 Test Reports: submit certified test reports from approved independent testing company indicating compliance with specifications for specified performance characteristics and physical properties. Include pressure test information and results as follows:

.1 Prepare report of results and submit to Departmental Representative within 24 hours of completion of tests. Include:

.1 Schematic of duct system.

.2 Schematic of section under test showing test site.

.3 Required and achieved static pressures.

.4 Orifice differential pressure at test sites.

.5 Permissible and actual leakage flow rate (L/s) for test sites.

.6 Witnessed certification of results.

.2 Include test reports in final TAB report.

.3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Instructions: submit manufacturer's installation instructions.

1.4 TEST INSTRUMENTS

.1 Test apparatus to include:

.1 Fan capable of producing required static pressure.

.2 Duct section with calibrated orifice plate mounted and accurately located pressure taps.

.3 Flow measuring instrument compatible with the orifice plate.

.4 Calibration curves for orifice plates used.

.5 Flexible duct for connecting to ductwork under test.

.2 Test apparatus: accurate to within +/- 3 % of flow rate and pressure.

.3 Test instruments: calibrated and certificate of calibration deposited with Departmental Representative no more than 28 days before start of tests.

Part 2 Products

2.1 NOT USED

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 TEST PROCEDURES

.1 Maximum lengths of ducts to be tested consistent with capacity of test equipment.

.2 Section of duct to be tested to include the entire exhaust duct system as follows:

.1 Seal the connection end of each flexible hose (connection to each carpentry equipment)

.2 Seal each hood connection of each exhaust arm.

.3 Close the slide gate and seal all visible openings of each floor sweep.

.4 Duct blower to be connected to duct close to connection point of the dust collector system.

.3 Repeat tests until specified pressures are attained. Bear costs for repairs and repetition to tests.

.4 Base partial system leakage calculations on SMACNA HVAC Air Duct Leakage Test Manual.

.5 Seal leaks that can be heard or felt, regardless of their contribution to total leakage.

3.3 SITE TOLERANCES

.1 System leakage tolerances specified are stated as percentage of total flow rate handled by system. Pro-rate specified system leakage tolerances. Leakage for sections of duct systems: not to exceed total allowable leakage.

.2 Leakage tests on following systems not to exceed specified leakage rates.

.1 High pressure duct systems up to 2,500 Pa pressure classification:

leakage per SMACNA.

.3 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

3.4 TESTING

.1 Test after seals have cured.

.2 Test when ambient temperature will not affect effectiveness of seals, and gaskets.

3.5 FIELD QUALITY CONTROL

.1 Performance Verification:

.1 Departmental Representative to witness tests and to verify reported results.

.2 To be certified by same TAB agency approved by Departmental Representative to undertake TAB on this project.

3.6 CLEANING

.1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 GENERAL

1.1 Related Work and Sections

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

.1 Section 01 91 13 - Commissioning

.2 Section 01 91 41 - Demonstration and Training

.3 Section 23 05 00 - Common Work Results for HVAC

.4 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC

1.2 Quality Assurance

.1 CSA Standard Z320 -2011 Building Commissioning.

.2 ASHRAE Standard 202-2013 Commissioning Process for Buildings and Systems.

.3 ASHRAE Guideline 1.1-2007 HVAC&R Technical Requirements for the Commissioning Process.

1.3 General

.1 Be responsible for the performance and commissioning of all equipment supplied under the sections of Division 23. Commissioning is the process of advancing the installation from the stage of static completion to full working order in accordance with the contract documents and design intent. It is the activation of the completed installation, and the verification of system operation and performance at all operational modes.

.2 In consultation with the Commissioning Manager (Prime Contractor), ensure that sufficient time is allowed and fully identified on the construction schedule for the proper commissioning of all mechanical systems. Coordinate mechanical commissioning activities with the Cx Manager to avoid redundancies and inefficiencies. The mechanical commissioning agent shall report to the Cx Manager and assist the Cx Manager with mechanical commissioning activities as they directly relate to the Cx Manager activities noted in Division 01 sections.

.3 Commissioning Agent shall agree to perform spot checks, where requested, in the presence of the Departmental Representative.

.4 See Division 01 specifications for project commissioning definitions, acronyms, roles and responsibilities.

1.4 Commissioning and Demonstration

.1 Provide the services of an approved independent specialist firm (commissioning agent) to coordinate the commissioning process specified under this division and those items of other Divisions which

interact with work of this Division as outlined herein, including the complete life safety and fire protection system that are affected by this renovation.

.2 The cooperation of all trades and the project team is essential for an efficient and planned process. A team comprising of the following is recommended:

.1 Departmental Representative

.2 Prime Contractor's Commissioning Manager

.3 Division 23 Mechanical Trades (including Controls)

.4 Division 26 Electrical Trades

.3 Prepare a commissioning statement for each of the four [4] phases that the process is perceived to be worked through. In sequence, the phases are expected to be:

.1 PHASE 1 - System readiness.

.2 PHASE 2 - System start-up, testing, balancing etc.

.3 PHASE 3 - Verification of system performance.

.4 PHASE 4 - Demonstration & instruction.

.4 Each phase is applicable to each major and/or separate system making up the work in Division 23 plus Division 26 interface as applicable.

.5 Regular meetings shall be held during the commissioning process. Minutes of the meetings shall be issued to all contractors involved, the Consultants and the Owners Representatives. Meeting times shall be coordinated with the Cx Manager. Suggested meeting times are immediately after regularly scheduled project meetings.

.6 Plan the work to be specific in respect of personnel, schedule, review and factory tests.

.1 Personnel: Assign direct overall charge of commissioning to a person (the commissioning agent) fully qualified through practical experience and a comprehensive knowledge of the interactive nature of building systems and their controls to understand the complete system and be available to carry the project through to total completion. This person shall be responsible for: Commissioning, Demonstration to the Owner and issuing certificates of Substantial and Total Performance.

.2 Schedule: Submit a schedule, as part of the construction schedules, for the commissioning phase of the work. This schedule shall show:

.1 Equipment start-up schedule.

.2 Submission dates for the various documents required prior to substantial performance.

.3 Timing of the various phases of the commissioning, testing, balancing, and demonstration process.

.4 Tentative dates for follow-up visits post-substantial.

.3 Review: Within [2] weeks of commencing with the project work, the person having direct overall charge of mechanical Cx shall review design intent and intended commissioning procedures with the Cx Manager, and Consultant. Six [6] weeks prior to the date of scheduled substantial performance, submit a detailed plan that addresses the entire approach to the commissioning process. The plan should be prepared specifically for the project at hand. The plan should include the following components:

.1 Name and qualifications of the commissioning agent.

.2 Itemized check lists for the readiness, start-up and operational verification of all equipment and systems.

.3 Outline of proposed method of notification and correction of interim operational deficiencies.

.4 Outline of proposed demonstration and operator training program.

.4 Troubleshooting: Where problems become apparent during the commissioning process, work at the identification and resolution of these problems. The basic functions in trouble shooting are:

.1 What - Identification and definition of the issue.

.2 Why - Determination and evaluation of the causes.

.3 When - Determine the time available to resolve the problem.

.4 Involve the Consultant in the review of the issue and proposed resolution.

.5 Co-ordinate remedial action with the appropriate parties.

.6 Evaluate the effectiveness of the remedial action.

.5 Laboratory (Factory) Tests: If the field tests indicate that equipment supplied to the project does not meet specifications, laboratory certification of the potentially deficient equipment may be requested by the Consultant. In the event that equipment does not meet specifications, the mechanical contractor shall be responsible for the costs of:

.1 The above laboratory tests, and

.2 All subsequent testing and correction required.

.7 The work included in each of the four phases shall be generally as follows:

.1 PHASE 1 System readiness

.1 Before starting any of the separate systems, provide a certificate stating that the specific system is ready for start-up and the following conditions have been met.

.1 All safety controls installed and fully operational (dry run test).

.2 Qualified personnel available to operate the plant.

.3 Permanent electrical connections made to all equipment.

.2 System readiness shall include, but not necessarily be limited to the following:

.1 Checking system physical completion, including all instrumentation.

.2 Equipment lubrication and prestart checks.

.3 Rotational checks.

.4 Filter systems installed and sealed in place.

.5 Adjusting vibration isolation and seismic restraints.

.6 Alignment of drives (direct and belt).

.7 Control function checks, including all alarms.

.8 Self-diagnostic packaged control items checked.

.9 All issues to be recorded, reviewed by the commissioning team, and, subsequently, corrected before proceeding to PHASE 2.

.2 PHASE 2 System startup, testing, balancing

.1 System commissioning shall include, but not necessarily be limited to:

.1 Activation of all equipment and systems.

.2 Testing and adjustment of all equipment and systems.

.3 All deficiencies are to be recorded, reviewed by the commissioning team and, subsequently, corrected. The process at the point of the deficiency, shall be repeated before proceeding to PHASE 3.

.2 Phase 2 is concluded when the installation is in full working order and acceptable for use. The work will include the following:

.1 Balancing of the air and liquid systems as specified in

this section.

.2 Set up all automatic control valves/dampers and automatic temperature control devices.

.3 Plug all air pressure and flow measuring holes.

.4 Adjust vibration isolators and earthquake restraints as necessary.

.5 Verification and certification of the sealing of all HVAC penetrations through fire separations (rated & non-rated) and sound separations.

.6 Verification of water tightness of all roof and exterior wall penetrations.

.7 Verification that all drain connections do not leak and are sloped.

.8 Testing and debugging of B.M.S. (Building Management System).

.9 Set up and test all alarm protective devices.

.10 Calibration and adjustment of the smoke venting and pressurization systems.

.3 Fine Tuning

.1 Setting up automatic controls for accurate response and precise sequencing.

.2 Correction of problems revealed by Balance Agency and change of motor speed and pitch as necessary.

.4 Testing

.1 A detailed check by a person having direct overall charge of commissioning at all operational modes. This check to include all items and functions to be later demonstrated to the Consultant and Owner's representatives.

.3 PHASE 3 Verification of System Performance

.1 Verification of system performance will not commence until PHASE 2 has been totally completed. Submit completion test certificates at the time of requesting the commencement of the verification procedure. The verification process will include the demonstration of the following:

.1 The ease of access that has been provided throughout for servicing coils, motors, drives, fusible

fire damper links, control and smoke dampers and damper operators.

.2 Location of and opening and closing of all access panels.

.3 Operability of randomly selected fire dampers.

.4 Operation of all equipment and systems, under each mode of operation.

.5 B.M.S. control features.

.6 Automatic controls and timers.

.7 Manual controls/switches and timers.

.8 Rooftop AHUs and associated gas fuel systems.

.9 Dust Collection Systems and controls

.10 Fans – Relief, Exhaust

.11 Hydronic heaters

.2 At the completion of Phase 3, the Commissioning Agent shall submit the following:

.1 A letter certifying that all work specified under this contract has been commissioned, clean and operational in accordance with the specification and drawings.

.2 A commissioning report shall include completed copies of all Phase 2 documentation outlined in the commissioning plan plus copies of start-up and test reports from specialty contractors, testing and balancing contractors and vendors and any other relevant information for inclusion in the operating & maintenance manuals.

.3 B.C. Gas Inspection Dept. approval of AHU on gas firing.

.4 Record drawings as specified, update to include changes resulting from commissioning.

.5 A statement confirming verification of B.M.S. installation and programming.

.4 PHASE 4 Demonstration and Acceptance

.1 Demonstration and acceptance shall not commence until the commissioning process PHASE 3 has been successfully completed.

.2 The Demonstration process is a planned process requiring a preplan approval before commencement and a signed statement of satisfaction from the Owner Representative upon completion.

.3 For Demonstration and instruction to Operating staff requirements, refer to this section of the specification and also to Section 23 09 01 (Controls General).

.5 Post Substantial Performance Visits

.1 Provide follow-up visits to the site at one month and six month after substantial performance for a minimum period of two days, to ensure that the systems are operating correctly and that they are being operated and maintained properly.

.2 Provide back check of outstanding commissioning issues identified at substantial completion.

.3 Submit a report which documents any issues that have arisen and corrective action required. The report shall identify all outstanding commissioning issues that have not been resolved.

END OF SECTION

1 GENERAL

1.1 Related Work

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 Scope of Work

.1 The new control systems, while being stand-alone (or unitary) controllers, shall be installed as an expansion of the existing Building Automation System (BAS) installed at the Mission Medium Security Institution.

.2 The new controllers shall be fully BACnet compatible for full integration with the existing system, and shall be fully programmable through the existing BAS front-end.

.3 The existing facility-wide DDC system is a Tridium – Niagara system installed and maintained by "Modern Systems".

.4 The contractor shall coordinate with the maintaining agency listed above to ensure the proper integration of the new controllers and control points, as well as to upgrade or make additions to the Graphics User Interface (GUI) at the existing front-end.

1.3 General

.1 The control system is to be fully microprocessor based.

.2 The controls system is to be complete with all necessary control components and connections to achieve the specified functions and to permit the H.V.A.C. systems to perform properly in the manner described and as hereinafter specified.

.3 The controls contractor shall furnish all materials, including all central computer hardware and software, operator input/output peripherals, standalone DDC panels, current transducers, voltage transformers, automation sensors and controls, wiring. The controls contractor shall be responsible for the design, installation, supervision and labour services, calibration, all software programming, and checkout necessary for a complete and fully operational Building Automation System.

.4 The control system is to be set up and adjusted to achieve optimum operation of the H.V.A.C. system. This includes sequencing, timing and readjustment, as required. Modifications to the sequence of operation using points indicated will not be considered as extra to the Contract. These modifications to continue through the construction period, commissioning period and warranty period as required to achieve optimum operation of the mechanical system.

.5 This Section is a performance specification clarified in certain sections to establish minimum standard of equipment, installation or level of control. The specification describes the basic functions required but not all of the installation details or components. This Trade is expected to have sufficient experience to be able to design and estimate the cost of an appropriate control system. Materials and work necessary to achieve a satisfactory result will not be considered extra to the contract.

.6 The contractor shall review all contract documents and visit the site if possible, prior to the closing date of the tender and site confirm the requirements regarding the routing of interconnecting transmission network, etc.

.7 When preparing shop drawings, review the proposed sequences, suggest improvements and review these with the Consultant.

.8 Work with the other parties involved in commissioning, assess how the programming can be modified to improve function, review this with the Consultant and modify the programming as instructed by the Consultant.

.9 The control system shall be a modular, flexible and fully commissioned Direct Digital Control (DDC) System except that controls not scheduled on the points list may be electric. Items identified in the sequence of operation as being under DDC control but which are not included in the points list shall be included in the DDC system.

1.4 Shop Drawings

.1 Submit shop drawings in accordance with paragraphs 1.4 of Section 00 01 50

.2 Shop drawings shall include:

.1 Manufacturer's descriptive technical literature for all equipment and devices.

.2 Interconnection schematics.

.3 Wiring and piping diagrams.

.4 One-line diagram from sensor and control points to Field Interface device and/or standalone DDC panel including all components and cables.

.5 Terminal cabinets, including termination listing.

.6 Written description indicating sequence of operation. Shop drawings will be rejected if the written description is not included with the submission. Sequences should reference English descriptors and labels for each point described.

.7 All input/output points which shall include the following information associated with each point.

.1 Sensing element type and location.

.2 Details of associated field wiring schematics and schedules.

.3 Software and programming details.

.8 Detailed block diagrams of transmission trunk routing and configuration.

.9 Valve and damper schedules indicating size, configuration, capacity and locations. If size varies greater than 10%, obtain approval of Consultant.

.10 Copies of all system graphics complete with system specific point labels.

1.5 Warranty

.1 Refer to General Conditions.

.2 The system including all hardware and software components shall be warranted for a period of one year following the date of final acceptance. Any manufacturing defects arising during this warranty period shall be corrected without cost to the Owner.

.3 All applicable software as detailed in this specification shall be updated by the Controls Contractor free of charge during the warranty period. This will ensure that all system software will be the most up-to-date software available from the Controls Contractor. All future patches to the software shall be made available to the Owner.

.4 Repairs required by a total system failure, or the malfunction of any priority portion of the system shall be considered an emergency repair, and shall be performed within eight (8) hours of the report of the failure.

.5 Repairs of a non-emergency nature shall be promptly repaired on the next normal business day.

.6 Provide written assurance that a local service centre will be maintained with a complete stock of replacement parts, and capable of servicing any and all troubles in the system.

.7 Use of installed equipment during construction shall not shorten or alter the warranty period as specified in the General Conditions.

.8 Take note of and provide any extended warranties specified.

2 MATERIALS

2.1 Electrical Components, Wiring and Conduit

.1 By Control Contractor (Division 23):

.1 All control system components to make a complete and operable system, except those supplied as part of packaged equipment controls, but including all auto-sequencing devices and electrical interlocks required to accomplish the sequences specified hereafter. Refer to the electrical equipment schedule, the electrical drawings and the electrical specification, which describes the limits of the extent to the work in Division 26 serving mechanical systems. Materials, equipment, connections and power not provided by Division 26 but required for the Control System shall be provided under this section.

.2 All control circuit voltage transformers (120/1/60 or 24/1/60 and as designated).

.3 All control wiring and metallic conduit for mechanical system controls.

.4 Supply, installation and connection of all electric control items including: damper motors, relays, outside sensors, sub-master control circuits, safety devices, electric thermostats, aquastats, flow switches, wiring to terminal strips, proportional controllers, controllers, voltage transformers, current transducers (CT) and sensors etc.

.5 All wiring and conduit from power distribution system to any control devices needing power (including B.M.S components).

.6 Be responsible for coordinating with Division 26.

.7 Electrical work installed under Division 23 shall be to the standards specified under Division 26.

.2 By Division 26:

.1 All power wiring and conduit from power distribution system up to and including connection to all motors and starters.

.2 All disconnect switches required (unless specified in schedules as being integral with equipment).

.3 All motor protection switches, stop-start switches, magnetic starters, contactors and hand-off-automatic selector switches except those supplied as part of packaged equipment.

.4 Terminal strips within the motor control centres (MCC) for control connections.

.5 Fire alarm signals.

.3 Note:

.1 All magnetic starters for equipment shall have the following features supplied under Division 26:

.1 Hand-off-automatic selector or on-off selector, or start-stop buttons in cover with hand-automatic bridge if applicable.

.2 Pilot light.

.3 120 volt coils.

.4 Four auxiliary dry contacts for interlocks; two normally open and two normally closed.

.2 The Controls Contractor is responsible for reading Division 26 plans and specifications to determine scope of responsibility and standards.

.4 Wiring:

.1 Wire:

.1 Line voltage power or switched power wiring - #12 gauge copper wire minimum.

.2 Line voltage control wiring - #14 gauge copper wire, length not to exceed 50 meters; #12 gauge copper wire, lengths exceeding 50 meters.

.3 Low voltage - minimum #22 gauge wire as directed by applicable electrical codes and requirements. 24 gauge wire for thermostat cables

.2 Cable:

.1 Data transmission cable shall be minimum #18 gauge twisted pairs (shielding as per manufacturers recommendations).

.3 Note:

.1 Run carrier system parallel to building lines. Conduit and wiring

shall appear straight with parallel.

.2 Support conduit carrier system every one meter independent of piping, ductwork and equipment.

.3 All wiring shall be concealed in finished spaces.

.4 Seal all penetrations through fire separations or walls as per code requirements.

.5 Identify all junction box covers with control company label.

.6 Identify with colour bands, all conduits at all junction and pullboxes, at both sides of wall and floors and at not more than 7.5 m [25 Ft] intervals along the length. Identification bands to be sprayed on and not less than 100mm [4"] wide. Bands to be pink in colour unless in conflict with Division 26 colours.

.7 Use colour coded conductors.

.8 Adhere to all applicable electrical codes and regulations.

.9 Obtain electrical permit.

.10 For non-CSA equipment where required by electrical code, submit to Inspection Authorities and obtain approval prior to installation of equipment on site.

2.2 Equipment Supplied for Installation Under Other Sections

.1 The following equipment shall be supplied under this section but installed under the appropriate trade sections of Division 23:

.1 Control dampers.

.2 Pressure tappings.

.3 Static pressure sensors.

.4 Control valves.

.2 The Controls Subcontractor shall be responsible for arranging, coordinating and supervising the installation of the above devices in a suitable manner and readily accessible location.

3 EXECUTION

3.1 Alarms - General

.1 No alarm shall be triggered for a device until the device has been started and is in stable operation. Use software time delays to achieve this effect.

.2 Generate an alarm on the B.M.S. if any equipment is not in the intended operating condition or if any analog input is not within the intended operating range.

3.2 Identification

.1 Identify all controls with symbols relating directly to the control diagram. Use plasticized tags, engraved brass, aluminum, metalphoto or lamicoid labels and secure them to, or adjacent to, the control devices with key chains or cable ties.

.2 All manual switches supplied by this trade, unless they come with standard nameplates, shall be labelled with engraved lamicoid plastic nameplates to clearly indicate the service. Wording on nameplates shall be subject to approval by the Consultant.

.3 Where "day" and "night" thermostats are adjacent to one another they shall be labelled with engraved lamicoid plastic nameplates.

.4 Mount an input/output layout sheet within each main DDC panel. This sheet shall include the name of the points connected to each controller channel.

.5 Identify all DDC panels and associated devices with symbols relating directly to the control diagram. Provide durable wire labels for each input and output point with the following information:

.1 Point descriptor.

.2 Point type and channel number.

.3 Corresponding DDC panel number.

3.3 System Commissioning and Calibration

.1 Program each standalone DDC panel immediately following installation.

.2 Set up and calibrate all control loops and sensors during the initial start-up of the systems and check, recalibrate and readjust as necessary during the Owner's Demonstration and Instruction period.

.3 Upon completion of the installation, perform all necessary testing and debugging operations satisfactorily.

.4 Perform all modifications and alterations as required to correct any deficiencies noted during these tests.

.5 Check sensor calibration and control system operation during the first heating season and prior to the first cooling season.

.6 Following each visit submit printed graphs of trend logs one week in duration with hourly samples for all analog inputs connected to each DDC panel.

3.4 Verification of System Commissioning

.1 Preliminary Tests

.1 After installation of each part of the system and completion of mechanical and electrical hook-up, perform tests to confirm correct installation and functioning of equipment.

.2 Notify the Consultant in writing at least seven days before testing is to take place stating the following:

.1 Location and part of system to be tested.

.2 Describe testing procedure and anticipated results.

.3 Provide all necessary testing equipment and personnel.

.4 Provide portable 2-way radios for communications during demonstrations. Provide three units on the same frequency and of sufficient power and

quality as to be useful throughout the building.

.5 Perform tests in presence of the Consultant, and provide minimum one week notice to schedule attendance.

.6 Demonstrate the proper operation of each component.

.7 Correct any deficiencies and re-test in the presence of the Consultant, until designated part of the system performs satisfactorily.

.2 Final Operational Acceptance Test

.1 A final operational test of not less than thirty (30) consecutive days, twenty-four (24) hours per day, shall be conducted on the complete and total installed and operational Control System to demonstrate that it is functioning properly in accordance with all requirements of this specification. The correct operation of all monitored and controlled points shall be demonstrated as well as the operation and capabilities of all sequences, reports, specialized control algorithms, diagnostics, and all other software. If the equipment operates at an average effectiveness level (AEL) of at least 95% during the performance test period of thirty (30) consecutive calendar days, it will be deemed to have met the Acceptable Standard of Performance, and final acceptance of the system shall be made, provided the contractor has satisfied all other requirements of this specification. In the event the required AEL is not reached during the initial thirty (30) consecutive calendar day period, the final operational acceptance test period shall be extended on a day-to-day basis until the required AEL is reached for thirty (30) consecutive calendar days. The average effectiveness level (AEL) is defined as the ratio between the total thirty-day test period less any system downtime accumulated within that period, and the thirty-day test period. Downtime shall result whenever the control system is unable to fulfill all required functions detailed within this specification due to any malfunction of either BMS hardware or software. Any defect of hardware or software shall be corrected when it occurs before the test may be resumed. Downtime created by non-BMS equipment or activities will not be considered as downtime for the AEL calculation.

3.5 Maintenance Service During the Warranty Period

.1 The Contractor shall provide all services, materials and equipment necessary for the maintenance of the entire Control System, for a period concurrent with the warranty period. Any necessary material required for the maintenance work shall be provided by the Contractor.

.2 The Controls Contractor shall provide one minor inspection per quarter or as required by the manufacturer and two major inspections per year, and all service for the required maintenance.

.3 Major Inspections: these inspections shall include but not be limited to the following:

.1 Work as detailed hereinafter for minor inspections.

.2 Clean all peripheral equipment, CPU, interface panels, multiplexing

panels and microprocessor interior and exterior surfaces.

.3 Provide signal, voltage and system isolation checks of all CPU, interface panels, multiplexing panels and peripherals.

.4 Provide mechanical adjustments, new ribbons and necessary maintenance on printers.

.5 Check and/or calibrate each field input/output device.

.6 Run system software diagnostics as required.

.4 Minor Inspections: These inspections shall include but not be limited to the following:

.1 Provide visual and operational checks to all CPU, peripheral equipment, interface panels, multiplexing panels, and field devices.

.2 Change filter and check fan for all CPU's peripheral equipment as required.

.3 Provide complete back up of BAS system.

.4 Regular service calls: these calls shall be performed during regular working hours, 8:00 a.m. to 4:30 p.m. Monday through Friday excluding legal holidays.

.5 Emergency Service: the Departmental Representative will initiate service calls when there is indication that the control system is not functioning properly. The Contractor shall have qualified control personnel available during the warranty period to provide service to the "critical" control system components whenever required at no additional cost to the Departmental Representative. The Contractor shall furnish the Departmental Representative with a telephone number where the service mechanic can be reached at all times. The service mechanic shall be on the job ready to service the control system within the next eight (8) hours, after receiving a request for service and the work shall be performed continuously until the control system is back in reliable operating condition. Repairs of a non-emergency nature shall be promptly repaired on the next normal business day.

.6 Records and Logs: records and logs shall be kept of each maintenance task.

.7 System Modifications: recommendations for system modification shall be provided in writing to the Consultant. No system modification, including operating parameters and control settings, shall be made without prior approval.

.8 Software: provide implementation of all software maintenance updates. These shall be accomplished as required and full coordination with control system supervisory personnel shall be maintained.

END OF SECTION

1 GENERAL

.1 Refer to Section 23 09 01 Control Systems General Requirements

2 PRODUCTS

.1 Refer to Section 23 09 01 Control Systems General Requirements

3 RELATED SECTIONS

.1 Section 23 09 94 Points List for HVAC Controls.

.2 Section 23 40 00 Dust Collectors

4 EXECUTION

4.1 HVAC Control Objectives:

.1 Program the system to meet the following objectives:

.1 Temperature:

.1 Control the temperature in each occupied space.

.2 Ventilation:

.1 Control the system's minimum outdoor air intake and the supply to each zone to meet code ventilation requirements under all operating conditions.

.2 Control the system's ventilation system with the dust collection system and maintain negative pressure in the Hobby Shop, relative to the adjacent spaces.

.3 Control the system's ventilation system in the Native Area to maintain negative pressurization relative to the adjacent spaces (during smudging).

.3 Energy:

.1 Provide no more heating than is essential during Normal Operation.

.4 Operation:

.1 Systems shall remain under BMS control during all times of the day.

.2 Systems shall remain under BMS control during all operating conditions (unoccupied mode, occupied mode)

4.2 Monitoring:

.1 The BMS monitors the following conditions and parameters as a minimum:

.1 All damper and valve positions

.2 Supply air temperature

.3 Outdoor air temperature

.4 Multiple fans operation and status

.5 Differential pressure drop across the RTU filter sections

.6 Differential pressure between the hobby shop and adjacent corridor.

4.3 Alarms and Safeties:

.1 The supply fan for RTU-15 shall be a hardwired interlock. RTU shall shut down

under fire alarm condition, and shall be indicated on the existing fire alarm panel.

.2 Provide similar fire alarm condition and sequence of operation for RTU-15A.

5 EQUIPMENT AND SUBSYSTEMS CONTROL

5.1 Hobby Shop Dust Collector:

.1 Scope:

.1 DC-1: Dust Collector.

.2 Components:

.1 Dust Collector control panel.

.2 Current Transducer (CT).

.3 Interlocks:

.1 When DC-1 is manually activated by the master-user switch, a current transducer shall send a signal to the DDC panel. See RTU-15A control.

.2 See electrical drawings for supplemental information regarding hobby shop equipment interlocks with hobby shop equipment.

.4 Normal Operation:

.1 Dust Collector DC-1 is manually enabled (energized) by a master-user switch located in the manager's office. An inmate-user switch located in the hobby shop, manually activates the dust collector. Upon activation of DC-1, the shop equipment shall be energized through an auxiliary relay (DC-1 control panel).

5.2 Hobby Shop Rooftop Unit (RTU-15A) Control:

.1 Scope:

.1 RTU-15A: Rooftop Heat-Vent Unit.

.2 EF-6: Propeller type exhaust fan.

.3 EF-7: Exhaust fan with VSD for room pressurization control.

.4 DC-1: Dust collector.

.5 MD-1: Motorized damper for EF-7.

.2 Components:

.1 Outdoor air control damper

.2 Return air control damper

.3 Air Filters

.4 Supply fans

.5 Modulating gas valve

.6 Temperature sensors (mixed air and discharge-air controller)

.7 Pressure differential sensors

.8 Barometric relief air damper

.9 Current transducers.

.3 Interlocks:

.1 DDC system to enable EF-7 to modulate speed with RTU-15A outside air damper and maintain Hobby Shop at negative pressure relative to adjacent spaces. Coordinate with balancing agent on site to balance and adjust system to maintain negative pressure relative to adjacent space. Upon activation of DC-1, EF-7 shall reduce speed and deactivate.

.2 MD-1 shall open when EF-7 is active.

.3 DDC system shall receive a signal from DC-1 (current transducer) when DC-1 is enabled by the end-user.

.4 RTU-15A shall be interlocked with DC-1 to modulate to 100% make-up air mode when DC-1 is activated (CT signal received). Coordinate with balancing agent on site to balance and adjust system to maintain negative pressure relative to adjacent spaces at all times.

.4 Normal Operation

.1 System Stopped:

.1 RTU-15A Supply fan stopped.

.2 RTU-15A Burner de-energized.

.3 RTU-15A Outdoor air damper closed.

.4 RTU-15A Mixed air damper open.

.5 Exhaust fan EF-6 disabled.

.6 Exhaust fan EF-7 disabled, MD-1 closed.

.2 System Start/Operation:

.1 RTU-15A supply fan shall run continuously.

.2 DDC system shall enable EF-7 to modulate to maintain negative pressure within the Hobby Shop, relative to adjacent spaces. The space differential pressure sensor shall confirm whether the hobby shop is negative pressure to the adjacent spaces.

.3 Economizer shall be set to minimum ventilation rate (adjustable). Coordinate with balancing agent to set up dampers at minimum ventilation rate.

.4 Heating Mode: On a call for heating from the room temperature sensor.

.1 The RTU discharge air controller shall modulate the gas fired burner to maintain discharge air temperature set-point.

.2 The DDC shall reset the RTU discharge air controller based on the room temperature.

.3 RTU-15A shall operate at make-up air mode (full economizer mode – 100% O/A); the temperature control strategy shall be maintained.

.5 Economizer Mode: When room temperature rises above set-point

and the outside air temperature is lower than the room temperature:

.1 The outside air damper shall modulate open and the mixed air damper shall modulate close to maintain discharge air and mixed air temperatures at set-points.

.2 A mixed air low-limit control shall prevent the dampers from allowing the air temperature to drop below a minimum discharge air temperature set-point (initially set to 12.8C - adjustable).

.3 The EF-7 controller shall modulate EF-7 to maintain room differential pressure set-point (initially set to 25 Pa – adjustable) in the space relative to the corridor with the doors closed and with DC-1 off. To avoid rapid cycling of the exhaust fan, set PID loop parameter and delays at controller to normalize pressure swings and prevent nuisance cycling.

.4 EF-6 shall run continuously.

.6 Night "Set-Back" Operation: Night set-back scheduling shall be determined by the facility.

.1 The RTU's outside air damper shall be fully closed and the return air damper fully open.

.2 When room temperature falls below the reduced set-back temperature set-point (initially set at 14.8°C). The RTU supply fan and burner shall be allowed to cycle in order to maintain room temperature above the set-back set-point. Dampers shall remain in their night set-back positions

.3 EF-6 shall be off.

.4 EF-7 shall be off.

.5 Smoke Alarm Operation:

.1 RTU-15A shall be provided with a supply air smoke detector. Refer to electrical drawings for details.

.2 When this detector senses smoke, the unit shall shut-down and a smoke detection alarm shall be sent to the building Fire Alarm Panel.

5.3 Native Area Rooftop Unit (RTU-15) Control:

.1 Scope:

.1 RTU-15: Rooftop Heat-Vent Unit Serving Native Area, Canteen, and Barber Shop.

.2 EF-19: Up-blast Exhaust Fan Serving Native Area

.2 Components:

.1 Outdoor air control damper

.2 Mixed air control damper

.3 Air Filters

.4 Supply fans

.5 Temperature sensors (Mixed air and discharge-Air controller)

.6 Barometric relief air damper

.7 Current transducers.

.3 Interlocks:

.1 RTU-15 shall be interlocked to EF-19 to operate in 100% make-up air mode whenever EF-19 is activated. Coordinate with balancing agent on site to balance and adjust system to maintain negative pressure relative to adjacent spaces.

.4 Normal Operation

.1 System Stopped:

.1 RTU-15 Supply fan stopped.

.2 RTU-15 Burner de-energized.

.3 RTU-15 Outdoor air damper closed.

.4 RTU-15 Mixed air damper open.

.5 Exhaust fan EF-19 stopped.

.2 System Start/Operation:

.1 RTU supply fan shall operate continuously.

.2 Economizer at minimum ventilation rate (adjustable). Coordinate with balancing agent to set up dampers to minimum ventilation rate.

.3 Heating Mode: On a call for heating from the room temperature sensor.

.1 The RTU discharge air controller shall modulate the gas fired burner to maintain discharge air temperature set-point.

.2 The DDC shall reset the RTU discharge air controller based on the room temperature.

.3 Upon activation of EF-19, the unit shall operate at full make-up air mode (100% O/A); the temperature control strategy shall be maintained.

.4 Economizer Mode: When room temperature rises above set-point and the outside air temperature is lower than the room temperature:

.1 The outside air damper shall modulate open and the return air damper shall modulate closed to maintain room temperature to set-point.

.2 A mixed air low-limit control shall prevent the dampers from allowing the air temperature to drop below a minimum discharge air temperature (initially set to 12.8°C).

.5 Night "Set-Back" Operation: Night set-back scheduling shall be determined by the facility.

.1 The RTU's outside air damper shall be fully closed and the return air damper fully open.

.2 When room temperature falls below the reduced set-back temperature set-point (initially set at 14.8°C). The RTU supply fan and burner shall be allowed to cycle in order to maintain room temperature above the set-back set-point. Dampers shall remain in their night set-back positions.

.3 EF-19 shall be off.

.6 EF-19 Normal Operation:

.1 User activated with a 0-100% speed adjustment controller with display. When unit is turned off, an adjustable Delay-Off timer (initially set for 60 minutes max delay) shall keep the unit running for time indicated.

.5 Smoke Alarm Operation:

.1 RTU-15 shall be provided with a supply air smoke detector. Refer to electrical drawings for details.

.2 When this detector senses smoke, the unit shall shut-down and a smoke detection alarm shall be sent to the building Fire Alarm Panel.

5.4 Exhaust Air Fans Control:

.1 Scope:

.1 EF-2: Serving Leather Shop

.2 EF-3A: Serving Electrical Room

.3 EF-13: Serving Canteen Room

.4 EF-14: Serving Barber Shop

.2 Exhaust Fan Controls

.1 EF-2: Provide with a manual on/off switch. Monitored at DDC.

.2 EF-3A: Provide with a reverse acting thermostat mounted in the room (initially set to 25.6°C)

.3 EF-13: Start/Stop at DDC. Monitored at DDC; runs whenever RTU-15 is on.

.4 EF-14: Start/Stop at DDC. Monitored at DDC; runs whenever RTU-15 is on.

5.5 Baseboard Radiation Unit Control:

.1 Space temperature sensor shall modulate baseboard radiation 2-position control valve open and close to maintain set point of 22.2°C via DDC.

END OF SECTION

1 GENERAL

1.1 General

.1 The following points list indicates the input and output points that shall be connected to the Building Automation System (BAS). Any additional points that are noted in Section 23 09 93 to be under DDC control shall also be included as if they were on the points list.

.2 All points associated with one mechanical system shall be connected to the same Local Controller (e.g. AHU Controller, Unitary Controller, or Local Programmable Controller). Control loops and sequences are usually programmed into and determined at the local controller level. However, all listed points associated with the local controller shall be available to the BAS for either monitoring, overrides, or for changes to set-points and scheduling.

.3 Program alarms as specified in the points list and sequences with user adjustable alarm thresholds. Provide descriptors for all programmed alarms which can be accessed via the graphics at the Operators Work Station (OWS).

1.2 Device Legend

.1 RTS = Room Temperature Sensor
.2 DTS = Duct Temperature Sensor
.3 ITS = Immersion temperature Sensor
.4 ATS = Averaging Duct Temperature Sensor
.5 OTS = Outdoor Temperature Sensor
.6 HS = Humidity Sensor
.7 DPT = Differential Pressure Transmitters
.8 SPT = Static Pressure Transmitter
.9 PSW = Pressure Switch
.10 TSW = Temperature Switch
.11 IPT = Current / Pneumatic Transducer
.12 CR = Current Relay
.13 CT = Current Transducer
.14 EPR = Electric / Pneumatic Relay
.15 EFS = Electronic Flame Sensing Device
.16 FSW = Flow Switch
.17 ESW = End Switch
.18 ER = Electric Relay
.19 DME = Damper Actuator Modulating Electronic
.20 DTE = Damper Actuator Two Position Electronic
.21 DMI = Damper Actuator Modulating Incremental Control
.22 BCM = Burner Control Modulating Electronic
.23 BCS = Burner Control Staging Electronic
.24 VTE = Valve 2 Position Electronic
.25 VME = Valve Modulating Electronic
.26 VSD = Variable Speed Device

1.3 Table Legend

.1 **DI** = DIGITAL INPUT; **DO** = DIGITAL OUTPUT; **AI** = ANALOG INPUT; **AO** = ANALOG

OUTPUT; **H** = HIGH ALARM; **L** = LOW ALARM; **S** = STATUS ALARM

1.4 **INPUT/OUTPUT POINTS LIST**

.1 Provide full integration into the existing DDC and connect to all new points.

1.5 **Systems: Rooftop Units RTU-15 and RTU-15A**

		INPUT		OUTPUT		Non		
	Point Description	**DI**	**AI**	**DO**	**AO**	**DDC**	**Alarm**	**Notes**
	OA-T Outdoor air temperature		X					OTS
	MA-D Mixed air temperature		X				HI/LO	ATS
	SA-T Supply air temperature		X				HI/LO	DTS
	Room temperature sensor		X				HI/LO	RTS
	Room temperature set-point adjust		X					
	OA-D Outdoor air ctrl damper enable				X			DME
	OA-D Outdoor air ctrl damper status		X				FAIL	ESW
	MA-D Mixed air ctrl damper enable				X			DME
	MA-D Mixed air ctrl damper status		X				FAIL	ESW
	SF- Supply air fan motor enable			X				ER
	SF- Supply air fan motor status	X					FAIL	CT
	Gas valve enable (modulating)				X			BVM
	Gas valve status		X					EFS
	Filters FF		X				DIRTY	DPT
	Smoke Alarm					X		

1.6 **System: Dust Collector DC-1**

		INPUT		OUTPUT				
Unit No.	**Point Description**	**DI**	**AI**	**DO**	**AO**		**Alarm**	**Notes**
DC-1	Current Transducer		X				HI/LO	CT

1.7 **System: Air Differential Pressure Sensors, Exhaust Fan EF-7, Motorized Damper MD1**

		INPUT		OUTPUT				
Unit No.	**Point Description**	**DI**	**AI**	**DO**	**AO**		**Alarm**	**Notes**
DP-1	Air Differential Pressure Hobby Shop		X				HI/LO	DPT
EF-7	Exhaust Fan enable (variable speed)				X			VSD
EF-7	Exhaust Fan status		X				FAIL	CT
MD-1	Motorized Damper open/close		X		X			

1.8 **System: Exhaust Fans EF-2, 3, 13, 14, & 19**

		INPUT		OUTPUT				
Unit No.	**Point Description**	**DI**	**AI**	**DO**	**AO**	**TUC**	**Alarm**	**Notes**
EF-19	Exhaust Fan enable (variable speed)				X			3

		INPUT		OUTPUT				
Unit No.	**Point Description**	**DI**	**AI**	**DO**	**AO**	**TUC**	**Alarm**	**Notes**
EF-19	Exhaust Fan status		X					3
EF-2	Exhaust Fan status	X						CT,1
EF-3A	Exhaust Fan status	X						2
EF-3A	Reverse-Acting Thermostat		X				HI/LO	RTS
EF-13	Exhaust Fan enable			X				
EF-13	Exhaust Fan status	X					FAIL	CT
EF-14	Exhaust Fan enable			X				
EF-14	Exhaust Fan status	X					FAIL	CT
EF-6	Exhaust Fan enable			X				
EF-6	Exhaust Fan status	X					FAIL	CT

Notes:

1. Exhaust Fan (EF-2) status shall be monitored by the BMS, On/Off control by hardwired wall switch.
2. Exhaust Fan (EF-3A) status shall be monitored by the BMS, On/Off control by hardwired reverse-acting thermostat.
3. Coordinate with fan manufacturer for interface.

1.9 **System: Wall-fin Heater WF-1**

		INPUT		OUTPUT				
Unit No.	**Point Description**	**DI**	**AI**	**DO**	**AO**	**TUC**	**Alarm**	**Notes**
WF-1	Wall Fin heater control valve			X				VTE
WF-1	Room temperature sensor		X				H / L	RTS
WF-1	Room temperature set-point adjust		X					

Notes:

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for piping, valves and fittings for gas fired equipment.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B16.5-03, Pipe Flanges and Flanged Fittings.

.2 ASME B16.18-01, Cast Copper Alloy Solder Joint Pressure Fittings.

.3 ASME B16.22-01, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

.4 ASME B18.2.1-96, Square and Hex Bolts and Screws Inch Series.

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM A47/A47M-99(2004), Standard Specification for Ferritic Malleable Iron Castings.

.2 ASTM A53/A53M-[04], Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.

.3 ASTM B75M-99, Standard Specification for Seamless Copper Tube [Metric].

.4 ASTM B837-01, Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems.

.3 Canadian Standards Association (CSA International)

.1 CSA W47.1-03, Certification of Companies for Fusion Welding of Steel.

.4 Canadian Standards Association (CSA)/Canadian Gas Association (CGA)

.1 CAN/CSA B149.1HB-00, Natural Gas and Propane Installation Code Handbook.

.2 CAN/CSA B149.2-00, Propane Storage and Handling Code.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals: In accordance with the Submittal Procedure requirements in Section 00 01 50 – General Instructions (CSC).

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.

.2 Indicate on manufacturer's catalogue literature following: valves.

.3 Instructions: submit manufacturer's installation instructions.

.4 Closeout Submittals: Provide all applicable close-out submittals per paragraph 1.18 "Closeout Submittals" of section 00 01 50 – General Instructions (CSC).

Part 2 Products

2.1 PIPE

.1 Steel pipe: to ASTM A53/A53M, Schedule 40, seamless as follows:

.1 NPS 1/2 to 2, screwed.

.2 NPS2 1/2 and over, plain end.

.2 Copper tube: to ASTM B837.

2.2 JOINTING MATERIAL

.1 Screwed fittings: pulverized lead paste.

.2 Welded fittings: to CSA W47.1.

.3 Flange gaskets: non-metallic flat.

.4 Brazing: to ASTM B837.

2.3 FITTINGS

.1 Steel pipe fittings, screwed, flanged or welded:

.1 Malleable iron: screwed, banded, Class 150.

.2 Steel pipe flanges and flanged fittings: to ASME B16.5.

.3 Welding: butt-welding fittings.

.4 Unions: malleable iron, brass to iron, ground seat, to ASTM A47/A47M.

.5 Bolts and nuts: to ASME B18.2.1.

.6 Nipples: schedule 40, to ASTM A53/A53M.

.2 Copper pipe fittings, screwed, flanged or soldered:

.1 Cast copper fittings: to ASME B16.18.

.2 Wrought copper fittings: to ASME B16.22.

2.4 VALVES

.1 Provincial Code approved, lubricated ball type.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PIPING

.1 Install in accordance with Section CAN/CSA B149.1, supplemented as specified.

.2 Install drip points:

.1 At low points in piping system.

.2 At connections to equipment.

3.3 VALVES

.1 Install valves with stems upright or horizontal unless otherwise approved by Departmental Representative.

.2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.

3.4 FIELD QUALITY CONTROL

.1 Site Tests/Inspection:

.1 Test system in accordance with CAN/CSA B149.1and requirements of authorities having jurisdiction.

.2 Manufacturer's Field Services:

.1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its product[s], and submit written reports, in acceptable format, to verify compliance of work with Contract.

.2 Provide manufacturer's field services, consisting of product use recommendations and periodic site visits for inspection of product installation, in accordance with manufacturer's instructions.

.3 Schedule site visits to review work at stages listed:

.1 After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.

.2 Twice during progress of work at 25% and 60% complete.

.3 Upon completion of work, after cleaning is carried out.

3.5 ADJUSTING

.1 Purging: purge after pressure test in accordance with CAN/CSA B149.1.

.2 Pre-Start-Up Inspections:

.1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.

.2 Check gas trains, entire installation is approved by authority having jurisdiction.

3.6 CLEANING

.1 Cleaning: in accordance with Section CAN/CSA B149.1, supplemented as specified.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 GENERAL

1.1 Related Work

.1 Refer to Section 23 05 49 for required seismic restraint of piping.

1.2 Reference Standards

.1 Do all piping system work in accordance with ASME/ANSI B31.9 code and CSA B51.

1.3 Regulatory Requirements

.1 Installation of, and repair or alterations to, pressure piping systems shall be performed only by licensed Contractors and licensed Welders, certified for the work being done in accordance with the Regulations and Requirements of the Province of British Columbia "Power Engineers Boiler and Pressure Vessel Safety Act and Regulations".

.2 All field welding to be in accordance with the procedures of CSA-W117.2 and the current edition of ASME/ANSI B31.1 or B31.9 Code.

1.4 System Pressure Ratings

.1 Pipe Fittings:

.1 Piping systems 860 kPa [125 psig] or less operating pressure - 860 kPa [125 psig] rating.

.2 Valves:

.1 Suitable for maximum system operating temperature and pressure.

2 PRODUCTS

2.1 General

.1 All products shall be registered with the regulatory authority in accordance with CSA B51.

2.2 Pipe

.1 Steel Pipe:

.1 to NPS 10, Schedule 40 to ASTM A53 Grade B or NPS 3/4 to NPS 2 to ASTM A795, Schedule 5, suitable for Pressfit.

.2 to NPS 12 and over, 9.5 mm [0.375"] wall thickness to ASTM A53 Grade B.

.3 for the following systems:

.1 Hot water heating

2.3 Pipe Joints - Steel Piping

.1 NPS 2 and under: screwed fittings, except where otherwise noted, with teflon tape and rectroseal teflon paste or pipe dope, Pressfit in applicable applications.

.2 NPS 2-1/2 and over: welding fittings and flanges to CSA W47.1.

.3 Flanges: raised face, steel weld neck, lap or back-welded slip on type. Use flat face for attachment to cast iron valves.

.4 Victaulic Pressfit fittings with grade "E" EPDM O-rings may be used on hot water heating up to 110°C [230°F] working temperature, glycol heating, glycol heat recovery, chilled water, heat pump water, condenser water-closed circuit systems.

.5 Flange Bolts and Nuts, carbon steel: to ANSI B18.2.1 and ANSI B18.2.2.

.6 Flange gaskets:

.1 Up to 860 kPa [125 psig] system pressure - non-asbestos gaskets for mating surfaces.

.2 Over 860 kPa [125 psig] system pressure - stainless steel spiral wound non-asbestos gaskets.

2.4 Pipe Fittings - Steel Pipe

.1 Pipe fittings, screwed, flanged or welded:

.1 Cast iron pipe flanges: Class 125 to ANSI B16.1.

.2 Cast iron screwed fittings: Class 125 to ANSI B16.3.

.3 Steel pipe flanges and flanged fittings: to ANSI B16.5.

.4 Steel butt-welding fittings: to ANSI B16.9a.

.5 Unions, malleable iron ground joint type: Class 150 to ANSI B16.3.

.2 Fittings for roll grooved piping: Ductile iron to ASTM 536; wrought steel to ASTM A234; or where cast or wrought pattern is not available factory fabricated and tested to ASTM A53.

.1 Fittings shall be of the same manufacturer as the adjoining couplings.

2.5 Valves General

.1 Wherever possible all valves shall be of one manufacturer.

.2 Provide valves with manufacturer's name and pressure rating clearly marked on outside of body. All valves must be suitable in all respects for service used.

.3 Include lock shield handles where shown or noted.

2.6 Gate Valves

.1 NPS 2 and under, screwed:

.1 Bronze body, rising stem, solid wedge disc, union or screwed bonnet.

2.7 Globe Valves

.1 NPS 2 and under, screwed:

.1 Bronze body, rising stem, renewable composition or bronze disc, union bonnet.

2.8 Ball Valves

.1 NPS 2 and under, screwed:

.1 Forged brass body, threaded cap, chrome plated ball, PTFE seats, blow out proof stem.

.2 Ball valves for isolation service shall have a large/full port.

.3 Ball valves for balancing service shall have a reduced port and valve handle shall have a memory stop.

.4 Acceptable Products:

.1 Class 600 W.O.G. [4140 kPa] - Crane F9202, Grinnell 3700, Kitz 58, Nibco T-585-70, Red-White/Toyo 5044A, Victaulic 722.

2.9 Circuit Balancing Valves

.1 NPS 2 and under: copper alloy body, screwed, 'Y' pattern globe.

.2 NPS 2-1/2 and over: cast iron body, flanged or grooved, 'Y' pattern globe.

.3 Maximum pressure 1715 kPa [250 psig] and maximum temperature 121°C [250°F].

.4 Calibrated balancing valve with memory, positive shut-off, inlet and outlet pressure measuring connections with integral shut-offs and drains.

.5 Calibration charts and adjustment tools to be included.

.6 Provide one (1) differential pressure meter kit suitable for direct readout c/w connection hoses suitable for the system pressure.

2.10 Swing Check Valves

.1 NPS 2 and under, screwed:

.1 Bronze body, bronze swing disc, screw in cap, regrindable seat.

2.11 Radiator Valves

.1 Screwed bronze body with bronze trim, wheel handle, rising stem, renewable composition disc, male union connections, angle and straight type.

2.12 Thermostatic Radiator Valves

.1 Screwed nickel plated brass body, stainless steel spindle, EPDM rubber valve disc, straight and angle type.

.2 Valves complete with sensors, operators and capillary tubing.

.3 Remote sensors/operators to have 8 m [26 ft] capillary tube.

.4 Capillary tubing to be run concealed in walls and ceilings, sheathed in 20 mm [3/4"] dia. plastic tubing.

.5 Acceptable Products: Danfoss

2.13 Drain Valves

.1 Globe type, bronze body with bronze trim and composition disc.

3 EXECUTION

3.1 Piping

.1 Ream pipe ends. Clean scale and dirt, inside and outside before and after assembly. Remove welding slag or other foreign material from piping.

.2 During construction, protect all openings in piping and equipment, by capping or plugging to prevent entry of dirt.

.3 Screw, or weld, fittings (unless otherwise specified) for all piping systems up to NPS 2.

.4 Install piping to conserve headroom and space. Run exposed piping parallel to walls.

.5 Maintain a minimum of 25 mm [1"] space between adjacent flanges or pipe insulation, whichever has the larger diameter.

.6 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.

.7 Saddle type branch fittings may be used on mains, if branch line is half size or smaller than main. Hole saw or drill and ream main to maintain full inside diameter of branch line prior to welding saddle.

.8 Use long radius elbows.

.9 Remake leaking joints using new materials, do not caulk or cement leaking threaded joints.

.10 Use eccentric reducers at pipe size changes, flush on top side, to permit positive venting and drainage.

.11 Do not use thread protection couplings, close nipples, running nipples or street elbows.

.12 Avoid locating water and drain piping over electrical equipment. Where this is unavoidable, provide galvanized drip pans under such pipe and weld piping and fittings. Provide drain and piping from drip pans to satisfactory floor drain.

.13 Bull head tees shall not be used for converging flows.

3.2 Pipe Grading

.1 Grade all piping to provide positive drainage and venting. Slope as follows:

.1 Supply mains and branches - up in the direction of flow, minimum 1:480 [1" in 40 ft].

.2 Return mains and branches - down in the direction of flow, minimum 1:480 [1" in 40 ft].

3.3 Connections to Equipment and to Existing Piping

.1 Install unions, grooved couplings, or flanges at connections to all equipment and specialty components and at all connecting points to existing systems which, for reasons of separation for testing, will require to be blank flanged or capped.

.2 Connect to equipment in accordance with manufacturer's instruction unless otherwise noted.

.3 Arrange piping connections to allow ease of access and for removal of equipment.

.4 Align and independently support piping connections adjacent to equipment to prevent piping stresses being transferred.

.5 Do not reduce equipment connection sizes by bushing.

.6 Branch connections to existing steel piping may be made using double strap service saddles.

.7 Where shut down of a service is not possible, a hot-tap process shall be used for the tie-in connection of the services. The hot-tap welding in-place requires special equipment and the services of a highly skilled journeyman welder. This work shall be carried out by Pacific Flow Control Ltd., 9886 - 134 St. Surrey, B.C. V3T 4B1, telephone 585-4799.

.8 When connecting to an existing antifreeze system, the antifreeze solution shall be drained into temporary storage tanks. Do not drain into sanitary / storm system.

3.4 Drain Connections

.1 Pipe the discharge from all liquid relief valves, liquid safety valves, high capacity air vents, steam drip pan elbows, equipment blowdowns, water columns, overflows and piping system drains to the nearest building drain. Install a brass, bronze or copper receiving funnel on the drain where shown.

.2 Drains from drain pans shall be DWV copper ASTM B306 32 mm [1-1/4"] minimum size.

.3 Drain and vent piping shall be of the same material as the piping system to which it is connected, except where otherwise specified.

.4 Where item being drained is under pressure, provide a deep seal trap.

3.5 Expansion of Piping

.1 Install all piping systems with due regard and provision for expansion avoiding strain or damage to equipment and building. Pay particular attention to piping running horizontal across building expansion joints and provide adequate expansion and contraction for all such piping.

.2 Only major expansion configuration and fittings have been shown on the drawings. Provide all required additional compensators, loops and swing connections.

.3 Provide anchors, where shown. Anchors shall be fabricated from mild steel plate and structural steel angle and channel sections, in accordance with ANSI B.31.

.4 Expansion loops shall be of all welded construction with long radius elbows.

.5 Install expansion loops, cold sprung 50% of the calculated expansion.

.6 Install at least three [3] elbows in all branch connections. Where space does not permit 3 elbows, install braided flexible pipe connectors in accordance with manufacturer's recommendations. Three [3] elbow branch connections shall

have sufficient developed length to ensure that excessive stresses are not generated in the piping and in no case less than 900 mm [36"].

3.6 Valves

.1 Install valves with stems upright or angled 45° above horizontal unless approved otherwise.

.2 Install control valves with their stems upright unless approved otherwise and with adequate clearance for removal of actuators.

.3 Use gate valves or (ball valves NPS 2 and under) to shut off branch takeoffs and to isolate equipment.

.4 Install balance fittings or valves in the return piping connections to each terminal heating and cooling unit - eg. radiators, unit heaters, fan coil units, heating and cooling coils.

.5 Install radiator valves in the supply connections to each convection heating element.

.6 Provide valves upstream of all meters, gauges, automatic air vents, etc. for isolation purposes.

3.7 Piping Tests

.1 Notify the Consultant and the Inspection Authority having jurisdiction, 48 hours in advance of intended test dates.

.2 Before testing piping, isolate all equipment, which cannot withstand the test pressure.

.3 Do not insulate, backfill or conceal until tests have been completed and approved by the inspection authorities.

.4 Examine all systems under test for leaks.

.5 Joints shall remain dry during the test. A general sweating around a weld shall be reason for rejection.

.6 Remake all leaking connections and joints.

.7 Tests shall be limited to new piping only.

.8 New connections to existing piping shall be warranted.

.9 Initial Hydrostatic test:

.1 150% of working pressure, but not less than 860 kPa [125 psig] for 1 working day.

.10 Final Hydrostatic test:

.1 150% of working pressure, after piping connections to all equipment are complete, maintain until all parts of piping systems have been inspected.

3.8 Flushing and Cleaning

.1 After completion of all piping tests, clean and flush all piping systems to remove all internal dirt, millscale, rust, piping dope, pipe reamings and slag. On completion of flushing, remove, clean and reinstall all strainer baskets.

3.9 Testing and Balancing

.1 Balance all piping systems in accordance with the requirements of Section 23 05 93.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation of low-pressure metallic ductwork, joints and accessories.

1.2 RELATED SECTIONS

.1 Section 23 05 94 - Pressure Testing of Ductwork

1.3 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

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

.1 ASTM A635/A635M-09b, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.

.2 ASTM A653/A653M-09a, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

.3 National Fire Protection Association (NFPA).

.1 NFPA 90A-02, Standard for the Installation of Air-Conditioning and Ventilating Systems.

.2 NFPA 90B-05, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

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

.1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005.

.2 SMACNA HVAC Air Duct Leakage Test Manual, 1985, 1st Edition.

1.4 SUBMITTALS

.1 Submittals: in accordance with the Submittal Procedure requirements in Section 00 01 50 – General Instructions (CSC).

.2 Submit all information and data in both printed paper format and PDF electronic format. The PDF electronic format will be used for insertion into the Building Interactive Electronic Operating and Maintenance and Commissioning Manuals.

.3 Submit the following shop drawings:

.1 Fabrication drawings for exhaust hoods. Indicate metal material, thickness and all dimensions.

.2 Perforated ductwork. Include drawings and calculations showing the designed air distribution along the duct length.

.4 Quality Control Check Sheets

.5 Closeout Submittals: Provide all applicable close-out submittals per paragraph 1.18 "Closeout Submittals" of section 00 01 50 – General Instructions (CSC).

1.5 QUALITY CONTROL

.1 General:

.1 Contractor to be responsible for quality control of the products and installation in this section.

.2 Submit all information and material required for the Quality Management System, in accordance with Section Section 00 01 50 General Instructions (CSC).

.3 Quality Control Program Submittals:

.1 Quality Control Check Sheet

.4 Quality Control Check Sheet:

.1 Prepare and maintain Quality Control Check Sheets.

.2 Check sheet to be kept on site and be made available for review by the Departmental Representative at any time.

.3 Check sheets to be filled in and submitted for review, prior to substantial completion.

.4 Check sheets to include the following information:

.1 Random checks of duct gauge compared to SMACNA requirements.

.2 Duct joints

.3 Tape and duct sealant quality.

.4 Smooth radius elbows.

.5 Type of hangars.

.6 Corrosion resistant hangars in Level 0.

.7 Support spacing as specified.

.8 Identification

.9 Duct leakage test report

.10 Duct cleaning report

.11 Visual inspection of duct cleanliness (interior and exterior).

.12 Damage to ductwork.

.5 For each tabulated item, state the following:

.1 Does the item comply with the specification? Yes/No/Not Applicable.

.2 Identify any areas of non compliance and the proposed action to make it compliant.

1.6 GENERAL

.1 Duct sizes on drawings indicate clear inside dimensions. For acoustically lined or internally insulated ducts, maintain inside duct dimensions.

.2 Where duct sizes are shown in nominal metric sizes, round and oval duct sizes may be supplied in the nearest available sizes in equivalent imperial units.

.3 Proper sized openings shall be arranged for in the correct locations through all slabs and walls. Openings shall be planned to include for the installation of fire dampers at all rated fire separations.

.4 Where ducts penetrate roofs, provide roof curbs with flashing and counterflashing.

.5 Ductwork used on this project shall be clean and free from scale, corrosion and deposits. All ductwork shall be degreased and wiped clean of all oil and other surface films with appropriate solvents prior to installation.

.6 All ductwork shall be delivered clean to the site and maintained in clean condition. Dirty ductwork shall be removed from site.

.7 Where welded ductwork is indicated, the welding shall be continuous. Tack welding is unacceptable except as specifically noted. Paint damaged areas with zinc coating after welding.

.8 Provide seismic restraints for ductwork in accordance with SMACNA "Guidelines for seismic restraints of mechanical systems and plumbing piping systems".

Part 2 Products

2.1 GALVANIZED STEEL

.1 Galvanized steel shall have a 380 g/sq.m. galvanizing coat both sides to ASTM A525 G90.

.2 Thickness to SMACNA requirements.

2.2 DUCTWORK AND PLENUM PRESSURES

.1 Provide ductwork and plenums fabricated from galvanized steel for the static pressure categories listed below.

.1 500 Pa static pressure

.1 All supply, return and exhaust air ductwork and plenums, unless otherwise specified.

.2 All outdoor air ductwork and plenums, except as otherwise specified.

2.3 DUCTWORK - 500 Pa STATIC PRESSURE

.1 Provide galvanized iron ductwork for system operating pressures 500 Pa and less. Ductwork shall be constructed, reinforced, sealed and installed to withstand 1-1/2 times the working static pressure.

.2 Construct rectangular ductwork in accordance with Section I including Tables 1-5, 1-10, 1-11, 1-12, 1-13 and Figs. 1-4 through 1-18 of the SMACNA Duct Standards.

.3 At least two opposite faces of all rectangular ductwork must be joined together using a type of joint, which cannot pull apart.

.4 Construct rectangular duct fittings in accordance with Section II including Figs. 2-1 to 2-11 and Figs. 2-16 to 2-18 of the SMACNA Duct Standards.

.5 Construct round ductwork in accordance with Section III including Table 3-2 and Figs. 3-1 and 3-2 of the SMACNA Duct Standards, but excluding beaded crimp joints and snaplock seams.

.6 Construct flat oval ductwork in accordance with Section III including Table 3-4 and Fig. 3-6 of the SMACNA Duct Standards. Joints and seams shall be similar to those indicated for round ducts. Flat oval duct to be used for positive pressure application only.

.7 Construct round and flat oval duct fittings in accordance with Section III including Table 3-1 and Figs. 3-3 through 3-6 of the SMACNA Duct Standards. Round elbows shall have a centreline radius of 1.5 times duct diameter. Sheet metal gauge of fittings and elbows shall be not less than the thickness of that specified for longitudinal seam straight duct. Adjustable elbows are not permitted.

2.4 SEAL CLASSIFICATION

.1 Classification as follows: .

Maximum Pressure Pa	SMACNA Seal Class
500	B

.2 Seal classification:

.1 Class B: longitudinal seams, transverse joints and connections made airtight with sealant, tape or combination thereof.

2.5 DUCT LEAKAGE

.1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

.2 Refer to Section 23 05 94 - Pressure Testing of Ductwork, for duct pressure testing.

2.6 FITTINGS

.1 Fabrication: to SMACNA.

.2 Radiused elbows.

.1 Rectangular: centreline radius for standard rectangular elbows shall be 1.5 times duct width, unless shown otherwise.

.2 Round: smooth radius. Centreline radius: 1.5 times diameter.

.3 Mitred elbows, rectangular with single thickness turning vanes.

.4 Branches:

.1 Rectangular main and branch: with radius on branch 1.5 times width of duct,
45 degrees entry on branch.

.2 Round main and branch: enter main duct at 45 degrees with conical connection.

.3 Provide volume control damper in branch duct near connection to main duct.

.4 Main duct branches: with splitter damper.

.5 Transitions:

.1 Diverging: 20 degrees maximum included angle.

.2 Converging: 30 degrees maximum included angle.

.6 Offsets:

.1 Full radiused elbows, or as indicated.

.7 Obstruction deflectors: maintain full cross-sectional area.

.1 Maximum included angles: as for transitions.

2.7 FIRE STOPPING

.1 Retaining angles around duct, on both sides of fire separation.

.2 Fire stopping material and installation must not distort duct.

2.8 GALVANIZED STEEL

.1 Lock forming quality: to ASTM A653/A653M, Z90 zinc coating.

.2 Thickness, fabrication and reinforcement: to SMACNA.

.3 Joints: to SMACNA. Proprietary manufactured flanged duct joint to be considered to be a class A seal.

2.9 DUCTWORK – OUTDOORS

.1 The exhaust ducts located outdoors shall be constructed watertight.

.2 All joints shall be caulked with a water impervious sealant. TDC clips should be continuous on the top and sides of the ducts.

.3 The top of the finished product (waterproof membrane) should be pitched to avoid pooling of water.

2.10 HANGERS AND SUPPORTS

.1 Hangers and Supports as follows:

.1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.

.1 Maximum size duct supported by strap hanger: 500 mm.

.2 Hanger configuration: to ASHRAE and SMACNA.

.3 Hangers: galvanized steel angle with galvanized steel rods to following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

2.11 UPPER HANGER ATTACHMENTS:

.1 Upper attachment structural: suspension from lower flange of I-Beam:

.1 Malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, ULC listed to MSS-SP58 and MSS-SP69.

.2 Upper attachment structural: suspension from upper flange of I-Beam:

.1 Malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut ULC listed.

.3 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, ULC listed to MSS SP69.

.3 Concrete inserts for existing concrete slabs: Refer to Section 03 30 00 – Cast-in-Place Concrete for requirements.

.4 Steel Joist:

.1 Steel washer plates with double locking nut, carbon steel clevis and malleable iron socket.

.5 Steel Channel or Angle (bottom):

.1 Universal channel clamp.

.6 Steel Channel or Angle (top):

.1 Steel jaw, hook rod with nut, spring washer and plain washer.

2.12 HOODS – GALVANIZED STEEL

.1 Fabricate hoods from galvanized steel with concealed angle iron framing members to the configuration shown on the drawings.

.2 Material thickness: 1.19 mm (18 ga) thick.

.3 Submit hood shop drawings showing framing, sheathing and hanging details.

2.13 WIRE MESH SCREENS

.1 Provide wire mesh screens in all air intake openings where noted on the drawings.

.2 Screens shall be constructed from aluminum wire 1.3 mm diameter.

.3 Screen mesh shall be 12.7 mm.

.4 Mount screens in 0.66 mm thick folded aluminum frames.

2.14 COUNTER FLASHINGS

.1 Counter flashings - galvanized sheet steel of 0.76 mm (22 ga) minimum thickness.

.2 Counter flashings are attached to mechanical equipment and lap the base flashings on the roof curbs.

.3 All joints in counter flashings shall be flattened and solder double seam. Storm collars shall be adjustable to draw tight to pipe with bolts. Caulk around the top edge. Storm collars shall be used above all roof jacks.

.4 Vertical flange section of roof jacks shall be screwed to face of curb.

Part 3 Execution

3.1 DUCTWORK & PLENUM INSTALLATION

.1 Where a duct contains a fire or smoke damper, construct the duct so that the free area of the duct is maintained through the fire or smoke damper.

.2 Where a duct is to be internally insulated, enlarge the duct so as not to reduce the duct free area.

.3 Make the taper of diverging transitions less than 20 deg. and the taper of converging transitions less than 30 deg., in accordance with Fig. 2-9 of the SMACNA Duct Standards. Maximum divergence upstream of equipment to be 30 deg. and 45 deg. convergence downstream.

.4 Make the inside radius of any rectangular duct elbow at least equal to the duct width, measured in the direction of the radius. If space conditions do not permit a full radius elbow to be installed, use square elbows with multi-blade turning vanes.

.5 Turning vanes shall be single wall type. Vanes in galvanized sheet metal ducts shall be constructed from galvanized steel, minimum thickness 0.76 mm (22 ga). Vanes shall be spaced at 40 mm centres and shall turn through 90 deg., with a radius of 50 mm. Vanes shall not include a straight trailing edge. Refer to Figs. 2-3 and 2-4 of the SMACNA Duct Standards. Vanes and runners in aluminum ducts shall be constructed from aluminum. Aluminum vanes shall be 0.86 mm thick.

.6 For 500 Pa pressure systems, install tie rods to limit the maximum unsupported vane length to 914 mm. Refer to Fig. 2-4 of the SMACNA Duct Standards.

.7 Install duct necks before grilles, registers and diffusers and cushion heads after diffuser take-offs as required to suit site conditions.

.8 Where indicated, install adjustable air turning devices, where full radius take-off fittings cannot be installed, in accordance with Fig. 2-16 of the SMACNA Duct Standards. Adjustment shall be accessible outside the duct with lockable quadrant operator or through the grille or register with key-operated worm gear mechanism.

.9 Cross-break or bead all metal duct panels unless otherwise noted.

.10 Do not cross-break bottom duct panels when ductwork is handling moisture.

.11 Roof mounted ducts shall have standing seams and shall be sealed weather tight.

.12 Grade all ductwork handling moisture, a minimum of 1:120 back to the source or at low points in the ductwork, provide a 150 mm deep drain sump and 32 mm dia. drain connection with deep seal trap and pipe to drain.

.13 Construct ductwork handling moisture with three sided bottom sections and a separate top panel. Install the three sided bottom sections and internally seal the transverse joints with Silicone Sealant Then install the top panels and seal the top panel seams and joints.

.14 Provide moisture collection sections inside all louvres for outside air and exhaust air.

.15 Support ductwork using galvanized steel straps, cadmium plated threaded rods, flat bar or angle hangers. Attachments to the structure shall be compatible with the structure and selected for the load of the ductwork. Install ductwork hangers in accordance with Section IV including Tables 4-1 through 4-3 and Figs. 4-1 through 4-9 of the SMACNA Duct Standards.

.16 Support duct risers at their base and at each floor and at not greater than 3.7 m intervals.

.17 Prior to the fabrication of ductwork, co-ordinate and field measure all ductwork to ensure a complete installation respecting all other services. Provide all necessary fittings, offsets, and alternate construction methods to facilitate the installation.

.18 Arrange ductwork and plenums so that duct and plenum mounted equipment can be easily removed.

.19 Arrange access doors so that they open against the airflow and static pressure.

.20 Provide necessary baffling in manufactured or built-up mixed air plenums to ensure good mixed air temperature with variations of not more than ± minus 5°C under all operating conditions.

.21 Ducts passing through non-rated fire separations, sound insulated walls and through non-rated walls and floors shall be tightly fitted and sealed on both sides of the separation with silicon sealant to prevent passage of smoke and/or transmission of sound. (U.L.C. approved fire stop sealant is not a requirement). Where ducts are insulated provide a 0.61 mm thick galvanized steel band tightly fitted around insulation and then caulk to band.

.22 During construction, protect openings in ductwork, from dust infiltration, by covering with polyethylene, and protect floor outlet duct openings with metal caps.

.23 Where ductwork is required to pass through open web steel joists, coordinate with the joist fabricator before fabricating ductwork.

.24 Where ducts penetrate roofs, install sleeves and roof curb c/w flashing and counterflashing. Pack sleeves in roof with fibreglass insulation.

.25 Provide drip pans under piping and shields for protection of electrical panels and equipment.

.26 Unless noted otherwise, line all builder's shafts and air plenums used as ducts and plenums with sheet metal.

.27 Do not break continuity of insulation vapour barrier with hangers or rods.

.1 Insulate strap hangers 100 mm beyond insulated duct. Ensure diffuser is fully seated.

.28 Install breakaway joints in ductwork on both sides of fire separation.

.29 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

.30 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

3.2 HANGERS

.1 Strap hangers: install in accordance with SMACNA.

.2 Angle hangers: complete with locking nuts and washers.

.3 Hanger spacing: as follows:

Duct Size (mm)	Spacing (mm)
to 1500	3000
1501 and over	2500

3.3 WATERTIGHT DUCT

.1 Provide watertight duct for:

.1 Outdoor air intake.

.2 Ductwork installed outdoors

.2 Form bottom of horizontal duct without longitudinal seams.

.1 Solder or weld joints of bottom and side sheets.

.2 Seal other joints with duct sealer.

.3 Slope horizontal branch ductwork down towards drain in section of waterproof duct.

.1 Slope header ducts down toward risers.

.4 Fit base of riser with 150 mm deep drain sump and 32 mm drain connected, with deep seal trap and trap primer.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation of high-pressure metallic ductwork, joints and accessories.

1.2 RELATED SECTIONS

.1 Section 23 05 94 - Pressure Testing of Ductwork

.2 Section 23 33 00 - Air Duct Accessories

1.3 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

.2 American Society for Testing and Materials (ASTM).

.1 ASTM A653/A653M-09a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process. (Metric).

.3 Sheet Metal Air Conditioning Contractors' National Association (SMACNA).

.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible, 2005.

.2 SMACNA HVAC Air Duct Leakage Test Manual, 1st Edition 1985.

1.4 SUBMITTALS

.1 Submittals: in accordance with the Submittal Procedure requirements in Section 00 01 50 – General Instructions (CSC).

.2 Submit all information and data in both printed paper format and PDF electronic format. The PDF electronic format will be used for insertion into the Building Interactive Electronic Operating and Maintenance and Commissioning Manuals.

.3 Submit the following shop drawings:

.1 Indicate table of duct metal material and thickness for all dimensions.

.2 Installation and joint details

.4 Quality Control Check Sheets

.5 Closeout Submittals: Provide all applicable close-out submittals per paragraph 1.18 "Closeout Submittals" of section 00 01 50 – General Instructions (CSC).

1.5 QUALITY CONTROL

.1 General:

.1 Contractor to be responsible for quality control of the products and installation in this section.

.2 Quality Control Program Submittals:

.1 Quality Control Check Sheet

.3 Quality Control Check Sheet:

.1 Prepare and maintain Quality Control Check Sheets.

.2 Check sheets to include the following information:

.1 Random checks of duct gauge compared to SMACNA requirements.

.2 Duct joints

.3 Tape and duct sealant quality.

.4 Smooth radius elbows.

.5 Type of hangars.

.6 Support spacing as specified.

.7 Identification

.8 Duct leakage test report

.9 Duct cleaning report

.10 Visual inspection of duct cleanliness (interior and exterior).

.11 Damage to ductwork.

.3 For each tabulated item, state the following:

.1 Does the item comply with the specification? Yes/No/Not Applicable.

.2 Identify any areas of non compliance and the proposed action to make it compliant.

Part 2 Products

2.1 DUCTWORK

.1 Material:

.1 Galvanized steel with Z90 designation zinc coating lock forming quality: to ASTM A653/A653M.

.2 Thickness: to SMACNA.

2.2 DUCTWORK AND PLENUM PRESSURES

.1 Provide ductwork and plenums fabricated from galvanized steel for the static pressure categories listed below.

.1 2,500 Pa static pressure (negative)

.1 All ductwork associated with dust collectors DC-1.

2.3 DUCTWORK - 750 Pa AND GREATER STATIC PRESSURE

.1 Provide galvanized iron ductwork for system operating pressure over 500 Pa. Ductwork shall be constructed, reinforced, sealed and installed to withstand 1-1/2 times the working static pressure.

.2 Construct rectangular ductwork in accordance with Section I including Tables 1-6 through 1-13 and Figs. 1-2 through 1-18 of the SMACNA Duct Standards.

.3 Construct rectangular duct fittings in accordance with Section II including Figs. 2-1 through 2-11 of the SMACNA Duct Standards.

.4 Construct round ductwork in accordance with Section III including Table 3-2 and Figs. 3-1 and 3-2 of the SMACNA Duct Standards.

.5 Construct round duct fittings in accordance with Section III including Table 3-1 and Figs. 3-3 through 3-6 of the SMACNA Duct Standards. Round elbows shall have a centreline radius of 1.5 times duct diameter. Construct 90 deg. elbows of not less than 5 tapered sections. All seams and joints in round or oval duct fittings and elbows shall be spot welded lap seams at not more than 50mm spacing and all inside seams sealed with approved duct sealant. If the zinc coating is burned off the steel during welding, the joints shall be painted to prevent corrosion. Sheet metal gauges of fittings and elbows shall be not less than the thickness of that specified for longitudinal seam straight duct but suitably thick for welding methods used.

2.4 DUCTWORK – GRINDING AND BUFFING EXHAUST (DC-1)

.1 Provide galvanized round ductwork of gauges as listed below:

DUCT DIAMETER	METAL THICKNESS
up to 200 mm	0.76 mm
225 to 450 mm	0.92 mm

.2 Construct round ductwork in accordance with Figs. 3-1 and 3-2 of the SMACNA Duct Standards, except that beaded sleeve joints shall be tack welded (not screwed).

.3 Transitions shall have an included angle of not more than 15°.

.4 Construct round duct fittings in accordance with Figs. 3-3 through 3-5 of the SMACNA Duct Standards. All seams and joints in round duct fittings and elbows shall be continuously welded. If the zinc coating is burned off the steel during welding, the joints shall be painted to prevent corrosion. During fabrication care shall be taken to eliminate projection of metal edges into the air stream. Sheet metal thickness of fittings and elbows shall be suitable for welding method used.

.5 Round elbows shall have a centreline radius of 2.0 times the duct diameter. Fabricate 90 deg. elbows using a minimum of five sections for ducts up to 150 mm diameter and from a minimum of seven sections for ducts 175 mm diameter and larger.

.6 Support ductwork using cadmium plated threaded rods or galvanized steel straps in accordance with Figs. 4-1 through 4-7 of the SMACNA Duct Standards.

.7 Branches down from the ceiling, shall terminate at the elevation shown above floor level with a cast iron or cast aluminum blast gate and spigot for the connection of metal hoses. Blast gates shall be attached to a fabricated column.

.8 Fabricate collection hoods and adapted to machinery to detail designs on the project drawings.

.9 Outdoor exhaust ductwork to be watertight. Paint to match building façade.

2.5 HANGERS AND SUPPORTS

.1 Band hangers: use on round and oval ducts up to 500 mm diameter, of same material as duct, but next sheet metal thickness heavier than duct.

.2 Trapeze hangers: ducts over 500 mm diameter or longest side, to ASHRAE and SMACNA.

.3 Hangers: galvanized steel angle with galvanized steel rods to following table.

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

.4 Upper hanger attachments:

.1 Upper attachment structural: suspension from lower flange of I-Beam:

.1 Malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, ULC listed to MSS-SP58 and MSS-SP69.

.2 Upper attachment structural: suspension from upper flange of I-Beam:

.1 Malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut ULC listed.

.3 Steel Joist:

.1 Steel washer plates with double locking nut, carbon steel clevis and malleable iron socket.

.4 Steel Channel or Angle (bottom):

.1 Universal channel clamp.

.5 Steel Channel or Angle (top):

.1 Steel jaw, hook rod with nut, spring washer and plain washer.

Part 3 Execution

3.1 GENERAL

.1 Do work in accordance with ASHRAE and SMACNA.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.

.1 Insulate band hangers 100 mm beyond insulated duct.

.2 Ensure diffuser is fully seated.

.3 Support risers in accordance with ASHRAE and SMACNA.

.4 Install breakaway joints in ductwork on sides of fire separation.

.5 Ensure installation of firestopping does not distort duct.

.6 Provide duct access panels (for cleanout) at each elbow and at minimum 5m intervals. Refer to Section 23 33 00 – Air Duct Accessories.

3.2 HANGERS

.1 Band hangers: install in accordance with SMACNA.

.2 Angle hangers: complete with locking nuts and washers.

.3 Hanger spacing: as follows:

Duct Size (mm)	Spacing (mm)
to 1500	3000
1501 and over	2500

3.3 SEALING AND TAPING

.1 Refer to Section 23 33 00 – Air Duct Accessories.

3.4 LEAKAGE TESTS

.1 Refer to Section 23 05 94 - Pressure Testing of Ductwork.

.2 In accordance with SMACNA HVAC Duct Leakage Test Manual.

.3 Perform leakage tests in sections on all systems listed in this Section.

.4 Perform trial leakage tests, as instructed to demonstrate workmanship.

.5 Do not install additional ductwork until trial tests have been achieved.

.6 Test section minimum of 30 m long with not less than three branch takeoffs and two 90 degrees elbows.

.7 Complete tests before performing insulation or concealment Work.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for sheetmetal duct accessories including flexible connections, access doors, vanes and collars.

1.2 REFERENCES

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

.1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 2005.

1.3 SUBMITTALS

.1 Submittals: in accordance with the Submittal Procedure requirements in Section 00 01 50 – General Instructions (CSC).

.2 Submit all information and data in both printed paper format and PDF electronic format. The PDF electronic format will be used for insertion into the Building Interactive Electronic Operating and Maintenance and Commissioning Manuals.

.3 Submit the following shop drawings:

.1 Duct Connectors

.2 Duct and plenum sealers

.3 Access doors in ducts and plenums.

.4 Instrument test ports.

.5 Spin-in Collars

.4 Quality Control Check Sheets

.5 Closeout Submittals: Provide all applicable close-out submittals per paragraph 1.18 "Closeout Submittals" of section 00 01 50 – General Instructions (CSC).

1.4 QUALITY CONTROL

.1 General:

.1 Contractor to be responsible for quality control of the products and installation in this section.

.2 Submit all information and material required for the Quality Management System, in accordance with Section 00 01 50 General Instructions (CSC).

.3 Quality Control Program Submittals:

.1 Quality Control Check Sheet

.4 Quality Control Check Sheet:

.1 Prepare and maintain Quality Control Check Sheets.

.2 Check sheet to be kept on site and be made available for review by the Departmental Representative at any time.

.3 Check sheets to be filled in and submitted for review, prior to substantial completion.

.4 Check sheets to include the following information:

.1 Ducts sealed all joints.

.2 Flexible connectors at all fan inlets, outlets and as shown.

.3 Wire mesh screens on all exhaust and intake locations

.4 Access doors at all listed locations and where shown.

.5 For each tabulated item, state the following:

.1 Does the item comply with the specification? Yes/No/Not Applicable.

.2 Identify any areas of non compliance and the proposed action to make it compliant.

Part 2 Products

2.1 GENERAL

.1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 DUCT CONNECTORS – VIBRATION ISOLATION

.1 Provide flexible duct connections to provide vibration isolation at all duct and plenum connections to fan and air handling units. See Figure 2-19 SMACNA Duct Standards.

.2 Minimum Requirements:

.1 Pre-assembled 75 mm minimum long flexible connection with 75 mm long, 0.62 mm galvanized steel duct connectors on each side of the flexible connection. Flexible connector - fiber glass fabric with elastomer coating.

.3 Centrifugal fans with 900 mm diameter and larger fan wheels, use 150 mm long flexible connection.

2.3 DUCTWORK AND PLENUM SEALERS

.1 Provide duct sealing compounds for use in fabrication of all ductwork and plenum joints.

.2 Low Pressure Systems - SMACNA Seal Classification B. Medium and High Pressure Systems - SMACNA Seal Classification A.

.3 Where accessible, apply sealer to inside of joints on ducts and plenums under positive pressure - e.g. on the discharge side of fans.

.4 Apply sealer to outside of joints on ducts and plenums under negative pressure - e.g. on the suction side of fans.

2.4 SEALANT AND TAPE

.1 Sealant: oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of minus 30 degrees C to plus 93 degrees C. shall meet VOC limits per SCAQMD Rule 1168.

.2 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

2.5 ACCESS DOORS IN DUCTS AND PLENUMS

.1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.

.2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.

.3 Gaskets: neoprene.

.4 Hardware:

.1 Up to 300 x 300 mm: two sash locks complete with safety chain.

.2 301 to 450 mm: four sash locks complete with safety chain.

.3 451 to 1000 mm: piano hinge and minimum two sash locks.

.4 Doors over 1000 mm: piano hinge and two handles operable from both sides.

.5 Hold open devices.

.6 300 x 300 mm glass viewing panels.

2.6 INSTRUMENT TEST PORTS

.1 1.6 mm thick steel zinc plated after manufacture.

.2 Cam lock handles with neoprene expansion plug and handle chain.

.3 28 mm minimum inside diameter. Length to suit insulation thickness.

.4 Neoprene mounting gasket.

2.7 SPIN-IN COLLARS

.1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.

.2 Sheet metal thickness to correspond with round duct standards.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 DUCT CONNECTORS – VIBRATION ISOLATION

.1 Install in following locations:
- .1 Inlets and outlets to supply air units and fans.
- .2 Inlets and outlets of exhaust and return air fans.
- .3 As indicated.

.2 Length of connection: 100 mm.

.3 Minimum distance between metal parts when system in operation: 75 mm.

.4 Install in accordance with recommendations of SMACNA.

.5 When fan is running:
- .1 Ducting on sides of flexible connection to be in alignment.
- .2 Ensure slack material in flexible connection.

.6 Ensure flexible duct connectors do not reduce duct free area on suction side of fans.

3.3 SEALING AND TAPING

.1 Apply sealant to outside of joint to manufacturer's recommendations.

.2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturers recommendations.

3.4 DUCT AND PLENUM ACCESS

.1 Locations: Provide access doors and panels as follows:

- .1 Doors: where shown on the drawings.
- .2 Panels:
  - .1 Every 12 m on all ductwork.
  - .2 At the base of each duct riser.
  - .3 Both sides of equipment blocking the duct e.g.
    - .1 Air flow measuring stations
    - .2 Coils
  - .4 At or to one side of other equipment in duct e.g
    - .1 Backdraft dampers (counter weight side)
    - .2 Balance dampers serving multiple outlets/inlets
    - .3 Bearings (fans/motors)

.4 Control/operating dampers
.5 Control sensors
.6 Fire dampers (rectangular ducts and round ducts 330 mm dia. and larger - latch side)
.7 Heat detectors (upstream from device)
.8 Smoke detectors (upstream from device)

.5 Panels need not be provided where access is available through a door or a register mounted on the side of the duct.

.3 Patches:

.1 Where required for cleaning and where access panels are not specified, e.g. on both sides of turning vanes.

.4 Flexible duct - on round duct and round fire dampers up to 300 mm dia.

.2 Seal frames airtight.

.3 Install so as not to interfere with airflow.

.4 Install to provide easiest possible access for service and cleaning.

.5 Do not use sheet metal screws for attaching access panels to ductwork.

.6 Round ducts 330 mm dia. and larger shall include a short collar for the installation of access panels.

.7 Small rectangular ducts shall be transitioned to a minimum dimension across the duct of 330 mm for the installation of access panels.

.8 Provide retaining chains on panels 2.1 m above floor, and higher.

3.5 INSTRUMENT TEST PORTS

.1 General:

.1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.2 Locate to permit easy manipulation of instruments.

.3 Install insulation port extensions as required.

.4 Locations:

.1 For traverse readings:

.1 Ducted inlets to roof and wall exhausters.

.2 Inlets and outlets of other fan systems.

.3 Main and sub-main ducts.

.4 And as indicated.

.2 For temperature readings:

.1 At outside air intakes.

.2 In mixed air applications in locations as approved by Departmental Representative.

.3 At inlet and outlet of coils.

.4 Downstream of junctions of two converging air streams of different temperatures.

.5 And as indicated.

3.6 SPIN-IN COLLARS

.1 Provide spin-in collar and balancing damper for all round duct takeoffs from a main duct.

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 SECTION INCLUDES

.1 Balancing dampers for sheet metal ventilation and air conditioning systems.

1.2 RELATED SECTIONS

.1 Not used.

1.3 REFERENCES

.1 Sheet Metal and Air Conditioning National Association (SMACNA)

.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-2005.

1.4 SUBMITTALS

.1 Submittals: In accordance with the Submittal Procedure requirements in Section 00 01 50 – General Instructions (CSC).

.2 Submit all information and data in both printed paper format and PDF electronic format. The PDF electronic format will be used for insertion into the Building Interactive Electronic Operating and Maintenance and Commissioning Manuals.

.3 Shop Drawings:

.1 Include the following shop drawings:

.1 Balancing dampers

.4 Quality Control Check Sheets.

.5 Closeout Submittals: Provide all applicable close-out submittals per paragraph 1.18 "Closeout Submittals" of section 00 01 50 – General Instructions (CSC).

1.5 DELIVERY, STORAGE AND HANDLING

.1 Protect on site stored or installed absorptive material from moisture damage.

1.6 WASTE MANAGEMENT AND DISPOSAL:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with paragraph 1.16 of section 00 01 50 General Instructions (CSC).

1.7 QUALITY CONTROL

.1 General:

.1 Quality Control Check Sheet:

.1 Prepare and maintain Quality Control Check Sheets.

.2 Check sheet to be kept on site and be made available for review by the Departmental Representative at any time.

.3 Check sheets to be filled in and submitted for review, prior to substantial completion.

.4 Check sheets include the following information:

.1 Dampers as specified.

.2 Ensure dampers installed in all duct branches.

.3 Dampers to be vibration and noise free.

.4 Damper operators to be accessible.

.5 No binding within duct.

.6 Check tape installed by balancing contractor.

.7 For each tabulated item, state the following:

.1 Does the item comply with the specification? Yes/No/Not Applicable.

.2 Identify any areas of non compliance and the proposed action to make it compliant.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Protect on site stored or installed absorptive material from moisture damage.

1.9 WASTE MANAGEMENT AND DISPOSAL:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with paragraph 1.16 of section 00 01 50 General Instructions (CSC).

Part 2 Products

2.1 GENERAL

.1 Manufacture to SMACNA standards.

2.2 BALANCING DAMPERS

.1 Construction in accordance with SMACNA Duct Standards - Figs. 2-14 and 2-15.

.2 Minimum Requirements:

.1 Rectangular ducts:

.1 Up to 300 mm deep - single blade (butterfly type).

.2 330 mm to 400 mm deep - two opposed blades, mechanically interlocked with pivots at quarter points.

.3 430 mm deep and over - multiple opposed blades, mechanically interlocked with blades not greater than 200 mm deep and pivots equally spaced.

.2 Round Ducts:

.1 Single blade (butterfly type).

.3 Material:

.1 Minimum 1.47 mm thick galvanized steel blade on all butterfly dampers (V-groove stiffened), 300mm and smaller.

.2 Use heavier industrial grade single blade balancing damper on ducts larger than 300mm diameter.

.3 Minimum 1.47 mm thick galvanized steel blades on multi-blade dampers with rigidly constructed galvanized steel frame (no frame required on single blade dampers). Factory manufactured.

.4 Minimum 1.14 mm thick stainless steel blades for industrial exhaust ducts.

.4 Bearings:

.1 End bearings on all low pressure single blade dampers above 300 mm dia.

.2 Inside and outside nylon end bearings for single blade dampers.

.3 Bearings on multiple blade dampers shall be bronze self-lubricating type.

.5 Operating Mechanism:

.1 Lockable quadrant type with end bearing on accessible rectangular ducts up to 400 mm deep and on accessible round ducts.

.2 Shaft extension to accommodate insulation thickness.

.3 Wide pitch screw mechanism type with crank operator on accessible rectangular ducts 430 mm and over in depth and on inaccessible rectangular and round ducts.

.4 Override limiting stops.

.5 No blade movement in set position.

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 where indicated and in each branch duct, for supply, return and exhaust systems.

.2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.3 Runouts to registers, grilles and diffusers: install single blade damper located as close as possible to main ducts. where branches are taken from larger duct, as required for proper air balancing.

.4 Dampers: vibration free.

.5 Ensure damper operators are observable and accessible.

.6 Identify the airflow direction and blade rotation and open and closed position.

.7 On all round ductwork larger than 300 mm diameter and on externally insulated rectangular ductwork, provide sheet metal bridge to raise quadrant type operators above the insulation thickness. Provide an open end bearing where bridges are used. Bridges on uninsulated round ducts shall be at least 25 mm high.

.8 Where quadrant type operators are used, the lever shall be arranged parallel with the damper blade.

3.3 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 SECTION INCLUDES

.1 Materials and installation of flexible ductwork, joints and accessories.

1.2 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

.2 National Fire Protection Association (NFPA).

- .1 NFPA 90A-02, Standard for the Installation of Air-Conditioning and Ventilating Systems.
- .2 NFPA 90B-05, Standard for Installation of Warm Air Heating and Air-Conditioning Systems.

.3 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).

- .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005.

.4 Underwriters' Laboratories of Canada (ULC).

- .1 CAN/ULC-S110-1986(R2001), Fire Tests for Air Ducts.

1.3 SUBMITTALS

.1 Submittals: In accordance with the Submittal Procedure requirements in Section 00 01 50 – General Instructions (CSC).

.2 Submit all information and data in both printed paper format and PDF electronic format.

.3 Submit shop drawings for flexible ducts. Include the following information:

- .1 Thermal properties.
- .2 Friction loss.
- .3 Leakage.
- .4 Fire rating.

.4 Quality Control Check Sheets.

.5 Closeout Submittals: Provide all applicable close-out submittals per paragraph 1.18 "Closeout Submittals" of section 00 01 50 – General Instructions (CSC).

1.4 QUALITY CONTROL

.1 General:

- .1 Contractor to be responsible for quality control of the products and installation in this section.
- .2 Submit all information and material required for the Quality Management System, in accordance with Section 01 45 01 – Quality Control: Construction.

.3 Quality Control Program Submittals:

.1 Quality Control Check Sheet.
.2 Check sheets to include the following information:

.1 Ducts installed as shown or as required to accommodate duct offsets.
.2 Duct free area maintained along complete length.
.3 Supports.
.4 Duct joints.

.3 For each tabulated item, state the following:

.1 Does the item comply with the specification? Yes/No/Not Applicable.
.2 Identify any areas of non compliance and the proposed action to make it compliant.

Part 2 Products

2.1 DUCTWORK – FLEXIBLE

.1 Minimum Requirements:

.1 Non-corrosive spiral wire reinforcing with flexible vinyl coated fiberglass cloth membrane.
.2 Suitable for up to 2500 Pa positive static pressure and 250 Pa negative static pressure.
.3 U.L. or U.L.C. labelled, Class 1, duct connector.
.4 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of 1.3 kg/m^2.
.5 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

Part 3 Execution

3.1 DUCTWORK– FLEXIBLE

.1 Installed lengths shall be limited to 4 times duct diameter but not longer than 1200 mm.
.2 Connect to ductwork and diffusers with stainless steel worm drive clamps or PVC duct strap applied over two wraps of duct tape. Use stainless steel clamps on connections to fire dampers.
.3 Minimum centreline radius of flexible ductwork bends shall be 1.5 times the duct diameter, alternatively, sheet metal elbows may be used at branch takeoffs and boot/diffuser connections.
.4 Support with 25 mm x 0.76 mm galvanized steel straps at a maximum of 600mm. Straps shall completely encircle duct.
.5 Support clear of ceiling assembly, light fixtures and hot surfaces.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for acoustic duct lining.

1.2 REFERENCES

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

.1 ASTM C423-09A, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

.2 ASTM C916-2007, Standard Specification for Adhesives for Duct Thermal Insulation.

.3 ASTM C1071/C1017M-07, Standard specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).

.4 ASTM C1338-08, Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.

.5 ASTM G21-09, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

.6 Canadian Environmental Protection Act (CEPA), 1999, c. 33.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Material Safety Data Sheets (MSDS).

.3 National Fire Protection Association (NFPA).

.1 NFPA 90A-02, Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 NFPA 90B-05, Standard for the Installation of Warm Air Heating and Air Conditioning Systems.

.4 North American Insulation Manufacturers Association (NAIMA).

.1 NAIMA AH116-5th Edition, Fibrous Glass Duct Construction Standards.

.5 Underwriter's Laboratories of Canada (ULC).

.1 CAN/ULC-S102-03-07, Methods of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.3 SUBMITTALS

.1 Submittals: In accordance with the Submittal Procedure requirements in Section 00 01 50 – General Instructions (CSC).

.2 Submit all information and data in both printed paper format and PDF electronic format.

.3 Submit the following shop drawings:

.1 Literature of acoustic lining material, including protective lining.

.2 Installation details

.4 Quality Control Check Sheets Closeout

.5 Submittals: Provide all applicable close-out submittals per paragraph 1.18 "Closeout Submittals" of section 00 01 50 – General Instructions (CSC).

Part 2 Products

2.1 DUCT LINER

.1 General:

.1 Mineral Fibre duct liner: mat facing.

.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50 when tested in accordance with CAN/ULC-S102.

.3 Recycled Content: EcoLogo certified with minimum 35% by weight recycled content.

.4 Fungi resistance: to ASTM C1338.

.2 Flexible

.1 Mineral Fibre duct liner: air surface coated, mat facing.

.2 Acoustic quality, glass fibre, bacteria and fungus resistant; free of corrosion causing or accelerating agents; packed to density to meet performance requirements; and meet NBC fire requirements.

.3 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50 when tested in accordance with CAN/ULC-S102.

.4 Fungi resistance: to ASTM C1338.

.5 Yellow or light coloured internal flexible glass fibre acoustical insulation with one face faced with non-woven fiberglass mat.

.6 Minimum sound absorption (NRC) of 0.60 as tested per ASTM C423 using type "A" mounting.

.7 Thermal Conductivity at 24 deg.C. - 0.040 W/m/deg.C.

.3 Rigid:

.1 Use on flat surfaces and where indicated.

.2 25 mm thick, to ASTM C1071, Type 2, fibrous glass rigid board duct liner.

.3 Density: 48 kg/m^3minimum.

.4 Thermal resistance to be minimum 0.76 (m^2. degrees C)/W for 25 mm thickness 1.15 (m^2.degrees C)/W for 38 mm thickness 1.53 (m^2.degrees C)/W for 50 mm thickness when tested in accordance with ASTM C177, at 24 degrees C mean temperature.

.5 Maximum velocity on faced air side: 20.3 m/sec.

.6 Minimum NRC of 0.70 at 25 mm thickness based on Type A mounting to ASTM C423.

.7 Recycled Content: EcoLogo certified containing minimum 45% by weight recycled content.

2.2 ADHESIVE

.1 Adhesive: to NFPA 90A and NFPA 90BASTM C916.

.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 29 degreesC to plus 93 degrees C.

.3 Water-based fire retardant type.

2.3 FASTENERS

.1 Weld pins 2.0 mm diameter, length to suit thickness of insulation. Polymer, Nylon or Metal retaining clips, 32 mm square.

2.4 JOINT TAPE

.1 Poly-Vinyl treated open weave fiberglass membrane, 50 mm wide.

2.5 SEALER

.1 Meet requirements of NFPA 90A and NFPA 90B.

.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 68 degrees C to plus 93 degrees C.

Part 3 Execution

3.1 GENERAL

.1 Do work in accordance with SMACNA HVAC Duct Construction Standards except as specified otherwise.

.2 Line inside of ducts where indicated.

.3 Duct size shown is dimension inside the insulation. Metal duct sizes shall be increased to allow for the internal acoustic insulation thickness.

3.2 SCOPE OF DUCT LINER INSULATION

.1 Scope 1: Internal Flexible Duct Liner

	Thickness
Service	**mm**
All ductwork where indicated on drawings	50
Acoustic elbows (room relief / return air ducts) where shown	25

.2 Scope 2: Internal Rigid Duct Liner

	Thickness
Service	**mm**
Outdoor air ductwork	25
Air plenums, where indicated.	50

3.3 DUCT LINER

.1 Adhere duct liner with liner adhesive applied to the whole of the metal surface. The coating side of duct liner shall be exposed to the airstream.

.2 Ducts 610 mm in width and less require no further adhesion.

.3 Ducts sides and plenum panels greater than 610 mm in width shall also have metal clips or nylon pins adhered to the metal surface at 300 mm to supplement the adhesive. (Welding pins may be used provided a capacitor type gun is used.) Impale insulation or the pins or clips, with the coated side of the duct liner exposed to the airstream and secured with holding washers. Cover holding washers with reinforcing membrane and insulation coating / sealer.

.4 Seal all transverse and longitudinal joints, raw edges, and other points of penetration of the coating with reinforcing membrane (joint tape) and duct liner coating/sealer.

.5 No raw edges of internal duct liner material shall be exposed to the moving airstream.

.6 Protect leading and trailing edges of duct sections with sheet metal nosing having 15 mm overlap and fastened to duct.

.7 Replace damaged areas of liner at discretion of the Departmental Representative.

3.4 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 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)

.1 ANSI/AMCA Standard 99-2010, Standards Handbook.

.2 ANSI/AMCA Standard 210-2007/(ANSI/ASHRAE 51-07), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.3 ANSI/AMCA Standard 300-2008, Reverberant Room Method for Sound Testing of Fans.

.4 ANSI/AMCA Standard 301-1990, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.2 The Master Painters Institute (MPI)

.1 Architectural Painting Specification Manual - current edition.

.1 MPI #18, Primer, Zinc Rich, Organic.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals: In accordance with the Submittal Procedure requirements in Section 00 01 50 – General Instructions (CSC).

.2 Product Data:

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

.3 Shop Drawings:

.1 Fan performance curves showing point of operation, bhp or kW and efficiency.

.2 Sound rating data at point of operation.

.4 Indicate:

.1 Motors, sheaves, bearings, shaft details.

.2 Minimum performance achievable with variable speed controllers.

1.3 MAINTENANCE MATERIAL SUBMITTALS

.1 Closeout Submittals: Provide all applicable close-out submittals per paragraph 1.18 "Closeout Submittals" of section 00 01 50 – General Instructions (CSC).

.2 Extra Materials:

.1 Provide:

.1 Matched sets of belts.

.2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:

.1 Bearings and seals.

.2 Addresses of suppliers.

.3 List of specialized tools necessary for adjusting, repairing or replacing.

1.4 DELIVERY, STORAGE AND HANDLING

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

.2 Storage and Handling Requirements:

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

.2 Store and protect HVAC fans from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SYSTEM DESCRIPTION

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.

.2 Capacity: flow rate, static pressure, bhp or W, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.

.3 Fans: statically and dynamically balanced, constructed in conformity with ANSI/AMCA Standard 99.

.4 Sound ratings: comply with ANSI/AMCA Standard 301, tested to ANSI/AMCA Standard 300.

.5 Performance ratings: based on tests performed in accordance with ANSI/AMCA Standard 210.

2.2 FANS GENERAL

.1 Motors:

.1 Sizes as indicated.

.2 Accessories and hardware: matched sets of V-belt drives, motor bases, belt guards, coupling guards fan inlet safety screens as indicated back-draft dampers and vanes and as indicated.

.3 Factory primed before assembly in colour standard to manufacturer.

.4 Scroll casing drains: as indicated.

.5 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

.6 Vibration isolation: to Section 23 05 48 - Vibration and Seismic Controls.

.7 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

2.3 CENTRIFUGAL FANS

.1 Fan wheels:

.1 Welded steel or aluminum construction.

.2 Maximum operating speed of centrifugal fans not more than 40% of first critical speed.

.2 Bearings: split pillow-block grease lubricated ball or roller self-aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 80,000 hours.

2.4 PROPELLER FANS

.1 Fabricate multi-bladed propellers within bell mouth entrance on integral mounts, with grease lubricated ball bearings, with extended lubrication fittings, suited for operating in any position, direct driven, complete with motor as indicated.

.2 Provide blade guards, bird screen and back draft dampers on discharge.

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 HVAC fans installation in accordance with manufacturer's written instructions.

.1 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.2 Proceed with installation only after unacceptable conditions have been remedied.

3.2 FAN INSTALLATION

.1 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment, flexible electrical leads and flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.

.2 Provide sheaves and belts required for final air balance.

.3 Bearings and extension tubes to be easily accessible.

.4 Access doors and access panels to be easily accessible.

3.3 ANCHOR BOLTS AND TEMPLATES

.1 Size anchor bolts to withstand seismic acceleration and velocity forces as specified.

3.4 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

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

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

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for exhaust arms.

1.2 SUBMITTALS

.1 Submittals: In accordance with the Submittal Procedure requirements in Section 00 01 50 – General Instructions (CSC).

.2 Submit all information and data in both printed paper format and PDF electronic format. The PDF electronic format will be used for insertion into the Building Interactive Electronic Operating and Maintenance and Commissioning Manuals.

.3 Submit shop drawings for exhaust arms. Include the following information:

.1 Exhaust arm construction, dimensions, weight, mounting details.
.2 Air flow and pressure data.

.4 Closeout Submittals: Provide all applicable close-out submittals per paragraph 1.18 "Closeout Submittals" of section 00 01 50 – General Instructions (CSC).

1.3 QUALITY CONTROL

.1 General:

.1 Contractor to be responsible for quality control of the products and installation in this section.

.1 Check sheets to include the following information:

.1 Exhaust arm construction details.
.2 Arm length.
.3 Support.
.4 Arm manoeuvrability.
.5 Air flow.

.2 For each tabulated item, state the following:

.1 Does the item comply with the specification? Yes/No/Not Applicable.
.2 Identify any areas of non compliance and the proposed action to make it complaint.

Part 2 Products

2.1 EXHAUST ARMS

.1 Exhaust arm designed and installed for heavy industrial applications.
.2 Exhaust arm manufactured and installed to provide 360° operation.
.3 Suction hood as indicated in the equipment schedule with ball joint connection to flexible hose. Safety mesh covering hood opening. Hood with handle for positioning of the hood.
.4 Lock handle to maintain position of arm.
.5 Designed to carry up to 50 kg weight.
.6 Arm to be complete with wall or ceiling plate, mounting bracket and all fittings required for support.
.7 Damper in the hood, with exterior adjustment.
.8 Flame retardant hose, with internal steel spiral.
.9 Submit fabrication shop drawings for review.

Part 3 Execution

3.1 INSTALLATION

.1 Comply with manufacturer's recommended installation requirements.
.2 Install arms in locations indicated on drawings.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation of supply, return and exhaust grilles, registers and diffusers.

1.2 SYSTEM DESCRIPTION

.1 Performance Requirements: Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.3 SUBMITTALS

.1 Submittals: In accordance with the Submittal Procedure requirements in Section 00 01 50 – General Instructions (CSC).

.2 Submit all information and data in both printed paper format and PDF electronic format.

.1 Submit the following shop drawings:

.1 Diffusers

.2 Grilles and registers

.2 Include product characteristics, performance criteria, and limitations.

.3 Indicate following:

.1 Capacity.

.2 Throw and terminal velocity.

.3 Noise criteria.

.4 Pressure drop.

.5 Neck velocity.

.3 Quality Control Check Sheets.

.4 Closeout Submittals: Provide all applicable close-out submittals per paragraph 1.18 "Closeout Submittals" of section 00 01 50 – General Instructions (CSC)

1.4 QUALITY CONTROL

.1 General:

.1 Contractor to be responsible for quality control of the products and installation in this section.

.2 Quality Control Checks:

.1 Prepare and maintain Quality Control Check Sheets.

.2 Check sheet to be kept on site and be made available for review by the Departmental Representative at any time.

.3 Check sheets to be filled in and submitted for review, prior to substantial completion.

.4 Check sheets to include the following information:

.1 Diffuser/grille/register type

.2 Material

.3 Colour

.4 Balance damper in duct branch or integral to register

.5 Seismic restraint

.6 Noise level

.7 Correct installation height for volume and throw

.8 Standard of installation

.5 For each tabulated item, state the following:

.1 Does the item comply with the specification? Yes/No/Not Applicable.

.2 Identify any areas of non compliance and the proposed action to make it compliant.

Part 2 Products

2.1 GENERAL

.1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated on drawing equipment schedules.

.2 Concealed manual volume control damper operators, as scheduled.

.3 Colour: as scheduled.

.4 Base air outlet application on space noise level of NC 30 maximum.

.5 All air terminals must be checked for compatibility with ceiling types. Refer to Mechanical plans.

.6 All ceiling mounted air terminals shall be provided with means for attachment of two seismic security wires at opposite corners of each air terminal.

.7 Ceiling tee-bar modules are in soft conversion metric, SI metric measurements, unless where specifically noted otherwise.

.8 The manufacturer (other than the design listed) shall match performance data and indicate a specific comparison for each item, with the shop drawing submission.

.9 Grilles, registers and diffusers of same generic type, products of one manufacturer.

2.2 SUPPLY GRILLES AND REGISTERS

.1 Refer to equipment schedules on drawings for sizes and air quantities.

2.3 RETURN AND EXHAUST GRILLES AND REGISTERS

.1 Refer to equipment schedules on drawings for sizes and air quantities.

2.4 DIFFUSERS

.1 Refer to equipment schedules on drawings for sizes and air quantities.

Part 3 Execution

3.1 INSTALLATION

.1 Install in accordance with manufacturers instructions.

.2 Install with cadmium plated screws in countersunk holes where fastenings are visible.

.3 Install ductwork as high as practical, using offsets where required to obtain maximum duct neck lengths for diffusers, unless shown otherwise.

.4 Refer to Mechanical plans for exact locations of air terminals.

.5 Paint ductwork behind grilles with matte black paint where duct or insulation surfaces are visible.

.6 Attach registers and grilles to branch ducts with duct necks having minimum length to prevent grille or register damper from protruding into branch duct.

.7 Where air terminals are installed in mechanical grid ceilings, provide at least two 12 ASWG galvanized steel wire seismic security bridles per air terminal tied either to the building structure or to ceiling hanger wires. Attach security bridles at opposite corners of each air terminal and in such a manner that the air terminal cannot fall.

3.2 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 ASTM International

.1 ASTM E90-09, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

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

.3 Society of Automotive Engineers (SAE)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals: In accordance with the Submittal Procedure requirements in Section 00 01 50 – General Instructions (CSC).

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for louvers, intakes and vents and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Indicate following:

.1 Pressure drop.

.2 Face area.

.3 Free area.

1.3 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

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

.2 Store and protect louvers, intakes and vents from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SYSTEM DESCRIPTION

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

2.2 FIXED LOUVRES - ALUMINUM

.1 Construction: welded with exposed joints ground flush and smooth.

.2 Material: extruded aluminum alloy.

.3 Blade: stormproof pattern with centre watershed in blade, reinforcing bosses.

.4 Frame, head, sill and jamb: 100 or 150 mm deep one piece extruded aluminum, minimum 3 mm thick with approved caulking slot, integral to unit.

.5 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.

.6 Screen: 12 mm exhaust 19 mm intake mesh, 2 mm diameter wire aluminum bird-screen on inside face of louvres in formed U-frame.

.7 Finish: factory applied enamel. Colour: to Departmental Representative's approval.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for louvres, intakes and vents installation in accordance with manufacturer's written instructions.

.1 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.2 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

.1 In accordance with manufacturer's and SMACNA recommendations.

.2 Reinforce and brace as indicated.

.3 Anchor securely into opening. Seal with caulking to ensure weather tightness.

3.3 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

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

.3 Waste Management: separate waste materials for reuse or recycling

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

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for dust collector DC-1

1.2 RELATED SECTIONS

.1 Section 23 05 49 - Seismic Restraints

1.3 SUBMITTALS

.1 Submittals: In accordance with the Submittal Procedure requirements in Section 00 01 50 – General Instructions (CSC).

.2 Submit all information and data in both printed paper format and PDF electronic format.

.3 Submit the following shop drawings:

.1 Dust Collectors:

.1 Cabinet material and finish

.2 Dimensions, weights.

.3 Fan and fan curves showing point of operation

.4 Motor drive, bearings

.5 Filters

.6 Mounting details

.7 Performance data.

.8 Electrical data

.4 Quality Control Check Sheets Closeout

.5 Submittals: Provide all applicable close-out submittals per paragraph 1.18 "Closeout Submittals" of section 00 01 50 – General Instructions (CSC).

1.4 QUALITY CONTROL

.1 General:

.1 Contractor to be responsible for quality control of the products and installation in this section.

.2 Quality Control Program Submittals:

.1 Check sheets to include the following information:

.1 Dust collector make and model

.2 Fan specifications

.3 Filtration

.4 Vibration isolation

.5 Seismic restraint

.6 Noise issues at all speeds

.7 Electrical disconnect

.8 High efficiency motor

.9 Access as required for maintenance

.10 Installation details

.2 For each tabulated item, state the following:

.1 Does the item comply with the specification? Yes/No/Not Applicable.

.2 Identify any areas of non-compliance and the proposed action to make it compliant.

Part 2 Products

2.1 DUST COLLECTORS (DC-1)

.1 Minimum Requirements

.1 Dust Collector DC-1 filters wood saw-dust and chips from the various Hobby Shop vacuum connections.

.2 Dust collector to be self-contained unit suitable for outdoor installation; 2mm galvanized steel housing to be angle reinforced all welded construction with factory standard epoxy industrial paint finish.

.3 Units will come with factory installed all welded support structure with cross bracing suitable for duty.

.4 Collectors will provide primary separation of heavier particles in the inlet section and secondary filtration of fine particles in the filter section.

.5 Filters to be tube or bag-type

.6 Waste storage will be in manufacturer's standard dust hoppers.

.7 Dust collector structure to be fabricated to comply with the seismic forces noted in Section 23 05 49 – Seismic Restraints.

.8 NFPA 664 compliant for outdoor use with no special fire protection requirements.

.2 Fan

.1 Unit complete with spark proof fan.

.2 Fan outlet damper.

.3 Fan shall be integral to collector, in acoustically lined enclosure on top of the unit.

.4 Provide an inline discharge silencer.

.1 Weatherproof galvanized steel construction

.2 Silencer shall insure a noise level of no more than 80 dB at 10 ft.

.3 Controls

.1 Provide Control Panel for complete dust collector operation, with connection to master-user switch (for remote installation), auxiliary relay to interlock shop equipment. Panel shall be factory wired with magnetic motor starters, and electrical components. See drawings for panel and switch locations. See electrical drawings for wiring schematic.

.2 Dust Collector shall be "enabled (energized)" by master-user switch located in the Manager's office, and then "activated" by an inmate-user switch located within the hobby shop. See electrical drawings for wiring schematic.

.3 Provide a fully automatic electric motor driven shaker mechanism, with a remote prewired control panel for each fan and shaker.

.4 Provide monitoring of dust collector bag (drum) levels. Provide alarm when bag (drum) is full.

.5 Provide custom lockable steel cage cover to prevent tampering.

.6 Electrical service to panel: 575/3/60 c/w single point connection.

.7 Division 26 will provide the following, coordinate with electrical.

.1 Power to the dust collector (single point connection).

.2 Power to the control panel.

.3 Power to master-user switch, inmate-user switch, and shop equipment served by the dust collector.

.4 Connection between control panel auxiliary relay and shop equipment (for interlocked operation).

.5 Master-user switch to enable (energize) the dust collector.

.6 Inmate-user switch to activate (turn-on) the dust collector.

.4 Unit Performance:

.1 Per Equipment Schedule

Part 3 Execution

3.1 INSTALLATION

.1 Mount the dust collector on a concrete pad.

.2 Mount within the protective chain-link fence and lockable gate. Coordinate placement to allow for sufficient service access to access doors and panels.

.3 Install in accordance with NFPA-91 and the Industrial Ventilation Manual of Recommended Practice.

.4 Provide cleanouts as required for maintenance, at each elbow, change of direction, duct junction and as indicated on the drawings.

.5 Dust collector and ductwork to be electrically grounded. Coordinate with

electrical trade.

3.2 ANCHOR BOLTS AND TEMPLATES

.1 Size anchor bolts to withstand seismic acceleration and velocity forces as specified in Section 23 05 49 - Seismic Restraints.

3.3 FIELD QUALITY CONTROL

.1 Commissioning:

.1 Manufacturer to:

.1 Certify installation.

.2 Start up and commission installation.

.3 Verify air flow measurements with testing and balancing contractor. Adjust and mark fan outlet damper.

.4 Carry out on-site performance verification tests.

.5 Demonstrate operation and maintenance.

.6 Test alarms.

.2 Provide Departmental Representative at least 24 hours notice prior to inspections, tests, and demonstrations.

.3 Submit written report of inspections, tests, and commissioning results.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for self-contained single zone, indirect gas-fired packaged rooftop heating/ventilation unit.

.2 This section applies to rooftop unit RTU-15A and RTU-15, which serves the Hobby Shop and the adjacent spaces respectively.

1.2 RELATED SECTIONS

.1 Not used.

1.3 REFERENCES

.1 ANSI/UL 1995 B-1998, Standard for Heating and Cooling Equipment.

.2 Canadian Standards Association (CSA International)

.1 CSA C22.1 HB-09, Canadian Electrical Code Handbook.

.3 National Fire Protection Association

.1 NFPA 90A-09, Standard for the Installation of Air Conditioning and Ventilating Systems.

1.4 SUBMITTALS

.1 Submittals: In accordance with the Submittal Procedure requirements in Section 00 01 50 – General Instructions (CSC).

.2 Shop Drawings:

.1 Submit shop drawings to indicate project layout and dimensions; indicate:

.1 Unit drawing showing dimensions, internal and external construction details, insulation, recommended method of installation with proposed structural steel support, mounting curb details, sizes and location of mounting bolt holes; include mass distribution drawings showing point loads.

.2 Equipment, piping, and connections, together with valves, strainers, control assemblies, thermostatic controls, auxiliaries and hardware, and recommended ancillaries which are mounted, wired and piped ready for final connection to building system, its size and recommended bypass connections.

.3 Piping, valves, fittings shipped loose showing final location in assembly.

.4 Control equipment shipped loose, showing final location in assembly.

.5 Detailed composite wiring diagrams for electrical and control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices of ancillaries, accessories, controllers.

.6 Fan performance curves.

.7 Details of vibration isolation.

.8 Estimate of sound levels to be expected across individual octave bands in dB referred to A rating.

.3 Instructions: submit manufacturer's installation instructions.

.4 Closeout Submittals: Provide all applicable close-out submittals per paragraph 1.18 "Closeout Submittals" of section 00 01 50 – General Instructions (CSC).

.1 Indicate: brief description of unit, indexed, with details of function, operation, control, and service for components.

.2 Provide for units, manufacturer's name, type, year, number of units, and capacity.

Part 2 Products

2.1 GENERAL

.1 Packaged single zone, roof mounted, direct gas fired heating and ventilation unit, bearing CSA, CGA and ULC labels.

.2 The entire package including dampers, fan and heating controls shall be approved by independent testing authority, and carry the approval label of that authority as a complete operating package. Unit shall be certified for use as a make-up air unit for painting, including operation for a high temperature recirculation curing mode. All components in the airstream shall be classified as spark proof/explosion proof.

.3 Completely factory assembled, wired and complete with all necessary controls, ready for field connections.

.4 Units shall consist of but not be limited to the following components:

.1 Cabinet and frame

.2 Mixing box with motorized outdoor and mixed air dampers.

.3 Filter Section.

.4 Supply fan section.

.5 Indirect gas-fired heating section

.6 Discharge air plenum with relief air damper

.7 Controls as specified

.8 Seismic roof curb

.5 Conform to ANSI/ARI 210/240, rating for unit larger than 40 kW nominal.

2.2 UNIT DESCRIPTION

.1 Unit Structure

.1 The composition of the structural aspects of the units may be of unitized construction, formed and reinforced to provide a rigid housing capable of withstanding wind and snow loads. Alternatively, the units may be structurally framed and sheet metal clad to meet the stated requirements.

.2 The separation of vibration, set up by any component within the unit, from the building is to be achieved by the application of vibration isolation devices and techniques within the units and not by vibration isolation applied between the building and the unit base frame.

.3 Ensure that the rigidity of the structure, e.g. minimal floor deflection, is adequate for this purpose. Refer to isolation/seismic requirements.

.4 Integral lifting lugs shall be provided for one piece hoisting.

.2 Unit Casing

.1 The rooftop units shall be weatherproofed and equipped for installation outdoors. This shall include oversized air intake cowls designed to exclude the infiltration of rain and snow into the unit.

.2 Insulation:

.1 Insulation to be neoprene coated glass fibre.

.2 50mm, 32 kg/m^3 density insulation throughout, unless stated otherwise, complete with perforated 24 ga sheetmetal liner throughout.

.3 Unit underside with 50mm, 32 kg/m^3 insulation with 22 ga solid liner.

.4 Heat exchanger section with 25mm, 32 kg/m^3 insulation with 22ga solid liner.

.3 Access doors:

.1 Doors shall be hinged, gasketted, fully lined, with welded steel door frame and latches.

.2 Provide doors to the following sections:

.1 Mixed air/Filter section

.2 Supply Fan section

.4 Welded bar grating over the bottom return air opening.

.5 Identification:

.1 Unit with lamicoid label to show name tag number

.2 Each access door complete with lamicoid name tag.

.3 Roof Mounting

.1 Mount on manufacturer seismic roof curb, and integrated into custom field fabricated roof support curb (RTU-15A), or structural re-enforcement from below roof (RTU-15). Coordinate exact dimensions and placement with general contractor. See structural and mechanical drawings and details. Submit roof curb shop drawing.

.2 Provide neoprene gasket to ensure there is an airtight seal between the unit and curb.

.3 Provide attachment points for seismic connection from the unit, roof curb, and structure. Coordinate placement of all attachments to allow space for ducting. See mechanical drawings and details.

.4 Fans

.1 Centrifugal fans shall be rated in accordance with AMCA Standard Test Code Bulletin 210. Fan manufacturer shall be a member of AMCA.

.2 All fans and fan assemblies shall be dynamically balanced.

.3 Fan shafts shall be selected for stable operation at least 25% below the first critical RPM.

.4 Bearing support shall be from a rigid structural steel. This frame shall be internally isolated and seismically restrained from the fan cabinet structural frame.

.5 Entire fan assembly shall be seismically restrained using approved methods.

.6 Fans complete with belt guards.

.7 Fans shall be attached to the discharge panel by a flexible connection.

.8 Fixed drives shall be provided. Manufacturer to include for the cost of one sheave change during the air balance procedure.

.9 Drives shall be selected for at least one motor size larger than specified and including 2 belts minimum.

.10 Sheaves shall be keyed to drive shafts.

.11 Motor mounting shall be adjustable to allow for variations in belt tension.

.12 High efficiency motors. Minimum efficiency: 93%. Motors selected for operation with a variable frequency drive (ECM).

.13 Submit fan curve details, showing operating points at clean filter, dirty filter and mid-point loaded filter with the parameters specified.

.14 Fan Connectors - Vibration Isolation

.1 Provide flexible connections for vibration isolation at plenum connections to fan units.

.2 Minimum Requirements:

.1 Pre-assembled 75 mm minimum long flexible connection with 75 mm long 0.62 mm galvanized steel duct connectors on each side of the flexible connection.

.5 Gas Burners Section:

.1 Heat exchangers shall be of stainless steel or titanium stainless steel. Aluminum heat exchangers are not acceptable.

.2 Burners to be of blow-through, positive pressure type, with interrupted pilot ignition.

.3 Flame surveillance via solid state programmed flame relay c/w flame rod.

.4 Burner and gas train shall be housed in a cabinet enclosure.

.5 RTU-15A only:

.1 Gas burner and control for shall have a minimum 15:1 turndown range.

.2 Two-pass heat exchanger configuration

.6 Install burners so that they can be easily removed.

.7 Burners shall have a 10 year warranty.

.6 Control Dampers

.1 Opposed or parallel type blades. Extruded aluminum or formed galvanized steel blades, frames, gussets and blade stops.

.2 Shafts - galvanized or stainless steel with keyways for securing blades to shafts hardware - keyed to prevent blade slippage and to provide smooth blade movement.

.3 Assemblies - rigid and adequately braced with corner gussets.

.4 Bearings and seals - suitable for exposure to a minimum of -29°C on outside air and exhaust air dampers and a maximum of 93°C for interior dampers.

.5 Maximum blade width - 200 mm.

.6 Low leakage type with blade and frame seals for intake dampers.

.7 Check that dampers are installed square and true and that blades close tightly against seals and stops.

.8 Ensure that damper end-linkages are easily accessible.

.9 Provide an additional drive shaft bearing if the drive shaft is longer than 75 mm.

.7 Plenum Cleanliness

.1 Wash clean all plenums and interior surfaces before shipping.

.8 Filters - General

.1 Filter media shall be UL listed, Class I or Class II.

.2 Filters: suitable for air at 100% RH and air temperatures between 3°C and 50°C.

.3 Efficiency: MERV 8 minimum

.4 Representative filters shall have been tested by an independent test laboratory and test results shall be made available on request.

.5 Filter identification shall be clearly marked on each filter.

.6 Provide two (2) sets of filter media (for each filter) -one for installation at substantial completion and one for handover to the owner as a spare.

.7 Filter holding frames fabricated from 1.6 mm galvanized steel with spring retaining clips and neoprene gaskets.

.8 Filters - Panel Type

.1 Minimum Requirements:

.1 Enclosing frame shall be constructed from rigid, heavy duty high wet strength beverage board with diagonal support members bonded to both sides of each pleat.

.9 Outdoor Air Intake Cowl

.1 Outdoor air intake cowl shall be sized, located and configured to prevent rain/snow from entering the unit.

.2 Intake birdscreen.

.10 Gauges - Air Pressure

.1 Application:

.1 Across filter bank.

.2 Gauges to have electronic output to tie into the building DDC system.

.2 Minimum Requirements:

.1 Ranges:

.1 Panel filters: 0-250 Pa.

.2 Accessories:

.1 Copper or aluminum tubing.

.2 Static pressure pick-up tips.

.3 Mounting assembly.

.4 Plastic vent valves.

.11 Electrical:

.1 Outdoor rated NEMA panel, secured to the unit face.

.2 Include for main disconnect, fan starters, contactors, relays, transformers, etc.

.3 Manufacturer shall provide a system of motor control including all necessary terminal blocks, motor contactors, motor overload protection, grounding lugs, auxiliary contactors and terminals for the connection of external control devices or relays. The manufacturer shall individually fuse all fan and branch circuits.

.4 All control devices, including motor starters, will be capable of being interfaced with the building DDC system, which will have the ability to program remotely; start/stop functions and temperature reset functions.

.5 Unit to be completely pre-wired to the main unit electrical panel. The Division 16 electrical contractor will bring a single 575 volt/3 phase feed to the unit mounted disconnect switch and also a separate 120 volt/single power supply to the 120V lighting/power receptacle circuit.

.6 All electrical wiring external to the electrical/control panel to be run in EMT conduit. Wiring to be in accordance with CSA, ETL and UL requirements.

.7 Colour code and number tag all electrical wiring.

.8 Marine light in each access section, pre-wired to a single on/off switch on the exterior of the unit.

.9 One duplex 120 volt receptacle mounted inside the control section

.12 Spare Parts

.1 Provide the following spare parts:

.1 One set of filters (in addition to the filters used during the commissioning).

.2 One set of spare fan belts per unit.

2.3 CAPACITY

.1 As indicated on drawing equipment schedules.

2.4 CONTROLS

.1 The manufacturer's unit control panel shall be pre-wired with motor contactors and overloads, control transformer, high limit, burner airflow switch, terminal block and all necessary relays.

.2 The controls contractor shall provide all other necessary controls and damper actuators to achieve the sequence of operation as specified in Section 23 09 93 – Control Sequences.

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 as per manufacturers' instructions for mounting on concrete roof curbs and as indicated.

.2 Manufacturer to certify installation, supervise start-up and commission unit.

.3 Pipe drain in unit service to storm system.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its product[s], and submit written reports, in acceptable format, to verify compliance of work with Contract.

.2 Provide manufacturer's field services, consisting of product use recommendations and periodic site visits for inspection of product installation, in accordance with manufacturer's instructions.

.3 Schedule site visits to review work at stages listed:

.1 After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.

.2 Upon completion of work, after cleaning is carried out.

.2 Obtain reports within 3 days of review and submit immediately to Departmental Representative.

.3 Performance Verification:

.1 Rooftop Air Handling Units:

.1 Set outside air and return air dampers for minimum outside air.

.2 Check for smooth, vibration less correct rotation of supply fan impeller.

.3 Measure supply fan capacity.

.4 Adjust impeller speed as necessary and repeat measurement of fan capacity.

.5 Measure pressure drop of each component of air handling unit.

.6 Set outside air and return air dampers for the % of outside air required by design and repeat measurements of fan capacity.

.7 Reduce differences between fan capacity at minimum and maximum outside air less than 5%.

.8 OAD: verify for proper stroking, interlock with RAD.

.9 Measure DBT, WBT of SA, RA, EA.

.10 Measure flow rates (minimum and maximum) of SA, RA, EA, relief air.

.11 Use smoke test to verify no short-circuiting of EA, relief air to outside air intake.

.12 Simulate maximum heating load and:

.1 Verify temperature rise across heat exchanger.

.2 Perform flue gas analysis. Adjust for peak efficiency.

.3 Verify combustion air flow to heat exchanger.

.4 Simulate minimum heating load and repeat measurements.

.13 Verify operating control strategies, including:

.1 Heat exchanger operating and high limit.

.2 Early morning warm-up cycle.

.3 Freeze protection.

.4 Economizer cycle operation, temperature of change-over.

.5 Alarms.

.6 Voltage drop across thermostat wiring.

.7 Operation of remote panel including pilot lights, failure modes.

.14 Measure leakage past zone mixing dampers by taking temperature measurements. Reduce leakage to less than 5%.

.15 Check capacity of heating unit.

.16 Refer to other sections of these specifications for PV procedures for other components.

.2 Start-Up:

.1 General: in accordance with manufacturer recommendations.

.3 Verify accessibility, serviceability of components including motorized dampers, filters, coils, fans, motors, operators, humidifiers, sensors, electrical disconnects.

.4 Verify accessibility, clean ability, drainage of drain pans for coils, humidifiers.

.4 Commissioning Reports:

.1 In accordance with Section 23 08 00 – Mechanical Commissioning.

3.4 DEMONSTRATION

.1 Training: Submittals: In accordance with the requirements in Section 00 01 50 – General Instructions (CSC).

3.5 CLEANING

.1 On 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 Institute of Boiler and Radiator Manufacturers (IBR)

.2 US Department of Commerce

.1 CS 140-47, Commercial Standard.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals: in accordance with the Submittal Procedure requirements in Section 00 01 50 – General Instructions (CSC).

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for [finned tube radiation heaters] and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate on drawings:

.1 Equipment, capacity, piping, and connections.

.2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.

.3 Special enclosures.

1.3 CLOSEOUT SUBMITTALS

.1 Provide all applicable close-out submittals per paragraph 1.18 "Closeout Submittals" of section 00 01 50 – General Instructions (CSC).

.2 Operation and Maintenance Data: submit operation and maintenance data for finned tube radiation heaters for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

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

.2 Store and protect finned tube radiation heaters from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 CAPACITY

.1 As indicated, based on 93°C average water temperature, 11°C temperature drop and 20°C at entering air temperature.

2.2 FINNED TUBE RADIATION

.1 Heating elements: NPS 1 1/4 steel tube 3.1 mm minimum wall thickness, mechanically expanded into flanged collars of evenly spaced steel fins 100 x 100 mm nominal fins, 105 fins per metre.

.2 Element hangers: Ball bearings or plastic lined cradle type providing unrestricted longitudinal movement on enclosure brackets. Space brackets 900 mm centres maximum.

.3 Standard enclosures: 1.6 mm thick steel complete with components for wall-to-wall or complete with die formed end caps having no knock-outs. Joints and filler pieces flush with cabinet. Support rigidly top and bottom, on wall mounted brackets. Joints and filler pieces clear of grilles located to provide easy access to valves and vents. Provide access doors for valves. Finish cabinet with factory applied baked primer coat.

.4 Dimensions for enclosures: measure site conditions. Do not scale from drawing.

.5 Provide for noiseless expansion of components.

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 finned tube radiation convector heater installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

.1 Install in accordance with manufacturer's instructions.

.2 Install in accordance with piping layout and reviewed shop drawings.

.3 Provide for pipe movement during normal operation.

.4 Maintain sufficient clearance to permit performance of service maintenance.

.5 Check final location with Departmental Representative if different from that indicated prior to installation. Should deviations beyond allowable clearances arise, request and follow Departmental Representative's directive.

.6 Valves:

.1 Install valves with stems upright or horizontal unless approved otherwise.

.2 Install isolating gate valves on inlet and lockshield globe balancing valves on outlet of each unit.

.7 Venting:

.1 Install standard air vent with cock on continuous finned tube radiation.

.8 Clean finned tubes and comb straight.

3.3 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

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

.3 Waste Management: separate waste materials for reuse or recycling.

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

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 Division 01.

.2 Reference to "Electrical Divisions" shall mean all sections of Divisions 26 & 28 in the Master Format or the Canadian Master Specifications.

.3 The word "Provide" shall mean "Supply and Install" the products and services specified. "As Indicated" means that the item(s) specified are shown on the drawings.

.4 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, ensure coordination, and establish orderly completion and the delivery of a fully commissioned installation.

.5 The most stringent requirements of this and other electrical sections shall govern.

.6 All work shall be in accordance with the Drawings and Specifications and their intent complete with all necessary components, including those not normally shown or specified, but required for a complete installation.

.7 Provide seismic restraints for all required equipment and wiring systems.

.8 Connect to equipment specified in other Sections and to equipment supplied and installed by other Contractors or by the Owner. 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 (current adopted edition) - except where specified otherwise.

.2 Refer to CSA C22.1 Appendix A "Safety Standards for Electrical Equipment" for applicable codes and the related revisions

.3 Refer to CSA C22.1 Pages xxix - xxxii for related 'Reference Publications'

.4 Refer to NBCC Table 1.3.1.2 for applicable codes and the related revisions.

.5 Comply with Local Electrical Bulletins and by-laws relating to the Authority having Jurisdiction.

.6 Install overhead and underground systems in accordance with CSA C22.3 No.1 (current adopted edition) - except where specified otherwise.

.7 Preferred Voltage Levels for AC Systems, 0-50,000V in accordance with CAN3-C235 (current adopted edition)

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- current edition

.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 SUBMITTALS

.1 Submittals to be in accordance with Section 00 01 50 General Instructions (CSC).

.2 Product Data: submit WHMIS MSDS in accordance with Division 01 - Sustainable Requirements and Division 02- Hazardous Materials

.3 Shop Drawings:

.1 Submit shop drawings, product data and samples in accordance with Division 01. The submission shall be reviewed, signed and processed as described in Division 01.

.2 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.

.3 Where applicable, include wiring, line and schematic diagrams. Include wiring drawings or diagrams showing interconnection with work of other Sections.

.4 Content

.1 Shop drawings submitted title sheet.

.2 Data shall be specific and technical.

.3 Identify each piece of equipment.

.4 Information shall include all scheduled data.

.5 Advertising literature will be rejected.

.6 The project and equipment designations shall be identified on each document.

.7 Information shall be given in metric units.

.8 The shop drawings/product data shall include:

.1 Dimensioned construction drawings with plans and sections showing size, arrangement and necessary clearances, with all equipment weights 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.

.4 Format

.1 PDF submitted via e-mail.

.2 Bill of Quantities for related components, identified by model number, listed on the front cover with item identification numbers.

.5 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.

.6 Keep one (1) copy of shop drawings and product data, on site, available for reference.

.7 Quality Control: in accordance with Division 01 - Quality Control

.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 "load balance" report.

.8 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.

1.6 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Division 01 - Quality Control

.2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction as per the conditions of Provincial and/or Territorial Act respecting manpower vocational training and qualification.

.1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.

.2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

.3 Site Meetings: in accordance with Division 01 - Construction Progress Schedule

.1 Site Meetings: as part of Manufacturer's Field Services: schedule site visits, to review Work, at stages listed below:

.1 At time of initial shop drawing submission to confirm any existing conditions and to coordinate with the project schedule and any cross discipline requirements.

.2 After delivery and storage of products, and when preparatory Work is complete but before installation begins.

.3 During progress of Work at key schedule points as determined.

.4 At commissioning.

.5 Upon completion of Work, after cleaning is carried out.

.4 Health and Safety Requirements: do construction occupational health and safety in accordance with Division 01 - Health and Safety Requirements.

1.7 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 Division 01 Construction/Demolition Waste Management and Disposal.

1.8 SYSTEM START-UP

.1 Refer to Division 01, and as follows.

.2 Instruct Departmental Representative and operating personnel in the operation, care and maintenance of equipment.

.3 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components, where required in these specifications.

.4 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

1.9 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.

1.10 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Division 01 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

.3 Place materials defined as hazardous or toxic waste in designated containers.

1.11 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 Architectural and Structural drawings.

.2 Consult the project drawings and details for exact locations of fixtures 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.

.4 Where imperial units have been indicated in brackets [ ] following the requirements in SI units, the conversion is approximate and provided for convenience. The SI units shall govern.

1.12 PROJECT COORDINATION

.1 Check drawings of all trades to verify space and headroom 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 to the Owner, 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 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.

1.13 SPRINKLER PROOF REQUIREMENTS

.1 All equipment and wiring systems shall be sprinklerproof standard where sprinkler fire protection systems are installed.

.2 In 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. Top entry to be avoided where possible

.3 In particular all unit substations, transformers, switchgear, motor control and panelboard shop drawings shall be certified 'sprinkler proof' design.

1.14 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.

1.15 REUSED EQUIPMENT

.1 Where existing equipment is being relocated and re-used, check and report on the condition to the Departmental Representative before reinstallation. Protect and carefully store equipment designated for reuse.

1.16 SEQUENCE OF WORK

.1 Before interrupting major services notify the Departmental Representative well in advance and arrange an acceptable schedule for the interruptions.

.2 Before interrupting any services complete all preparatory work as far as reasonably possible and have all necessary materials on site and prefabricated (where practical) and work continuously to keep the length of interruption to a minimum.

.3 Include for the cost of all work that may be required out of regular hours to minimize the period of service interruption when modifying the existing systems.

1.17 BUILDING OPERATION DURING CONSTRUCTION

.1 In order to minimize operational difficulties for the existing building staff, the various trades must cooperate with the owner throughout the entire construction period and particularly ensure that noise is minimized.

.2 Convenient access for the staff and public to the building must be maintained at all times. Minor inconvenience and interruption of services will be tolerated, provided advance notice is given, but the Contractor will be expected to coordinate his work, in consultation with the owner, so the operation of the facility can be maintained as nearly normal as possible.

1.18 EXISTING SERVICES

.1 Protect all existing services encountered. Every effort has been made to show the known existing services. However, the removal of concealing surfaces may reveal other existing services. Work with the Departmental Representative staff to trace the originating source and points served. Obtain instructions from the Departmental Representative when existing services require relocation or modifications, other than those already indicated in the Contract Documents.

.2 Arrange work to avoid shutdowns of existing services. Where shutdowns are unavoidable, obtain the Departmental Representative approval of the timing, and work to minimize any interruptions.

.3 Shutdowns, to permit connections, to be coordinated with the maintenance staff.

.4 In order to maintain existing services in operation, temporary relocations and wiring may be required.

.5 Be responsible for any damages to existing systems by this work.

.6 The interruption of utility services to permit tie-ins shall be arranged through the Departmental Representative. Application must be received in writing at least seven (7) calendar days prior to the date required for the shutdown. Service shutdowns shall only be carried out by Physical Plant and will normally be scheduled to occur during evenings or weekends. The Owner reserves the right to withhold permission for a reasonable period with respect to any shutdown, if the shutting-off of a service interferes with essential building operations.

1.19 SALVAGE

.1 All conduit, wiring and equipment which becomes redundant and is no longer required due to the work in this Contract shall be completely removed.

.2 All existing items which need to be removed, and which have a reasonable salvage value, shall be carefully removed and handed over to the Departmental Representative. Handing over to the Departmental Representative includes moving to Departmental Representative's designated storage place on site. These items shall not become the property of the Contractor. Obtain a written receipt from the Departmental Representative detailing each of the items handed over.

.3 Remove all redundant material not required by the Departmental Representative from the site.

1.20 WARRANTY

.1 Use of installed equipment during construction shall not shorten or alter the warranty period as specified in the Division 01.

.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 (1) 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.

1.21 TENDER INQUIRIES

.1 All contractor queries during the tender period shall be made in writing to the Departmental Representative. Contractor queries will be collected and suitable addenda will be issued for clarification. No verbal information will be considered valid or issued by the Departmental Representative's office during tender. All tender queries may be faxed, mailed or couriered to the Departmental Representative's office. No telephone questions will be answered.

1.22 EXAMINATION

.1 Examine the documents for details of work included. Obtain a written clarification in the event of conflict within the specification, between the specification and the drawing, or in the drawing. 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.

1.23 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 Where the Contract Documents do not contain sufficient information for the proper selection of equipment for bidding, notify the Departmental Representative during the tendering period. If clarification is not obtainable, allow for the most expensive arrangement. Failure to do this shall not relieve the Contractor of responsibility to provide the intended equipment.

.3 Protect equipment and material from the weather, moisture, dust and physical damage.

.4 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.

.5 Protect all existing services encountered. Obtain instructions from the Departmental Representative when existing services require relocation or modification.

.6 Refinish damaged or marred factory finish to factory finish.

.7 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.

1.24 PROGRESS CLAIM AND CHANGEORDER BREAKDOWNS

.1 Submit price breakdowns ten (10) days after the award of contract,

.2 In particular cases more detail may be necessary to properly assess a change order or progress claims. This additional information could include all suppliers and all sub-contractors when requested by the Departmental Representative. Provide details for each section of the electrical work listed for each separate electrical change order item exceeding $10,000.00.

.3 Mark-up information is required for change orders but is optional on the original tender price.

.4 Progress claims will not be certified nor payment made beyond 90% 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.

1.25 PROJECT CLOSE-OUT REQUIREMENTS

.1 Refer to detailed specifications in each section for detailed requirements. Record drawings to be submitted to Departmental Representative and all life safety systems must be operational, verified and tested, and demonstrated to Departmental Representative prior to issuance of Schedule C.

1.26 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. 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 owner have been completed.

.3 Departmental Representative's Letters of Assurance will not be issued until the following requirements have been met:

.1 All items listed in .1 above have been completed or addressed.

.2 Certificate of Penetrations through separations.

.3 Provincial or City Electrical Inspection - Certificate of inspection.

.4 Seismic Engineer's letter of Assurance and final inspection report (As required).

.5 Certificate of Substantial Performance.

.6 Signed off copy of Departmental Representative's final inspection report.

.7 Fire alarm verification.

1.27 DEFICIENCY HOLDBACKS AND DEFICIENCY INSPECTIONS

.1 Work under this Division which is still outstanding when substantial performance is certified will be considered deficient and a sum equal to at least twice the estimated cost of completing that work will be held back.

.2 It is expected that outstanding work will be completed in an expeditious manner and the entire holdback sum will be retained until the requirements for Total Performance of Division 26 and 28 (electrical) work have been met and verified.

Part 2 Products

2.1 MATERIALS AND EQUIPMENT

.1 Provide materials and equipment in accordance with Division 01 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.

.4 Factory assemble control panels and component assemblies.

2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

.1 Provide all power and control wiring, conduit, wire, fittings, disconnect switches, motor starters, 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.

2.3 WIRING TERMINATIONS

.1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

2.4 EQUIPMENT IDENTIFICATION

.1 Identify all electrical equipment including but not limited to starters, disconnects, remote ballasts and controls with nameplates and labels as follows:

.2 Nameplates:

.1 Lamicoid 3 mm [0.125"] thick plastic engraving sheet, white face, black core, self-adhesive unless specified otherwise. Provide white face, red core for all essential distribution equipment.

.2 Nameplate Sizes:

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

.3 Typical Labelling:

.1 Panelboard & CDP – 5 lines

.1 Line 1 – Panel/CDP designation – Size 4 lettering

.2 Line 2 – eg 225A, 120/208V, 3 phase 4W – Size 2 lettering

.3 Line 3 – Feeder: eg 4#3 – 35mm C – Size 2 lettering

.4 Line 4 – Origin eg: Main Elect. Room – Size 2 lettering

.2 Distribution Circuit Breakers – 4 lines

.1 Line 1 – Main Circuit Breaker – Size 4 lettering

.2 Line 2 – Feeder: eg 4#3 – Size 2 lettering

.3 Line 3 – Origin: eg K1 Sub-station – Size 2 lettering

.3 Label colours unless otherwise indicated:

.1 120/208V labels: white letters on black base.

.2 347/600V labels: Black letters on white base.

.4 Wording on nameplates to be approved prior to manufacture.

.5 Allow for average of twenty-five (25) letters per nameplate.

.6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.7 Terminal cabinets and pull boxes: indicate system and voltage.

.8 Transformers: indicate capacity, primary and secondary voltages.

.3 Labels:

.1 Identify each outlet, starter, disconnect and all items of fixed equipment with the appropriate panel and circuit number origin by means of a small but good quality vinyl, self-laminating label such 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. Confirm location of labels with Departmental Representative before installing. Circuit numbers to agree with Record Drawings.

.4 Provide plastic covered panel directory with circuits and areas served typed in, and mounted on inside of door. Directory to conform to Record Drawings.

2.5 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour code: to CSA C22.1.

.4 Use colour coded wires in communication cables, matched throughout system.

2.6 CONDUIT, CABLE AND PULLBOX IDENTIFICATION

.1 Colour code conduits, metallic sheathed cables, pullboxes and junction boxes.

.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:

SYSTEM	MAJOR BAND	MINOR BAND	CHARACTERS
347/600V Normal	Dark Blue		
120/208V Normal	Light Blue		
Ground	Dark Green		GR
Fire Alarm	Red		FA
Emg Voice Paging	Red	Dark Green	EP
Computer/Data	Light Green		COM
Telephone	Light Green	Black	TEL
General Intercom	Light Green	Yellow	IC
Low Level Paging	Light Green	White	PA

SYSTEM	MAJOR BAND	MINOR BAND	CHARACTERS
Building Alarm	Purple	White	BA
BAS (Digital)	White	Green	BCD
BAS (110V)	White	Black	BCH
BAS (LV)	White	Blue	BCL
PLC (Digital)	White	Brown	PLC
Low Voltage Control	White	Yellow	LVC

2.7 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.

.4 Paint outdoor electrical equipment "equipment green" finish.

.5 Paint indoor switchgear and distribution enclosures light gray unless otherwise indicated in particular specification sections for specialised or emergency power equipment.

2.8 ANCHOR BOLTS AND TEMPLATES

.1 Supply anchor bolts and templates for installation by other Divisions.

2.9 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] [refer to structural drawings].

.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, or equivalent.

.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, or equivalent 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, or equivalent stud anchor for concrete. (Do not use in seismic restraint applications).

.3 Hilti HDI or UCAN IPA, or equivalent drop-in anchor for concrete.

.4 Hilti or UCAN Sleeve Anchor, or equivalent. (medium and light duty) for concrete and masonry.

.5 Hilti ZBP or UCAN Zamac, or equivalent pin bolt (light duty) for concrete and masonry.

.3 Drilled, adhesive type:

.1 Hilti HVA or UCAN, or equivalent Adhesive Anchor consisting of anchor rod assembly with a capsule containing a two-component adhesive, resin and hardener.

.2 Hilti HY150 or equivalent 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; or equivalent.

2.10 EQUIPMENT SUPPORTS

.1 Provide stands and supports for equipment and materials supplied.

.2 Lay out concrete bases and curbs required under Electrical Divisions. Coordinate with Concrete Divisions.

.3 Concrete bases shall be a minimum of 100 mm [4"] thick, or as noted and shall project at least 150 mm [6"] outside the equipment base, unless otherwise directed. Bases and curbs shall be keyed to the floor and incorporate reinforcing bars and/or steel mesh. Chamfer edges of bases at 45 degrees.

.4 Equipment with bedplates shall have metal wedges placed under the edges of the bedplates to raise them 25mm [1"] above the base after levelling. The wedges shall be left permanently in place. Fill the space between the bedplate and the base with non-shrink grout - Embeco or In-Pakt; or equivalent.

.5 Construct equipment supports of structural steel. Securely brace. Employ only welded construction. Bolt mounting plates to the structure.

.6 Support ceiling hung equipment with rod hangers and/or structural steel.

2.11 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.

2.12 MAINTENANCE MATERIALS AND CABINET

.1 Provide maintenance materials in accordance with Division 01 and specified in appropriate Sections.

2.13 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for incorporation into maintenance manual specified in Division 01 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 troubleshooting instructions.

.4 Local source of supply for each item of equipment.

.5 Wiring and control diagrams.

.4 The manual information shall be bound in a three "D-ring" hard back reinforced vinyl covered ("bar lock" post type where more than 50mm [2"] rings required) binder c/w index tab separators to divide the different sections. The binder cover shall be black with white lettering. Printing of the binder cover shall be completed before the binder is manufactured and the wording shall be approved by the Departmental Representative before printing.

.5 Submit a draft copy to the Departmental Representative for review thirty (30) days prior to start up of the systems and equipment.

.6 Submit three (3) copies in the final approved form.

2.14 PROJECT RECORD DRAWINGS

.1 Provide project record documents as specified in Division 01 as further called for in this Division.

.2 During the construction period, keep on Site a clean set of drawings marked up to reflect the "As-Built" state, for examination by the Departmental Representative on a regular basis. Include elevations and detailed locations of buried services, empty conduit systems and junction and pull boxes.

.3 At the time of "substantial performance" CAD files will be provided by the Departmental Representative. The Electrical Division shall include all associated costs to obtain and complete the CAD Record Drawings including retaining the services of an approved CAD draftsperson to transfer all changes to amend the CAD files in the latest version of AutoCAD. Include all revisions and change orders.

.4 Submit the "Record Drawing" CAD files and one set of plots to the Departmental Representative prior to Total Performance of the contract.

.5 Note: The Contractor will be required to sign a standard Stantec / Contractor agreement entitled "Authorization to Use CAD drawing files". The agreement restricts the use of the CAD files to the purpose of "as-built" only and determines the editing procedures.

Part 3 Execution

3.1 INSTALLATION

.1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

3.2 NAMEPLATES AND LABELS

.1 Ensure manufacturers nameplates and CSA labels to be 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"].

.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 to be installed concealed in finished areas.

3.4 COORDINATION OF PROTECTIVE DEVICES

.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to the required values and settings to provide a fully coordinated system.

3.5 FIELD QUALITY CONTROL

.1 Load and Balance:

.1 Measure voltage and phase & neutral currents to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.2 Conduct and pay for the following tests:

.1 Circuits originating from branch distribution panels.

.2 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

.3 Systems: fire alarm system for all affected devices.

.4 Main ground resistance (at all grounding locations).

.5 Insulation resistance testing:

.1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.

.2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.

.3 Check resistance to ground before energizing.

.3 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.4 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.

.2 Furnish manufacturer's certificate or letter conforming that entire installation as it pertains to each system has been installed to manufacturer's instructions.

.3 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.

.4 Schedule site visits to review Work.

.5 Reports:

.1 Provide written reports in a timely manner upon completion of the testing and load balance. Indicate test hour and date.

3.6 CLEANING

.1 Do final cleaning in accordance with Division 01.

.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 Division 09.

3.7 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.

3.8 PROTECTION OF WORK

.1 Protect equipment and materials, stored or in place, from the weather, moisture, dust and physical damage.

.2 Mask machined surfaces. Secure covers over equipment openings and open ends of equipment and conduit, as the installation work progresses.

.3 Equipment having operating parts, bearings or machined surfaces, showing signs of rusting, pitting or physical damage will be rejected.

.4 Refinish damaged or marred factory finish.

3.9 PROTECTION OF 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.

3.10 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.

3.11 SERVICE PENETRATIONS IN RATED FIRE SEPARATIONS

.1 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.

.2 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.

.3 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.

.4 Contractors are expected to submit system information detailing firestopping product, backing, penetrant, penetrated assembly, Fire (F) and Temperature (T) rating, and ULC or cUL system number.

.5 Provide fire stopping material and system information in the maintenance manuals and via labels at major penetrations that are likely to be repenetrated.

.6 Allow openings for 100% capacity of raceway or 200% capacity of J-hooks.

.7 Provide split systems where existing cables are involved.

.8 Provide Firestopping approval certificate in including a Building Code / By-Law Schedule B-1, B-2 & C-B signed by a BC registered Professional Engineer. Submit a letter certifying that all work is complete and in accordance with this specification.

.9 Allow for 5% destructive testing of installed firestopping assemblies under this contract.

3.12 SERVICE PENETRATIONS IN NON-RATED SEPARATIONS

.1 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.

3.13 CONDUIT SLEEVES

.1 Provide conduit sleeves for all conduit and wiring passing through rated walls and floors. Sleeves to be concentric with conduit or wiring.

.2 Except as otherwise noted conduit sleeves are not required for holes formed or cored in interior concrete walls or floors.

.3 Conduit sleeves shall extend 50 mm [2"] above floors in unfinished areas and wet areas and 6 mm [1/4"] above floors in finished areas.

.4 Conduit sleeves shall extend 25 mm [1"] on each side of walls in unfinished areas and 6 mm [1/4"] in finished areas.

.5 Conduit sleeves shall extend 25mm [1"] beyond exterior face of building. Caulk with flexible caulking compound.

.6 Sleeve Size: 12 mm [1/2"] clearance all around, between sleeve and conduit or wiring.

.7 Paint exterior surfaces of ferrous sleeves with heavy application of rust inhibiting primer.

.8 Packing of Sleeves:

.1 Where sleeves pass through foundation walls and perimeter walls the space between sleeve and conduit shall be caulked with waterproof fire retardant non-hardening mastic.

.2 Pack future-use sleeves with mineral wool insulation and then seal with ULC approved fire stop sealant for rated fire separations.

3.14 ACCESSIBILITY AND ACCESS PANELS

.1 Install all equipment, controls and junction boxes so as to be readily accessible for future modification, adjustment, operation and maintenance as appropriate.

.2 Provide access panels where required in building surfaces. Do not locate access panels in panelled or special finish walls, without prior approval of the Departmental Representative.

.3 Access panels in U.L.C. fire separations and fire walls shall have a compatible fire rating and U.L.C. label. Acquire approval in writing from the local fire authority if required.

.4 Access panels shall be painted with a primer coat if applicable and then with a

finish coat, colour and type to the Departmental Representative's approval.

.5 Locate equipment and junction boxes in service areas wherever possible.

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 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 all cutting, patching, digging, canning and coring required to accommodate the electrical services.

.3 Be responsible for correct location and sizing of all openings required under Electrical Divisions, including piped sleeves.

.4 Verify the location of existing and planned service runs and structural components within concrete floor and walls prior to core drilling and/or cutting. Repairs to existing services and structural components damaged as a result of core drilling and cutting is included in this section of the work.

.5 Openings through structural members of the building shall not be made without the approval of the Structural Engineer.

.6 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 Refer to structural drawings for locations of steel reinforcing.

.5 Be responsible for repairing any damage to steel reinforcing.

.7 Openings in building surfaces other than concrete:

.1 Lay out all openings required.

.8 Poured concrete for duct encasements shall be provided by other Divisions,

coordinated and supervised by the Electrical Divisions.

.9 Excavation and backfilling will be provided by other Divisions. This Division to superintend the work and provide all layouts and parameters.

3.17 PAINTING

.1 Clean exposed bare metal surfaces supplied under the Electrical Divisions removing all dirt, dust, grease and millscale. 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.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Section 00 01 50 General Instructions (CSC).

.2 Do verification requirements in accordance with Division 01 Sustainable Requirements: Contractor's Verification.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Division 01 – Construction / Demolition Waste Management And Disposal and with the Waste Reduction Workplan.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

.3 Place materials defined as hazardous or toxic waste in designated containers.

1.4 PCB (POLYCHLORINATED BIPHENYLS)

.1 Carefully remove any electrical items containing PCB's (eg light fixture ballasts) from equipment or fixtures to be renovated or demolished. Removed items (containing PCB's) to be catalogued and stored on site in approved labelled storage containers in accordance with regulations.

1.5 SCOPE

.1 The Electrical Division to take note that the demolition and renovation will be done in an occupied building that is normally occupied during the day. Maintain electrical and communication systems as required to minimize services disruption.

.2 The Electrical Division to also take note of the dust containment requirements as outlined in the architectural and front end specification.

.3 Electrical tender documents do not show all existing luminaires, wiring devices, conduit, boxes or wire. Conduit routing and wire grouping is not known. During demolition, the Electrical trade(s) are to deactivate all existing electrical and communication systems affected in such a manner that complete systems are not deactivated and system circuits affected in party wall partitions to be reactivated immediately on a temporary or permanent basis as site conditions dictate.

.4 Any discrepancies appearing on the drawings or in this specification are to be brought to the attention of the Departmental Representative who will provide instruction.

.5 Where devices are not shown on the new plans in walls that are not being removed, such devices are to be reinstated and remain.

Part 2 Products

2.1 STANDARDS

.1 Refer to applicable material standards in other specification sections and/or as detailed on drawings.

Part 3 EXECUTION

3.1 DEMOLITION

.1 Demolition to be carried out in strict conformance to provincial, local and municipal authorities and Part 8 of the B.C. Building Code current edition.

.2 All redundant electrical components in the areas of demolition excluding those specifically identified in the following clauses shall become the property of the Electrical Division and shall be removed from site.

3.2 DISRUPTION TO OPERATIONS

.1 Contractor to issue a scheduled shutdown time and coordinate installation of the new equipment as appropriate. All equipment installed and modified requires testing before start-up.

.2 Contractor to provide temporary connections to all required equipment for temporary power during the installation of any new equipment.

3.3 REUSE OF EXISTING COMPONENTS

.1 Existing components may be reused only where so specifically indicated on the drawings or in the specifications, however in all cases all wiring shall be new and no splicing shall be permitted at any location.

3.4 DISTRIBUTION OF CIRCUITS

.1 Circuit: power, voice/data, fire alarm, control etc. which are disrupted during demolition and are essential, to be made good immediately. The Electrical Trade(s) to identify these circuits to the Departmental Representative. Specific tasks involving the demolition of essential circuits will require that the contractor to obtain permission from the Owner before proceeding.

3.5 ABANDONED CONDUIT, WIRE AND EXISTING CIRCUITS

.1 All abandoned conduit and wire to be removed and disposed of by the Electrical Divisions.

.2 Remove all accessible (eg. Surface) wiring and cables back to source.

.3 Remove abandoned outlets and raceway, even if in or behind drywall, where they are located behind millwork or in locations unsuitable for reuse i.e. not at standard heights for switches or outlets.

.4 All remaining circuits to be rerouted as required and suitably secured to the building structure.

.5 Any cabling, including voice/data wiring, presently resting on any suspended ceiling system to be removed as part of the renovation process and shall be neatly bundled, protected and permanently secured to building structure. No cabling is permitted to rest on the ceiling system.

3.6 EXCAVATION AND CUTTING DAMAGE

.1 Circuits disrupted by floor cutting or drilling (ie. buried cables) to be brought to the attention of the Departmental Representative. Obvious systems disturbed because due care and attention was not followed, shall be repaired immediately at no additional cost to owner.

3.7 FIRE ALARM SYSTEM

.1 Construction/demolition activities in existing building may require that certain fire alarm devices are protected from construction dust, damage etc. Coordinate with the Departmental Representative as required to protect components of the fire alarm system to prevent nuisance operation and alarms.

.2 Provide, install and test temporary heat detectors in the area of construction where the construction area is not protected by an active supervised fire protection sprinkler system. The "construction" detectors to be removed and discarded at the end of the project.

.3 Provide temporary replacement of smoke detectors with heat detectors including interim programming and testing and final re-verification to minimize false alarms and to ensure other occupants of the building are protected.

.4 Maintain existing fire alarm system in areas under construction where practical. Relocate, rewire and provide interim connections as required while installing the new system to replace the existing. Provide temporary fire alarm devices and audible signals to suit any temporary Existing provisions.

.5 Contractor to check in with the Departmental Representative at the start and end of each working day to confirm the fire alarm status in the area of work. Arrange for the related fire alarm zone card or area to be deactivated either to suit the progress of the work and/or where dust will be present on a day to day basis. Bag and protect fire detectors in dusty areas during construction. Remove any bagging at the end of the work day. Any existing detectors subject to

construction dust to be immediately vacuumed and marked to be replaced at the end of the project. Any fire alarm devices subject to moisture to be replaced immediately.

.6 The fire alarm system is to be fully functional in the area of construction when the contractor is neither on site nor after the contractors normal work hours. (ie overnight, holidays, weekends)

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 - Common Work Results for Electrical.

.2 Section 26 05 32 - Conduit, Tray, Wireway, Boxes, and Fittings

.3 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

.4 Refer to division 28 for particular communications, electronic safety & security wiring systems and types.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA C22.2 No. 131, Type Teck 90 Cable

.2 CAN/CSA C22.2 No.65, Wire Connectors

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

.1 EEMAC 1Y-2, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

Part 2 Products

2.1 PRODUCT DATA

.1 Submit product data in accordance with Section 00 01 50 General Instructions.

2.2 BUILDING WIRES

.1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.

.2 Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE, Jacketed.

.3 Underground installations: RWU90XLPE, size as indicated.

2.3 TECK 90 CABLE

.1 Teck 90 cable only permitted to connect to equipment susceptible to vibrations.

.2 Cable:

.1 To CAN/CSA-C22.2 No.131 Type Teck 90 Cable.

.2 In accordance with Section 26 05 00 - Common Work Results for Electrical.

.3 Conductors:

.1 Grounding conductor: copper.

.2 Circuit conductors: copper, size as indicated.

.4 Insulation:

.1 Cross-linked polyethylene XLPE.

.2 Rating: 1000 V.

.5 Inner jacket: polyvinyl chloride material.

.6 Armour: interlocking.

.7 Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project.

.8 Fastenings:

.1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.

.2 Channel type supports for two or more cables at 1000 mm centers.

.3 Threaded rods: 6 mm diameter to support suspended channels.

.9 Connectors:

.1 Watertight approved for TECK cable.

.10 Flame-spread rating: FT4

2.4 ARMOURED CABLES

.1 Flexible armoured cabling (BX) shall not be used for the general wiring system other than final drops to recessed light fixtures in concealed locations, where approved by Departmental Representative.

.2 Conductors: insulated, copper, size as indicated.

.3 Type: AC90.

.4 Armour: interlocking type fabricated from aluminum strip.

.5 Type: ACWU90 PVC flame retardant jacket over thermoplastic armour and compliant to applicable Building Code classification for this project in wet locations.

.6 Connectors: anti short connectors.

2.5 CONTROL CABLES

.1 Type: LVT: soft annealed copper conductors, with thermoplastic insulation, outer covering of thermoplastic jacket. Minimum size #18 AWG.

.2 Unless otherwise specified wiring to be multicore individually identified and colour coded with grey sheath enclosed in conduit or (EMT).

Part 3 Execution

3.1 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Perform tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

.1 Cables only permitted for applications as noted above.

.2 Cables to be run parallel to other cables and conduit, supported by uni-strut at intervals as stated above.

.3 Terminate cables according to code.

.4 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.

.5 Conductor length for parallel feeders to be identical.

.6 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.

.7 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.

.8 All grounding conductors and straps to be copper. All bonding conductors to have green insulation jacket.

.9 Colour coding to be strictly in accordance with Section 26 05 00.

.10 Provide sleeves where cables enter or exit cast concrete or masonry.

.11 Power wiring up to and including No.6 gauge shall be spliced with nylon-insulated expandable spring-type connectors. Large conductors shall be spliced using split-bolt or other compression type connectors wrapped with cambric tape then PVC tape.

.12 Wires shall be sized for 2% maximum voltage drop to farthest outlet on a loaded circuit. Increase home run cable size to meet these requirements.

3.3 INSTALLATION OF BUILDING WIRES

.1 Install wiring as follows:

.1 In conduit systems in accordance with Section 26 05 32 - Conduit, Tray, Wireway, Boxes, and Fittings.

.2 In wireways and auxiliary gutters in accordance with Section 26 05 32 - Conduit, Tray, Wireway, Boxes, and Fittings.

3.4 INSTALLATION OF TECK90 CABLE (0 -1000 V)

.1 Group cables wherever possible on channels.

.2 Install cable securely supported by straps and/or hangers.

3.5 INSTALLATION OF ARMOURED CABLES

.1 Group cables wherever possible on channels.

.2 Install cable securely supported by straps and/or hangers.

3.6 INSTALLATION OF CONTROL CABLES

.1 Install control cables in conduit.

.2 Ground control cable shield.

3.7 VOLTAGE REGULATION

.1 The drawings are diagrammatic and indicate the general routing of conduit runs and not exact routing, either horizontally or vertically.

.2 Branch circuit conductor sizes shall be #12 AWG or larger based on the Canadian Electrical Code CSA 22.1 Section 8, which allows a maximum 3% voltage drop for branch circuits.

3.8 WIRE & BOX CONNECTORS

.1 Remove insulation carefully from ends of conductors and:

.1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65

.2 Install fixture type connectors and tighten. Replace insulating cap.

.3 Install bushing stud connectors in accordance with EEMAC 1Y-2

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Division 01 – Construction / Demolition Waste Management and Disposal and with the Waste Reduction Workplan.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

.3 Place materials defined as hazardous or toxic waste in designated containers.

1.3 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)

.2 Transformer grounding shall comply with CSA C22.2 No.41.

.3 All grounding conductors to be stranded soft annealed copper unless otherwise noted.

.4 Install complete grounding and bonding system in accordance with Canadian Electrical Code and local inspection authority requirements.

1.4 TESTING REQUIREMENTS

.1 Perform ground continuity and resistance tests using method appropriate to site conditions.

.2 Any third party testing agency costs for the testing and reporting shall be included in the Electrical Division base tender and shall be carried out by a pre-approved testing agency.

1.5 ADDITIONAL SCOPE

.1 Refer to drawings for extent of grounding in addition to code requirements.

.2 Provide grounding for all dust collector ductwork.

Part 2 Products

2.1 MATERIALS

.1 Grounding equipment to: CSA C22.2 No.41.

2.2 EQUIPMENT

.1 Clamps for grounding of conductor, size as required.

.2 System and circuit, equipment, grounding conductors, bare stranded copper, soft annealed, sized as indicated. Insulation where specified or required to be green.

2.3 INSTALLATION GENERAL

.1 Expand existing complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories to suit new equipment.

.2 Provide ground wire in EMT conduits installed in grade or below slabs.

.3 Install connectors in accordance with manufacturer's instructions.

.4 Protect exposed grounding conductors from mechanical injury.

.5 Use mechanical connectors for grounding connections to equipment provided with lugs.

.6 Soldered joints not permitted.

.7 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.

.8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

.9 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

.10 Bond single conductor, metallic armoured cables to cabinet at supply end and provide non-metallic entry plate at load end.

.11 Provide a bonding conductor appropriately sized within each raceway routed within the building.

.12 All bonding and grounding connections to be compression type unless noted otherwise.

.13 Expand existing system as required to provide complete grounding and bonding system as indicated and as required by Canadian Electrical Code and the local electrical inspection authorities.

.14 All components shall be securely and adequately bonded and where required to accomplish this, bonding jumpers, grounding studs and bushings shall be used.

.15 Ensure that all raceways, terminal panels, etc. for fire alarm, etc. are securely and adequately bonded and provide grounding conductor to main ground bus where called for or when required.

.16 All interior metallic gas piping which may become energized to be made electrically continuous and to be bonded in accordance with requirements of Canadian Electrical Code.

.17 Bond all low tension equipment with #6 AWG bonding conductor.

.18 All metallic conduits longer than 1m in length, containing a single grounding or bonding conductor, shall be bonded as per the Canadian Electrical Code.

2.4 EQUIPMENT GROUNDING OR BONDING

.1 Install grounding or bonding connections to typical equipment included in, but not necessarily limited to following list: duct systems, frames of motors, starters, control panels, building steel work, and distribution panels.

2.5 MECHANICAL EQUIPMENT GROUNDING

.1 Bond frames of all mechanical equipment

.2 Provide a #6 ground conductor from the mechanical room ground bus to each VFD/VSD.

.3 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.

2.6 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00.

.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 RELATED WORK

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Division 01 – Construction / Demolition Waste Management and Disposal and with the Waste Reduction Workplan.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

.3 Place materials defined as hazardous or toxic waste in designated containers.

1.3 REFERENCES

.1 All conduits and accessories to be manufactured and certified by the related CSA standard.

1.4 SCOPE

.1 Drawings do not show all conduits. Those shown are in diagrammatic form only.

.2 Conceal all conduits where possible in finished areas. Conduits may be surface mounted either only where indicated or in service areas accessible only to authorized personnel.

.3 If a finished area is concrete (existing) or concealment is not practical, obtain ruling from Departmental Representative where exposed wiremold may be substituted.

.4 Note particular requirements for routing of conduits where detailed.

.5 Provide polypropylene pull cord in all "empty" conduits.

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.

2.2 CONDUIT FASTENINGS

.1 One hole steel straps to secure surface conduits 41mm [1.5"] and smaller. Use two hole steel straps to conduits larger than 41mm [1.5"].

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits.

.4 10mm [3/8"] 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 27mm [1"] and larger conduits.

.3 EMT couplings and connectors shall be steel, set screw type. Cast fittings and couplings are not acceptable. Provide plastic bushings (insulated throat) for all connectors. 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 21mm [3/4"] 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"or equal.

.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 [4"] 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 347V outlet boxes for 347V switching devices.

.6 Combination boxes with barriers where outlets for more than one system are grouped.

.7 Bushing and connectors with nylon insulated throats.

.8 Knock-out fillers to prevent entry of foreign materials.

.9 Conduit outlet bodies for conduit up to 35 mm[1.25"]. Use pull boxes for larger conduits.

.10 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 [3" x 2" x 1.5"] or as indicated. Larger 102 mm square x 54mm deep [4"x 2"] 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; or equivalent.

.4 Lighting fixture outlets: 102 mm [4"] square outlet boxes (No 52151, 52171 or 72171) or octagonal outlet boxes (No 54151 or 54171).

.5 102 mm [4"] square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster and/or tile walls.

2.8 CONCRETE BOXES

.1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

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 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.

.3 Conceal conduits in finished spaces unless noted otherwise.

.4 Any conduit exposed in finished areas to be free of unnecessary labels and trademarks.

.5 All conduit ends to be reamed to ensure a smooth interior finish that will not damage the insulation of the wiring.

.6 Ensure grounding continuity in all conduit systems.

.7 Surface conduits are acceptable in mechanical and electrical service rooms and in unfinished areas or where indicated.

.8 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 1.5m [5'] above the finished floor.

.9 Field threads on rigid conduit shall be sufficient length to draw conduits ends together.

.10 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.

.11 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.

.12 All branch circuit conduit and communication/data conduits to be minimum 21mm [3/4"] diameter unless otherwise indicated.

.13 All homerun conduits to be minimum 27mm [1"] diameter unless noted otherwise.

.14 Generally use Rigid PVC conduits in or below ground level slab unless otherwise noted. Transition to RGS conduit in exposed locations: eg where conduits emerge from ground level slab.

.15 Conduits are not permitted in terrazo or concrete toppings.

.16 Cap turned up conduits to prevent the entrance of dirt of moisture during construction.

.17 Locate conduits more than 75mm [3"] parallel to steam or hot water lines with a minimum of 25mm [1"] at crossovers.

.18 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.

.19 Provide polypropylene pull cord in empty conduits to facilitate pulling wiring in future.

.20 Where conduits become blocked, the use of corrosive agents is prohibited. Remove and replace blocked section.

.21 Damaged conduits to be repaired or replaced.

.22 Dry conduits out thoroughly before installing wiring. Swab out conduit and thoroughly clean internally before wires and cables are pulled.

.23 Conduits shall not pass through structural members except as indicated.

.24 Conduit sizes indicated on drawings are minimum only. Increase sizes as required to suit alternative wiring types or to comply with Code.

.25 Conduits and ducts crossing building expansion joints shall have approved conduit expansion fittings to suit the type of conduit used.

.26 Seal conduits with approved sealant where conduits are run between heated and unheated areas.

.27 Seal openings with approved sealant where conduits, cables, or cable trays pierce fire separations in accordance with cUL or ULC approved firestopping assemblies.

.28 Where conduits pass through walls, they shall be grouped and installed through openings. After all conduits are installed, wall openings shall be closed with material compatible with the wall construction and/or to meet any fire separation integrity.

.29 Where drawings show conduit designations, these conduits shall be identified at each point of termination with Thomas & Betts "Ty-Rap" No. TY532M labels, or equivalent.

.30 Use "Condulet" fittings for power and telephone type conduit terminations in lieu of standard boxes where box support is not provided.

.31 Provide necessary roof jacks or flashing where conduits pass through roof or watertight membranes. Apply approved sealant to maintain membrane integrity.

.32 Use liquid tight flexible metal conduit for connection to motors, and other vibrating equipment and transformers.

3.2 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with minimum 1.5m [5'] clearance.

.3 Conduits to be run in flanged portion of structural steel.

.4 Group conduits wherever possible on suspended and/or surface channels.

.5 Surface conduits will not be accepted in finished areas unless detailed.

3.3 SURFACE RACEWAYS

.1 Where practical provide regularly spaced device outlets and factory pre-cut raceway covers and cover plates. Field install outlets where factory installation is not possible due to delivery issues or irregularly spaced outlet requirement. In this event covers may be field cut with proprietary factory cover shear equipment with sharp blades.

.2 Raceways shall be free of burrs inside and out.

.3 Covers to be matching colour, smooth, free of burrs and parallel with no gaps.

.4 Preserve and organize the space within the wireway to facilitate multiple wiring runs and future additions. In finished areas and where practical, conduit to feed the surface raceway from a box recessed behind and via grommetted openings to the back of the surface raceway. Maintain pullbox access as required by the Canadian Electrical Code.

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 6mm [0.25"] 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 RELATED WORK

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Division 01 – Construction / Demolition Waste Management and Disposal and with the Waste Reduction Workplan.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

.3 Place materials defined as hazardous or toxic waste in designated containers.

Part 2 Products

2.1 BREAKERS

.1 All breakers to be bolt on type, moulded case, non-adjustable and non-interchangeable trip, single, two and three pole, 120/208(240)V or 347/600V and with trip free position separate from "On" or "Off" positions.

.2 Two and three pole breakers to have common simultaneous trip and able to be located in any circuit position within the panelboard. Interrupting ratings of new breakers added to existing panels to match ratings of existing breakers in panel.

.3 Provide circuit breakers with indicated trip ratings as shown in the panelboard schedules.

2.2 PANELBOARD IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00.

.2 Complete circuit directory for existing panelboards with typewritten card(s) located in slide-in plastic pocket(s) fixed to the back of the related door. Directory card to indicate the panel designation, mains size, voltage/phase and the location and load controlled of each circuit. Include a "letter sized" paper copy of each directory in the project maintenance manual.

Part 3 Execution

3.1 INSTALLATION

.1 Connect loads to circuits as indicated.

.2 Connect neutral conductors to common neutral bus with respective neutral identified.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

.2 Provide and locate safety disconnect switches to isolate individual items of equipment in accordance with Canadian Electrical Code CSA 22.1 whether indicated on not on the contract drawings.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International):

.1 CAN/CSA C22.2 No.4, Enclosed Switches.

.2 CSA C22.2 No.39, Fuseholder Assemblies.

1.3 HEALTH AND SAFETY

.1 Do construction occupational health and safety in accordance with Division 01- Health and Safety Requirements.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Division 01 – Construction / Demolition Waste Management and Disposal and with the Waste Reduction Workplan.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

.3 Place materials defined as hazardous or toxic waste in designated containers.

1.5 PRODUCT DATA

.1 Submit product data in accordance with Section 26 05 00.

Part 2 Products

2.1 DISCONNECT EQUIPMENT

.1 "Heavy Duty" class, enclosed manual air break switches in non-hazardous locations: to CSA C22.2 No.4

.2 Fuseholder assemblies to CSA C22.2 No.39.

.3 Fusible and non-fusible disconnect switch in CSA enclosure.

.4 Provision for padlocking in off switch position.

.5 Fuses as indicated. Allow for Class J or L for general circuits, Class RK5 for transformer, motor or other high inrush current circuits

.6 Fuseholders in each switch suitable without adaptors, for type of fuse as indicated.

.7 Quick-make, quick-break action.

.8 ON-OFF switch position indication on switch enclosure cover.

.9 Weatherproof as required.

2.2 EQUIPMENT IDENTIFICATION

.1 Indicate name of load controlled on size 4 nameplate to Section 26 05 00.

Part 3 Execution

3.1 INSTALLATION

.1 Install disconnect switches complete with fuses where indicated or required.

.2 Provide and locate safety disconnect switches to isolate individual items of equipment in accordance with Canadian Electrical Code CSA 22.1 whether indicated on not on the contract drawings.

3.2 MOTOR PLUG/RECEPTACLE AND QUICK DISCONNECTS

.1 Motor quick disconnects do not negate the requirement for a switched safety disconnect as specified in this Division. A separate disconnect is still required unless the Departmental Representative has given a special pre-approved circumstance.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 – Common Work Results for Electrical.

1.2 REFERENCES

.1 International Electrotechnical Commission (IEC)

.1 IEC 947-4-1-2002, Part 4: Electromechanical contactors and motor-starters.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 00 01 50 – General Instructions.

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Provide shop drawings: in accordance with Section 00 01 50 – General Instructions.

.1 Provide shop drawings for each type of starter to indicate:

.1 Mounting method and dimensions.

.2 Starter size and type.

.3 Layout and components.

.4 Enclosure types.

.5 Wiring diagram.

.6 Interconnection diagrams.

1.4 CLOSEOUT SUBMITTALS

.1 Provide maintenance materials in accordance with Section 00 01 50 – General Instructions.

.2 Submit operation and maintenance data for each type and style of motor starter for incorporation into maintenance manual.

Part 2 Products

2.1 MATERIALS

.1 Starters: to IEC 947-4 with AC4 utilization category.

2.2 MANUAL MOTOR STARTERS

.1 Single and three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:

.1 Switching mechanism, quick make and break.

.2 One or three overload heater(s), manual reset, trip indicating handle.

.2 Accessories:

.1 Toggle switch: standard, labelled as indicated.

.2 Indicating light: standard duty type and colour as indicated.

.3 Locking tab to permit padlocking in "ON" or "OFF" position.

2.3 FULL VOLTAGE MAGNETIC STARTERS

.1 Combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:

.1 Contactor solenoid operated, rapid action type.

.2 Motor overload protective device in each phase, manually reset from outside enclosure.

.3 Wiring and schematic diagram inside starter enclosure in visible location.

.4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.

.2 Combination type starters to include circuit breaker with operating lever on outside of enclosure to control circuit breaker, and provision for:

.1 Locking in "OFF" position with up to 3 padlocks.

.2 Independent locking of enclosure door.

.3 Provision for preventing switching to "ON" position while enclosure door open.

.3 Accessories:

.1 Pushbuttons: standard duty, labelled as indicated.

.2 Indicating lights: standard duty type and color as indicated.

.3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

2.4 FINISHES

.1 Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.5 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Manual starter designation label, size 1, engraved as indicated. Colours as follows:

.1 600V: white plate with black letters

.2 120 or 208V: black plate with white letters

.3 Magnetic starter designation label, size 1, engraved as indicated. Colours as follows:

.1 600V: white plate with black letters

.2 120 or 208V: black plate with white letters

Part 3 Execution

3.1 INSTALLATION

.1 Install starters and control devices in accordance with manufacturer's instructions.

.2 Install and wire starters and controls as indicated.

.3 Ensure correct fuses installed.

.4 Confirm motor nameplate and adjust overload device to suit.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and manufacturer's instructions.

.2 Operate switches and contactors to verify correct functioning.

.3 Perform starting and stopping sequences of contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

3.3 CLEANING

.1 Clean in accordance with Section 00 01 50 – General Instructions.

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

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Division 01 – Construction / Demolition Waste Management and Disposal.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

.3 Place materials defined as hazardous or toxic waste in designated containers.

1.3 REGULATORY REQUIREMENTS

.1 The fire alarm system devices are to be installed in accordance the following standards:

.1 C.S.A. Standard C22.1, Canadian Electrical Code, Part 1 (current edition) and bulletins & amendments for British Columbia

.2 The National Building Code (current edition).

.3 CAN/ULC S524-06: Standard for Installation of Fire Alarm System.

.4 CAN/ULC S537-04: Standard for Verification of Fire Alarm System.

.2 Installation subject to approval of Departmental Representative and fire marshal for final acceptance.

1.4 SYSTEM

.1 The fire alarm system is existing and will remain. The scope of this project is limited to the removal and reinstallation of one existing, and one new, duct smoke detector to be installed in the dedicated air handling units. The scope of work to include testing, demonstration, and verification to the satisfaction of the Departmental Representative and fire marshall.

.2 Equipment to be ULC approved.

1.5 TESTS AND ADJUSTMENTS

.1 Upon completion of system installation, tests to be conducted by the system installer to determine system conformity to requirements of the specification. Tests to be conducted in presence of the Departmental Representative who may suspend or discontinue tests at any time performance is considered unsatisfactory. Resumption of testing to cover the previously untested elements

and any completed elements at the discretion of the Departmental Representative.

.2 All equipment or wiring provided by system installer which tests prove to be defective or operating improperly to be corrected or replaced promptly at no additional cost to the Owner.

1.6 LABELLING – DEVICES AND PULLBOXES

.1 Provide a 'Brother' style commercial quality label on each fire alarm device. Label to be clearly visible from the ground and contain the address information to correspond to the walk test voice or page.

Part 2 Products

2.1 GENERAL

.1 DUCT SMOKE DETECTORS

.1 Duct smoke detectors supplied by Mechanical.

.2 Provide integral control and power modules required for operation with main control panel.

.3 Ensure detectors and associated modules are compatible with main control panel and suitable for use in supervised circuit. Coordinate with Mechanical.

.4 Detector circuits: 4-wire type where detector operating power is transmitted over conductors separate from initiating circuit. Malfunction of electrical circuits to detector or its control or power modules to cause operation of system trouble signals.

.5 The existing fused power circuit for smoke detection initiation in RTU-15 can be reused. Provide a new, separate, fused power circuit for smoke detection initiation circuit for RTU-15A.

.6 Failure of power circuit: indicated as a trouble condition on corresponding initiating circuit.

.7 Mount and install duct detectors in accordance with CAN/ULC s524.

.8 Provide duct detectors with approved duct housing, mounted exterior to duct, with perforated sampling tubes extending across width of duct.

.9 Activation of duct detectors to cause shutdown of associated air handling unit, annunciation at control panel and sounding of building alert signal.

.10 Provide detectors with visible indicator lamp that flashes when detector is in normal standby mode and glows continuously when detector is activated.

.11 Provide remote indicator lamp for each detector.

.12 Permanently label remote indicator with description of associated air handling unit (e.g. RTU-15).

.13 Provide each detector with remote test switch. Mount switch not more than 1.8m [6'0"] above finished floor.

.14 Permanently label test switch with description of associated air handling unit(s) (e.g. RTU-15 Test Switch).

.2

Part 3 Execution

3.1 INSTALLATION

.1 System installation shall conform to the latest CAN/ULC-S524 Standard for the Installation of Fire Alarm Systems.

3.2 AUTOMATIC DETECTORS

.1 Locate automatic smoke detectors in locations as shown indicated.

.2 Coordinate with other trades before proceeding.

.3 Mount detectors out of line of direct heat and minimum 3m [10'-0"] from unit heaters.

.4 Install duct smoke detectors on the supply air side of air handling units as indicated. Exact location of duct detectors to be coordinated with Division 23 and fire alarm system manufacturer.

3.3 WIRING

.1 Make conductor terminations on fixed terminal strips with separate terminal for each conductor. No loose wiring connections allowed.

.2 Fire alarm wiring splices to be minimal. Line splices are not acceptable.

.3 Neatly install wiring clamped with nylon cable straps or laced with jute cord.

.4 Number and identify all wiring terminations and terminal strips as indicated on shop drawings.

.5 Attach wiring diagram to inside of panel doors.

.6 All cables crossing fire zones to be protected by 1-hour fire rating.

.7 Provide separate fire alarm zone (and indicated at the graphic annunciators) for each duct mounted detector for mechanical pressurization and recirculation units.

.8 Coordinate duct detector location and accessibility with mechanical. Provide remote LED's for locations not readily viewable by maintenance personnel.

.9 All backboxes in exposed installations to be as provided by system manufacturer.

3.4 PROTECTION OF COMPLETED WORK

.1 Protect equipment in areas of construction to prevent the entry of dust, paint and any other foreign matter into the devices or panels.

3.5 SYSTEM INSPECTION

.1 Carry out a complete inspection and test of system on completion of the installation to ensure the following:

.1 System is complete and functional in accordance with the contract documents and regulatory requirements.

.2 System is installed in accordance with the manufacturer's recommendations.

.3 Fire suppression detection devices are connected into the system and are functioning.

.4 Smoke control equipment has been installed, connected and functioning.

.5 All auxiliary equipment has been connected and functioning.

.6 On completion of inspection deliver four (4) final sets of maintenance and operating instructions manuals to the Departmental Representative.

3.6 PERFORMANCE VERIFICATION

.1 The Electrical Division Contractor shall be responsible for directing performance verification of the fire alarm system in accordance with the latest CAN-S537, Standard for Verification of Fire Alarm System Installations.

.2 Provide interim partial verifications to suit the progress of the work and any staged occupancy. All work to be tested and verified directly following the installation.

.3 Submit all verification reports to the Departmental Representative. Provide an unconditional Appendix C and written test reports from the equipment manufacturer showing that the complete system has been tested, verified and commissioned by him/her and that the Fire Alarm system complies with all points of the specifications. Include the verification worksheets identifying every device and its status (i.e. "duct smoke detector, RTU-15A - room xx, verified for operation and supervision").

.4 The qualified Fire Alarm verification agency shall be independent of the installing company.

.5 Prior to requesting the final performance verification, ensure that fire alarm system is fully operable and that subsequent work to be performed on system will not invalidate examinations and tests performed during verification procedure.

.6 Include all costs for fire alarm system verifications, including the Fire Alarm System

Manufacturer's representative's costs. Take into account that the system may have to be commissioned and verified after normal working hours.

.7 Provide a minimum of ten workings days written notice ahead of the verification process to the Departmental Representative.

.8 Activate alarms and demonstrate all controls as requested.

END OF SECTION

Part 1 GENERAL

1.1 MEASUREMENT AND PAYMENT

.1 Measure supply and erection of chain link fence gates as units of each size erected.

1.2 REFERENCES

.1 ASTM International

.1 ASTM A53/A53M-[10], Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

.2 ASTM A90/A90M-[09], Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.

.3 ASTM A121-[07], Standard Specification for Zinc-Coated (Galvanized) Steel Barbed Wire.

.4 A653/A653M-[10], Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.5 ASTM C618-[08a], Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.

.6 ASTM F1664-[08], Standard Specification for Poly(Vinyl Chloride) (PVC)-Coated Steel Tension Wire Used with Chain-Link Fence.

.7 ASTM A123/A123M-[09], Standard Specification for Zinc (Hot Dip Galvanized) coatings on Iron and Steel Products.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-138.1-[96], Fabric for Chain Link Fence.

.2 CAN/CGSB-138.2-[96], Steel Framework for Chain Link Fence.

.3 CAN/CGSB-138.3-[96], Installation of Chain Link Fence.

.4 CAN/CGSB-138.4-[96], Gates for Chain Link Fence.

.5 CAN/CGSB-1.181-[99], Ready-Mixed Organic Zinc-Rich Coating.

.3 CSA International

.1 CSA A23.1/A23.2-[09], Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.

.2 CAN/CSA-A3000-[08], Cementitious Materials Compendium.

.4 Master Painters Institute (MPI)

.1 Architectural Painting Specification Manual - [current edition].

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals: In accordance with the Submittal Procedure requirements in Section 00 01 50 – General Instructions (CSC).

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for concrete mixes, fences, posts and gates 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 the requirements in Section 00 01 50 – General Instructions (CSC).

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

.3 Storage and Handling Requirements:

.1 Store materials in accordance with manufacturer's recommendations.

.2 Store and protect fence and gate materials from damage.

.3 Replace defective or damaged materials with new.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Concrete mixes and materials: in accordance with CSA A23.1

.1 Nominal coarse aggregate size: 20-5.

.2 Compressive strength: 20 MPa minimum at 28 days.

.3 Additives: fly ash to CSA A3000 or ASTM C618.

.2 Chain-link fence fabric: to CAN/CGSB-138.1.

.1 Type 1, Class, heavy style, Grade 1.

.2 Height of fabric: as indicated.

.3 Posts, braces and rails: to CAN/CGSB-138.2, galvanized steel pipe. Dimensions as indicated.

.4 Tension wire: to CAN/CGSB-138.2, single strand, galvanized steel wire.

.5 Tie wire fasteners: steel wire.

.6 Tension bar: to ASTM A653/A653M, 5 x 20 mm minimum galvanized steel.

.7 Gates: to CAN/CGSB-138.4.

.8 Gate frames: to [ASTM A53/A53M], galvanized steel pipe, standard weight 45 mm outside diameter pipe for outside frame, 35 mm outside diameter pipe for interior bracing.

.1 Fabricate gates as indicated with electrically welded joints, and hot-dip galvanized after welding.

.2 Fasten fence fabric to gate with twisted selvage at top.

.3 Furnish gates with galvanized malleable iron hinges, latch and latch catch with provision for padlock which can be attached and operated from either side of installed gate.

.9 Fittings and hardware: to CAN/CGSB-138.2 malleable or ductile cast iron.

.1 Tension bar bands: 3 x 20 mm minimum galvanized steel or 5 x 20 mm minimum aluminum.

.2 Post caps to provide waterproof fit, to fasten securely over posts and to carry top rail.

.3 Overhang tops to provide waterproof fit, to hold top rails and an outward projection to hold barbed wire overhang.

.4 Include projection with clips or recesses to hold 3 strands of barbed wire spaced 100 mm apart.

.5 Projection of approximately 300 mm long to project from fence at 45 degrees above horizontal.

.6 Turnbuckles to be drop forged.

.10 Organic zinc rich coating: to CAN/CGSB-1.181 or MPI #18.

.11 Barbed wire : to ASTM A121, 4 point barbs 125 mm spacing.

.12 Barbed wire: to CAN/CGSB-138.2, 2.5 mm diameter.

.13 Single Coil Helical Barbed Tape: "Razor-Ribbon" Helical Barbed Tape manufactured by "Razor-Ribbon"- 1600 South Lathrop, Harvey, IL, 60426, USA, Tool Free: 877-285-4066.

.1 Tape Material: 430 Stainless Steel | 1" wide prior to forming

.2 Core Material: Galvanized or Stainless Steel | .098" diameter

.3 Barb Length/Spacing/Offset: 2.5" (+/-.10") tip/tip | 4" on center

.4 Coil loop, strip material and loop spacing to match existing application in similar areas.

2.2 FINISHES

.1 Galvanizing:

.1 For chain link fabric: to CAN/CGSB-138.1 Grade 2.

.2 For pipe: 550 g/m²minimum to ASTM A90.

.3 For barbed wire: to CAN/CGSB-138.2 or ASTM A121, Class 2.

.4 For other fittings: to ASTM A123/A123M.

.2 Aluminum coating:

.1 For barbed wire: to ASTM A121, Class 2.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrate previously installed under other Sections or Contracts are acceptable for fence and gate installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental PM.

.2 Inform Departmental PM of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied [and after receipt of written approval to proceed from Departmental PM.

3.2 ERECTION OF FENCE

.1 Erect fence along lines as indicated

.2 Excavate post holes to dimensions indicated

.3 Space line posts [3] m apart, measured parallel to ground surface.

.4 Install end posts at end of fence and at buildings.

.1 Install gate posts on both sides of gate openings.

.5 Place concrete in post holes then embed posts into concrete to depths indicated.

.1 Extend concrete 50 mm above ground level and slope to drain away from posts.

.2 Brace to hold posts in plumb position and true to alignment and elevation until concrete has set.

.6 Install fence fabric after concrete has cured, minimum of 5 days.

.7 Install brace between end and gate posts and nearest line post, [placed in centre of panel and parallel to ground surface] [at inclination as indicated].

.1 Install braces on both sides of corner and straining posts in similar manner.

.8 Install overhang tops and caps.

.9 Install top rail between posts and fasten securely to posts and secure waterproof caps and overhang tops.

.10 Install bottom tension wire, stretch tightly and fasten securely to end, corner, gate and straining posts with turnbuckles and tension bar bands.

.11 Lay out fence fabric. Stretch tightly to tension recommended by manufacturer and fasten to end, corner, gate and straining posts with tension bar secured to post with tension bar bands spaced at [300] mm intervals.

.1 Knuckled selvedge at bottom.

.2 Twisted selvedge at top.

.12 Secure fabric to top rails, line posts and bottom tension wire with tie wires at [450] mm intervals.

.1 Give tie wires minimum two twists.

.13 Install barbed wire strands and clip securely to lugs of each projection.

.14 Install grounding rods as indicated.

3.3 INSTALLATION OF GATES

.1 Install gates in locations as indicated.

.2 Level ground between gate posts and set gate bottom approximately [40] mm above ground surface.

.3 Determine position of centre gate rest for double gate.

.1 Cast gate rest in concrete as directed.

.2 Dome concrete above ground level to shed water.

.4 Install gate stops where indicated.

END OF SECTION

Appendix

ARCADIS
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Imagine the result

Public Works and Government Services Canada

Mission Institution – Hobby Shop (Room 248) – Pre-Renovation Hazardous Materials Survey

Mission Institution, 8751 Stave Lake Street,
Mission, British Columbia

Revised March 9, 2016

Our Ref.:
702358-004

ARCADIS

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Hazardous Materials Survey

Mission Institution Hobby Shop
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1. Introduction

Arcadis Canada Inc. (Arcadis) was retained by Public Works and Government Services Canada (PWGSC), Pacific Region, on behalf of Correctional Service Canada, to conduct a hazardous materials survey in the Hobby Shop (Room 248) and surrounding rooms at the Mission Institution.

Mission Institution is a minimum and medium security facility located at 8751 Stave Lake Street, Mission, British Columbia. The minimum security facility opened in 1973, and the medium security facility opened in 1977.

The survey was undertaken to report on the presence or suspected presence of readily observable hazardous materials. It is our understanding that renovations are planned for the areas.

A floor plan showing the study area is provided in Attachment A.

1.1 Scope of Work

The scope of work for our investigation included:

- reviewing a previous hazardous materials survey report and abatement reports provided by PWGSC;
- conducting a limited hazardous building materials assessment (including but not limited to assessment of asbestos-containing materials, lead (based paints), mould, mercury, PCBs, halocarbon-containing equipment and silica);
- obtaining representative bulk samples of materials which could contain asbestos, and paint chip samples;
- laboratory analyses of bulk samples for asbestos content and analysis of paint chip samples for lead content; and
- preparation of a report outlining the findings of the investigation.

Mr. Kenny Luong of Arcadis visited the site on November 19, 2015, and February 9, 2016 to conduct the hazardous materials survey.

2. Background Information on Hazardous Materials

Canada Labour Code

Requirements related to disclosing the presence of hazardous substances (including designated substances) in federal government buildings are specified in Part II of the *Canada Labour Code*, sections 124(1)y and 125(1)Z.14, which state that employers shall:

- *"ensure that the activities of every person granted access to the work place do not endanger the health and safety of employees [Section y]; and*
- *take all reasonable care to ensure that all of the persons granted access to the workplace, other than the employer's employees, are informed of every known or foreseeable health or safety hazard to which they are likely to be exposed in the workplace. [Section Z.14]".*

When construction or redevelopment work is undertaken by a company whose primary activity is construction or redevelopment work at the site of a federally-regulated employer, the provincial health and safety laws apply. The British Columbia Workers Compensation Act and Occupational Health and Safety Regulations (B.C. Reg. 296/97) would therefore apply to any construction work undertaken at the subject site.

2.1 Asbestos

Asbestos has been widely used in buildings, both in friable applications (materials which can be crumbled, pulverized or powdered by hand pressure, when dry) such as pipe and tank insulation, sprayed-on fireproofing and acoustic texture material and in non-friable manufactured products such as floor tile, gaskets, cement board and so on. The use of asbestos in friable applications was curtailed around the mid-1970s. The use of asbestos in certain non-friable materials continued beyond the mid-1970s.

Control of exposure to asbestos is governed in British Columbia by B.C. Reg. 296/97 – Occupational Health and Safety Regulations. The WorkSafe BC publication *Safe Work Practices for Handling Asbestos* provides additional guidance.

B.C. Reg. 296/97 states that "asbestos-containing material" means the following:

(a) a manufactured article or other material, other than vermiculite insulation, that would be determined to contain at least 0.5% asbestos if tested in accordance with one of the prescribed methods.

(b) vermiculite insulation that would be determined to contain any asbestos if tested in accordance with the prescribed EPA method.

B.C. Reg. 296/97 prescribes certain requirements for asbestos management in buildings.

For on-going asbestos management in buildings, employers are required to:

- develop and implement an exposure control plan if a worker is or may be exposed to potentially harmful levels of asbestos;
- prepare an inventory (i.e., asbestos survey report) of all asbestos-containing materials in the workplace; keep the inventory at the workplace and keep the inventory current;
- ensure that a risk assessment is conducted by qualified person on asbestos-containing material identified in the inventory, with due regard for the condition of the material, its' friability, accessibility and likelihood of damage, and the potential for fibre release and exposure of workers;
- ensure that before a work activity that involves working with or in proximity to asbestos-containing material begins, the work activity is assessed by a qualified person and classified as a low, moderate or high risk activity;
- ensure that all friable asbestos-containing materials in the workplace are controlled by removal, enclosure or encapsulation so as to prevent the release of airborne asbestos fibre;
- prohibit any work that would disturb asbestos-containing material unless necessary precautions have been taken to protect workers;
- ensure that procedures for handling or using asbestos-containing material prevent or minimize the release of airborne asbestos fibres;

- ensure that the procedures for control, handling or use of asbestos are in accordance with procedures acceptable to the board;

- provide training for staff who are at risk of exposure to asbestos;

"Waste asbestos" is classified as a "hazardous waste" and is defined in the British Columbia Hazardous Waste Regulation (B.C. Reg. 63/88) as "a waste containing friable asbestos fibres or asbestos dust in a concentration greater than 1% by weight". Section 40, Part 6 of the regulation provides requirements for management of asbestos waste.

2.2 Lead

Lead is a heavy metal that can be found in construction materials such as paints, coatings, mortar, concrete, pipes, solder, packings, sheet metal, caulking, glazed ceramic products and cable splices. Lead has been used historically in exterior and interior paints.

The *Surface Coating Materials Regulations* made under the *Hazardous Products Act* (SOR/2005-109) sets a maximum concentration of total lead of 90 mg/kg (0.009 percent or 90 parts per million) for surface coating materials, including paints, effective 21 October 2010. This criterion level applies to the sale and importation of new surface coating materials.

The National Plumbing Code allowed lead as an acceptable material for pipes until 1975 and in solder until 1986.

B.C. Reg. 296/97 prescribes specific requirements for control of workplace exposure to lead. Employers are responsible for developing and implementing an exposure control plan if workers are or may be exposed to lead. The WorkSafe BC publication "Lead-Containing Paints and Coatings, Preventing Exposure in the Construction Industry" provides guidance in the measures and procedures that should be followed when handling lead-containing paints and coatings during construction projects and states the following:

- "Information from the U.S. Occupational Safety and Health Administration (OSHA) suggests that the improper removal of lead paint containing 600 mg/kg lead results in airborne lead concentrations that exceed half of the exposure limit. This would

trigger the requirement for an Exposure Control Plan (ECP) and safe work procedures.

- Lead concentrations as low as 90 mg/kg may present a risk to pregnant women and children. Any risk assessment should include for the presence of high risk individuals within the workplace."

2.3 Mercury

Mercury has been used in electrical equipment such as alkaline batteries, fluorescent light bulbs (lamps), high intensity discharge (HID) lights (mercury vapour, high pressure sodium and metal halide), "silent switches" and in instruments such as thermometers, manometers and barometers, pressure gauges, float and level switches and flow meters. Mercury-containing lamps, the bulk of which are 1.22 m (four foot) fluorescent lamps contain between 7 and 40 mg of mercury each. Mercury compounds have also been used historically as additives in latex paint to protect the paint from mildew and bacteria during production and storage.

The intentional addition of mercury to Canadian-produced consumer paints for interior use was prohibited in 1991. Mercury may have remained in paints after 1991, however, as a result of impurities in the paint ingredients or cross-contamination due to other manufacturing processes. The *Surface Coating Materials Regulations* made under the Hazardous Products Act set a maximum total mercury concentration of 10 mg/kg (0.001 percent) for surface coating materials (including paint). This criterion level applies to the sale and importation of new surface coating materials.

Mercury-containing thermostats and silent light switches are mercury tilt switches which are small tubes with electrical contacts at one end of the tube. A mercury tilt switch is usually present when no switch is visible. Mercury switches often have the word "TOP" stamped on the upper end of the switch, which is visible after removing the cover plate. If mercury switches are to be removed, the entire switch should be removed and placed into a suitable container for storage and disposal.

Waste light tubes generated during renovations or building demolition and waste mercury from equipment must either be recycled or disposed of in accordance with the requirements of B.C. Reg. 63/88 – *Hazardous Waste Regulation.*

Waste mercury is classified as "leachable toxic waste" if the extraction criterion value prescribed in Table 1 of Schedule 4 of the regulation is exceeded. Waste mercury from mercury switches or gauges should be properly collected and shipped to a recycling facility or disposed of as a hazardous waste. Removal of mercury-

containing equipment (e.g., switches, gauges, controls, etc.) should be carried out in a manner which prevents spillage and exposure to workers.

2.4 Silica

Silica exists in several forms of which crystalline silica is of most concern with respect to potential worker exposures. Quartz is the most abundant type of crystalline silica. Some commonly used construction materials containing silica include brick, refractory brick, concrete, concrete block, cement, mortar, rock and stone, sand, fill dirt, topsoil and asphalt containing rock or stone.

Employers in British Columbia are required to develop an exposure control plan (ECP) when workers are or may be exposed to airborne silica dust in excess of 50 percent of the exposure limit. The WorkSafe BC guidance document "Developing a Silica Exposure Control Plan" provides information on each of the required elements of an ECP, including safe work procedures for controlling exposure to silica during construction activities.

2.5 PCBs

In most institutional and commercial facilities and in smaller industrial facilities, the primary source of equipment potentially containing PCBs is fluorescent and H.I.D. light ballasts. Small transformers may also be present. In larger industrial facilities, larger transformers and switch gear containing, or potentially containing, PCBs may also be present.

PCBs were also commonly added to industrial paints from the 1940s to the late 1970s. PCBs were added directly to the paint mixture to act as a fungicide, to increase durability and flexibility, to improve resistance to fires and to increase moisture resistance. The use of PCBs in new products was banned in Canada in the 1970s. PCB amended paints were used in speciality industrial/institutional applications prior to the 1970s including government buildings and equipment such as industrial plants, radar sites, ships as well as non-government rail cars, ships, grain bins, automobiles and appliances.

Removal of in-service equipment containing PCBs, such as fluorescent light ballasts, capacitors and transformers, is subject to the requirements of the federal *PCB Regulations*.

The *PCB Regulations*, which came into force on 5 September 2008, were made under the *Canadian Environmental Protection Act*, 1999 (CEPA 1999) with the

objective of addressing the risks posed by the use, storage and release to the environment of PCBs, and to accelerate their destruction. The *PCB Regulations* set different end-of-use deadlines for equipment containing PCBs at various concentration levels.

The Regulations Amending the PCB Regulations and Repealing the Federal Mobile PCB Treatment and Destruction Regulations were published on 23 April 2014, in the Canada Gazette, Part II, and came into force on 1 January 2015. The most notable part of the amendments is the addition of an end-of-use deadline date of 31 December 2025 for specific electrical equipment located at electrical generation, transmission and distribution facilities.

"PCB wastes" are defined in B.C. Reg. 63/88 – *Hazardous Waste Regulation* as *PCB liquid, PCB solid and PCB equipment that have been taken out of service for the purpose of treatment, recycling, reuse or disposal or for the purpose of storage prior to treatment, recycling, reuse or disposal*. "PCB liquid" means any liquid containing more than 50 parts per million by weight of chlorobiphenyls. "PCB solid" means any material or substance other than PCB liquid that contains or is contaminated with chlorobiphenyls at a concentration greater than 50 parts per million by weight of chlorobiphenyls. "PCB equipment" means a manufactured item that contains or is contaminated with PCB liquids or PCB solids and includes transformers, capacitors and containers.

2.6 Ozone-depleting Substances and Halocarbons

In Canada, the federal, provincial and territorial governments have legislation in place for the protection of the ozone layer and management of ozone-depleting substances and their halocarbon alternatives. The use and handling of these substances are regulated by the provinces and territories in their respective jurisdictions, and through the *Federal Halocarbon Regulations, 2003* (FHR 2003) for refrigeration, air-conditioning, fire-extinguishing and solvent systems under federal jurisdiction.

The FHR 2003 were published in August 2003 and amended in July 2009 under the authority of the *Canadian Environmental Protection Act, 1999*. The purpose of the FHR 2003 is to reduce and prevent emissions of ozone-depleting substances and of their halocarbon alternatives to the environment from air-conditioning units, refrigeration, fire-extinguishing and solvent systems that are:

- located on federal or aboriginal lands; or

- owned by federal departments, board agencies, Crown corporations, or federal works and undertakings.

The FHR 2003 replaced the former *Federal Halocarbon Regulations* and incorporated new provisions to achieve an orderly transition from CFCs and Halons to alternative substances and technologies, reflecting *Canada's Strategy to Accelerate the Phase-Out of CFC and Halon Uses and to Dispose of the Surplus Stocks*.

Under the FHR 2003, a person who installs, services, leak tests, or charges a refrigeration system or an air conditioning system or does any other work on the system that may result in the release of a halocarbon must do so in accordance with the *Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems*.

Some of the requirements of FHR 2003 include:

- certification is required for all persons testing, repairing, filling or emptying equipment containing ozone-depleting substances and their halocarbon alternatives;

- no person shall store, transport or purchase a halocarbon unless it is in a container designed and manufactured to be refilled and to contain that specific type of halocarbon;

- before dismantling, decommissioning or destruction of any system, a person shall recover all halocarbons contained in the system into a container designed and manufactured to be refilled and to contain that specific type of halocarbon;

- before dismantling, decommissioning or destruction or destroying a system, a person shall affix a notice to the system containing information as required in Column 3, Item 1 of Schedule 2. This information includes the name and address of the owner of the system; name of the operator of the system, specific location of the system before its dismantling, decommissioning or destruction; description of the system; name of service technician who recovered the halocarbons; certificate number of the service technician (if applicable); name of employer of service technician (if applicable); type and quantity of halocarbon and date recovered; type and

charging capacity of the system; and final destination of the system; and

- in the case of dismantling, decommissioning or destruction of any system, the owner shall keep a record of the information contained in the notice as described above.

2.7 Mould

Moulds are forms of fungi that are found everywhere both indoors and outdoors all year round. Outdoors, moulds live in the soil, on plants and on dead and decaying matter. More than 1000 different kinds of indoor moulds have been found in buildings. Moulds spread and reproduce by making spores, which are all small and light-weight, able to travel through air, capable of resisting dry, adverse environmental conditions, and hence capable of surviving a long time. Moulds need moisture and nutrients to grow and their growth is stimulated by warm, damp and humid conditions.

Recommended work practices are outlined in the following document:

- *Mould Guidelines for the Canadian Construction Industry*. Standard Construction Document CCA 82 2004. Canadian Construction Association.

3. Methodology

3.1 Asbestos

Bulk sampling and analysis was performed in general accordance with the requirements specified in B.C. Reg. 296/97 and in the WorkSafe BC publication *Safe Work Practices for Handling Asbestos.*

Determination of the locations of asbestos-containing materials was made based on the results of bulk sample analyses, visual observations and physical characteristics of the applications as well as our knowledge of the uses of asbestos in building materials.

Analysis of bulk samples was performed following EPA method 600/R-93/116 in conformity with the requirements specified in B.C. Reg. 296/97.

3.2 Lead

Samples of select, representative paint applications collected during the course of the site inspection were forwarded to the Maxxam Analytical Inc. laboratory in Mississauga, Ontario for analysis of lead content.

3.3 Mercury

The presence of equipment which may contain mercury, such as fluorescent light tubes, thermometers, gauges, etc. observed during the course of our site inspection was recorded.

3.4 Silica

The presence of silica-containing materials observed during the course of our site inspection was documented. Silica is known to be a constituent of brick, concrete, cement, etc. Sampling and laboratory analysis are not required to make this determination.

3.5 PCBs

Fluorescent lights were inspected during the course of our survey to determine whether they were the TI2 type and may therefore contain PCB ballasts. Nameplate information on transformers was inspected to determine whether they were an air or liquid-cooled type.

3.6 Ozone-Depleting Substances and Halocarbons

Information on the presence of air-conditioning equipment, cooling equipment (refrigerators, etc.), etc. was recorded during the site inspections by ARCADIS staff.

3.7 Mould

The presence of "suspect" mould observed during the course of our site inspection was documented. "Suspect" mould is typically a coloured, textured substance or discolouration or staining on a building material surface which, based on our experience, may be mould growth. The adjective "suspect" is used where the presence of mould has not been confirmed by laboratory analysis.

4. Results and Discussion

4.1 Asbestos

During the course of our hazardous materials survey, representative bulk samples of materials were collected by Arcadis staff. The samples were forwarded to EMSL Canada Inc. for asbestos analyses. EMSL holds a current Certificate of Accreditation for Bulk Asbestos Fibre Analysis under the Voluntary Accreditation Program (NVLAP). The results of the bulk sample analyses for asbestos content are provided in Table 4.1, and the laboratory report is provided in Appendix B.

Table 4.1
Summary of Results of Analyses of Bulk Samples for Asbestos Content
Hobby Shop (Room 248), Mission Institution

SAMPLE №	LOCATION	DESCRIPTION	ASBESTOS CONTENT
B1A	Room 248, entrance to Room 247C (Wood Room)	drywall joint compound	None detected
B1B	Room 248, rear exit door (east)	drywall joint compound	None detected
B1C	Room 248, southeast corner	drywall joint compound	None detected
B1D	Room 248, entrance to Room 236	drywall joint compound	None detected
B1E	Room 248, north window-top	drywall joint compound	None detected
B1E	Room 248, north window-bottom	drywall joint compound	**1% chrysotile**
B2A	Room 236, west wall	drywall joint compound	None detected
B2B	Room 247C, bulkhead	drywall joint compound	**1% chrysotile**
B2C	Room 239, north corner	drywall joint compound	None detected
B3	Room 248, northeast bulkhead	drywall joint compound	**1% chrysotile**

Sample №	Location	Description	Asbestos Content
B4	Room 248, at entrance to Room 236	pipe elbow insulation	None detected
B5	Room 248, under table, north side	(12" x 12") grey vinyl floor tile	**1% chrysotile**
B5	Room 248, under table, north side	(12" x 12") vinyl floor tile-mastic	**1% chrysotile**
B6	Room 248, under table, centre	(12" x 12") grey vinyl floor tile	**1% chrysotile**
B6	Room 248, under table, centre	(12" x 12") vinyl floor tile-mastic	**1% chrysotile**
B7A	Room 248, centre area	grey levelling compound	None detected
B7B	Room 248, west area	grey levelling compound	None detected
B7C	Room 248, north area	grey levelling compound	None detected
B8	Room 236	(12" x 12") white/blue vinyl floor tile	None detected
B8	Room 236	(12" x 12") white/blue vinyl floor tile-mastic	None detected
B9	Room 236	(2' x 4') ceiling tile	None detected
B10	Room 248, ceiling	grey duct mastic	None detected
B11A	Room 237	grey duct mastic	None detected (1)
B11B	Room 237	grey duct mastic	None detected (1)
B12A	Room 239	(2' x 4') white ceiling tile	None detected (1)
B12B	Room 238	(2' x 4') white ceiling tile	None detected (1)
B13A	Room 238	(12" x 12") white vinyl floor tile	None detected (1)
B13A	Room 238	(12" x 12") white vinyl floor tile-mastic	None detected (1)
B13B	Room 238	(12" x 12") white vinyl floor tile	None detected (1)
B13B	Room 237	(12" x 12") white vinyl floor tile-mastic	None detected (1)
B14A	Room 240	(12" x 12") white vinyl floor tile	None detected (1)
B14A	Room 240	(12" x 12") white vinyl floor tile-mastic	None detected (1)
B14B	Room 240	(12" x 12") white vinyl floor tile	None detected (1)

SAMPLE Nº	LOCATION	DESCRIPTION	ASBESTOS CONTENT
B14B	Room 240	(12" x 12") white vinyl floor tile-mastic	None detected (1)
B15A	Room 247	mechanical insulation	None detected (1)
B15B	Hallway 241	mechanical insulation	None detected (1)
B15B	Hallway 241	mechanical insulation-canvas	None detected (1)
B16	Hallway 241	wall caulking	None detected (1) None detected (PLM gravimetric)
B16	Room 237	pipe canvas	None detected

NOTES:

(1) Sample collected in February 2016.

Only one sample of the ceiling tiles in Room 236 was collected due to the limited amount of them.

Based on visual observations and results of laboratory analyses of samples collected by Arcadis, the following asbestos-containing materials were found to be present in the study area:

- drywall joint compound located throughout the study area;
- (12" x 12") vinyl floor tiles and underlying mastic in Rooms 247A, 247B and 247C; and
- (12" x 12") vinyl floor tiles and underlying mastic at various locations in Room 248

In addition, it was reported by PWGSC that the Living Unit exterior walls had asbestos-containing vermiculite. This was not confirmed, as no destructive investigations were performed.

A summary of the asbestos-containing materials and quantities is provided in Table 4.2.

Table 4.2
Summary of Asbestos-Containing Materials and Approximate Quantities
Hobby Shop (Room 248), Mission Institution

DESCRIPTION	APPROXIMATE QUANTITY	LOCATION
drywall joint compound	500 m^2	throughout study area
(12" x 12") vinyl floor tiles	40 m^2	Rooms 247A, 247B, 247C and 248
vinyl floor tile mastic	55 m^2	Rooms 247A, 247B, 247C and 248

The locations of the asbestos-containing materials are provided on the floor plan in Appendix A.

Photographs are provided in Appendix C.

The vinyl floor tiles and mastic are non-friable materials. Removal of these asbestos-containing materials can be performed as a moderate risk work activity as specified in B.C. Reg. 296/97 if the work is done only using non-powered, hand-held tools or if the removal work is done using power tools that are attached to dust-collecting devices equipped with HEPA filters.

Drywall joint compound is a semi-friable material. Removal of this asbestos-containing material can also be performed as a moderate risk work activity as specified in B.C. Reg. 296/97 if the work is done only using non-powered, hand-held tools or if the removal work is done using power tools that are attached to dust-collecting devices equipped with HEPA filters.

Asbestos may also be present in materials which were not sampled during the course of the asbestos survey carried out by Arcadis, including, but not limited to, components of electrical equipment (e.g. electric wiring insulation, non-metallic sheathed cable, electrical panel partitions, arc chutes, high-grade electrical paper, etc.) and/or in locations that are presently inaccessible (e.g., in pipe chases, behind walls). Asbestos may also be present in the form of vermiculite insulation in cavities in concrete or cement block walls (used as in-fill insulation). Confirmatory testing of any such materials could be undertaken as the need arises (i.e., at the time of renovations) or the materials can be assumed to contain asbestos based on findings in adjacent areas.

If any materials which may contain asbestos and which were not tested during the course of the hazardous materials survey are discovered during any renovation

activities, the work shall not proceed until such time as the required notifications have been made and an appropriate course of action is determined.

4.2 Lead

Three samples of the predominant paints were collected by Arcadis during the course of the survey. The samples were submitted to EMSL Canada Inc. for analysis of lead content. The results of the analyses are presented in Table 4.3, and the laboratory report is provided in Appendix B.

Lead was detected at a level above the WorkSafe BC guideline value of 600 mg/kg in two of the three samples, and above the *Surface Coating Materials Regulations* maximum concentration of 90 mg/kg in all of the samples. Where one colour of paint is indicated in the sample descriptions (L1) in Table 4.2, only one layer of paint was observed. Where multiple colours are indicated in the sample description (L2 and L3), multiple layers of paint were observed.

All paint applications were noted to be generally in fair condition at the time of the survey by ARCADIS. If paint will be disturbed during the course of renovation work, the measures and procedures outlined in the WorkSafe BC publication *Lead-Containing Paints and Coatings, Preventing Exposure in the Construction Industry*, should be followed.

Table 4.3
Summary of Results of Analyses of Paint Samples for Lead Content
Hobby Shop (Room 248), Mission Institution

SAMPLE №	LOCATION	DESCRIPTION	CONDITION	LEAD CONTENT (mg/kg)
L1	Room 248	Interior white wall paint	Fair	190
L2	Room 247C	Interior blue/red/white wall trim paint	Fair	**670**
L3	Room 247C	Interior grey/red door paint	Fair	**10,000**

NOTES:

mg/kg - milligrams lead per kilogram paint.
1 mg/kg - 1 part per million (ppm).

Results shown in bold type exceed the criterion level of 600 mg/kg for classification of lead paint (where high risk individuals, such as pregnant women and children, are not present).
All levels exceeded the *Surface Coating Materials Regulations* concentration of 90 mg/kg.

4.3 Mercury

During the course of our site investigation, fluorescent light fixtures were observed in the study area. Mercury should be assumed to be present as a gas in all fluorescent light tubes. If any fluorescent light tubes are removed, the light tubes should be recycled for mercury.

Proper procedures for removing and handling mercury-containing fluorescent light tubes typically involve:

- ensuring that electrical power to light fixtures has been disconnected and locked out;
- taking all necessary precautions to ensure that fluorescent lamp tubes are removed in a manner that prevents breakage; and
- transporting fluorescent lamp tubes to a licensed processing location for separation and recovery of mercury.

4.4 Silica

Materials observed in the study area which should be considered to contain silica included drywall, drywall joint compound, ceiling tiles, floor levelling compound and concrete.

The WorkSafe BC guidance document *Developing a Silica Exposure Control Plan*, provides guidance in controlling exposure to silica dust during construction/renovation activities.

4.5 PCBs

Fluorescent lights were observed in the study area during the course of our site investigation. Light ballasts, such as those associated with the type of fluorescent lights (T8s) observed in the study area, are usually an electronic-type which do not contain PCBs, however, this should be confirmed by an electrician at the time of dismantling of the lights.

4.6 Ozone-depleting Substances and Halocarbons

No suspect ODS- or halocarbon-containing equipment was observed during the course of the investigation.

4.7 Mould

No readily-evident mould was observed during the course of the investigation.

During renovation activities, any mould-impacted materials that may be uncovered/discovered should be remediated following the measures and procedures outlined in the Canadian Construction Association Standard Construction Document CCA-82 2004 - Mould guidelines for the Canadian Construction Industry.

5. Recommendations

We recommend the following on the basis of the findings of the hazardous material assessment outlined in this report:

1. Ensure that all asbestos-containing materials identified in the study area (drywall joint compound, vinyl floor tiles and underlying mastic) are removed, if they are affected by the renovation work, in accordance with work practices and procedures specified in B.C. Reg. 296/97 and outlined in WorkSafe BC publication "Safe Work practices for Handling Asbestos".

2. Ensure that a risk assessment is performed and an exposure control plan is developed for lead-containing paint prior to demolition.

3. Prior to undertaking demolition activities:
   - ensure that a licensed electrician inspects ballasts to determine whether or not any light ballasts may contain PCBs. Guidance in identification of PCB ballasts is provided in the Environment Canada publication titled "Identification of Lamp Ballasts Containing PCBs. Report EPS 2/CC/2 (revised)", August 1991;
   - develop a silica exposure control plan; and
   - remove all fluorescent light tubes and transport to a licensed processing location for separation and recovery of mercury.

6. Use and Limitations of Hazardous Materials Survey Report

This report, prepared for Public Works and Government Services Canada, on behalf of Correctional Service Canada, does not provide certification or warranty, expressed or implied, that the investigation conducted by Arcadis identified all hazardous materials in the subject facility. The work undertaken by Arcadis was directed to provide information on the presence of hazardous materials in building construction materials based on visual inspection of readily accessible areas in the designated study area and on the results of laboratory analysis of a limited number of bulk samples of material for asbestos content and laboratory analysis of a limited number of paint samples for lead content. The survey did not include for identification of asbestos in equipment (including electrical equipment and wiring), nor material outside of the building (e.g. asphaltic pavement).

The material in this report reflects Arcadis' best judgment in light of the information available at the time of the investigation, which was performed on November 19, 2015, and February 9, 2016.

This report is not intended to be used as a scope of work or technical specification for remediation of designated substances or hazardous materials.

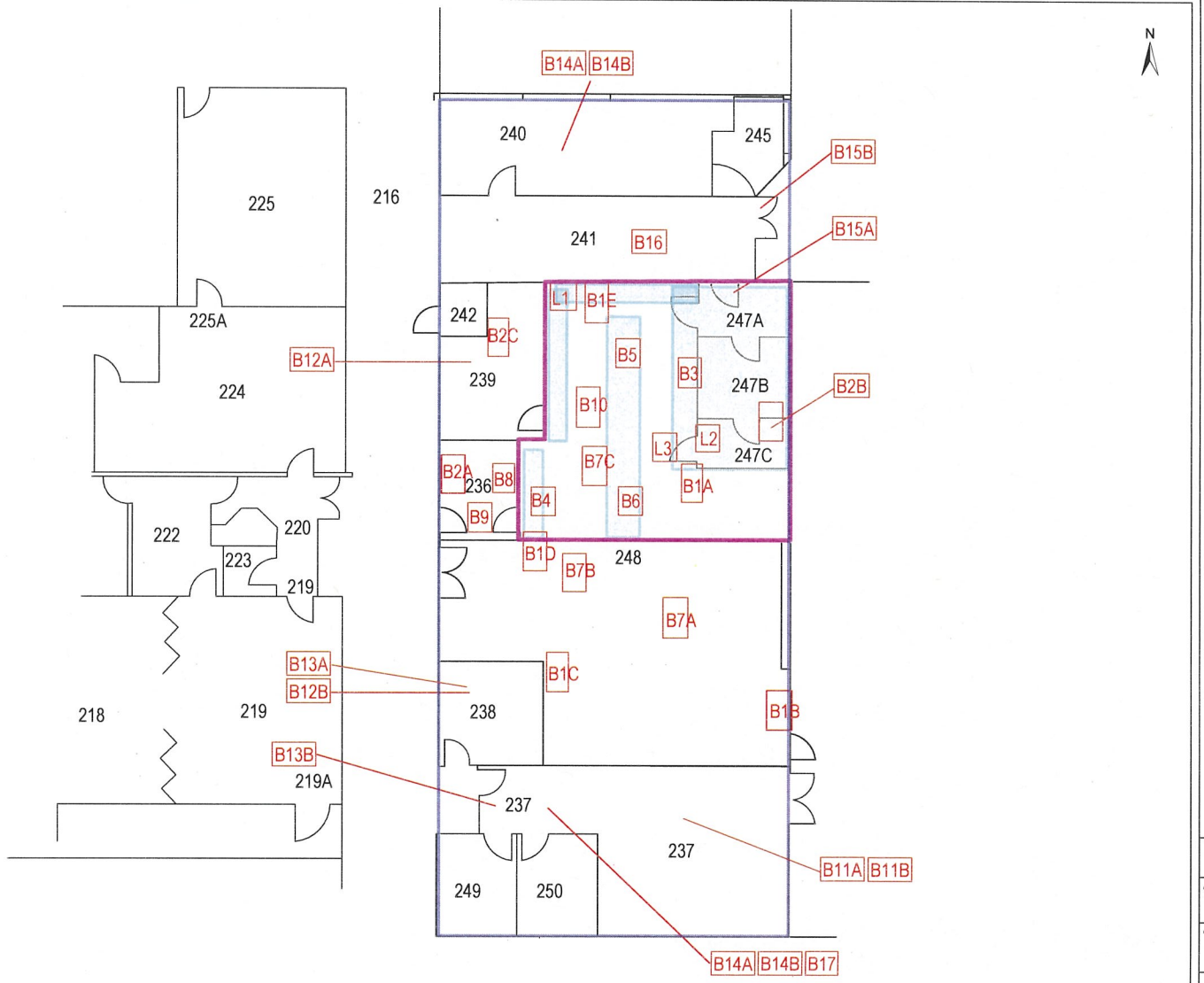
This report was prepared by Arcadis for Public Works and Government Services Canada, on behalf of Correctional Service Canada. Any use which any other party makes of the report, or reliance on, or decisions to be based on it, is the responsibility of such parties.

ARCADIS

Hazardous Materials Survey
Mission Institution Hobby Shop (Room 248)
Mission, British Columbia

Appendix A

Floor Plan



LEGEND

- Designated Study Area
- B1 Asbestos Sample Location
- L1 Paint Sample Location
- Asbestos-Containing Floor Tiles
- Asbestos-Containing Mastic

Note:
All drywall joint compound should be assumed to contain asbestos

3 1.5 0 1.5 3
metres

Title: **HAZARDOUS MATERIALS SURVEY**

Project: MISSION INSTITUTION - HOBBY SHOP

Client: PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

Project Number: 702358-004	Drawn By: CB	Plot Size: 11X17"	Date: MARCH 2016

ARCADIS

FIGURE 1

HOBBY Z:\STORAGE\STAFF\Cary\702358 - Mission Institution\CAD\004 - Hobby Shop\Hobby d20160303-v200705.dwg

ARCADIS

Appendix B

Laboratory Reports

EMSL Canada Inc.

4506 Dawson Street Burnaby, BC V5C 4C1
Phone/Fax: 604-757-3158 / (604) 757-4731
http://www.EMSL.com / vancouverlab@EMSL.com

EMSL Canada Order 691500326
Customer ID: 55DCSL97
Customer PO: 702358-004
Project ID:

Attn: Paul Smith
ARCADIS Canada Inc.
121 Granton Drive
Unit 12
Richmond Hill, ON L4B 3N4

Proj: 702358-004

Phone: (905) 882-5984
Fax: (905) 882-8962
Collected:
Received: 11/20/2015
Analyzed: 11/27/2015

Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

Client Sample ID: B1A **Lab Sample ID:** 691500326-0001
Sample Description: WOOD ROOM ENTRANCE/DWJC

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	11/27/2015	White	0%	100%	None Detected	

Client Sample ID: B1B **Lab Sample ID:** 691500326-0002
Sample Description: REAR EXIT DOOR EAST/DWJC

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	11/27/2015	White	0%	100%	None Detected	

Client Sample ID: B1C **Lab Sample ID:** 691500326-0003
Sample Description: S.E. CORNER/DWJC

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	11/27/2015	White	0%	100%	None Detected	

Client Sample ID: B1D **Lab Sample ID:** 691500326-0004
Sample Description: OFFICE ENTRANCE/DWJC

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	11/25/2015	White	0%	100%	None Detected	

Client Sample ID: B1E-Top **Lab Sample ID:** 691500326-0005
Sample Description: NORTH WINDOW/DWJC

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	11/27/2015	White	0%	100%	None Detected	

Client Sample ID: B1E-Bottom **Lab Sample ID:** 691500326-0005A
Sample Description: NORTH WINDOW/DWJC

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	11/27/2015	White	0%	99%	**1% Chrysotile**	

Client Sample ID: B2A **Lab Sample ID:** 691500326-0006
Sample Description: OFFICE WEST WALL/DWJC

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	11/27/2015	White	0%	100%	None Detected	

EMSL Canada Inc.

4506 Dawson Street Burnaby, BC V5C 4C1
Phone/Fax: 604-757-3158 / (604) 757-4731
http://www.EMSL.com / vancouverlab@EMSL.com

EMSL Canada Order 691500326
Customer ID: 55DCSL97
Customer PO: 702358-004
Project ID:

Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

Client Sample ID: B2B **Lab Sample ID:** 691500326-0007
Sample Description: WOOD ROOM BULKHEAD/DWJC

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	11/27/2015	White	0%	99%	1% Chrysotile	

Client Sample ID: B2C **Lab Sample ID:** 691500326-0008
Sample Description: N.W. ROOM NORTH CORNER/DWJC

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	11/25/2015	White	0%	100%	None Detected	

Client Sample ID: B3 **Lab Sample ID:** 691500326-0009
Sample Description: N.E. BULKHEAD/DWJC

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	11/27/2015	White	0%	99%	1% Chrysotile	

Client Sample ID: B4 **Lab Sample ID:** 691500326-0010
Sample Description: BY OFFICE ENTRANCE/PIPE ELBOW INSULATION

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	11/27/2015	Gray	10%	90%	None Detected	

Client Sample ID: B5 **Lab Sample ID:** 691500326-0011
Sample Description: UNDER TABLE NORTH/12" VFT + MASTIC

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	11/27/2015	Gray	0%	99%	1% Chrysotile	

Client Sample ID: B5 - Mastic **Lab Sample ID:** 691500326-0011A
Sample Description: UNDER TABLE NORTH/12" VFT + MASTIC

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	11/27/2015	Black	0%	99%	1% Chrysotile	

Client Sample ID: B6 **Lab Sample ID:** 691500326-0012
Sample Description: UNDER TABLE CENTRE/12" VFT + MASTIC

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	11/27/2015	Gray	0%	99%	1% Chrysotile	

Client Sample ID: B6 - Mastic **Lab Sample ID:** 691500326-0012A
Sample Description: UNDER TABLE CENTRE/12" VFT + MASTIC

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	11/27/2015	Black	0%	99%	1% Chrysotile	

EMSL Canada Inc.

4506 Dawson Street Burnaby, BC V5C 4C1
Phone/Fax: 604-757-3158 / (604) 757-4731
http://www.EMSL.com / vancouverlab@EMSL.com

EMSL Canada Order 691500326
Customer ID: 55DCSL97
Customer PO: 702358-004
Project ID:

Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

Client Sample ID: B7A ***Lab Sample ID:*** **691500326-0013**
Sample Description: CENTRE/GREY LEVELING COMPOUND

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	11/27/2015	Gray	0%	100%	None Detected	

Client Sample ID: B7B ***Lab Sample ID:*** **691500326-0014**
Sample Description: WEST/GREY LEVELING COMPOUND

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	11/27/2015	Gray	0%	100%	None Detected	

Client Sample ID: B7C ***Lab Sample ID:*** **691500326-0015**
Sample Description: NORTH/GREY LEVELING COMPOUND

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	11/25/2015	Gray	0%	100%	None Detected	

Client Sample ID: B8 ***Lab Sample ID:*** **691500326-0016**
Sample Description: OFFICE/12" WHITE/BLUE VFT + TAN MASTIC

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	11/27/2015	White	0%	100%	None Detected	

Client Sample ID: B8 - Mastic ***Lab Sample ID:*** **691500326-0016A**
Sample Description: OFFICE/12" WHITE/BLUE VFT + TAN MASTIC

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	11/27/2015	Brown	0%	100%	None Detected	

Client Sample ID: B9 ***Lab Sample ID:*** **691500326-0017**
Sample Description: OFFICE/2' X 4' CEILING TILE

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	11/27/2015	Gray	20%	80%	None Detected	

Client Sample ID: B10 ***Lab Sample ID:*** **691500326-0018**
Sample Description: CEILING/GREY DUCT MASTIC

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	11/27/2015	Gray	0%	100%	None Detected	

EMSL Canada Inc.

4506 Dawson Street Burnaby, BC V5C 4C1
Phone/Fax: 604-757-3158 / (604) 757-4731
http://www.EMSL.com / vancouverlab@EMSL.com

EMSL Canada Order 691500326
Customer ID: 55DCSL97
Customer PO: 702358-004
Project ID:

Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

Analyst(s):

Alice Feng PLM (17)
Kathleen Cruz PLM (5)

Reviewed and approved by:

Alice Feng, Laboratory Manager
or Other Approved Signatory

None Detected = <0.5%. EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client. Samples received in good condition unless otherwise noted. This report must not be used to claim product endorsement by NVLAP of any agency of the U.S. Government.

Samples analyzed by EMSL Canada Inc. Burnaby, BC

Initial report from: 11/27/201516:22:46

EMSL Canada Inc.

4506 Dawson Street Burnaby, BC V5C 4C1
Phone/Fax: 604-757-3158 / (604) 757-4731
http://www.EMSL.com / vancouverlab@EMSL.com

EMSL Canada Order 691600122
Customer ID: 55DCSL97
Customer PO: 702358-004
Project ID:

Attn: Paul Smith
ARCADIS Canada Inc.
121 Granton Drive
Unit 12
Richmond Hill, ON L4B 3N4

Proj: 702358-004

Phone: (905) 882-5984
Fax: (905) 882-8962
Collected: 2/ 8/2016
Received: 2/12/2016
Analyzed: 2/19/2016

Test Report: Asbestos Analysis of Bulk Materials for Ontario Regulation 278/05 via EPA600/R-93/116 Method

Client Sample ID: B11A **Lab Sample ID:** 691600122-0001
Sample Description: Room 237/Grey Duct Mastic

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	2/18/2016	Gray	0%	100%	None Detected	

Client Sample ID: B11B **Lab Sample ID:** 691600122-0002
Sample Description: Room 237/Grey Duct Mastic

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	2/19/2016	Gray	0.0%	100%	None Detected	

Client Sample ID: B12A **Lab Sample ID:** 691600122-0003
Sample Description: Room 239/White 2'x4' Ceiling Tile

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	2/18/2016	Tan	80%	20%	None Detected	

Client Sample ID: B12B **Lab Sample ID:** 691600122-0004
Sample Description: Room 238/White 2'x4' Ceiling Tile

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	2/18/2016	Tan	80%	20%	None Detected	

Client Sample ID: B13A-Tile **Lab Sample ID:** 691600122-0005
Sample Description: Room 238/White 12" Vinyl Floor Tile

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	2/18/2016	White	0%	100%	None Detected	

Client Sample ID: B13A-Mastic **Lab Sample ID:** 691600122-0005A
Sample Description: Room 238/White 12" Vinyl Floor Tile

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	2/18/2016	Yellow	0%	100%	None Detected	

Client Sample ID: B13B-Tile **Lab Sample ID:** 691600122-0006
Sample Description: Room 237/White 12" Vinyl Floor Tile

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	2/19/2016	White	0.0%	100%	None Detected	

EMSL Canada Inc.

4506 Dawson Street Burnaby, BC V5C 4C1
Phone/Fax: 604-757-3158 / (604) 757-4731
http://www.EMSL.com / vancouverlab@EMSL.com

EMSL Canada Order 691600122
Customer ID: 55DCSL97
Customer PO: 702358-004
Project ID:

Test Report: Asbestos Analysis of Bulk Materials for Ontario Regulation 278/05 via EPA600/R-93/116 Method

Client Sample ID: B13B-Mastic ***Lab Sample ID:*** **691600122-0006A**
Sample Description: Room 237/White 12" Vinyl Floor Tile

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	2/19/2016	Yellow	0%	100%	None Detected	

Client Sample ID: B14A-Tile ***Lab Sample ID:*** **691600122-0007**
Sample Description: Room 240/White 12" Vinyl Floor Tile

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	2/18/2016	White	0%	100%	None Detected	

Client Sample ID: B14A-Mastic ***Lab Sample ID:*** **691600122-0007A**
Sample Description: Room 240/White 12" Vinyl Floor Tile

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	2/18/2016	Yellow	0%	100%	None Detected	

Client Sample ID: B14B-Tile ***Lab Sample ID:*** **691600122-0008**
Sample Description: Room 240/White 12" Vinyl Floor Tile

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	2/19/2016	White	0.0%	100%	None Detected	

Client Sample ID: B14B-Mastic ***Lab Sample ID:*** **691600122-0008A**
Sample Description: Room 240/White 12" Vinyl Floor Tile

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	2/19/2016	Yellow	0%	100%	None Detected	

Client Sample ID: B15A ***Lab Sample ID:*** **691600122-0009**
Sample Description: Room 247/Mechanical Insulation

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	2/18/2016	Gray	35%	65%	None Detected	

Client Sample ID: B15B ***Lab Sample ID:*** **691600122-0010**
Sample Description: Hallway 241/Mechanical Insulation

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	2/18/2016	Gray	35%	65%	None Detected	

Client Sample ID: B15B-Canvas ***Lab Sample ID:*** **691600122-0010A**
Sample Description: Hallway 241/Mechanical Insulation

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	2/18/2016	White/Beige	67%	33%	None Detected	

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EMSL Canada Order 691600122
Customer ID: 55DCSL97
Customer PO: 702358-004
Project ID:

Test Report: Asbestos Analysis of Bulk Materials for Ontario Regulation 278/05 via EPA600/R-93/116 Method

Client Sample ID: B16 ***Lab Sample ID:*** **691600122-0011**

Sample Description: Hallway 241/Wall Caulking

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	2/18/2016	Gray/White	0%	100%	None Detected	
PLM Grav. Reduction	2/19/2016	Gray/White	0.0%	100%	None Detected	

Client Sample ID: B17 ***Lab Sample ID:*** **691600122-0012**

Sample Description: Room 237/Pipe Canvas

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	2/18/2016	White	75%	25%	None Detected	

Analyst(s):

Alice Feng PLM (14)
PLM Grav. Reduction (4)

Reviewed and approved by:

Alice Feng, Laboratory Manager
or Other Approved Signatory

None Detected = <0.5%. EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client. Samples received in good condition unless otherwise noted. This report must not be used to claim product endorsement by NVLAP of any agency of the U.S. Government.

Samples analyzed by EMSL Canada Inc. Burnaby, BC

Initial report from: 02/19/201617:20:12

EMSL Canada Inc.
2756 Slough Street, Mississauga, ON L4T 1G3
Phone/Fax: 289-997-4602 / (289) 997-4607
http://www.EMSL.com torontolab@emsl.com

EMSL Canada Or	551512249
CustomerID:	55DCSL97
CustomerPO:	702358-004
ProjectID:	

Attn: **Paul Smith**
ARCADIS Canada Inc.
121 Granton Drive
Unit 12
Richmond Hill, ON L4B 3N4

Phone:	(905) 882-5984
Fax:	(905) 882-8962
Received:	11/24/15 10:11 AM
Collected:	

Project: **702358-004**

Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

Client Sample Description	*Lab ID*	*Collected*	*Analyzed*	*Lead Concentration*
L1	*551512249-0001*		11/25/2015	190 mg/Kg
	Site: WALLS- WHITE			
L2	*551512249-0002*		11/25/2015	670 mg/Kg
	Site: DOOR TRIM- BLUE/RED/WHITE			
L3	*551512249-0003*		11/25/2015	10000 mg/Kg
	Site: DOORS-GREY/RED			

Lisa Podzyhun
or other approved signatory

*Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.010 % wt based on the minimum sample weight per our SOP. Unless noted, results in this report are not blank corrected. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities. Samples received in good condition unless otherwise noted. "<" (less than) result signifies that the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. The QC data associated with the sample results included in this report meet the recovery and precision requirements established by the AIHA-LAP, unless specifically indicated otherwise.

Samples analyzed by EMSL Canada Inc. Mississauga, ON A2LA Accredited Environmental Testing Cert #2845.08

Initial report from 11/30/2015 08:45:17

ARCADIS

Hazardous Materials Survey
Mission Institution Hobby Shop (Room 248)
Mission, British Columbia

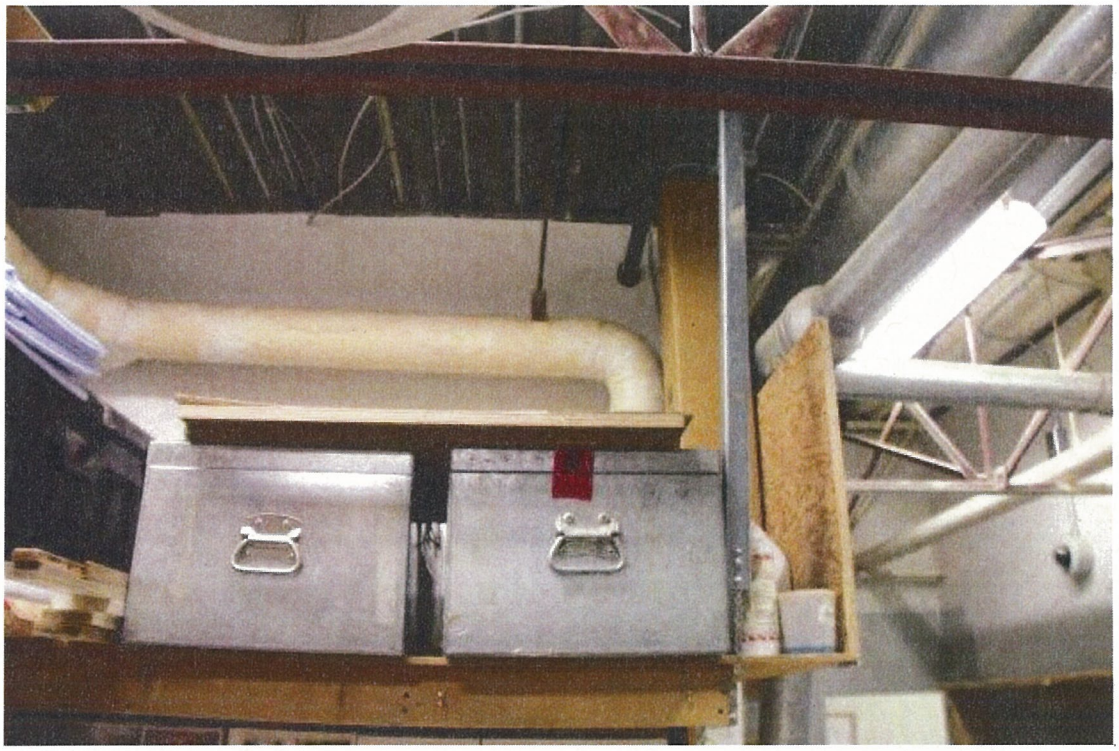
Appendix C

Photographs

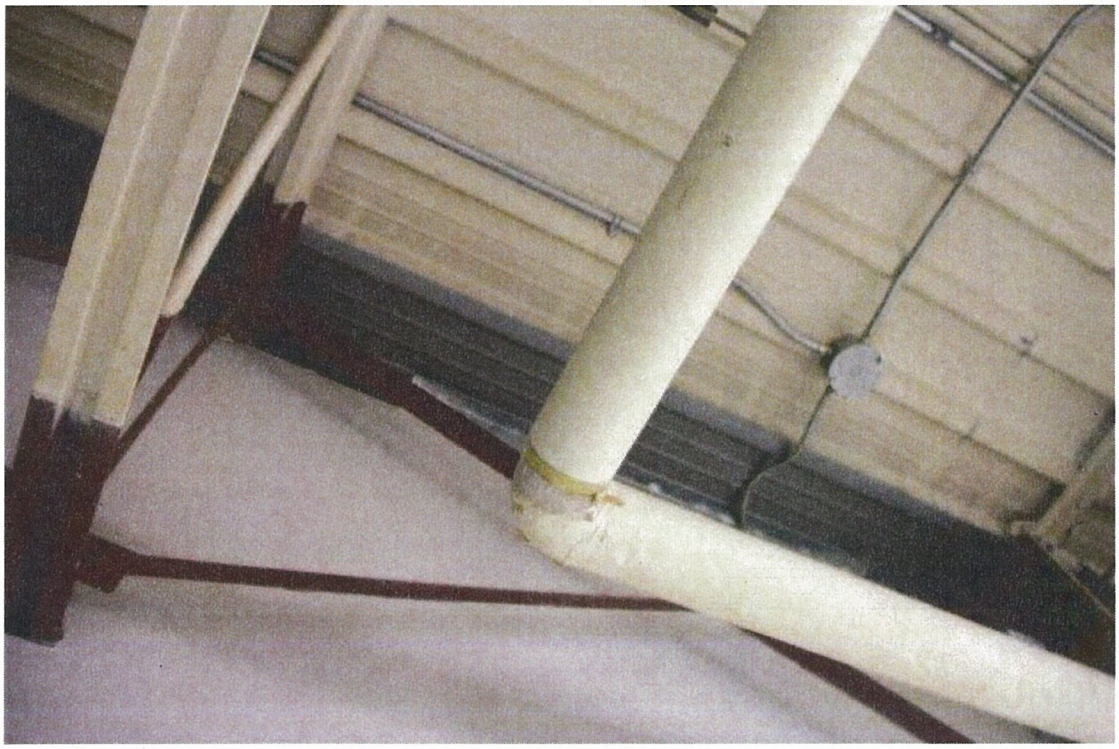
Hobby Shop

Southwest corner (Room 248) - Foam firestop.

Northeast corner (Room 248) – pipe insulation – elbow.



Northeast corner (Room 248) – pipe insulation – elbow.



Above office door – pipe elbow insulation.

Traces of floor tile under sink in Room 248.

Room 247C – Traces of floor tile same as the rest of the floor (grey 12" VFT samples B5 and B6) – tiles are just painted red. Asbestos-containing mastic exposed inside 247C, also in 247A and 247B damaged. About 250 ft² total floor tile, about 350 ft² mastic – randomly scattered.

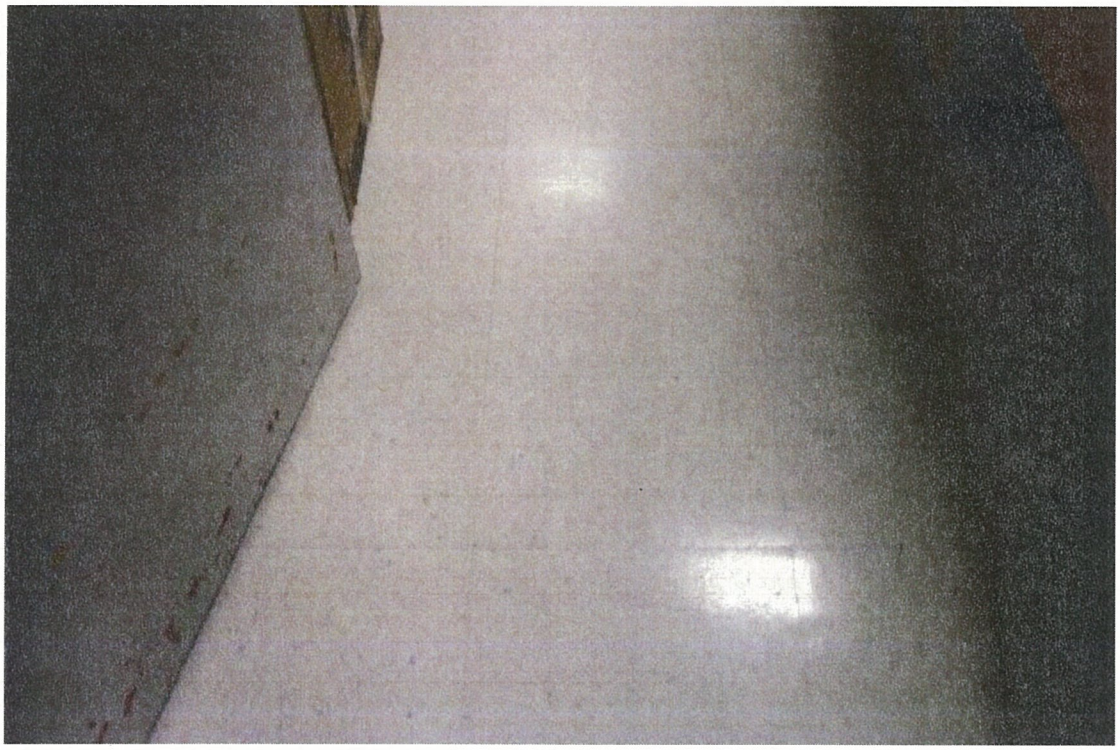
Room 247C and under lockers – traces of floor tile same as the rest of the floor (grey 12" VFT Samples B5 and B6) – tiles are just painted red.

Centre of Hobby Shop – traces of floor tile, grey floor paint.

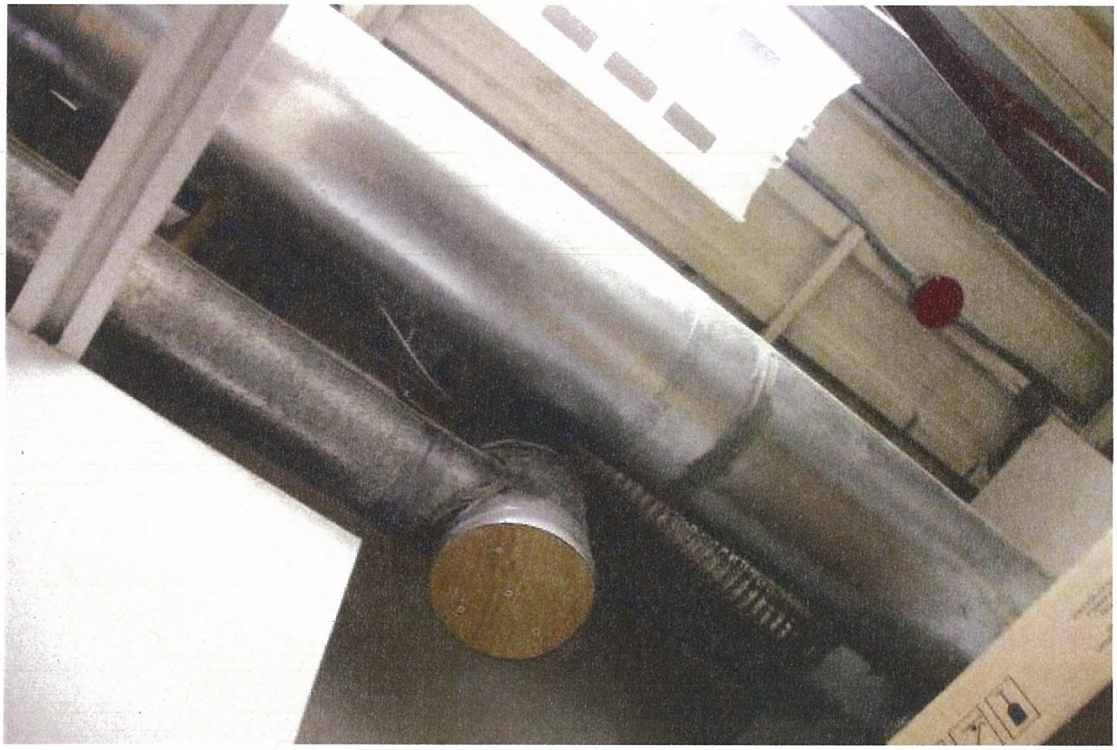
Centre of Hobby Shop – traces of floor tile, grey floor paint.

Room 247C – damaged drywall mud – north wall.

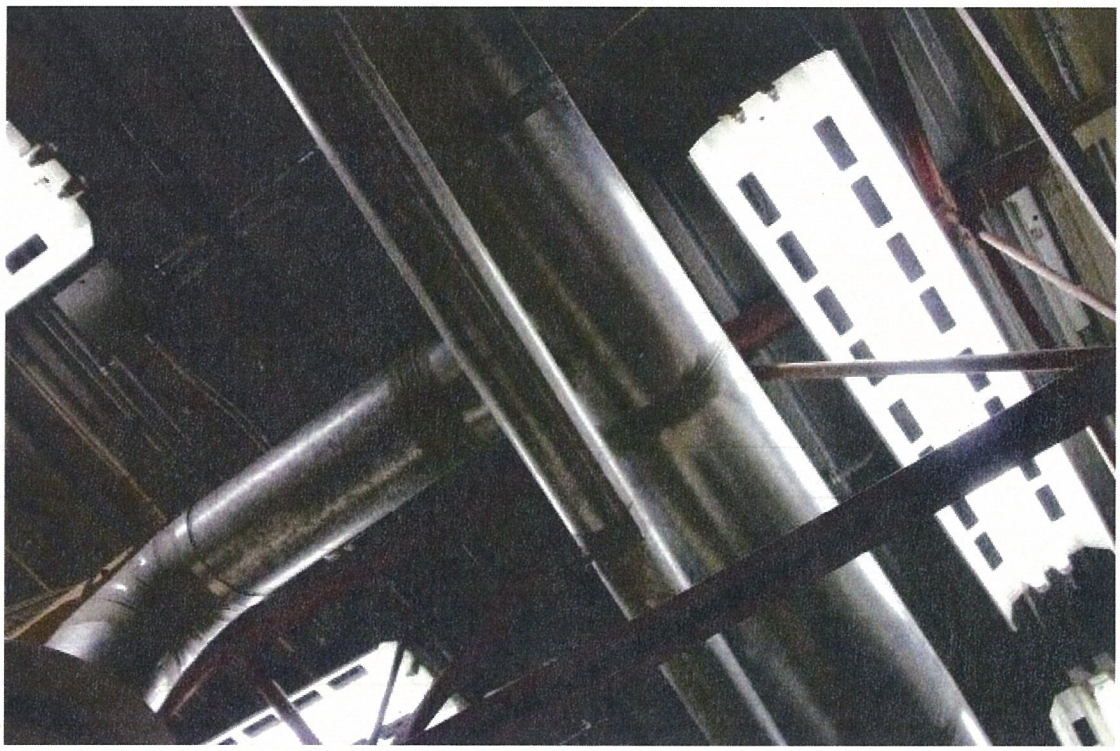
Room 247C – damaged drywall mud – north wall.



Office – Room 236 white/blue floor tile.



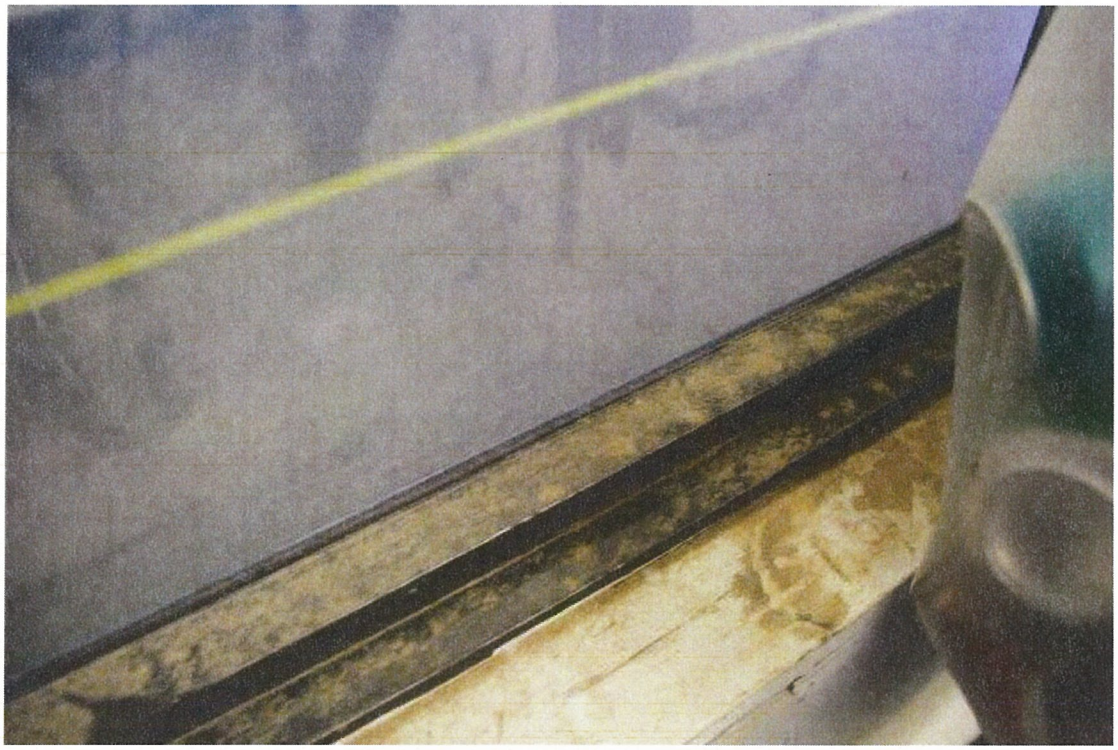
Grey duct mastic on air ducts throughout.



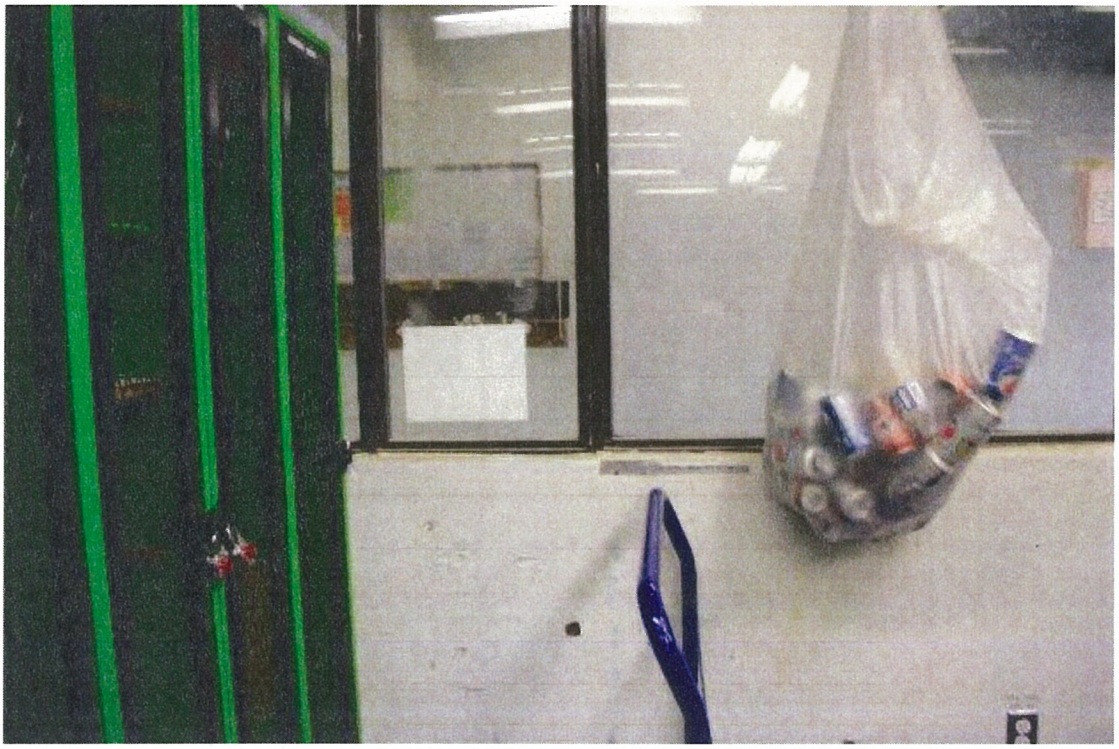
Grey duct mastic on air ducts throughout.

Traces of grey floor tile and exposed mastic throughout perimeter of Hobby Shop (Room 248).

Traces of grey floor tile and exposed mastic throughout perimeter of Hobby Shop and under tables.



No mastic on north windows.



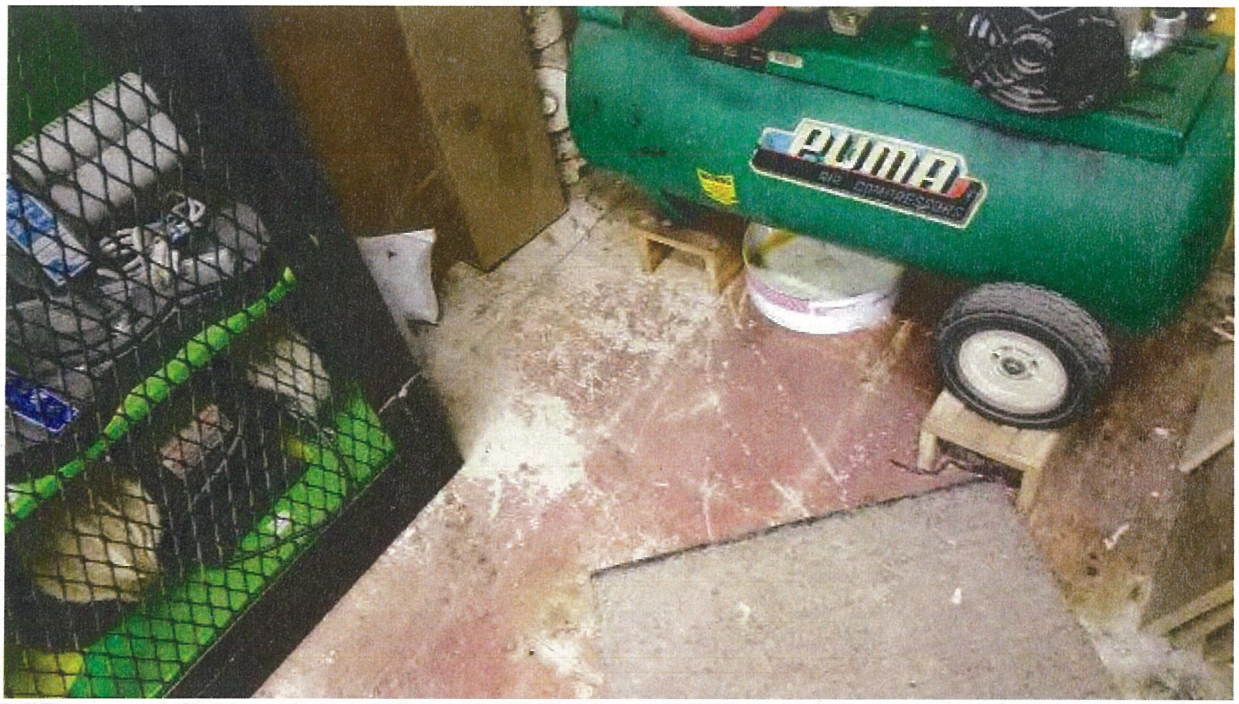
Damaged drywall on north windows.

Damaged drywall on office entrance.

Southwest corner of Hobby Shop.

Southeast exit of Hobby Shop.

Pipe lagging – fibreglass.

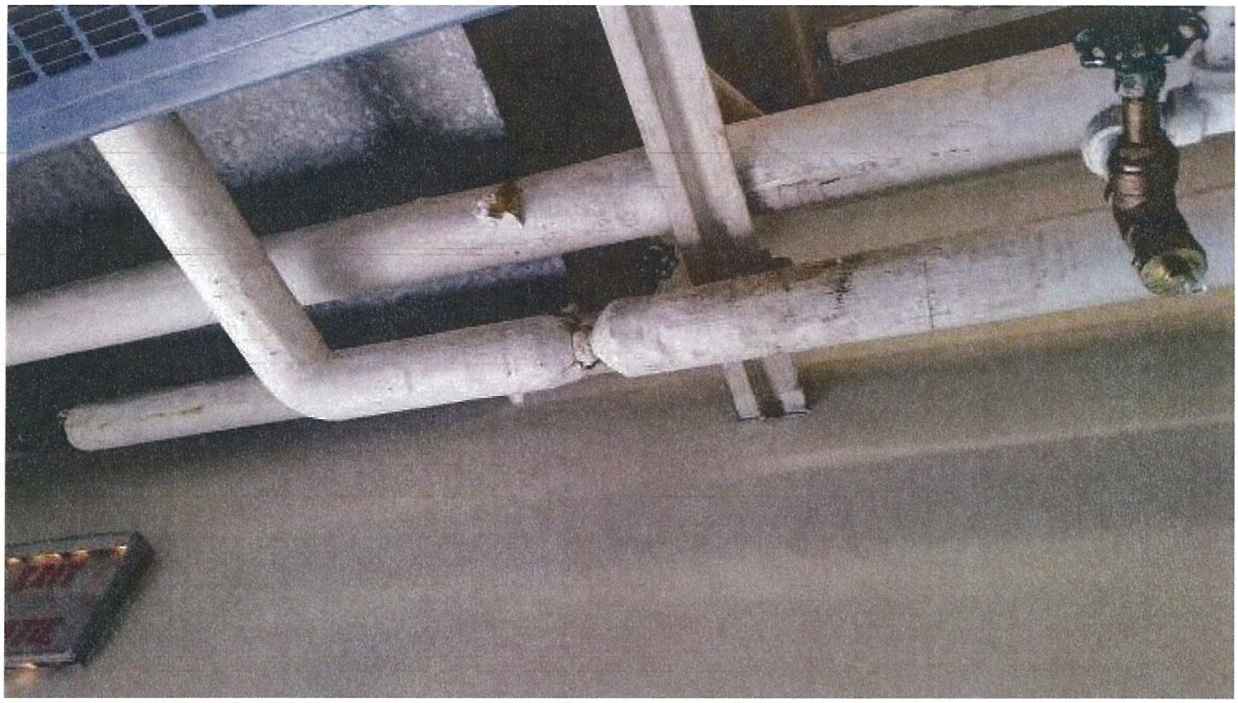


Known asbestos floor tiles in 247 – with red paint on top – minor damage.

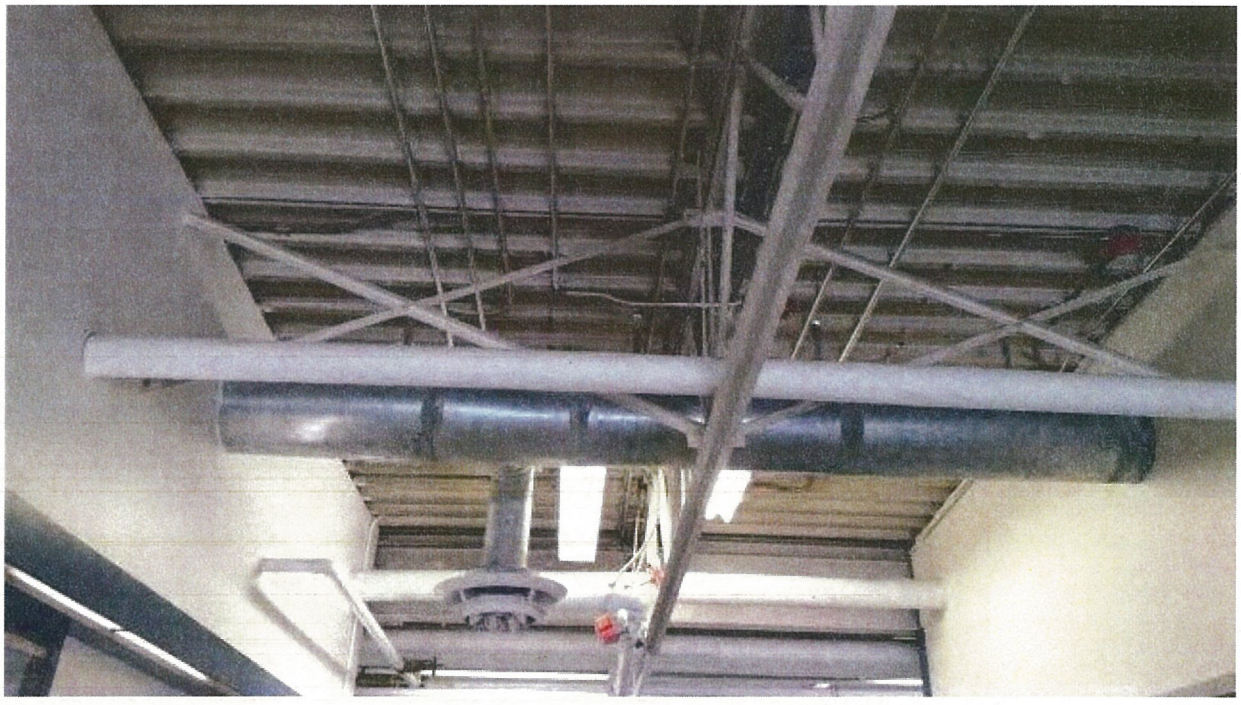
Some missing, damaged asbestos floor tiles in 247A.

Fibreglass pipe lagging.

T8 light tubes throughout.



Damaged pipe insulation at valve in Room 241 – mechanical insulation – Sample B15B.

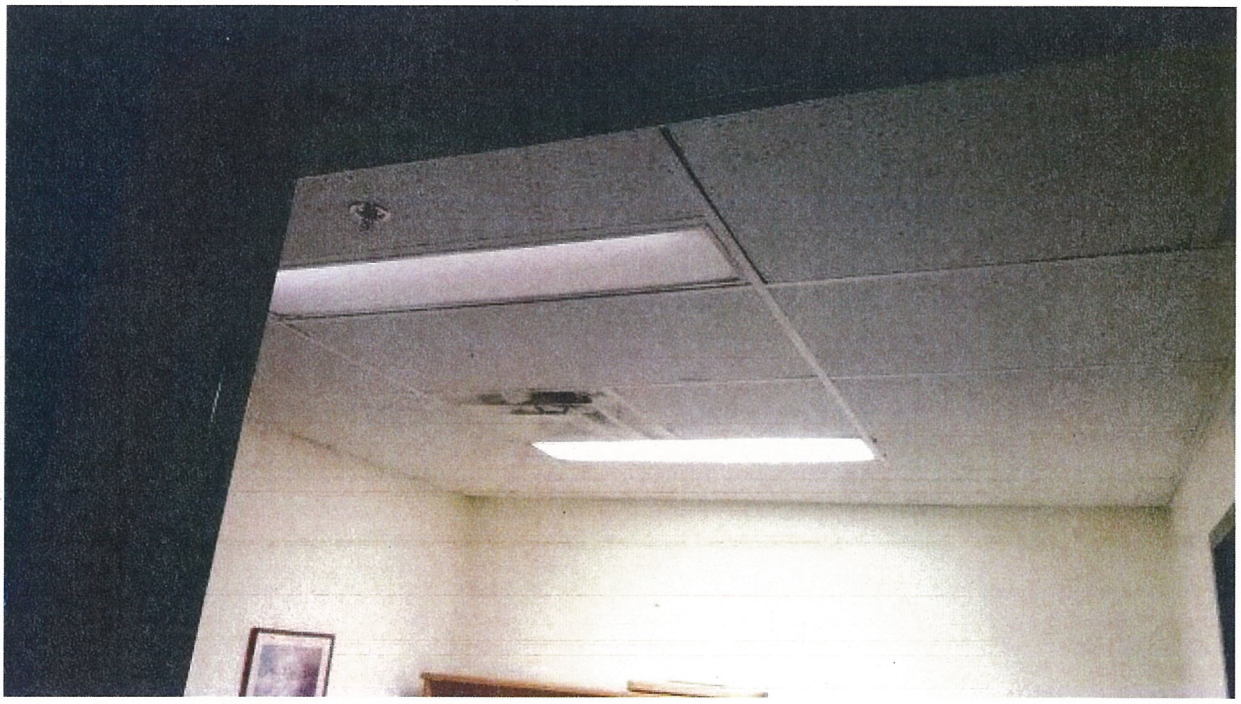


Grey duct insulation in Hallway 241.

Drywall in barber shop (Room 245).

Floor tiles in Rooms 240 and 245 – Samples B14A and B14B.

Grey duct mastic in ceiling ducts (Room 237).



Ceiling tiles (Room 249).

Ceiling tiles (Room 238).

Sample B5 – floor tile same as 238 that was previously sampled – non ACM.

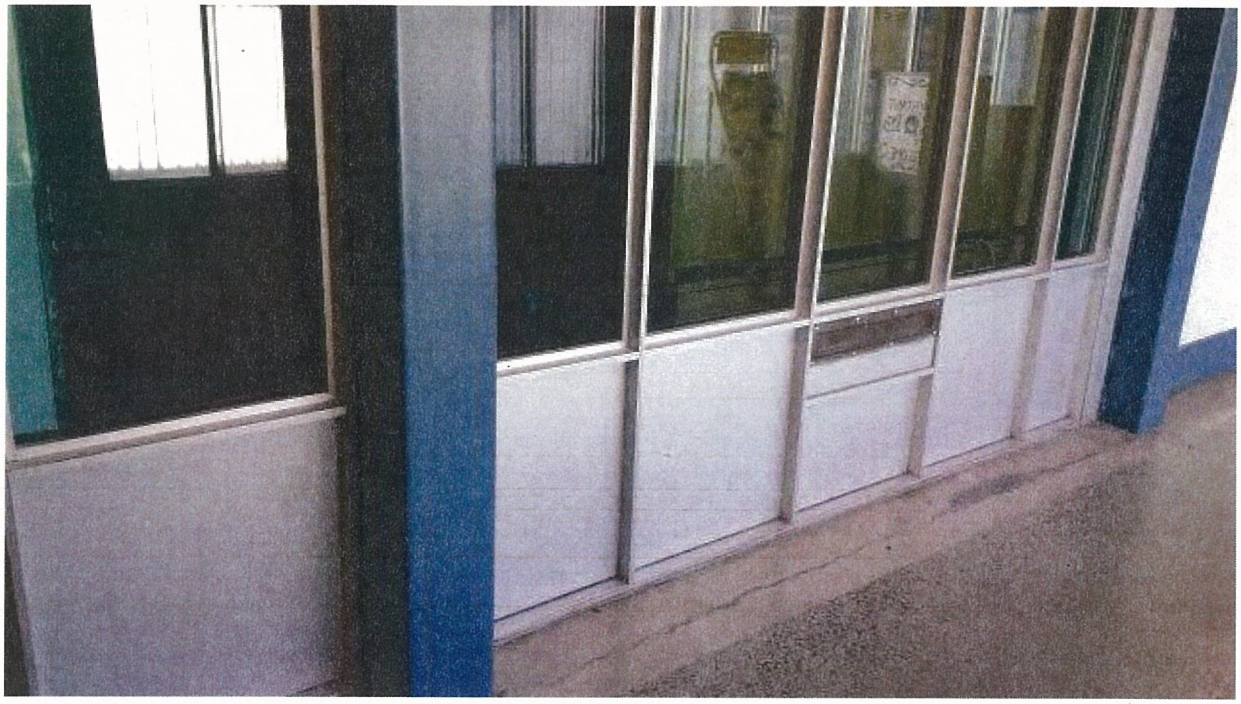
T8 lights throughout.

Fibreglass pipe insulation.

Fibreglass insulation around roof drain.

Metal structure above doors and windows (Hallway 216).

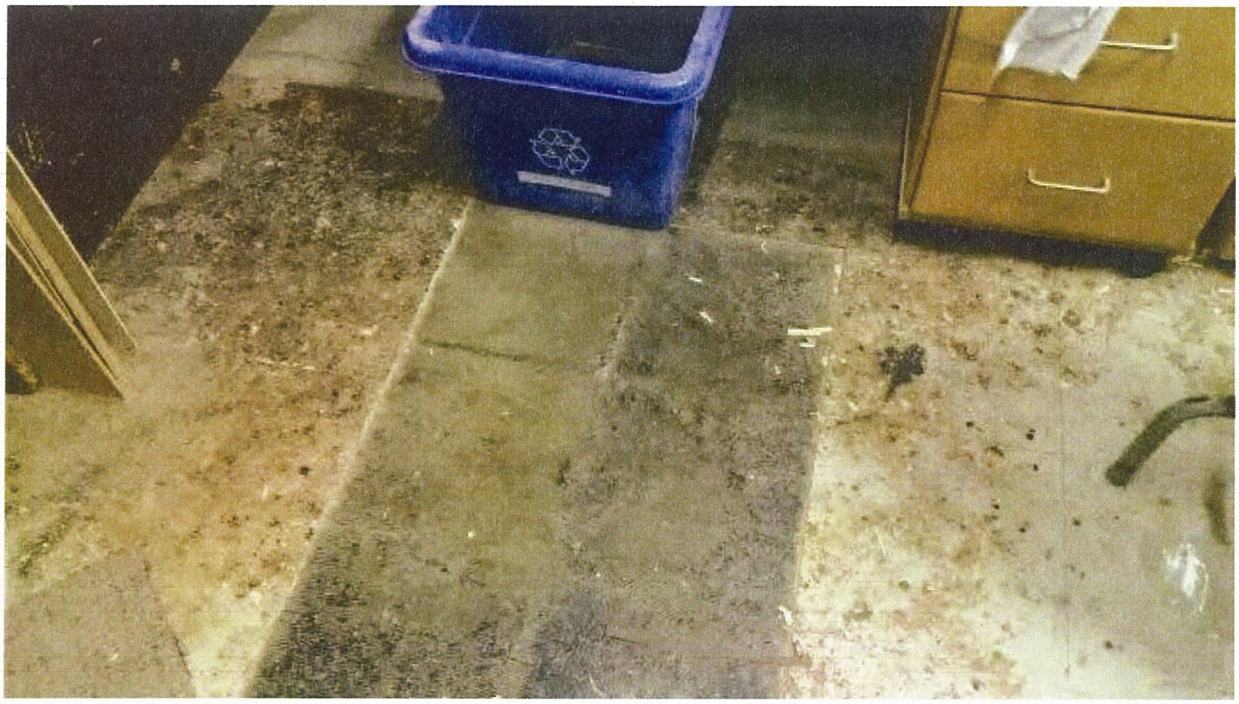
No drywall in Hallway 216.



No mastic – rubber seals only.

Minor water staining on ceiling tiles (in Room 238).

Damaged pipe insulation in Room 247 - Sample B15A.



Some areas of missing floor tiles in 247A – not damaged – Known ACM.