Public Works and Government Services Canada

Requisition Number: EZ899-170526/A

MERX 1.0. Number:

SPECIFICATIONS for:

Pacific Forestry Centre
506 West Burnside Road
Victoria, BC

Upgrade Cold Rooms 4,5,6

Project Number: **R.076290.001**

REGISTERED ARCHITECT
TONY GILL
BRITISH COLUMBIA

DEC 2 2 2015

APPROVED BY:

Regional Manager, AES — Date: 2016-06-08

Construction Safety Coordinator — Date: 2016-02-29

TENDER:

Project Manager — Date: 2016-03-01

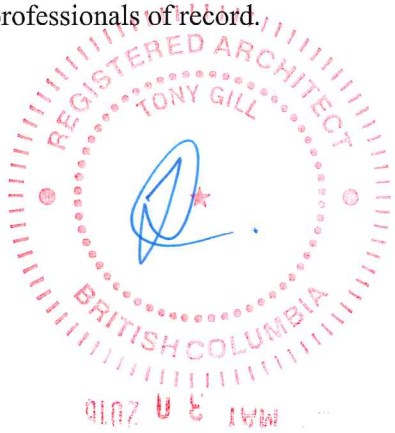
END OF SECTION

1.1 DESIGN PROFESSIONALS OF RECORD

.1 Architect

.1 IBI Group, Tony Gill

.2 Responsible for Divisions 01-44 as applicable to the project, except where indicated as prepared by other design professionals of record.



.2 Mechanical Engineer

.1 MCW Consultants Ltd., Sam Louie

.2 Responsible for Divisions 20-23 as applicable to the project.

.3 Electrical Engineer

.1 MCW Consultants Ltd., Erik Mak

.2 Responsible for Divisions 26, 28 as applicable to the project.

END OF SECTION

Part 1 General

1.1 WORK COVERED BY CONTRACT DOCUMENTS

.1 Work of this Contract comprises removal of existing cold rooms and equipment and installation of new cold rooms and equipment at the Pacific Forestry Centre, located at 506 West Burnside Road, Victoria, BC and further identified as:

Pacific Forestry Centre
Upgrade Cold Rooms 4, 5, 6
Project: R.076290.001

1.2 CONTRACT METHOD

.1 Construct Work under stipulated price.

1.3 SCHEDULE

.1 Complete Work within twelve (12) weeks of award of Contract.

1.4 WORK BY OTHERS

.1 Other projects will be in progress at the same time as the Work of this Contract. Co-operate with other Contractors in carrying out their respective Work and carry out instructions from Departmental Representative.

.2 Work around and coordinate access, material deliveries, etc. with other projects to ensure traffic congestion or delays do not occur.

.3 Additional delays, coordination or other costs shall be included by the contractor as part of this project.

.4 Co-operate with other Contractors in carrying out their respective works and carry out instructions from Departmental Representative.

1.5 WORK SEQUENCE

.1 Construct Work in stages to accommodate Owner's continued use of premises during construction.

.2 Co-ordinate Progress Schedule and co-ordinate with Owner Occupancy during construction.

.3 Required stages:

.1 Phase 1: Cold Rooms 1,2,3; refer to drawings.

.2 Phase 2: Cold Rooms 4,5,6; refer to drawings

1.6 CONTRACTOR USE OF PREMISES

.1 Limit use of premises for Work to allow:

.1 Owner occupancy.

.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.

.4 Remove or alter existing work to prevent injury or damage to portions of existing work which remain.

.5 Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as directed by Departmental Representative.

.6 At completion of operations condition of existing work: equal to or better than that which existed before new work started.

1.7 OWNER OCCUPANCY

.1 Owner will occupy premises adjacent to the area of Work during entire construction period for execution of normal operations.

.2 Co-operate with Departmental Representative in scheduling operations to minimize conflict and to facilitate Owner usage.

1.8 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 ACCESS AND EGRESS

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

1.2 USE OF SITE AND FACILITIES

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

.2 Maintain existing services to building and provide for personnel and vehicle access.

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

1.3 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

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

1.4 EXISTING SERVICES

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

.2 Where Work involves breaking into or connecting to existing services, give Departmental Representative 48 hours of notice for necessary interruption of mechanical or electrical service throughout course of work. Keep duration of interruptions minimum. Carry out interruptions after normal working hours of occupants, preferably on weekends.

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

1.5 SPECIAL REQUIREMENTS

.1 Carry out noise generating Work Monday to Friday from 16:30 to 07:30 hours and on Saturdays, Sundays, and statutory holidays.

.2 Submit schedule in accordance with Section 01 32 16 - Construction Progress Schedule - Bar (GANTT) Chart.

.3 Ensure Contractor's personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.

.4 Keep within limits of Work and avenues of ingress and egress.

.5 Ingress and egress of Contractor vehicles at site is limited to locations and times as instructed by Departmental Representative.

1.6 SECURITY

.1 Where security has been reduced by Work of Contract, provide temporary means to maintain security.

.2 Contractor's Site Superintendent shall sign out a Contractor pass for each construction crew member at the start of the project. Wear pass visibly at all times while on property. Surrender pass to designated official at the end of the project. Replacement costs of $100 per pass shall be assessed against the Contractor for passes lost during the course of the project.

.3 Contractor's personnel shall be in possession of Government issued picture identification at all times while on property.

1.7 BUILDING SMOKING ENVIRONMENT

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

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE

.1 Schedule and administer project meetings throughout the progress of the work and at the call of Departmental Representative.

.2 Prepare agenda for meetings.

.3 Distribute written notice of each meeting four days in advance of meeting date to Consultant.

.4 Provide physical space and make arrangements for meetings.

.5 Preside at meetings.

.6 Record meeting minutes. Include significant proceedings and decisions. Identify actions by parties.

.7 Reproduce and distribute copies of minutes within three days after meetings and transmit to meeting participants and affected parties not in attendance.

.8 Representative of Contractor, subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

1.2 PRECONSTRUCTION MEETING

.1 Within 10 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.

.2 Representatives of Owner, Consultant, Contractor, major subcontractors, suppliers listed in bid form, field inspectors and supervisors will be in attendance.

.3 Coordinate time and location of meeting and notify parties concerned minimum 5 days before meeting.

.4 Agenda to include:

.1 Appointment of official representative of participants in the Work.

.2 Schedule of Work: in accordance with Construction Progress Schedules.

.3 Schedule of submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.

.4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences in accordance with Section 01 52 00 - Construction Facilities.

.5 Delivery schedule of specified equipment.

.6 Site security in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

.7 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.

.8 Owner provided products and salvaged items as indicated on drawings.

.9 Record drawings in accordance with Section 01 33 00 - Submittal Procedures.

.10 Maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals.

.11 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 - Closeout Submittals.

.12 Monthly progress claims, administrative procedures, photographs, hold backs.

.13 Appointment of inspection and testing agencies or firms.

.14 Insurances, transcript of policies.

1.3 PROGRESS MEETINGS

.1 During course of Work schedule progress meetings regularly once every two weeks.

.2 Contractor, major subcontractors involved in Work, Consultant, and Owner are to be in attendance.

.3 Notify parties minimum 5 days prior to meetings.

.4 Record minutes of meetings and circulate to attending parties and affected parties not in attendance within 7 days after meeting.

.5 Agenda to include the following:

.1 Review, approval of minutes of previous meeting.

.2 Review of Work progress since previous meeting.

.3 Field observations, problems, conflicts.

.4 Problems which impede construction schedule.

.5 Review of off-site fabrication delivery schedules.

.6 Corrective measures and procedures to regain projected schedule.

.7 Revision to construction schedule.

.8 Progress schedule, during succeeding work period.

.9 Review submittal schedules: expedite as required.

.10 Maintenance of quality standards.

.11 Review proposed changes for affect on construction schedule and on completion date.

.12 Other business.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 DEFINITIONS

.1 Activity: element of Work performed during course of Project. Activity normally has expected duration, and expected cost and expected resource requirements. Activities can be subdivided into tasks.

.2 Bar Chart (GANTT Chart): graphic display of schedule-related information. In typical bar chart, activities or other Project elements are listed down left side of chart, dates are shown across top, and activity durations are shown as date-placed horizontal bars. Generally Bar Chart should be derived from commercially available computerized project management system.

.3 Baseline: original approved plan (for project, work package, or activity), plus or minus approved scope changes.

.4 Construction Work Week: Monday to Friday, inclusive, will provide five day work week and define schedule calendar working days as part of Bar (GANTT) Chart submission.

.5 Duration: number of work periods (not including holidays or other nonworking periods) required to complete activity or other project element. Usually expressed as workdays or workweeks.

.6 Master Plan: summary-level schedule that identifies major activities and key milestones.

.7 Milestone: significant event in project, usually completion of major deliverable.

.8 Project Schedule: planned dates for performing activities and the planned dates for meeting milestones. Dynamic, detailed record of tasks or activities that must be accomplished to satisfy Project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.

.9 Project Planning, Monitoring and Control System: overall system operated by Departmental Representative to enable monitoring of project work in relation to established milestones.

1.2 REQUIREMENTS

.1 Ensure Master Plan and Detail Schedules are practical and remain within specified Contract duration.

.2 Plan to complete Work in accordance with prescribed milestones and time frame.

.3 Limit activity durations to maximum of approximately 10 working days, to allow for progress reporting.

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

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit to Departmental Representative within five working days of Award of Contract Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of project progress.

.3 Submit Project Schedule to Departmental Representative within five working days of receipt of acceptance of Master Plan.

1.4 MASTER PLAN

.1 Structure schedule to allow orderly planning, organizing and execution of Work as Bar Chart (GANTT).

.2 Departmental Representative will review and return revised schedules within five working days.

.3 Revise impractical schedule and resubmit within five working days.

.4 Accepted revised schedule will become Master Plan and be used as baseline for updates.

1.5 PROJECT SCHEDULE

.1 Develop detailed Project Schedule derived from Master Plan.

.2 Ensure detailed Project Schedule includes as minimum milestone and activity types as follows:

.1 Award.
.2 Shop Drawings, Samples.
.3 Permits.
.4 Mobilization.
.5 Demolition
.6 Cold Rooms: Walls, Floors and Ceiling.
.7 Metal Shelving.
.8 Plumbing.
.9 Lighting.
.10 Electrical.
.11 Piping.
.12 Controls.
.13 Heating, Ventilating, and Air Conditioning.
.14 Testing and Commissioning.
.15 Supplied equipment long delivery items.
.16 Engineer supplied equipment required dates.

1.6 PROJECT SCHEDULE REPORTING

.1 Update Project Schedule on weekly basis reflecting activity changes and completions, as well as activities in progress.

.2 Include as part of Project Schedule, narrative report identifying Work status to date, comparing current progress to baseline, presenting current forecasts, defining problem areas, anticipated delays and impact with possible mitigation.

1.7 PROJECT MEETINGS

.1 Discuss Project Schedule at regular site meetings, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.

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

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE

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

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

.3 Present shop drawings, product data, samples and mock-ups in SI Metric units.

.4 Where items or information is not produced in SI Metric units converted values are acceptable.

.5 Review submittals prior to submission to Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.

.6 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

.7 Verify field measurements and affected adjacent Work are co-ordinated.

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

.9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.

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

1.2 SHOP DRAWINGS AND PRODUCT DATA

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

.2 Submit drawings stamped and signed by professional engineer registered or licensed in British Columbia.

.3 Submissions shall be electronic, readable in pdf format.

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

.5 Allow seven (7) days for Departmental Representative's review of each submission.

.6 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.

.7 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions other than those requested.

.8 Accompany submissions with transmittal letter, in duplicate, containing:

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

.9 Submissions include:

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

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

.11 Submit of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.

.12 Submit product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.

.13 Submit test reports for requirements requested in specification Sections and as requested by Departmental Representative.

- .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.

.2 Testing must have been within 3 years of date of contract award for project.

.14 Submit certificates for requirements requested in specification Sections and as requested by Departmental Representative.

.1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.

.2 Certificates must be dated after award of project contract complete with project name.

.15 Submit manufacturer’s instructions for requirements requested in specification Sections and as requested by Departmental Representative.

.1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.

.16 Submit Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.

.17 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.

.18 Submit Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.

.19 Delete information not applicable to project.

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

.21 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, submissions will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

.22 The review of shop drawings by Public Works and Government Services Canada (PWGSC) is for sole purpose of ascertaining conformance with general concept.

.1 This review shall not mean that PWGSC approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.

.2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

1.3 SAMPLES

.1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.

.2 Deliver samples prepaid to Departmental Representative's business address site office.

.3 Notify Departmental Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.

.4 Where colour, pattern or texture is criterion, submit full range of samples.

.5 Adjustments made on samples by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.

.6 Make changes in samples which Departmental Representative may require, consistent with Contract Documents.

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

1.4 MOCK-UPS

.1 Erect mock-ups in accordance with 01 45 00 - Quality Control.

1.5 PHOTOGRAPHIC DOCUMENTATION

.1 Submit digital photography in jpg format, fine resolution as directed by Departmental Representative.

.2 Project identification: name and number of project and date of exposure indicated.

.3 Number of viewpoints: 4 locations.

.1 Viewpoints and their location as determined by Departmental Representative.

.4 Frequency of photographic documentation: as directed by Departmental Representative.

1.6 CERTIFICATES AND TRANSCRIPTS

.1 Immediately after award of Contract, submit WorkSafeBC status.

.2 Submit transcription of insurance immediately after award of Contract.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations

.2 Province of British Columbia

.1 Workers Compensation Act, WorkSafeBC.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit site-specific Health and Safety Plan: Within 7 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:

.1 Results of site specific safety hazard assessment.

.2 Results of safety and health risk or hazard analysis for site tasks and operation found in work plan.

.3 Submit 2 copies of Contractor's authorized representative's work site health and safety inspection reports weekly to Departmental Representative.

.4 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.

.5 Submit copies of incident and accident reports.

.6 Submit WHMIS MSDS - Material Safety Data Sheets.

.7 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 5 days after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative within 5 days after receipt of comments from Departmental Representative.

.8 Departmental Representative's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.

.9 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.

.10 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.

1.3 FILING OF NOTICE

.1 File Notice of Project with WorkSafeBC prior to beginning of Work.

.2 Work zone locations include:

.1 Areas as indicated on drawings.

.3 Contractor shall agree to install proper site separation and identification in order to maintain time and space at all times throughout life of project.

1.4 SAFETY ASSESSMENT

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

1.5 MEETINGS

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

1.6 REGULATORY REQUIREMENTS

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

1.7 PROJECT/SITE CONDITIONS

.1 Work at site will involve contact with:

.1 Hazardous materials as identified in report.

1.8 GENERAL REQUIREMENTS

.1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.

.2 Departmental Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

1.9 RESPONSIBILITY

.1 Contractor shall be the Prime Contractor in accordance with WorkSafeBC.

.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.

1.10 COMPLIANCE REQUIREMENTS

.1 Comply with Workers Compensation Act, B.C. WorkSafeBC.

1.11 UNFORESEEN HAZARDS

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

.2 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, advise Health and Safety co-ordinator and follow procedures in

accordance with Acts and Regulations of the province of British Columbia and advise Departmental Representative verbally and in writing.

1.12 HEALTH AND SAFETY CO-ORDINATOR

.1 Employ and assign to Work, competent and authorized representative as Health and Safety Co-ordinator. Health and Safety Co-ordinator must:

.1 Have working knowledge of occupational safety and health regulations.

.2 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.

.3 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.

.4 Be on site during execution of Work.

1.13 POSTING OF DOCUMENTS

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

1.14 CORRECTION OF NON-COMPLIANCE

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

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

.3 Departmental Representative may stop Work if non-compliance of health and safety regulations is not corrected.

1.15 POWDER ACTUATED DEVICES

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

1.16 WORK STOPPAGE

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

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Definitions:

.1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humans; or degrade environment aesthetically, culturally and/or historically.

.2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

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

.2 Submit 2 copies of WHMIS MSDS.

.3 Before commencing construction activities or delivery of materials to site, submit Environmental Protection Plan for review and approval by Departmental Representative.

.4 Environmental Protection Plan must include comprehensive overview of known or potential environmental issues to be addressed during construction.

.5 Address topics at level of detail commensurate with environmental issue and required construction tasks.

.6 Include in Environmental Protection Plan:

.1 Names of persons responsible for ensuring adherence to Environmental Protection Plan.

.2 Names and qualifications of persons responsible for manifesting hazardous waste to be removed from site.

.3 Names and qualifications of persons responsible for training site personnel.

.4 Descriptions of environmental protection personnel training program.

.5 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use.

.1 Plan to include measures for marking limits of use areas and methods for protection of features to be preserved within authorized work areas.

.6 Spill Control Plan to include procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.

.7 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.

.8 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, are contained on project site.

.9 Contaminant Prevention Plan identifying potentially hazardous substances to be used on job site; intended actions to prevent introduction of such materials into air, water, or ground; and detailing provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.

.10 Waste Water Management Plan identifying methods and procedures for management of discharge of waste waters which are directly derived from construction activities, such, clean-up water, cleaning of paint materials and equipment, disinfection water, hydrostatic test water, and water used in flushing of lines.

.11 Historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands.

.12 Pesticide treatment plan to be included and updated, as required.

1.3 FIRES

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

1.4 DRAINAGE

.1 Ensure water directed into, sewer or drainage systems is free of contaminants and suspended materials.

.2 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

1.5 POLLUTION CONTROL

.1 Maintain temporary erosion and pollution control features installed under this Contract.

.2 Control emissions from equipment and plant in accordance with local authorities' emission requirements.

.3 Prevent sandblasting and other extraneous materials from contaminating air and waterways beyond application area.

.1 Provide temporary enclosures where indicated and where directed by Departmental Representative.

.4 Cover dry materials and rubbish to prevent blowing dust and debris.

1.6 NOTIFICATION

.1 Departmental Representative will notify Contractor in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan.

.2 Contractor: after receipt of such notice, inform Departmental Representative of proposed corrective action and take such action for approval by Departmental Representative.

.1 Take action only after receipt of written approval by Departmental Representative.

.3 Departmental Representative will issue stop order of work until satisfactory corrective action has been taken.

.4 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

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

.2 Ensure public waterways, storm and sanitary sewers remain free of waste and volatile materials disposal.

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

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

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

END OF SECTION

Part 1 General

1.1 REFERENCES AND CODES

.1 Perform Work in accordance with National Building Code of Canada (NBC) and the British Columbia Building Code (BCBC) 2012 including amendments up to tender closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.

.2 Professional Consultants and Engineers shall be using Schedules as provided in the BCBC.

.3 Meet or exceed requirements of:

.1 Contract documents.

.2 Specified standards, codes and referenced documents.

1.2 HAZARDOUS MATERIAL DISCOVERY

.1 Asbestos: demolition of spray or trowel-applied asbestos is hazardous to health. Stop work immediately when material resembling spray or trowel-applied asbestos is encountered during demolition work. Notify Departmental Representative.

.2 Mould: stop work immediately when material resembling mould is encountered during demolition work. Notify Departmental Representative.

1.3 BUILDING SMOKING ENVIRONMENT

.1 Smoking is not permitted anywhere on the property.

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 INSPECTION

.1 Allow Departmental Representative access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.

.2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Departmental Representative instructions, or law of Place of Work.

.3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.

.4 Departmental Representative will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, Departmental Representative shall pay cost of examination and replacement.

1.2 ACCESS TO WORK

.1 Allow inspection/testing agencies access to Work, off site manufacturing and fabrication plants.

.2 Co-operate to provide reasonable facilities for such access.

1.3 PROCEDURES

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

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

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

1.4 REJECTED WORK

.1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Departmental Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.

.2 Make good other Contractor's work damaged by such removals or replacements promptly.

.3 If in opinion of Departmental Representative it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Owner will deduct from Contract Price difference in value between Work performed and that called for by

Contract Documents, amount of which will be determined by Departmental Representative.

1.5 REPORTS

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

.2 Provide copies to subcontractor of work being inspected or tested.

1.6 TESTS AND MIX DESIGNS

.1 Furnish test results and mix designs as requested.

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

1.7 MOCK-UPS

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

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

.3 Prepare mock-ups for Departmental Representative review with reasonable promptness and in orderly sequence, to not cause delays in Work.

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

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

.6 Remove mock-up at conclusion of Work or when acceptable to Departmental Representative.

.7 Mock-ups may remain as part of Work.

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

1.8 MILL TESTS

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

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

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

1.2 INSTALLATION AND REMOVAL

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

.2 Remove from site all such work after use.

1.3 WATER SUPPLY

.1 Departmental Representative will provide continuous supply of potable water for construction use.

1.4 TEMPORARY HEATING AND VENTILATION

.1 Departmental Representative will pay for temporary power during construction for temporary lighting and operating of power tools, to a maximum supply of 230 volts 30 amps.

.2 Temporary power for electric cranes and other equipment requiring in excess of above is responsibility of Contractor.

.3 Provide and maintain temporary lighting throughout project. Ensure level of illumination on all floors and stairs is not less than 162 lx.

.4 Maximum power supply of 230 V, single phase, 60 Hz is available and will be provided for construction use at no cost. Connect to existing power supply in accordance with Canadian Electrical Code.

1.5 TEMPORARY POWER AND LIGHT

.1 Departmental Representative will pay for temporary power during construction for temporary lighting and operating of power tools, to a maximum supply of 230 volts 30 amps.

.2 Temporary power for electric cranes and other equipment requiring in excess of above is responsibility of Contractor.

.3 Provide and maintain temporary lighting throughout project. Ensure level of illumination on all floors and stairs is not less than 162 lx.

.4 Maximum power supply of 230 V, single phase, 60 Hz is available and will be provided for construction use at no cost. Connect to existing power supply in accordance with Canadian Electrical Code.

1.6 TEMPORARY COMMUNICATION FACILITIES

.1 Provide own cell phone during the course of the Work for communication with Departmental Representative

1.7 FIRE PROTECTION

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

.2 Burning rubbish and construction waste materials is not permitted on site.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-S269.2-M1987(R2003), Access Scaffolding for Construction Purposes.

.2 CAN/CSA-Z321-96(R2001), Signs and Symbols for the Occupational Environment.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 INSTALLATION AND REMOVAL

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

.2 Remove from site all such work after use.

1.4 SCAFFOLDING

.1 Scaffolding in accordance with CAN/CSA-S269.2.

.2 Provide and maintain scaffolding, ramps, ladders, platforms, temporary stairs.

1.5 HOISTING

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

.2 Hoists, cranes and lifts to be operated by qualified operator.

1.6 ELEVATORS

.1 Existing permanent elevators not to be used for construction personnel and transporting of materials.

1.7 SITE STORAGE/LOADING

.1 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.

.2 Do not load or permit to load any part of Work with weight or force that will endanger Work.

1.8 CONSTRUCTION PARKING

.1 Parking at rear of the property. Do not occupy any other parking areas without the approval of the Departmental Representative.

1.9 SECURITY

.1 Provide and pay for responsible security personnel to guard site and contents of site after working hours and during holidays.

1.10 OFFICES

.1 Provide office heated to 22 degrees C, lighted 750 lx and ventilated, of sufficient size to accommodate site meetings and furnished with drawing laydown table.

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

1.11 EQUIPMENT, TOOL AND MATERIALS STORAGE

.1 Provide and maintain, in clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.

.2 Locate materials not required to be stored in weatherproof sheds on site in manner to cause least interference with work activities.

1.12 SANITARY FACILITIES

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

.2 Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.

1.13 CONSTRUCTION SIGNAGE.

.1 The use of construction signs is at the sole discretion of the Departmental Representative.

1.14 PROTECTION AND MAINTENANCE OF TRAFFIC

.1 Provide measures for protection and diversion of traffic, including provision of watch-persons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs

.2 Protect travelling public from damage to person and property.

.3 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.

1.15 CLEAN-UP

.1 Remove construction debris, waste materials, packaging material from work site daily.

.2 Store materials resulting from demolition activities that are salvageable.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 Polyethylene film: to CAN/CGSB-51.34.

.2 Canadian Standards Association (CSA International)

.1 CSA O121-08 (R2013), Douglas Fir Plywood (DFP), Includes Update No. 1 (2013)

.2 CSA O141-05 (R2014), Softwood Lumber

.3 Underwriters Laboratories of Canada (ULC)

.1 CSA B111-74(R2003), Wire Nails, Spikes and Staples.

.2 CAN/ULC-S702-09-AM1, Standard for Thermal Insulation Mineral Fibre for Buildings.

.4 Underwriters Laboratories of Canada (ULC)

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

1.2 INSTALLATION AND REMOVAL

.1 Provide temporary controls in order to execute Work expeditiously.

.2 Remove from site all such work after use.

1.3 DUST TIGHT SCREENS

.1 Provide dust tight screens or partitions to localize dust generating activities, and for protection of workers, finished areas of Work and public.

.2 Maintain and relocate protection until such work is complete.

1.4 INSULATED SCREEN

.1 Provide insulated, air tight screen, complete with man sized door.

1.5 PUBLIC TRAFFIC FLOW

.1 Provide and maintain competent signal flag operators, traffic signals, barricades and flares, lights, or lanterns as required to perform Work and protect public.

1.6 FIRE ROUTES

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

1.7 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

.1 Protect surrounding private and public property from damage during performance of Work.

.2 Be responsible for damage incurred.

1.8 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.

.3 Confirm with Departmental Representative locations and installation schedule 10 days prior to installation.

.4 Be responsible for damage incurred due to lack of or improper protection.

1.9 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products

2.1 MATERIALS

.1 Insulated, air tight screen:

.1 Plywood: DFP to CSA O121, 12.5 mm thick.

.2 Solid lumber: 2 x 4 to CSA O141.

.3 Poly vapour barrier: 6 mil poly to CAN/CGSB-51.34.

.4 Insulation: R12 fibrous insulation to CAN/ULC S702.

.5 Door: insulated metal door complete with weatherstripping and locking hardware.

Part 3 Execution

3.1 INSULATED, AIR TIGHT SCREEN

.1 Construct insulated wall, 2x4 framing, DFP both sides, poly VB on warm side complete with insulated man door.

.2 Construct in location as indicated on drawings.

.3 Insulated screen is to be built to facilitate Phasing of cold rooms.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Within text of each specifications section, reference may be made to reference standards.

.2 Conform to these reference standards, in whole or in part as specifically requested in specifications.

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

.4 Cost for such testing will be born by Departmental Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.

1.2 QUALITY

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

.2 Procurement policy is to acquire, in cost effective manner, items containing highest percentage of recycled and recovered materials practicable consistent with maintaining satisfactory levels of competition. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of work.

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

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

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

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

1.3 AVAILABILITY

.1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for items. If delays in supply of products are foreseeable, notify Departmental Representative of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.

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

1.4 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 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.

.5 Touch-up damaged factory finished surfaces to Departmental Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.5 TRANSPORTATION

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

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

1.6 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 will establish course of action.

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

1.7 QUALITY OF WORK

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

.2 Do not employ anyone unskilled in their required duties. Departmental Representative reserves right to require dismissal from site, workers deemed incompetent or careless.

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

1.8 CO-ORDINATION

.1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.

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

1.9 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.

1.10 REMEDIAL WORK

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

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

1.11 LOCATION OF FIXTURES

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

.2 Inform Departmental Representative of conflicting installation. Install as directed.

1.12 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.

1.13 FASTENINGS - EQUIPMENT

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

.2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.

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

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

1.14 PROTECTION OF WORK IN PROGRESS

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

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit written request in advance of cutting or alteration which affects:

- .1 Structural integrity of elements of project.
- .2 Integrity of weather-exposed or moisture-resistant elements.
- .3 Efficiency, maintenance, or safety of operational elements.
- .4 Visual qualities of sight-exposed elements.
- .5 Work of Owner or separate contractor.

.3 Include in request:

- .1 Identification of project.
- .2 Location and description of affected Work.
- .3 Statement on necessity for cutting or alteration.
- .4 Description of proposed Work, and products to be used.
- .5 Alternatives to cutting and patching.
- .6 Effect on Work of Owner or separate contractor.
- .7 Written permission of affected separate contractor.
- .8 Date and time work will be executed.

1.2 MATERIALS

.1 Required for original installation.

.2 Change in Materials: Submit request for substitution in accordance with Section 01 33 00 - Submittal Procedures.

1.3 PREPARATION

.1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.

.2 After uncovering, inspect conditions affecting performance of Work.

.3 Beginning of cutting or patching means acceptance of existing conditions.

.4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.

.5 Provide protection from elements for areas which are to be exposed by uncovering work; maintain excavations free of water.

1.4 EXECUTION

.1 Execute cutting, fitting, and patching to complete Work.

.2 Fit several parts together, to integrate with other Work.

.3 Uncover Work to install ill-timed Work.

.4 Remove and replace defective and non-conforming Work.

.5 Remove samples of installed Work for testing.

.6 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.

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

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

.9 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.

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

.11 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

.12 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.

1.5 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 PROJECT CLEANLINESS

.1 Maintain Work in tidy condition, free from accumulation of waste products and debris, other than that caused by Owner or other Contractors.

.2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Departmental Representative.

.3 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

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

.5 Provide and use marked separate bins for recycling. Refer to Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.6 Dispose of waste materials and debris at licensed facilities.

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

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

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

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

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

1.2 FINAL CLEANING

.1 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.

.2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.

.3 Prior to final review remove surplus products, tools, construction machinery and equipment.

.4 Remove waste products and debris other than that caused by Owner or other Contractors.

.5 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site.

.6 Clean and polish glass, hardware, stainless steel, chrome, enamel, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.

.7 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, ceilings, floors, exterior surfaces.

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

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

.10 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.

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

.12 Remove dirt and other disfiguration from exterior surfaces.

.13 Sweep and wash clean paved areas.

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

1.3 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 WASTE MANAGEMENT GOALS

.1 Prior to start of Work conduct meeting with Departmental Representative to review and discuss PWGSC's waste management goal and Contractor's proposed Waste Reduction Workplan for Construction, Renovation and /or Demolition (CRD) waste to be project generated.

.2 PWGSC's waste management goal: to divert a minimum 75 percent of total Project Waste from landfill sites. Prior to project completion provide Departmental Representative documentation certifying that waste management, recycling, reuse of recyclable and reusable materials have been extensively practiced.

.3 Specific material target percentages for reuse and/or recycling:

.1 Metals: 100%

.2 Mechanical - HVAC: 80%.

.3 Mechanical - plumbing piping: 100%.

.4 Mechanical - fixtures: 80%.

.5 Mechanical - other: 80%.

.6 Electrical - wiring/conduits/boxes: 100%.

.7 Electrical - lighting: 100%.

.8 Electrical - other: 80%.

.9 Miscellaneous - furnishing/specialized equipment: 60%.

.4 Target percentage goals are achievable for waste diversion. Contractor to review and confirm Departmental Representative's Waste Audit acceptable values.

.5 Minimize amount of non-hazardous solid waste generated by project and accomplish maximum source reduction, reuse and recycling of solid waste produced by construction and demolition activities.

.6 Protect environment and prevent environmental pollution damage.

1.2 REFERENCES

.1 Definitions:

.1 Approved/Authorized recycling facility: waste recycler approved by applicable provincial authority or other users of material for recycling approved by the Departmental Representative.

.2 Class III: non-hazardous waste - construction renovation and demolition waste.

.3 Construction, Renovation and/or Demolition (CRD) Waste: Class III solid, non-hazardous waste materials generated during construction, demolition, and/or renovation activities

.4 Inert Fill: inert waste - exclusively asphalt and concrete.

.5 Waste Source Separation Program (WSSP): implementation and co-ordination of ongoing activities to ensure designated waste materials will be sorted into pre-defined categories and sent for recycling and reuse, maximizing diversion and potential to reduce disposal costs.

.6 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.

.7 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.

.8 Recycling: process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

.9 Reuse: repeated use of product in same form but not necessarily for same purpose. Reuse includes:

.1 Salvaging reusable materials from re-modelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.

.2 Returning reusable items including pallets or unused products to vendors.

.10 Salvage: removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.

.11 Separate Condition: refers to waste sorted into individual types.

.12 Source Separation: act of keeping different types of waste materials separate beginning from the point they became waste.

.13 Waste Diversion Report: detailed report of final results, quantifying cumulative weights and percentages of waste materials reused, recycled and landfilled over course of project. Measures success against Waste Reduction Workplan (WRW) goals and identifies lessons learned.

.14 Waste Management Co-ordinator (WMC): contractor representative responsible for supervising waste management activities as well as co-ordinating required submittal and reporting requirements.

.15 Waste Reduction Workplan (WRW): written report which addresses opportunities for reduction, reuse, or recycling of materials generated by project. Specifies diversion goals, implementation and reporting procedures, anticipated results and responsibilities.

.2 Reference Standards:

.1 Public Works and Government Services Canada (PWGSC)

.1 2002 National Construction, Renovation and Demolition Non-Hazardous Solid Waste Management Protocol.

.2 CRD Waste Management Market Research Report (available from PWGSC's Environmental Services).

.3 Sustainable Development Strategy 2007-2009: Target 2.1 Environmentally Sustainable Use of Natural Resources.

1.3 DOCUMENTS

.1 Post and maintain in visible and accessible area at job site, one copy of following documents:

.1 Waste Reduction Workplan (Schedule A).

.2 Waste Source Separation Program (WSSP).

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Prepare and submit following prior to project start-up:

.1 1 copy and 1 electronic copy of completed Waste Reduction Workplan (WRW): Schedule A.

.2 1 copy and 1 electronic copy of Waste Source Separation Program (WSSP).

.3 Prepare and submit on weekly basis, throughout project or at intervals agreed to by Departmental Representative the following:

.1 Receipts, scale tickets, waybills, and/or waste disposal receipts that show quantities and types of materials reused, recycled, or disposed of.

.2 Written once every two weeks summary report detailing cumulative amounts of waste materials reused, recycled and landfilled, and brief status of ongoing waste management activities.

.4 Submit prior to final payment the following:

.1 Waste Diversion Report, indicating final quantities in tones by material types salvaged for reuse, recycling or disposal in landfill and recycling centres, re-use depots, landfills and other waste processors that received waste materials.

.2 Provide receipts, scale tickets, waybills, waste disposal receipts that confirm quantities and types of materials reused, recycled or disposed of and destination.

1.5 WASTE REDUCTION WORKPLAN (WRW)

.1 Prepare and submit WRW (Schedule A) at least 10 days prior to project start-up.

.2 WRW identifies strategies to optimize diversion through reduction, reuse, and recycling of materials and comply with applicable regulations.

.3 WRW should include but not limited to:

.1 Applicable regulations.

.2 Specific goals for waste reduction, identify existing barriers and develop strategies to overcome them.

.3 Destination of materials identified.

.4 Deconstruction/disassembly techniques and schedules.

.5 Methods to collect, separate, and reduce generated wastes.

.6 Location of waste bins on-site.

.7 Security of on-site stock piles and waste bins.

.8 Protection of personnel, sub-contractors.

.9 Clear labelling of storage areas.

.10 Training plan for contractor and sub-contractors.

.11 Details on materials handling and removal procedures.

.12 Recycler and reclaimer requirements.

.13 Quantities of materials to be salvaged for reuse or recycled and materials sent to landfill.

.14 Requirements for monitoring on-site wastes management activities.

.4 Structure WRW to prioritize actions and follow 3R's hierarchy, with Reduction as first priority, followed by Reuse, then Recycle.

.5 Post WRW or summary where workers at site are able to review content.

1.6 WASTE SOURCE SEPARATION PROGRAM (WSSP)

.1 As part of Waste Reduction Workplan, prepare WSSP prior to project start-up.

.2 WSSP will detail methodology and planned on-site activities for separation of reusable and recyclable materials from waste intended for landfill.

.3 Provide list and drawings of locations that will be made available for sorting, collection, handling and storage of anticipated quantities of reusable and recyclable materials.

.4 Provide sufficient on-site facilities and containers for collection, handling, and storage of anticipated quantities of reusable and recyclable materials.

.5 Locate containers to facilitate deposit of materials without hindering daily operations.

.6 Provide training for sub-contractors and workers in handling and separation of materials for reuse and/or recycling.

.7 Locate separated materials in areas which minimizes material damage.

.8 Clearly and securely label containers to identify types/conditions of materials accepted and assist sub-contractors and workers in separating materials accordingly.

.9 Monitor on-site waste management activities by conducting periodic site inspections to verify: state of signage, contamination levels, bin locations and condition, personnel participation, use of waste tracking forms and collection of waybills, receipts and invoices.

.10 On-site sale of salvaged materials is not permitted unless authorized in writing by Departmental Representative and provided that site safety regulations and security requirements are adhered to.

1.7 USE OF SITE AND FACILITIES

.1 Execute Work with minimal interference and disturbance to normal use of premises.

.2 Maintain security measures established by facility provide temporary security measures approved by Departmental Representative.

1.8 WASTE PROCESSING SITES

.1 Contractor is responsible to research and locate waste diversion resources and service providers. Salvaged materials are to be transported off site to approved and/or authorized recycling facilities or to users of material for recycling.

1.9 QUALITY ASSURANCE

.1 After award of Contract, a mandatory site examination will be held for this Project for Contractor and/or sub-contractors responsible for construction, renovation demolition/deconstruction waste management.

.1 Date, time and location will be arranged by Departmental Representative.

.2 Waste Management Meeting: Waste Management Co-ordinator is to provide an update on status of waste diversion and management activities at each project meeting.

1.10 STORAGE, HANDLING AND PROTECTION

.1 Store, materials to be reused, recycled and salvaged in locations as directed by Departmental Representative.

.2 Unless specified otherwise, materials for removal become Contractor's property.

.3 Protect, stockpile, store and catalogue salvaged items.

.4 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.

.5 Protect structural components not removed and salvaged materials from movement or damage.

.6 Support affected structures. If safety of building is endangered, cease operations and immediately notify Departmental Representative.

.7 Protect surface drainage, mechanical and electrical from damage and blockage.

.8 Provide on-site facilities and containers for collection and storage of reusable and recyclable materials.

.9 Separate and store materials produced during project in designated areas.

.10 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated processing facilities.

.1 On-site source separation is recommended.

.2 Remove co-mingled materials to off site processing facility for separation.

.3 Obtain waybills, receipts and/or scale tickets for separated materials removed from site.

.4 Materials reused on-site are considered to be diverted from landfill and as such are to be included in all reporting.

1.11 DISPOSAL OF WASTES

.1 Do not bury rubbish or waste materials.

.2 Do not dispose of waste, volatile materials, mineral spirits, oil, paint thinner, into waterways, storm, or sanitary sewers.

.3 Keep records of construction waste including:

.1 Number and size of bins.

.2 Waste type of each bin.

.3 Total tonnage generated.

.4 Tonnage reused or recycled.

.5 Reused or recycled waste destination.

.4 Remove materials on-site as Work progresses.

.5 Prepare project summary to verify destination and quantities on a material-by-material basis as identified in the waste audit.

1.12 SCHEDULING

.1 Co-ordinate Work with other activities at site to ensure timely and orderly progress of Work.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 APPLICATION

.1 Do Work in compliance with WRW and WSSP.

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

3.2 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

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

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

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

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

.2 Source separate materials to be reused/recycled into specified sort areas.

3.3 DIVERSION OF MATERIALS

.1 From following list, separate materials from general waste stream and stockpile in separate piles or containers, as reviewed by Departmental Representative, and consistent with applicable fire regulations.

.1 Mark containers or stockpile areas.

.2 Provide instruction on disposal practices.

.2 On-site sale of materials is not permitted.

3.4 WASTE DIVERSION REPORT

.1 At completion of Project, prepare written Waste Diversion Report indicating quantities of materials reused, recycled or disposed of as well as the following:

.1 Identify final diversion results and measure success against goals from Waste Reduction Workplan.

.2 Compare final quantities/percentages diverted with initial projections in Waste Audit and Waste Reduction Workplan and explain variances.

.1 Supporting documentation.

.2 Waybills and tracking forms.

.3 Description of issues, resolutions and lessons learned.

3.5 WASTE REDUCTION WORKPLAN (WRW)

.1 Schedule A

(1) Material Category	(2) Person(s) Respon-sible	(3) Total Quantity of Waste (unit)	(4) Reused Amount (units) Projected	Actual	(5) Recycled Amount (unit) Projected	Actual	(6) Material(s) Destina-tion
Metal							
Mechanical HVAC							
Plumbing piping							
Mechanical Fixtures							
Mechanical Other							
Electrical Wiring/conduit/boxes							
Electrical Lighting							
Electrical Other							
Other							

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE REQUIREMENTS

.1 Acceptance of Work Procedures:

.1 Contractor's Inspection: conduct inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.

.1 Notify Departmental Representative in writing of satisfactory completion of Contractor's inspection and submit verification that corrections have been made.

.2 Request Departmental Representative inspection.

.2 Departmental Representative Inspection:

.1 Departmental Representative and Contractor to inspect Work and identify defects and deficiencies.

.2 Contractor to correct Work as directed.

.3 Completion Tasks: submit written certificates in English that tasks have been performed as follows:

.1 Work: completed and inspected for compliance with Contract Documents.

.2 Defects: corrected and deficiencies completed.

.3 Equipment and systems: tested, adjusted balanced and fully operational.

.4 Operation of systems: demonstrated to Owner's personnel.

.5 Work: complete and ready for final inspection.

.4 Final Inspection:

.1 When completion tasks are done, request final inspection of Work by Departmental Representative, and Contractor.

.2 When Work incomplete according to Departmental Representative, complete outstanding items and request re-inspection.

.5 Declaration of Substantial Performance: when Departmental Representative considers deficiencies and defects corrected and requirements of Contract substantially performed, make application for Certificate of Substantial Performance.

.6 Commencement of Lien and Warranty Periods: date of Owner's acceptance of submitted declaration of Substantial Performance to be date for commencement for warranty period and commencement of lien period unless required otherwise by lien statute of Place of Work.

.7 Final Payment:

.1 When Departmental Representative considers final deficiencies and defects corrected and requirements of Contract met, make application for final payment.

.8 Payment of Holdback: after issuance of Certificate of Substantial Performance of Work, submit application for payment of holdback amount in accordance with contractual agreement.

1.2 FINAL CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

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

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

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE REQUIREMENTS

.1 Pre-warranty Meeting:

.1 Convene meeting one week prior to contract completion with Departmental Representative, in accordance with Section 01 31 19 - Project Meetings to:

.1 Verify Project requirements.

.2 Review warranty requirements, manufacturer's installation instructions.

.2 Departmental Representative to establish communication procedures for:

.1 Notifying construction warranty defects.

.2 Determine priorities for type of defects.

.3 Determine reasonable response time.

.3 Contact information for bonded and licensed company for warranty work action: provide name, telephone number and address of company authorized for construction warranty work action.

.4 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work action.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Two weeks prior to Substantial Performance of the Work, submit to the Departmental Representative, four final copies of operating and maintenance manuals in English .

.3 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.

.4 Provide evidence, if requested, for type, source and quality of products supplied.

1.3 FORMAT

.1 Organize data as instructional manual.

.2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.

.3 When multiple binders are used correlate data into related consistent groupings.

.1 Identify contents of each binder on spine.

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

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

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

.7 Text: manufacturer's printed data, or typewritten data.

.8 Drawings: provide with reinforced punched binder tab.

.1 Bind in with text; fold larger drawings to size of text pages.

1.4 CONTENTS - PROJECT RECORD DOCUMENTS

.1 Table of Contents for Each Volume: provide title of project;

.1 Date of submission; names.

.2 Addresses, and telephone numbers of Consultant and Contractor with name of responsible parties.

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

.2 For each product or system:

.1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.

.3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.

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

.5 Typewritten Text: as required to supplement product data.

.1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.

1.5 AS -BUILT DOCUMENTS AND SAMPLES

.1 Maintain, in addition to requirements in General Conditions, at site for Departmental Representative one record copy of:

.1 Contract Drawings.

.2 Specifications.

.3 Addenda.

.4 Change Orders and other modifications to Contract.

.5 Reviewed shop drawings, product data, and samples.

.6 Field test records.

.7 Inspection certificates.

.8 Manufacturer's certificates.

.2 Store record documents and samples in field office apart from documents used for construction.

.1 Provide files, racks, and secure storage.

.3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual.

.1 Label each document "PROJECT RECORD" in neat, large, printed letters.

.4 Maintain record documents in clean, dry and legible condition.

.1 Do not use record documents for construction purposes.

.5 Keep record documents and samples available for inspection by Departmental Representative.

1.6 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

.1 Record information on set of black line opaque drawings, and in copy of Project Manual, provided by Departmental Representative.

.2 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.

.3 Record information concurrently with construction progress.

.1 Do not conceal Work until required information is recorded.

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

.1 Measured depths of elements of foundation in relation to finish first floor datum.

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

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

.4 Field changes of dimension and detail.

.5 Changes made by change orders.

.6 Details not on original Contract Drawings.

.7 References to related shop drawings and modifications.

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

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

.2 Changes made by Addenda and change orders.

.6 Other Documents: maintain inspection certifications, field test records, required by individual specifications sections.

.7 Provide digital photos, if requested, for site records.

1.7 EQUIPMENT AND SYSTEMS

.1 For each item of equipment and each system include description of unit or system, and component parts.

.1 Give function, normal operation characteristics and limiting conditions.

.2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

.2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.

.3 Include installed colour coded wiring diagrams.

.4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.

.1 Include regulation, control, stopping, shut-down, and emergency instructions.

.2 Include summer, winter, and any special operating instructions.

.5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

.6 Provide servicing and lubrication schedule, and list of lubricants required.

.7 Include manufacturer's printed operation and maintenance instructions.

.8 Include sequence of operation by controls manufacturer.

.9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

.10 Provide installed control diagrams by controls manufacturer.

.11 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.

.12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

.13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

.14 Additional requirements: as specified in individual specification sections.

1.8 MATERIALS AND FINISHES

.1 Building products, applied materials, and finishes: include product data, with catalogue number, size, composition, and colour and texture designations.

Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.2 Moisture-protection and weather-exposed products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.3 Additional requirements: as specified in individual specifications sections.

1.9 MAINTENANCE MATERIALS

.1 Spare Parts:

.1 Provide spare parts, in quantities specified in individual specification sections.

.2 Provide items of same manufacture and quality as items in Work.

.3 Deliver to location as directed; place and store.

.4 Receive and catalogue items.

.1 Submit inventory listing to Departmental Representative.

.2 Include approved listings in Maintenance Manual.

.5 Obtain receipt for delivered products and submit prior to final payment.

.2 Extra Stock Materials:

.1 Provide maintenance and extra materials, in quantities specified in individual specification sections.

.2 Provide items of same manufacture and quality as items in Work.

.3 Deliver to location as directed; place and store.

.4 Receive and catalogue items.

.1 Submit inventory listing to Departmental Representative.

.2 Include approved listings in Maintenance Manual.

.5 Obtain receipt for delivered products and submit prior to final payment.

.3 Special Tools:

.1 Provide special tools, in quantities specified in individual specification section.

.2 Provide items with tags identifying their associated function and equipment.

.3 Deliver to location as directed; place and store.

.4 Receive and catalogue items.

.1 Submit inventory listing to Departmental Representative.

.2 Include approved listings in Maintenance Manual.

1.10 DELIVERY, STORAGE AND HANDLING

.1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.

.2 Store in original and undamaged condition with manufacturer's seal and labels intact.

.3 Store components subject to damage from weather in weatherproof enclosures.

.4 Store paints and freezable materials in a heated and ventilated room.

.5 Remove and replace damaged products at own expense and for review by Departmental Representative.

1.11 WARRANTIES AND BONDS

.1 Develop warranty management plan to contain information relevant to Warranties.

.2 Submit warranty management plan, 30 days before planned pre-warranty conference, to Departmental Representative approval.

.3 Warranty management plan to include required actions and documents to assure that Departmental Representative receives warranties to which it is entitled.

.4 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.

.5 Submit, warranty information made available during construction phase, to Departmental Representative for approval prior to each monthly pay estimate.

.6 Assemble approved information in binder, submit upon acceptance of work and organize binder as follows:

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

.2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

.3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.

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

.5 Co-execute submittals when required.

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

.7 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.

.8 Conduct joint 4 month and 9 month warranty inspection, measured from time of acceptance, by Departmental Representative.

.9 Include information contained in warranty management plan as follows:

.1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, subcontractors, manufacturers or suppliers involved.

.2 Listing and status of delivery of Certificates of Warranty for extended warranty items, to include roofs, windows and glazing.

.3 Provide list for each warranted equipment, item, feature of construction or system indicating:

.1 Name of item.

.2 Model and serial numbers.

.3 Location where installed.

.4 Name and phone numbers of manufacturers or suppliers.

.5 Names, addresses and telephone numbers of sources of spare parts.

.6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.

.7 Cross-reference to warranty certificates as applicable.

.8 Starting point and duration of warranty period.

.9 Summary of maintenance procedures required to continue warranty in force.

.10 Cross-Reference to specific pertinent Operation and Maintenance manuals.

.11 Organization, names and phone numbers of persons to call for warranty service.

.12 Typical response time and repair time expected for various warranted equipment.

.4 Contractor's plans for attendance at 4 and 9 month post-construction warranty inspections.

.5 Procedure and status of tagging of equipment covered by extended warranties.

.6 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

.10 Respond in timely manner to oral or written notification of required construction warranty repair work.

.11 Written verification to follow oral instructions.

.1 Failure to respond will be cause for the Departmental Representative to proceed with action against Contractor.

1.12 WARRANTY TAGS

.1 Tag, at time of installation, each warranted item. Provide durable, oil and water resistant tag approved by Departmental Representative.

.2 Attach tags with copper wire and spray with waterproof silicone coating.

.3 Leave date of acceptance until project is accepted for occupancy.

.4 Indicate following information on tag:

.1 Type of product/material.
.2 Model number.
.3 Serial number.
.4 Contract number.
.5 Warranty period.
.6 Inspector's signature.
.7 Construction Contractor.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 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 Sections:

.1 Section 01 33 00 - Submittal Procedures
.2 Section 01 45 00 - Quality Control.
.3 Section 01 91 13 - General Commissioning Cx Requirements
.4 Section 01 91 31- Commissioning (Cx) Plan
.5 Section 01 91 33 - Cx Forms.
.6 Section 23 05 00 - Common Work Results - Mechanical
.7 Section 23 05 93 - Testing, Adjusting And Balancing for HVAC.
.8 Section 23 08 00 - Commissioning of Mechanical Systems
.9 Section 25 05 01 – EMCS General Requirements
.10 Section 25 90 11 – EMCS: Sequence of Operations
.11 Section 26 05 00 - Common Work Results - Electrical.

.3 Acronyms:

.1 AFD - Alternate Forms of Delivery, service provider.
.2 BMM - Building Management Manual.
.3 Cx - Commissioning.
.4 EMCS - Energy Monitoring and Control Systems.
.5 O&M - Operation and Maintenance.
.6 PV - Performance Verification.
.7 TAB - Testing, Adjusting and Balancing.
.8 CxA – Commissioning Authority.
.9 DC – Design Consultant.
.10 PWGSC – Public Works and Government Services Canada.
.11 ECxC – Electrical Commissioning Coordinator.
.12 MCxC – Mechanical Commissioning Coordinator.
.13 QCM - .Quality control Manger.
.14 ECA – Electrical Commissioning Agent.
.15 MCA – Mechanical Commissioning Agent.
.16 O&M – Operations and Maintenance.

1.2 REFERENCE

.1 CSA Z320-11 Standard

1.3 GENERAL

.1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved.

Objectives:

.1 Verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent.

.2 Ensure appropriate documentation is compiled into the BMM.

.3 Effectively train O&M staff.

.2 Cx is to be performed by an independent third party professional Cx Agent(s) after work is completed and prior to energizing any equipment. The independent third party must have performed similar HV work for a minimum of 5 years. Qualifications of Cx Agent submitted by General Contractor shall be reviewed by Commissioning Authority and can only be hired after acceptance by Departmental Representative.

.3 General Contractor to retain the services of an independent third party professional Cx Agent to carry out the tests and calibration as required herein. Testing Agency shall be familiar with NETA Standards as specified herein and shall have accreditation equivalent to a full NETA member company:

.1 All protection settings must be reviewed by a Professional Engineer registered in British Columbia who is an employee of Cx Agency. Provide documentation naming this individual along with their credentials.

.2 All work must be performed by qualified technicians/electricians with applicable accreditation for the appropriate permitting required. Provide a list of all personnel and their qualifications.

.3 Provide three references, including contact information for completed projects similar to this in scope and technical content.

.4 Qualifications of the Cx Agency must be submitted and reviewed by Departmental Representative and only after acceptance will the Testing Agency be allowed to perform the work.

.4 Furnish Independent Cx agency professional engineer’s letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions. The letter is to be submitted stamped by a Professional Engineer, registered in BC, and provided to the Commissioning Authority.

.5 Employ only personnel who are qualified and experienced in high voltage work. Personnel must be familiar with the equipment and procedures necessary to complete the work as specified herein.

.6 Contractor assists in Cx process, operating equipment and systems, troubleshooting and making adjustments as required.

.1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems must interact with each other as intended in accordance with Contract Documents and design criteria.

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

.7 Design Criteria: as per client's requirements or determined by designer to meet Project functional and operational requirements.

1.4 COMMISSIONING OVERVIEW

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

.2 Cx activities supplement field quality and testing procedures described in relevant technical sections.

.3 Cx is to ensure the built facility is constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities include the transfer of critical knowledge to facility operational personnel.

.4 Complete all start-up and verification of systems prior to review by Commissioning Agent.

.1 To bring mechanical, electrical and building architectural systems and components from a state of static completion to a state of dynamic operation.

.2 To verify conformance to contract requirements.

.3 To confirm installations meet requirements of Contract Documents.

.4 To provide all testing documents and records.

.5 To ensure completed facility meets contract requirements.

.6 To provide a documented operator training program.

.7 To verify accuracy of project record drawings and operating and maintenance manuals.

.5 Departmental Representative will issue Certificate of Substantial Completion when:

.1 Completed Cx documentation has been received, reviewed for suitability and approved by Commissioning Authority.

.2 Equipment, components and systems have been commissioned.

.3 O&M staff training has been completed.

1.5 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 un-functional system, including related systems as deemed required by the Commissioning Authority, Commissioning Authority 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 General Contractor. Above costs to be in form of progress payment reductions or hold-back assessments.

1.6 PRE-CX REVIEW

.1 Before Construction:

.1 Review contract documents, confirm by writing to Commissioning Authority.

.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, systems is complete.

.3 Fully understand Cx requirements and procedures.

.4 Have Cx documentation shelf-ready.

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

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

.7 Have Cx schedules up-to-date.

.8 Ensure systems have been cleaned thoroughly.

.9 Complete TAB procedures on systems, submit TAB reports to Departmental Representative for review and approval.

.10 Submit factory testing report of Electrical Equipment to Departmental Representative for review and approval.

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

.12 Conduct coordination and protection study of upstream breakers, as indicated in drawings, to determine if trip settings are adequate for additional demand. Determine trip setting adjustments and where required, re-set breaker parameters accordingly. The study shall be performed at both 12.5 kV and 25 kV distribution voltages.

.13 Factory test each transformers, regulator and switchgear assemblies and all accessories. Notify Commissioning Authority 7 days in advance of tests and confirm 2 days in advance. Commissioning Authority and Engineer will attend/witness tests. Tests must be conducted in the Lower Mainland area of British Columbia. Alternatively, if tests are conducted elsewhere, pay the costs of travel time (at $130/hour) and all travel/living expenses for two attendees (at actual cost) associated with Commissioning Authority and engineer’s attendance at factory tests and at repeat tests if necessary.

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

1.7 CONFLICTS

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

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

1.8 SUBMITTALS

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

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

.1 Name of Contractor's Cx agent.

.2 Draft Cx documentation.

.3 Preliminary Cx schedule.

.2 Request in writing to Commissioning Authority for changes to submittals and obtain written approval at least 8 weeks prior to start of Cx.

.3 Submit proposed Cx procedures to Commissioning Authority where not specified and obtain written approval at least 8 weeks prior to start of Cx.

.4 Provide additional documentation relating to Cx process required by Departmental Representative, specifically;

.1 Cx Plan and Schedule
.2 Accepted Shop drawings
.3 Completed PI forms
.4 Approved TAB report
.5 Approved PV forms
.6 Approved O&M manuals
.7 Approved System and Integrated System Test Report
.8 Approved Factory testing reports
.9 Approved Training and Attendance forms
.10 Accepted “As-built” Plans and Specifications
.11 Final Cx Report

1.9 COMMISSIONING DOCUMENTATION

.1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Static Verification Forms, Startup and Functional Performance Testing Forms for requirements and instructions for use.

.2 General Contractor to review and approve Cx documentation submitted by Cx Agent prior to submission to Departmental Representative for review.

.3 Provide completed and approved Cx documentation to Commissioning Authority.

1.10 COMMISSIONING SCHEDULE

.1 Provide detailed Cx schedule as part of construction schedule in accordance with Section 01 32 57 Construction Progress Schedule Bar (GANTT Chart).

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

.1 Approval of Cx reports.
.2 Verification of reported results.
.3 Repairs, retesting, re-commissioning, re-verification.
.4 Training.

1.11 COMMISSIONING MEETINGS

.1 Convene Cx meetings following project meetings: Section 01 32 16.07 Construction Progress Schedule Bar (GANTT Chart) and as specified herein.

.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. Section 01 32 16.07 Construction Progress Schedule Bar (GANTT Chart). General Contractor to call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:

.1 Review duties and responsibilities of General Contractor and subcontractors, addressing delays and potential problems.

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

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

.6 Meeting will be chaired by General Contractor with their Commissioning Agent, who will record and distribute minutes.

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

1.12 STARTING AND TESTING

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

1.13 WITNESSING OF STARTING AND TESTING

.1 Provide 14 days' notice prior to commencement.

.2 Commissioning Authority to witness of start-up and testing.

.3 General Contractor's Cx Agent to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

.1 Minimum of 5 years experience 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.

1.14 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 general 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 Prior to start-up:

.1 Insulation resistance test and continuity test of all new cables and all cables with connections changed during construction

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

.3 Operational testing: document equipment performance.

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

.3 Conduct following tests in accordance with Section 01 45 00 - Quality Control.

.1 Power distribution system including phasing, voltage, grounding and load balancing.

.2 Circuits originating from branch distribution panels.

.3 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

.4 Insulation resistance testing:

.1 Megger circuits, feeders and equipment up to 350 V with a 500V instrument.

.2 Check resistance to ground before energizing.

.4 Correct deficiencies and obtain approval from Commissioning Authority after distinct phases have been completed and before commencing next phase.

.5 Document required tests on approved PV forms.

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

.1 Minor equipment/systems: implement corrective measures approved by Departmental Representative.

.2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Commissioning Authority.

.3 If evaluation report concludes that major damage has occurred, Departmental Representative shall reject equipment.

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

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

1.15 START-UP DOCUMENTATION

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

.1 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.

1.16 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 toDepartmental Representative for approval before implementation.

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

.4 After completion of commissioning, operate and maintain systems until issuance of Certificate of Substantial Performance.

1.17 TEST RESULTS

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

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

1.18 START OF COMMISSIONING

.1 Notify Departmental Representative at least 4 weeks prior to start of Cx.

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

1.19 INSTRUMENTS / EQUIPMENT

.1 Submit to Departmental Representative for review and approval:

.1 Complete list of instruments proposed to be used.

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

.2 Provide the following equipment as required:

.1 2-way radios.

.2 Ladders.

.3 Equipment as required to complete work.

1.20 COMMISSIONING PERFORMANCE VERIFICATION

.1 Carry out Cx:

.1 Under accepted simulated operating conditions, over entire operating range, in all 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.

1.21 WITNESSING COMMISSIONING

.1 Cx Authority and Departmental Representative to witness activities and verify results.

1.22 AUTHORITIES HAVING JURISDICTION

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

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

.3 Provide copies to Departmental Representative within 5 days of test and with Cx report.

.4 Authorities having jurisdiction in this project include Municipality of Port Hardy and BC Safety Authority.

1.23 EXTRAPOLATION OF RESULTS

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

1.24 SUNDRY CHECKS AND ADJUSTMENTS

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

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

1.25 DEFICIENCIES, FAULTS, DEFECTS

.1 Correct deficiencies found during start-up and Cx to satisfaction of Commissioning Authority.

.2 Report problems, faults or defects affecting Cx to Commissioning Authority in writing. Stop Cx until problems are rectified. Proceed with written approval from Commissioning Authority.

1.26 COMPLETION OF COMMISSIONING

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

.2 Except for warranty and seasonal verification activities, complete Cx prior to issuance ofCertificate of Substantial Performance.

.3 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by Commissioning Authority.

1.27 ACTIVITIES UPON COMPLETION OF COMMISSIONING

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

1.28 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

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

1.29 OCCUPANCY

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

1.30 INSTALLED INSTRUMENTATION

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

.1 Accuracy complies with these specifications.

.2 Calibration certificates have been deposited with Commissioning Authority.

.2 Calibrated EMCS sensors may be used to obtain performance data provided that sensor calibration has been completed and accepted.

1.31 PERFORMANCE VERIFICATION TOLERANCES

.1 Application tolerances:

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

.2 Instrument accuracy tolerances:

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

.3 Measurement tolerances during verification:

.1 Unless otherwise specified actual values to be within +/- 2% of recorded values.

1.32 OWNER'S PERFORMANCE TESTING

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Description of overall structure of Cx Plan and roles and responsibilities of Cx team.

.2 Related Requirements

.1 Section 01 91 33 Cx Forms.

.2 Section 01 91 41 Cx Training.

1.2 REFERENCES

.1 CSA Z-320-11 Commissioning Standard.

1.3 GENERAL

.1 Provide fully functional facilities:

.1 Systems, equipment and components meet user's functional requirements before date of acceptance, and operate consistently at peak efficiencies and within specified energy budgets under normal loads.

.2 Facility user and O M personnel have been fully trained in aspects of installed systems.

.3 Complete documentation relating to installed equipment and systems.

.2 Term "Cx" in this section means "Commissioning".

.3 Use this Cx Plan as master planning document for Cx:

.1 Outlines organization, scheduling, allocation of resources, documentation, pertaining to implementation of Cx.

.2 Communicates responsibilities of team members involved in Cx Scheduling, documentation requirements, and verification procedures.

.3 Sets out deliverables relating to O M, process and administration of Cx.

.4 Describes process of verification of how built works meet design requirements.

.5 Produces a complete functional system prior to issuance of Certificate of Substantial Performance.

.6 Management tool that sets out scope, standards, roles and responsibilities, expectations, deliverables, and provides:

.1 Overview of Cx.

.2 General description of elements that make up Cx Plan.

.3 Process and methodology for successful Cx.

.4 Acronyms:

.1 Cx - Commissioning.

.2 BMM - Building Management Manual.

.3 EMCS - Energy Monitoring and Control Systems (aka DDC or BAS).

.4 MSDS - Material Safety Data Sheets.

.5 PI - Product Information.

.6 PV - Performance Verification.
.7 TAB - Testing, Adjusting and Balancing.
.8 WHMIS - Workplace Hazardous Materials Information System.
.9 CxA – Commissioning Authority.
.10 DC – Design Consultant.
.11 PWGSC – Public Works and Government Services Canada.
.12 ECxC – Electrical Commissioning Coordinator.
.13 MCxC – Mechanical Commissioning Coordinator.
.14 QCM - .Quality control Manger.
.15 ECA – Electrical Commissioning Agent.
.16 MCA – Mechanical Commissioning Agent.
.17 O&M – Operations and Maintenance.

1.4 Five Phases of Cx to be Used on This Project

.1 Each system is to be checked, verified and documented 4 times at the appropriate phase of installation, and to have the training & demonstration phase accepted and documented:

PHASE	DESCRIPTION	STATIC TEST	DYNAMIC TEST	FUNCTIONAL PERFORMANCE TEST
1	System readiness or Pre-functional Testing	✓		
2	System start-up, testing, balancing, and adjustment		✓	✓
3	Verification of integrated system performance		✓	✓
4	Demonstration and training	na	na	Na
5	Seasonal testing and verification	✓	✓	✓

1.5 DEVELOPMENT OF 100% CX PLAN

.1 Cx Plan to be 95% completed before added into Project Specifications.

.2 Cx Plan to be 100% completed by Contractor within 12 weeks of award of contract to take into account:

.1 Approved shop drawings and product data.
.2 Approved changes to contract.
.3 Contractor's project schedule.
.4 Cx schedule.
.5 Contractor's, sub-contractor's, suppliers' requirements.
.6 Project construction team's and Cx team's requirements.

.3 Submit completed Cx Plan to Commissioning Authority and obtain written approval.

1.6 REFINEMENT OF CX PLAN

.1 During construction phase, revise, refine and update Cx Plan to include:

.1 Changes resulting from Client program modifications.

.2 Approved design and construction changes.

.2 Submit each revised Cx Plan to Commissioning Authority for review every 3 months, and obtain written approval.

1.7 COMPOSITION, ROLES AND RESPONSIBILITIES OF CX TEAM

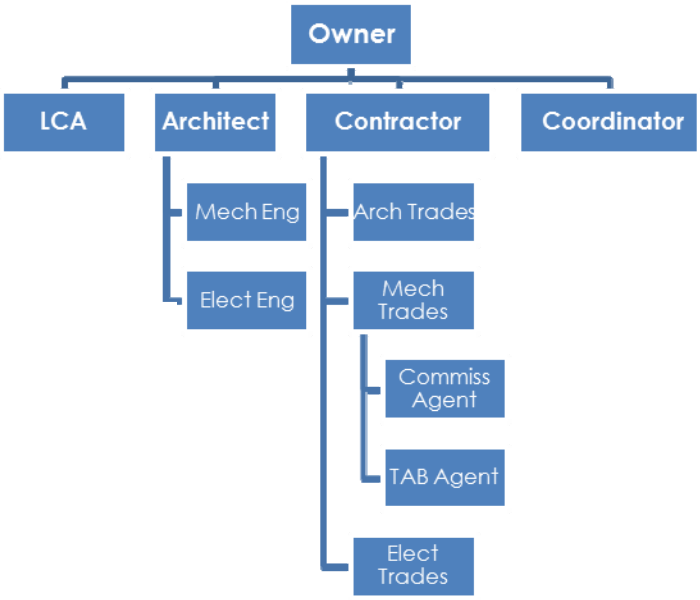
.1 General Contractor to maintain overall responsibility for project and is sole point of contact between members of commissioning team.

.2 The "Commissioning Team" consists of various participants involved in the Cx process. The table below lists team members, and shows some required tasks.

	Provide Design Intent	Review CxA's Design Review	Review Cx Plan	Respond to CxA Tender Review	Attend Cx Meetings	Other Duties Described Herein
Client: PWGSC, PM		✓	✓	✓	✓	✓
Client: Patrick Truong PWGSC Mechanical to Norman Paul PWGSC Commissioning Manager		✓	✓	✓	✓	✓
Architect (Consultant): IBI Group		✓	✓		✓	✓
General Contractor: To be determined			✓			✓
Owner's Commissioning Authority: Avalon			✓		✓	✓
Contractor's Mechanical Commissioning Agent: To be determined	✓	✓	✓	✓	✓	✓
Mechanical Engineer: MCW	✓	✓	✓	✓	✓	✓
Electrical Engineer: MCW	✓	✓	✓	✓		✓
Envelope: IBI Group	✓	✓	✓	✓		✓
Testing and Balancing Agent: To be determined			✓		✓	✓
Controls Trade Contractor: To be determined			✓		✓	✓
Electrical Contractor: To be determined					✓	✓
Manufacturer's Representatives (as applicable): To be determined						✓
Inspectors and Testing Agencies: To be determined						✓

.3 This list is to be updated on an ongoing basis as tendering and hiring occurs.

.4 The project's preliminary Cx Organization Chart is as follows:



The team members' commissioning responsibilities are detailed in the specifications and this Commissioning Plan. The following is a summary table to assist team members in better understanding their roles:

LEGEND: "**A**" denotes ACCEPT; "**L**" denotes LEAD;
"**P**" denotes PARTICIPATE

TASK	Building owner or rep.	Building op's and maint. staff	Cx authority	Cx provider	Design consultants	Contractor& sub-contractors	Manuf' rep's	Independent testing specialists
Concept Phase								
Define owner's project req's	**L**				**P**			
Select a Cx authority	**L**							
Form a Cx team		**P**	**L**		**P**	**P**	**P**	
Review OPRs			**P**		**P**			
Include Cx responsibilities		**P**	**L**		**P**	**P**	**P**	
Determine scope and initial Cx budget	**A/L**		**P**		**P**			
Develop basis of design (BOD)			**P**		**L**	**P**	**P**	
Develop initial Cx plan outline			**L**		**P**	**P**	**P**	

Acceptance	**A**							
Design Phase								
Hold design phase Cx meetings		**P**	**L**		**P**	**P**	**P**	**P**
Identify project-specific Cx responsibilities		**P**	**L**		**P**	**P**	**P**	**P**
Verify OPR and BOD for completeness and clarity			**L**		**P**			
Perform Cx-focused design reviews of drawings and specs		**P**	**P**		**L**			
Plan/prepare verification checklists and test procedures			**L**		**P**	**P**	**P**	**P**
Define requirements for systems manuals		**P**	**P**		**L**	**P**		
Determine operational training requirements		**P**	**L/P**		**L/P**			
Develop Cx specifications	**A**		**P**		**L**			
Prepare Cx report			**L**					
Update Cx plan			**L**					
Acceptance	**A**							
Construction Phase								
Integrate Cx activities into project schedule			**P**			**L**		
Hold construction Cx phase kickoff and progress meetings		**P**	**L**	**P**	**P**	**P**	**P**	**P**
Review contractor submissions and shop drawings			**P**		**L**	**P**		
Construct mock-ups	**A**	**P**	**P**	**P**	**P**	**L**	**P**	**P**
Update OPR and BOD	**A**		**P**		**L**			
Perform and document static verification			**P**	**L/P**		**L/P**	**P**	**P**
Perform and document start-up			**P**	**P**		**L**	**P**	**P**
Perform and document functional performance testing		**P**	**P**	**L**		**P**	**P**	**P**
Prepare and update issues logs			**L**		**P**	**P**		
Resolve issues resulting from all tests			**P**	**P**	**L**	**P**		
Verify, review, and conduct training		**P**	**P**	**L**	**P**	**P**	**P**	
Review maintenance and data manuals		**P**	**P**		**L**	**P**		
Review operations manuals		**P**	**P**		**L**	**P**		

Prepare Cx report			**P**	**L**				
Update Cx plan			**L**					
Prepare Cx manual			**L**					
Acceptance	**A**							
Occupancy & operations phase								
Resolve outstanding Cx issues		**P**	**P**	**L**	**P**	**P**	**P**	**P**
Perform seasonal/deferred testing		**P**	**P**	**L**		**P**	**P**	**P**
Resolve issues resulting from seasonal/deferred tests		**P**	**P**	**L**	**P**	**P**	**P**	**P**
Update issues logs resulting from seasonal/deferred tests			**L**		**P**	**P**		
Complete final Cx report		**P**	**L**	**P**	**P**	**P**		
Acceptance	**A**							

1.8 DELIVERABLES RELATING TO O&M PERSPECTIVES

.1 General requirements:

.1 Compile English documentation.

.2 Documentation to be computer-compatible format ready for inputting for data management.

.2 Provide deliverables:

.1 Warranties.

.2 Project record documentation.

.3 Inventory of spare parts, special tools and maintenance materials.

.4 Maintenance Management System (MMS) identification system used.

.5 WHMIS information.

.6 MSDS data sheets.

.7 Electrical Panel inventory containing detailed inventory of electrical circuitry for each panel board. Duplicate of inventory inside each panel.

.8 Other deliverables described later in this section.

1.9 DELIVERABLES RELATING TO THE CX PROCESS

.1 Consultants and CxA to witness and review sample tests and reports of results provided by Contractors.

1.10 CX ACTIVITIES AND RELATED DOCUMENTATION

.1 Perform Cx by specified Cx agency using procedures reviewed by Commissioning Authority and Consultant.

.2 Commissioning Authority and Consultant to monitor Cx activities.

.3 Upon satisfactory completion, Cx agency performing tests to prepare Cx Report using approved PV forms.

.4 Commissioning Authority reserves right to verify a percentage of reported results at no cost to contract.

1.11 CX OF INTEGRATED SYSTEMS AND RELATED DOCUMENTATION

.1 Cx to be performed by specified Cx specialist, using procedures developed by Contractor and approved by Commissioning Authority, and reviewed by Consultant.

.2 Sample of tests to be witnessed by Commissioning Authority and/or Consultant and documented on approved report forms.

.3 Upon satisfactory completion, Cx specialist to prepare Cx Report, to be reviewed by Commissioning Authority and Consultant.

.4 Commissioning Authority reserves right to verify percentage of reported results.

.5 Identification:

.1 In later stages of Cx, before hand-over and acceptance Consultant, Contractor, Project Manager, Property Manager and Cx Manager to co-operate to complete inventory data sheets and provide assistance to PWGSC in full implementation of MMS identification system of components, equipment, sub-systems, systems.

1.12 STATIC VERIFICATION FORMS

.1 Refer to Section 01 91 33 1.2 - Commissioning (Cx) Forms: Static Verification Forms.

1.13 START-UP FORMS

.1 Refer to Section 01 91 33 1.3 - Commissioning (Cx) Forms: Start-up Forms.

1.14 FUNCTIONAL PERFORMANCE TESTING

.1 Refer to Section 01 91 33 1.4 - Commissioning (Cx) Forms: Functional Performance Testing Forms.

1.15 DELIVERABLES RELATING TO ADMINISTRATION OF CX

.1 General:

.1 Complete Cx of occupancy, weather and seasonal-sensitive equipment and systems in these areas before building is occupied.

1.16 CX SCHEDULES

.1 Prepare detailed Cx Schedule and submit to Commissioning Authority and Consultant for review at the same time as project Construction Schedule. Include:

.1 Milestones, testing, documentation, training and Cx activities of components, equipment, subsystems, systems and integrated systems, including:

.1 Design criteria, design intents.

.2 Pre-TAB review: 14 days after contract award, and before construction starts.

.3 Cx agents' credentials: 14 days after contract award and before start of Cx.

.4 Cx procedures: 14 days after contract award.

.5 Cx Report format: 14 days after contract award.

.6 Submission of list of instrumentation with relevant certificates: 21 days before start of Cx.

.7 Notification of intention to start TAB: 21 days before start of TAB.

.8 TAB: after successful start-up, correction of deficiencies and verification of normal and safe operation.

.9 Notification of intention to start Cx: 14 days before start of Cx.

.10 Notification of intention to start Cx of integrated systems: after Cx of related systems is completed 14 days before start of integrated system Cx.

.11 Identification of deferred Cx.

.12 Implementation of training plans.

.13 Cx of smoke management/control systems: after Cx of related systems is completed and 7 days before proposed date of Cx these systems.

.14 Cx reports: immediately upon successful completion of Cx.

.2 Detailed training schedule to demonstrate no conflicts with testing, completion of project and hand-over to Departmental Representative.

.3 Allow for a day of work on site for MCxC, ECxC, MCA, ECA,TAB Agent and Controls Contractor, after Substantial Completion, after TAB and Cx Reports are submitted. The goal is to allow the CxA to confirm sample Cx checklists, and sample TAB readings.

.4 Within 9 months of Substantial Completion, MCxC, ECxC, MCA, ECA,TAB Agent shall visit site for verification of performance in all seasons and load conditions.

.2 After approval, incorporate Cx Schedule into Construction Schedule.

.3 Consultant, Contractor, Contractor's Cx agent, and Commissioning Authority will monitor progress of Cx against this schedule.

1.17 CX REPORTS

.1 Submit reports of tests, with samples witnessed and reviewed by Commissioning Authority and Consultant.

.2 Include completed and certified PV reports in properly formatted Cx Reports.

.3 Before reports are accepted, reported results to be subject to verification by Commissioning Authority and Consultant.

1.18 ACTIVITIES DURING WARRANTY PERIOD

.1 Cx activities must be completed before issuance of Interim Certificate, it is anticipated that certain Cx activities may be necessary during Warranty Period, including:

.1 Fine tuning of HVAC and electrical systems.

.2 Adjustment of ventilation rates to ensure adequate code ventilation and cooling of electrical equipment.

.3 Load testing inspection and IR inspection to coincide with high usage/occupancy

1.19 TRAINING PLANS

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

1.20 FINAL SETTINGS

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

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 Systems to be Cx'd

.1 The proposed system is generally comprised of the following:

- .1 Space Heat — Expand existing system
- .2 Space Cool — Process D/X units (3 split units)
- .3 Ventilation — Existing to be modified and new panel board, breakers, switches, starters, and luminaires.
- .4 Process Cooling and Dehumidification systems
- .5 Controls — Digital building automation - Existing to be modified
- .6 Power — Existing to be modified
- .7 Interior lighting — Modification to interior lighting
- .8 Interior Plumbing — Some existing connections will be capped off
- .9 Fire Alarm — Existing

.2 The Contractor shall use the 5 phase Cx process and document the proper operation of these systems, and the sub-systems they depend on, at least.

.3 Building Envelope Systems – insulation, air & water leakage.

.1 The project area has a pre-existing exterior wall assembly.

.4 This plan, or any other commissioning document or correspondence, does not relieve contractors from other testing, verification and commissioning duties that may be described in the project specifications or other agreements.

3.2 CxA's Duties

.1 The Commissioning Authority (CXA) serves as an objective advocate for the Owner, oversees the commissioning process and presents final recommendations to the Owner regarding the performance of the commissioned building. Avalon Energy Management (Contact Bob Landell) will perform the following tasks:

- .1 Support efforts to implement the Building Systems Commissioning requirements throughout the project.
- .2 List all relevant features and systems included in the Commissioning scope. The designers and contractors are to provide the detailed equipment lists, checklists, and schedules.
- .3 Review the Owner's requirements and basis of design.
- .4 Help coordinate the commissioning-related activities of the "Commissioning Team".
- .5 Review the Contract Documents to help verify inclusion of commissioning responsibilities.
- .6 Review Contractor's testing plans and criteria for each of the 5 Cx Phases
- .7 Organize and chair Cx meetings of the Commissioning Team; facilitate the process of distributing minutes to all Commissioning Team members as required.
- .8 Monitor construction for commissioning-related installation issues.

.9 Review start up process by observing a sampling of measurements.

.10 Verify commissioning process of automatic control systems by:

.1 Observing a sampling of point to point checks

.2 Obtaining and reviewing a copy of installation end-to-end check sheets.

.3 Observing a sampling of actuator travel ranges

.4 Observing a sampling of sensor calibration

.5 Observing a sampling of controls functional response

.6 Reviewing sample trend logs

.7 Verifying documentation of the testing of control sequences under all operating modes.

.11 Verify the documentation of performance of all systems being commissioned and witness a sample of functional performance tests, and review whether the results meet test criteria.

.12 Verify reported Testing and Balancing results by observing a sampling of measurements.

.13 Review consultant-approved Operating and Maintenance Manuals for compliance with specified content.

.14 Review seasonal testing by contractors, and carry out warranty year duties.

.15 Compile a commissioning report in accordance with the requirements.

3.3 General Contractor`s Duties

.1 The General Contractor shall ensure that the following Cx procedures and tests are within the scope of appropriate trades and sub-trades, and that they are performed and documented as required to meet the Owner's Project Requirements:

System	PRE-START	STARTUP	MANUF START RPT	TAB	FUNCTIONAL PERFORMANCE	VALIDATION & VERIFICATION
Heating	□	□	□	□	□	□
Cooling/ Dehumidification	□	□	□	□	□	□
Air distribution	□	□	□	□	□	□
Ventilation	□	□	□	□	□	□
Controls	□	□	□	□	□	□
Domestic Hot & Cold Water Systems	□	□	□	□	□	□
Lighting	□	□	□	□	□	□
Data Comm's	□	□	□	□	□	□
Fire Alarm	□	□	□	□	□	□
Power distribution Systems	□	□	□	□	□	□

.2 General Contractor will select independent Commissioning Agents and/or Coordinators to ensure Cx activities are carried out to ensure delivery of a fully operational project including:

.1 Organizing Cx.

.2 Monitoring operations Cx activities.

.3 Review of Cx documentation from operational perspective.

.4 Review for performance, reliability, durability of operation, accessibility, maintainability,

.5 Operational efficiency under conditions of operation.

.6 Protection of health, safety and comfort of occupants and O&M personnel.

.7 Monitoring of Cx activities, training, and development of Cx documentation.

.8 Work closely with members of Cx Team.

.9 Certifying accuracy of reported results

.10 Certifying tabs and other results

.11 Developing BMM.

.12 Ensuring implementation of final Cx Plan.

.3 The General Contractor shall incorporate the mechanical and electrical Cx schedules into the project's construction schedule, and coordinate milestones with the CXA.

.4 The General Contractor shall oversee or delegate the preparation for testing and Cx. The following are examples:

DYNAMIC TEST READINESS CHECKLIST

	YES	NO	N/A	DATE	INITIALS
GENERAL					
Applicable tests such as duct/pipe pressure tests submitted					
Construction, painting, millwork and flooring complete in areas served					
Building rooms clean and ready for fan start-up; "All Clean" declared					
AIRSIDE MECHANICAL					
TAB contractor has reviewed the system and completed job preparation					
Ductwork complete, terminals installed, dampers open					
Duct and fan plenum cleaning complete					
Correct filters installed					
Piping complete, gauges installed					
Piping filled, tested, treated and documented					
Valves positioned for testing					
Equipment mounts complete, shipping bolts removed, vibration isolation active					
Equipment lubricated					
Manufacturer's start-up reports received					
PLUMBING & WATERSIDE MECHANICAL					
Drainage connected					
Piping systems flushed out and treated					
Air removed from the system					
DHW systems activated					
CONTROLS					

Control wiring complete					
Control panels mounted and connected					
Thermostats, sensors, actuators, etc. installed					
End-to-end checks completed					
POWER					
Permanent electrical connections complete, including power to starters, rotation checks and overload sizes and settings checked					
Lighting					
Fire alarm system as per ULC					
Other tests and checks cited herein					

VERIFICATION READINESS CHECKLIST

	YES	NO	N/A	DATE	INITIALS
MECHANICAL					
Balancing complete					
Drive changes complete (as required)					
Applicable inspections by authorities having jurisdiction received					
FIRE PROTECTION					
Fire alarm installed and tested					
CONTROLS					
Control program installed, and verification checklist or de-bugging documentation completed with changes noted. Major changes copied to consultant for review					

.5 The General Contractor shall ensure that Training Plans are developed by the appropriate trades and sub-trades, and that they are submitted to the Architect for review. See section

.6 The General Contractor shall ensure that Seasonal and Deferred Testing is performed and documented by the appropriate trades and sub-trades, and that the reports are submitted to the CxA for review.

3.4 The Commissioning Agent is responsible for:

.1 Witnessing reported results.

.2 Witnessing TAB and other tests.

.3 Provides basis of design data not included in the Contract Documents.

.4 Reviews commissioning checklists and test forms to ensure applicability to the project and provide comments to the Commissioning Agent.

.5 Attends commissioning activities as required to certify the site adaptation and related work meet the design intent and the project requirements.

3.5 Facility Manager: represents lead role in Operation Phase and onwards and is responsible for:

.1 Receiving facility on completion.

.2 Day-To-Day operation and maintenance of facility.

3.6 Mechanical Contractor`s Duties

.1 The Mechanical Commissioning Agent (MCA) shall be engaged by the Mechanical Trade Contractor to execute the requirements set out by the CaGBC's documentation, and the Contract Documents. The Commissioning Agent shall perform the following tasks:

.1 Prepare an MCA's Commissioning Plan outlining each of the following five phases involved in the Cx process:

.1 Phase 1 - System readiness.

.2 Phase 2 - System start-up, testing, balancing, and adjustment.

.3 Phase 3 - Verification of system performance.

.4 Phase 4 - Demonstration and instruction.

.5 Phase 5 – Seasonal testing and verification.

.2 Prepare an equipment inventory and all functional testing criteria as required by the specifications and Commissioning Plan for all features and systems requiring commissioning.

.3 Submit all required testing documentation to the Commissioning Authority and Mechanical Consultant for review.

.4 Attend all commissioning meetings as required by the Commissioning Authority or Owner.

.5 Execute or delegate all commissioning tasks as set out in the final functional testing criteria documents.

.6 Coordinate with Trade Contractors regarding sequencing of work. For example, before manufacturer site start-up of AHUs, safety features must be in place, ductwork must be ready, "All Clean" must be declared, power must be connected, hydronics must be cleaned, filled and free of air, controls must have been tested, etc.. Manufacturer start-up must be done prior to air balance, and so on.

.7 Record and document the verification of the specified Pre-Start checks, including but not limited to the following:

Compliant make and model,
CSA label,
no visible damage,
proper equipment installation as per specifications and manufacturer's recommendations,
mounting as specified,
seismic restraint as specified,
electrical connection safe and complete,
safety controls & interlocks functional,
operating controls connected and adequately functional,
pre-start safety checks (where applicable),
connection of other services complete,
supporting or related systems in place,
access for maintenance in place,
strainers/filters clean and firmly in place,
isolation valves, dampers or switches in place, set correctly and functional,
alignment of drives and components correct,
proper coil drain pan draining,
bypasses in place and appropriately positioned open or closed,
vibration isolation adjusted,
insulation as specified and full coverage,
lubrication complete,
penetrations through fire separations in place as specified,
purges and pressure/leak tests complete and passed,
environment (cleanliness, clearance, cooling, drainage, freeze protection, etc.) good,
water tightness of mechanical service roof and exterior wall penetrations,
air and water distribution cleaned degreased,
charges & pressures correctly set; proper air and water pressure relief in place.

.8 Record and document the verification of the specified Startup checks, including but not limited to the following:

pre-start test passed and conditions still in effect,
qualified personnel present,
confirmation of regulatory authorities' inspections, including reports,
manufacturer or vendor representative present,
factory technician test and start-up (where applicable),
correct rotation,
safety controls operate properly,
operating controls function properly
sequencing correct,
desired temperature/pressure/humidity maintained,
electrical characteristics conform to ratings,
no leaks,
noise as per ratings,
obtain certificates of approval and for compliance with regulations from Authorities Having Jurisdiction; include copies of certificates with startup reports.

.9 Immediately after start-up, submit Pre-start checklists and Start-up checklists, signed by the person performing the start-up, to the CxA.

.10 Prepare Functional performance test checklists containing the step-by-step procedures by which the functional requirements of a system, and its various components, will be confirmed. System's response is to be verified and clearly documented according to the respective manufacturer's written instructions, this plan, and the Contract Documents.

.11 The MCA is to prepare Functional Performance Test Checklists, including but not limited to the following:

.1 individual test procedures,

.2 the expected system response or acceptance criteria for each procedure,

.3 a place to record the actual response or findings,

.4 comments pertinent to the ongoing performance of the system and building.

.12 Each control sequence and strategy shall be tested, verified and documented by the Contractor, including:

.1 start-up, and shut down,

.2 modulation up and down over unit's range of capacity, and/or component staging,

.3 unoccupied and manual modes,

.4 power failure and backup/restart,

.5 abnormal or emergency modes,

.6 interlocks and alarms,

.7 sensor calibration.

.13 The checklists are to confirm the Owner's Project Requirements and design intent with respect to the following:

.1 electrical characteristics

.2 flows,

.3 pressures,

.4 temperatures

.5 overall system control programming and automatic performance and alarms.

The goal is to determine whether the installation functions properly under all specified conditions, not that it can be shown to function under one condition. Functional Performance Checklists, signed by the person performing the tests, must be submitted to the CXA immediately after testing.

.14 Participate in troubleshooting those systems that do not meet the functional testing criteria and provide all necessary follow-up testing and documentation.

.15 Submit completed functional test documentation to the Commissioning Authority and Mechanical Design Consultant for inclusion into the final Commissioning Report.

.16 Within 2 months of award, provide a preliminary Cx schedule for pipe and duct system testing, flushing and cleaning, equipment start-up and TAB start and completion to the Project Manager and the CXA. Update the schedule as appropriate. Submit information to the Project Manager on a monthly basis to refine the schedule for the commissioning phase of the work. Provide the following information:

.17 Building "All Clean"

.18 Equipment start-up schedule.

.19 Submission dates for the various documents required prior to substantial performance.

.20 Timing of the various phases of the commissioning, testing, balancing and training/demonstration process.

.21 Provide a certificate of building cleanliness: An "All Clean" declaration is to be signed by the Architect, Mechanical Engineer, and General Contractor. It shall signify that the building and ductwork is adequately clean to allow air distribution start-up without contaminating coils, controls, fan chambers, etc.

.22 Provide regular updates on project progress, of and witnessing of Cx. MCA to contact Avalon prior to Cx, and to provide 48 hours' notice of tests.

.23 Provide a Commissioning Report as specified in the contract documents and herein.

.24 Plan, coordinate and execute Owner and Building Operator training and demonstrations as set out in the specifications and Commissioning Plan.

.25 Provide two follow-up site visits to re-test and verify occupancy and seasonal-sensitive systems after the facility has been fully occupied. Coordinate seasonal performance verification with CXA. Tests must be done during normal (high) occupancy working hours, and at near winter design conditions, and near summer design conditions. Cx Agent shall review equipment operation, status of energy saving strategies. Submit a report of findings to CXA for each visit. Report to contain the following:

.1 Verification of whether conditions meet the Owner Requirements (as documented by Cx Authority), and whether equipment performance meets the design intent.

.2 List of out-of-tolerance conditions, and malfunctioning equipment, components and systems.

.3 Recommendations addressing each problem that was identified.

Seasonal Test Report – **Mechanical Cx Agent** - Required Sections:

WINTER	**SUMMER**
Date: Time of visit: Outdoor Temperature: Outdoor Cloud Cover: Areas too hot: Areas too cold: Areas Humidity: Areas With High Noise:	Date: Time of visit: Outdoor Temperature: Outdoor Cloud Cover: Areas too hot: Areas too cold: Areas Humidity: Areas With High Noise:
Air distribution equipment operating properly: Occupant Concerns Operator Concerns	Air distribution equipment operating properly: Occupant Concerns Operator Concerns
Owner Requirements being met for plumbing. List of Equipment Functioning Improperly	*Owner Requirements* being met for plumbing. List of Equipment Functioning Improperly
Problems:	**Problems:**
1 Description: Solution: Recommendation:	1 Description: Solution: Recommendation:
2 Description: Solution: Recommendation:	2 Description: Solution: Recommendation:
3 Description: Solution: Recommendation:	3 Description: Solution: Recommendation:

.26 Depending on the details of the contractors' contracts among themselves, either the Mechanical Cx Agent, or the mechanical trade shall provide further Seasonal Testing as follows:

Seasonal Test Report – **Mechanical Contractor** Required Sections

	Six Months After Occupancy
	Date: Time of visit: Outdoor Temperature: Outdoor Cloud Cover: Areas too hot: Areas too cold: Areas Humidity: Areas With High Noise:
	Air distribution equipment operating properly: Filters not bypassing and clean Vibration/noise acceptable Leaks found and plugged Warranty Issues
	Owner Requirements being met (details)
	List of Equipment Functioning Improperly
	Problems:
1	Description: Solution: Recommendation:
2	Description: Solution: Recommendation:
3	Description: Solution: Recommendation:

.27 Provide a report, for inclusion in the Re-commissioning Manual, which describes problems, solutions, and suggested improvements revealed in the first months of operation (Word and Excel format).

3.7 Testing & Balancing Agent Duties

.1 The Testing and Balancing Agent (TAB) shall be engaged by the Mechanical Trade Contractor to execute the contract requirements to meet the design intent and the Commissioning Authority. The TAB Agent must perform the following tasks:

.1 Prepare all functional testing criteria (including specific documentation) as required by the Commissioning Plan for all features and systems requiring testing or balancing.

.2 Submit all required testing documentation to the Commissioning Authority and Mechanical Consultant for review, including schedule, proposed procedures, and sample forms.

.3 Visit the site prior to TAB to review adequacy (quantities, locations and types) of balance-related devices.

.4 Attend all commissioning meetings as required by the Commissioning Authority.

.5 Provide Avalon with 7 days' notice of TAB testing periods.

.6 Execute or delegate all TAB tasks as set out in the final functional testing criteria documents.

.7 Coordinate with trade contractors regarding sequencing of work. For example, before balancing, ductwork must be ready, safeties must be functioning, power must be connected, hydronics to be filled and free of air, controls to have been tested, and, in the case of air distribution, the "All Clean" status must have been granted. Manufacturer start-up must be done prior to air balance, and so on.

.8 Provide the following TAB Process Quality Assurance Review to the CxA 2 months prior to commencement of balancing:

PROJECT: **PFC Cold Room Upgrade**
DATE: (Month)

	Test process	Test Equip	Equip Calibration	Test Staff	Staff Experience	Pass/Fail Criteria
AHU CFM			Certificate from X dated X	Mr John Doe	X yr; X projects; Qualifications	+/- X% from spec
Max/Min OAD Volumes			Certificate from X dated X	Ms Jane Doe	X yr; X projects; Qualifications	+/- X% from spec
Exhaust Fan Flows			Certificate from X dated X	Mr John Doe	X yr; X projects; Qualifications	+/- X% from spec
Diffuser Flows			Certificate from X dated X	Ms Jane Doe	X yr; X projects; Qualifications	+/- X% from spec
Pump Flows			Certificate from X dated X	Mr John Doe	X yr; X projects; Qualifications	+/- X% from spec
Heat Terminals			Certificate from X dated X	Ms Jane Doe	X yr; X projects; Qualifications	+/- X% from spec
DX AC			Certificate from X dated X	Mr John Doe	X yr; X projects; Qualifications	heat, cool, air change, OA CFM, controls

.9 At the completion of balancing, and following review of the TAB report, visit the site with the CXA and retest a sampling of balanced air. The CXA could require that up to 5% of terminals be verified, depending on the results of initial tests.

.10 Participate in troubleshooting those systems that do not meet the functional testing criteria and provide all necessary follow-up testing and documentation.

.11 Submit completed functional test documentation to the Commissioning Authority and Mechanical Design Consultant for inclusion into the final Commissioning Report.

.12 Provide O&M Manuals as specified. Provide sections of O&M Manual for inclusion in Systems Recommissioning Manual to CxA, in Word and Excel file format, as required.

.13 Plan and execute demonstrations and training as set out in the Commissioning Plan or specifications.

.14 Provide deferred or seasonal functional performance testing and documentation of proper operation during warrantee period. Seasonal test to be done so that systems' performance is reviewed during both warm (summer) days and cold (winter) days. Correct deficiencies and make necessary adjustment to O&M manuals and as-built drawings.

3.8 Seasonal Test Report – TAB Agent- Required Sections:

Three, Six or Nine Months After Occupancy

Date:
Time of visit:
Outdoor Temperature:
Outdoor Cloud Cover:

Areas too hot:
Areas too cold:
Areas Humidity:
Areas With High Noise:

Air distribution equipment operating properly:
- Motor rotation
- Volumes still as per design intent
- Supply Air Temperatures appropriate and efficient
- Outdoor Air volumes minimal for heating, max for free cooling

Flow and ventilation Owner Requirements being met (details)

List of Equipment Functioning Improperly

Problems:

1	Description: Solution: Recommendation:
2	Description: Solution: Recommendation:
3	Description: Solution: Recommendation:

3.9 Controls Contractor Duties

.1 The Controls Trade Contractor shall provide a Commissioning Agent (CCA) from their staff to:

.2 Prepare a CCA's Commissioning Plan outlining each of the following five phases involved in the Cx process:

.1 Phase 1 - System readiness (clean, grounded, interlocked, mounted properly, accessible, etc.).

.2 Phase 2 - System start-up, testing, balancing, and adjustment.

.3 Phase 3 - Verification of system performance.

.4 Phase 4 - Demonstration and instruction.

.5 Phase 5 – Seasonal testing and verification.

.3 Prepare Functional Performance Test Checklists as a record that all controls provided have been inspected, checked and verified for proper installation and performance. Prepare an equipment inventory and all functional testing criteria as required by the specifications and Commissioning Plan for all features and systems requiring commissioning. Example checklists are as follows:

CONTROLLERS	**Controller**	**Card**	**Card**
ITEM INSPECTED	1	**Expansion Module 1**	**Expansion Module 2**
	Y/N/na	Y/N/na	Y/N/na
Shop drawings approved			
Software licensing in place			
QC inspection report reviewed and deficiencies corrected			
Device matches specified products			
Devices mounted and restrained properly			
Number of control panels & system architecture correct			
Number of points monitored is correct			
Conduit, plenum-rated cable and flex connections selected and installed appropriately			
Wire shielding is correct			
Control device properly located and installed			
Devices and components tagged and identified at all terminations, splices, and junctions			
Point lists present inside panel			
Software and hardware alarms are in			

CONTROLLERS	**Controller**	**Card**	**Card**
ITEM INSPECTED	1	**Expansion Module 1**	**Expansion Module 2**
	Y/N/na	Y/N/na	Y/N/na
place			
Connection to EMCS Server DDC network is made			
Graphics accepted by ME & Owner			
BACnet interface between proprietary controls and DDC system are functioning properly			
Trend-log in place for all necessary inputs, outputs, variables			
Operating software complete, including energy strategies (weekly and annual schedules, economizers, optimized water and air set points, optimized motor speeds, etc.).			
REMARKS/COMMENTS:			
ACKNOWLEDGED			
Controls Contractor:			
MCA:			

INPUT POINTS	**Card**	**Inputs**	
ITEM INSPECTED	**1**	1ip1	1ip2
		Y/N/na	Y/N/na
Shop drawings approved			
QC inspection report reviewed and deficiencies corrected			
Devices matches specified products			
Devices mounted and restrained properly			
Number of points monitored is correct			
Conduit, plenum-rated cable and flex connections selected and installed appropriately			
Wire shielding is correct			
Control device properly located and installed			
Sensors and devices calibrated and verified			
Devices and components tagged and identified at all terminations, splices, and junctions			
Trend-log in place for all necessary (inputs, outputs, variables)			
REMARKS/COMMENTS:			
ACKNOWLEDGED			
Controls Contractor:			
MCA:			

OUTPUT POINTS	**Card**	**Outputs**	
ITEM INSPECTED	**1**	1OP1	1OP2
	Y/N/na	Y/N/na	Y/N/na
Shop drawings approved			
Sequences of operation are understood and make sense			
QC inspection report reviewed and deficiencies corrected			
Devices matches specified products			
Devices mounted and restrained properly			
Conduit, plenum-rated cable and flex connections selected and installed appropriately			
Wire shielding is correct			
Control device properly located and installed			
Sensors and devices calibrated and verified			
Devices and components tagged and identified at all terminations, splices, and junctions			
Software and hardware alarms are in place			
BACnet interface between proprietary controls and DDC system are functioning properly			
Trend-log in place for all necessary (inputs, outputs, variables)			
REMARKS/COMMENTS:			
ACKNOWLEDGED			
Controls Contractor:			
MCA:			

.4 Submit all required testing documentation to the Commissioning Authority and Mechanical Consultant for review.

.5 Attend all commissioning meetings as required by the Commissioning Authority or Owner.

.6 Execute or delegate all commissioning tasks as set out in the final functional testing criteria documents.

.7 Verify that systems are functionally meeting the design intent, and produce a Cx Report documenting this, and identifying where design intent is not being met.

.8 Controls Contractor to provide O&M Manual, including sequences of operation, network diagrams, graphics, shop drawings, recommended post-occupancy calibration, test and maintenance procedures, etc. to CXA for inclusion in Systems Recommissioning Manual. Submit in Word and Excel file format, as required.

.9 Controls Contractor to provide training and training materials for temperature controls, DDC operation and reporting, energy conservation strategies, and other control items having an impact on building or system operation.

.10 Provide deferred or seasonal functional performance testing and documentation of proper operation during warrantee period. Seasonal test to be done during normal working hours, and so that systems' performance is reviewed during both warm (summer) days and cold

(winter) days. Correct deficiencies and make necessary adjustment to O&M manuals and as-built drawings.

Seasonal Test Report – **Controls Contractor -** Required Sections:

Three, Six or Nine Months After Occupancy

Date:
Time of visit:
Outdoor Temperature:
Outdoor Cloud Cover:

Areas too hot:
Areas too cold:
Areas Humidity:
Areas With High Noise:

Control system operating properly:	Sequences in "auto"
	Minimal simultaneous heating and cooling
	Heat recovery dampers operating properly
	Minimal heating O/A ventilation (MAD, CO2/RH) and proper free cooling operation
	Motor speeds no higher than necessary
	Lighting interface and unoccupied sweeps functioning
	Time Schedules correct

Owner Energy and Temp Control Requirements being met (details)

List of Equipment Functioning Improperly

Problems:

1	Description:	
		Solution:
		Recommendation:
2	Description:	
		Solution:
		Recommendation:
3	Description:	
		Solution:
		Recommendation:

3.10 Electrical Trade Contractor Duties

.1 The Electrical Trade Contractor shall provide a Commissioning Agent or Coordinator (ECA) to

- .1 Prepare an ECA's Commissioning Plan outlining each of the following five phases involved in the Cx process:
  - .1 Phase 1 - System readiness (clean, grounded, interlocked, mounted properly, accessible, etc.).
  - .2 Phase 2 - System start-up, testing, balancing, and adjustment.
  - .3 Phase 3 - Verification of system performance.
  - .4 Phase 4 - Demonstration and instruction.
  - .5 Phase 5 – Seasonal testing and verification.
- .2 Conduct and pay for tests of the following:
  - .1 Low voltage breaker set-up, calibration, testing and reporting.
  - .2 Testing protection and control DC supply, voltage, current and wiring systems.
  - .3 Grounding Test and Certification.
  - .4 Megger testing
  - .5 Voltage testing
  - .6 Phase rotation testing
  - .7 Motors heaters and controls.
  - .8 Polarization testing of receptacles and utilization devices
  - .9 Testing and reporting and certification of fire alarm and emergency alarm systems.
  - .10 Such additional testing as required for completion of the test forms laid out in 01 91 31 3.9.24
- .3 Furnish manufacturer's certificate or letter confirming that entire installation relating to their product has been installed to manufacturer's instructions.
- .4 Carry out tests in presence of the Commissioning Authority.
- .5 Give advance notice of proposed time of tests so that the Commissioning Authority can be represented at the tests.
- .6 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .7 Submit test results for review by the Commissioning Authority.
- .8 Test all systems in accordance with details in appropriate sections.
- .9 Testing methods and test results: in accordance with CSA, CEC, NETA MTS, and regulations of the supply authority and other authorities having jurisdiction.
- .10 Liability: During tests, assume responsibility for damages in the event of injury to personnel, building or equipment and bear costs for liability, repairs and restoration.
- .11 Remove and replace with new materials all conductors that are found to be shorted or grounded.

.12 Conduct dielectric tests, hi-pot tests, insulation resistance tests and ground continuity tests as required by the nature of the various systems and equipment.

.13 With the systems completely connected and lamped, conduct and document the following tests on the power system:

.1 Control and Switching: test all circuits for the correct operation of devices, switches and controls.

.2 Polarity Tests: test all circuits for correct operation of devices, switches and controls.

.3 Voltage Tests: make a voltage test at the last outlet of each circuit. Maximum drop in potential permitted will be 2% on 120V, and 208V branch circuits. 2% on 208V feeder circuits, and 5% on 600V feeder circuits. Correct any deficiency in this respect.

.4 Phase Balance: measure the load on each phase at each switchboard, splitter, distribution panel board and lighting and power panel board. Report results in writing to the Commissioning Authority. Re-arrange phase connections as necessary to balance the load on each phase as instructed by the Commissioning Authority with the re-arrangement being restricted to the exchanging of connections at the distribution points mentioned in this paragraph. After marking any such changes, make available to the Commissioning Authority, drawings or marked prints showing the modified connections.

.5 Supply Voltage: measure the line voltage of each phase at the load terminals of the main breakers and report the results in writing to the Commissioning Authority. Perform this test with the majority of electrical equipment in use.

.6 Motor Loading: measure the line current of each phase of each motor with the motor operating under load and report the results in writing to the Commissioning Authority. Upon indications of any imbalance or overload, thoroughly examine electrical connections and rectify any defective parts or wiring. If electrical connections are correct, overloads due to defects in the driven machines shall be reported in writing to the Departmental Representative. Verify motor full load amps and overload relays are properly sized and adjusted accordingly.

.7 General Operations: energize and put into operation each and every electrical circuit and item. Make repairs, alterations, replacements, tests and adjustments necessary for a complete and satisfactory operating electrical system.

.14 Carry out tests covering "General Operation" at the time of acceptance of the work.

.15 Test all systems and obtain written confirmation from the manufacturer of each system that all components have been installed correctly and that the system is functioning as intended. Present separate certification for all systems including: fire alarm, power distribution, to the Commissioning Authority.

.16 Provide labour, instruments, apparatus and pay all expenses required for the tests. The Departmental Representative reserves the right to demand proof of the accuracy of all instruments used.

.17 When tests are performed, the Departmental Representative may require that equipment be opened and removed from their housings to examine interior of equipment, terminations and connections. Provide all required labour and tools.

.18 Co-ordinate the testing of motors with the trades providing the equipment driven by the motors so that they are carried out at the time the driven equipment is put on test. In addition to the motor loading tests, provide labour and instruments to take and record all motor load readings required to supplement the tests on the driven equipment through various load sequences, as required by the trades involved.

.19 Prepare Functional Performance Test Checklists that will be a record that all electrical services provided have been inspected, checked and verified for proper installation and performance. Prepare an equipment inventory and all functional testing criteria as required by the specifications and Commissioning Plans for all features and systems requiring commissioning. The system list overview is; but not limited to the following:

	Cx Plans			**Cx Execution**			
CHECKLIST	**Submitted**	**Reviewed**	**Updated**	**Complete**	**Reviewed**	**Notes**	**Comments**
Molded Case Circuit Breakers							
Installation of Electrical Equipment: Conduits, trays Cables and Boxes							
Installation of Electrical Equipment: Utilization Devices – Outlets and Heating/Cooling							
Interior Lighting Systems							
Motor Control and Motor Starters							
Variable Frequency Drive							

Note: there may be Cx requirements in other sections of the specification.

.2 Submit all required testing documentation to the Commissioning Authority and Electrical Consultant for review. For example:

.1 Implementation of Coordination Study Settings

.2 Certificates and/or Equipment Test Report

.3 Equipment Spare Parts Report

.4 Generic Acceptance Report

.5 Final Acceptance Report.

.3 Attend all commissioning meetings as required by the Commissioning Authority or Owner.

.4 Execute or delegate all commissioning tasks as set out in the final functional testing criteria documents.

.5 Verify that systems are functionally meeting the design intent, and produce a Cx Report documenting this, and identifying where design intent is not being met.

.6 Electrical Trade Contractor to provide O&M Manual, sequences of operation, recommended post-occupancy calibration, test and maintenance procedures, etc. to CXA

for inclusion in Systems Recommissioning Manual. Submit in Word and Excel file format, as required.

.7 Electrical Trade Contractor to provide training and training materials

.8 Provide deferred or seasonal functional performance testing and documentation of proper operation during warrantee period. Seasonal test to be done during normal working hours, and so that systems' performance is reviewed during both long (summer) days and short (winter) days. Correct deficiencies and make necessary adjustment to O&M manuals and as-built drawings.

.9 Allow minimum 8 hours for each of two site visits for seasonal/deferred testing and reporting. 16 hours total.

Seasonal Test Report – **Electrical Contractor & Cx Agent** - Required Sections:

Three to Nine Months After Occupancy

Date:
Time of visit:
Outdoor Temperature:
Outdoor Cloud Cover:

Areas too dark:
Areas too bright:

Lighting

Interior light levels after sundown

Power equipment operating properly:

Labelling and cleanliness
Breakers holding
Motor starters in Auto
Power quality still good; phase output, phase to phase output, power factor, etc. acceptable
Line voltage controls by Elect operating properly

Owner Requirements for lighting and energy being met (details)

List of Equipment Functioning Improperly

Problems:

1	Description:	Solution: Recommendation:
2	Description:	Solution: Recommendation:
3	Description:	Solution: Recommendation:

3.11 Required Written Work Products – Consultants, and Trades Other Than Cx Agencies, Controls and Electrical

.1 COMMISSIONING AUTHORITY

.1 Schematic design review.
.2 CxA'S Cx Plan (this document),
.3 Review of construction documents,
.4 Commissioning Binder, Systems Manual and 10 Month Warranty Report.

.2 DESIGN CONSULTANTS

.1 Contract Documents by consultants. The Consultants' (Architect, Designers and Engineers) Contract Documents shall clearly require that features, equipment and systems are to be installed in such a way that TAB and commissioning are facilitated. The documents shall also identify Trade Contractors' responsibilities for execution and documentation of the Commissioning Process.

.2 Shop drawing process:

.1 The contractor is to forward the shop drawings, via architect, to the consultants, for review.

.2 The architect shall forward mechanical, electrical and lighting shop drawings to the CxA at the same time as the engineers.

.3 All Change Orders and Site Instructions are to be copied to the CxA. Consultants to verify that changes are in keeping with the Owner's Project Requirements.

.4 Reviews and acceptance of electrical power and lighting components and of proper system installation and operation, provided by Electrical Engineer.

.5 Reviews and acceptance of mechanical components, and of proper system installation and operation, to be provided by Mechanical Engineer.

.6 Building "All Clean" certification is required to allow fan operation. The Architect, General Contractor and Owner shall jointly sign a letter declaring that the building and systems are clean enough to run the fans.

.7 Reviews of TAB and commissioning submittals and documents by Design Consultants, with written acceptance forwarded to the CXA for inclusion in the Commissioning Report.

.3 TRADE CONTRACTORS

.1 Construction Schedule integrating all divisions of the work, and allowing adequate time for submittal reviews, commissioning of equipment, verification of systems' operation, and the demonstration to (and training of) the Owner, review of operating and maintenance and Cx manuals. The schedule shall include, but not be limited to, the following items:

.1 Installation and testing of piping systems and equipment, including protection of heat exchangers during cleaning.

.2 Installation and cleaning of air distribution systems and equipment.

.3 Connection of electrical services to equipment by electrical trade contractor.

.4 Chemical cleaning and treatment of water distribution systems.

.5 Control system installation.

.6 Pre-start checks.

.7 Start-up of equipment and systems.

.8 Air/Water balancing, including samples witnessed by CXA.

.9 Check-out of control systems.

.10 Commissioning of systems, including samples witnessed by CXA.

.11 Correction of deficiencies and retests.

.12 Demonstration of systems and equipment to Consultant.

.13 Demonstration of systems and equipment to Owner.

.14 Preparation of maintenance manuals and as-built drawings.

.15 Submission of the various documents required prior to substantial performance.

.16 Project closeout documents.

.2 Contractor Submittal Drawings and Equipment Data: Submittals will be reviewed by Design consultants and CXA to help verify that the systems and equipment being supplied are consistent with the required commissioning test procedures, and if not, that the variances are acceptable to the Team, and that commissioning checklists are revised accordingly.

.3 Approved Pre-start checklists and Start-up checklists must be completed prior to start-up of each specific system or piece of equipment. Checklists, signed by the person performing the start-up, must be submitted to the CXA immediately after start-up.

.4 Functional performance verifications for equipment and systems must be performed, and redone until proper system performance is verified.

.5 As-built drawings forwarded by installing contractors. The various trades shall mark-up the consultants' drawings to indicate design or layout changes that took place during construction.

.6 Training materials by sub-trades to meet the requirements of See Section 01 91 41.

.7 Reports on seasonal testing and documentation of proper operation during warrantee period.

.8 See other sections for specific MCA, ECA, CCA, and TAB Trade requirements and duties.

.9 The following tables provides a partial checklist of submittals required by each sub-trade:

DESCRIPTION	FORMAT			FROM			
	PDF	.doc .xls	sign-off	Consultant	Cx Agent	TAB	Mech Contractor
Cx Plan (5 Phases), Process, Inventories and Checklists		☐			☐	☐	☐
Cx Schedule (5 Phases)		☐			☐	☐	☐
Preliminary O&M Manual from Cx Agents		☐			☐	☐	☐
Reviewed TAB Report	☐	☐		☐			
TAB Report Test Performance Sheets	☐	☐			☐	☐	☐
Reviewed O&M Manual	☐		☐	☐			
System Descriptions and all sections described in Contract Doc's	☐	☐			☐	☐	
Validation Of Testing and Balancing			☐		☐	☐	
Training Plans		☐			☐	☐	☐
Validation of Fire Damper Operation			☐		☐	☐	
Training Materials and Validation of Owner's Training	☐	☐	☐	☐	☐	☐	☐
Deferred & Seasonal System Tests, Adjustments and Reports	☐				☐	☐	☐

DESCRIPTION	FORMAT				
	PDF	.doc .xls	sign-off	Mech Contractor	Controls Contractor
Controls Cx Plan (5 Phases), Inventories and Checklists		☐			☐
Cx Schedule (5 Phases)		☐			☐
Preliminary O&M Manual from Cx Agents		☐		☐	☐
Signed Commissioning Checklists	☐	☐		☐	☐
DDC & Other Controls Sequences of Operation	☐	☐			☐
Controls Checkouts	☐	☐			☐
Recommended Post-Occ Calib, Test & Maint Procedures		☐			☐
Training Plan	☐	☐		☐	☐
Training Materials and Validation of Owner's Training		☐	☐	☐	☐
Seasonal System Tests, Adjustments and Reports		☐		☐	☐

DESCRIPTION	FORMAT			FROM
	pdf	.doc .xls	Sign off	Electrical Contractor
Cx Plan (5 Phases) Inventories and Checklists				☐
Cx Schedule (5 Phases)				☐
Preliminary O&M Manual from Cx Agents		☐		☐
Validation of Power Systems Operation			☐	☐
Reviewed Commissioning Report	☐	☐		
Start-up and Operation Requirements – Electrical Systems			☐	☐
Signed Commissioning Checklists	☐	☐		☐
Reviewed O&M Manual	☐		☐	☐
System Descriptions	☐	☐		
Reviewed Controls Manual	☐	☐		
Line Voltage Controls Checkouts	☐	☐		☐
Electrical Training Plan				☐
Validation of Penetrations Through Separations			☐	☐
Validation of Seismic Restraint Installation			☐	☐
Validation of Vibration Isolation			☐	☐
Validation of Electrical System Demonstration			☐	☐
Training Materials and Validation of Owner's Training	☐	☐	☐	☐
Problems & Suggestions in First Few Months		☐		☐
Seasonal System Tests, Adjustments and Reports	☐			☐

DESCRIPTION	FORMAT			FROM
	PDF	.doc .xls	sign-off	Electrical Trade
Cx Schedule (5 Phases)				☐
Power Shop Drawings	☐			☐
Electrical Training Plan	☐			☐
Validation of Fire Stopping	☐		☐	☐
Letters of Assurance from Trades' Engineers	☐			☐
Validation of Items To Be Handed Over To Owner	☐		☐	☐
Validation of Electrical System Demonstration	☐		☐	☐
Training Materials and Validation of Owner's Training	☐	☐	☐	☐
Record Drawings	☐	☐	☐	☐

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Commissioning forms to be completed for equipment, system and integrated system.

.2 Related Requirements

.1 Section 01 91 31 Cx Plan.

.2 Section 01 91 41 Cx Training.

1.2 INSTALLATION/START-UP CHECK LISTS

.1 Include the following data:

.1 Product manufacturer's installation instructions and recommended checks.

.2 Special procedures as specified in relevant technical sections.

.3 Items considered good installation and engineering industry practices deemed appropriate for proper and efficient operation.

.2 Equipment manufacturer's installation/start-up check lists are acceptable for use. As deemed necessary by Commissioning Authority, supplemental additional data lists will be required for specific project conditions.

.3 Use check lists for equipment installation. Document check list verifying checks have been made, indicate deficiencies and corrective action taken.

.4 Installer to sign check lists upon completion, certifying stated checks and inspections have been performed. Return completed check lists to Commissioning Authority. Check lists will be required during Commissioning and will be included in Building Maintenance Manual (BMM) at completion of project.

.5 Use of check lists will not be considered part of commissioning process but will be stringently used for equipment pre-start and start-up procedures.

1.3 PRODUCT INFORMATION (PI) REPORT FORMS

.1 Product Information (PI) forms compiles gathered data on items of equipment produced by equipment manufacturer, includes nameplate information, parts list, operating instructions, maintenance guidelines and pertinent technical data and recommended checks that is necessary to prepare for start-up and functional testing and used during operation and maintenance of equipment. This documentation is included in the BMM at completion of work.

.2 Prior to Performance Verification (PV) of systems complete items on PI forms related to systems and obtain Commissioning Authority's approval.

1.4 PERFORMANCE VERIFICATION (PV) FORMS

.1 PV forms to be used for checks, running dynamic tests and adjustments carried out on equipment and systems to ensure correct operation, efficiently and function independently and interactively with other systems as intended with project requirements.

.2 PV report forms include those developed by Contractor records measured data and readings taken during functional testing and Performance Verification procedures.

.3 Prior to PV of integrated system, complete PV forms of related systems and obtain Commissioning Authority's approval.

1.5 SAMPLES OF COMMISSIONING FORMS

.1 Commissioning Authority will review project-specific Commissioning forms developed by the Contractor, in electronic format complete with specification data.

.1 HVAC.

.2 Refrigeration and dehumidification

.3 HVAC Controls

.4 Plumbing

.5 Power Systems – Normal power systems (breakers/ receptacles). No switchgear, back-up power or isolated power.

.6 Lighting & Lighting Controls – Interior lighting. No specialty lighting.

.7 Fire Alarm - To be certified by the fire alarm company (operation, zoning). Integration into the existing system.

.8 Emergency Lighting - 30 minute test (we'll conduct this)

.2 Revise items on Commissioning forms to suit project requirements.

.3 Samples of Commissioning forms and a complete index of produced to date will be attached to this section.

1.6 CHANGES AND DEVELOPMENT OF NEW REPORT FORMS

.1 When additional forms are required, develop appropriate verification forms and submit to Commissioning Authority for approval prior to use.

1.7 COMMISSIONING FORMS

.1 Use Commissioning forms to verify installation and record performance when starting equipment and systems.

.2 Strategy for Use:

.1 Contractor will provide required shop drawings information and Cx Pre-start, Start-up and Functional Performance Verification checklists and verify correct installation and operation of items indicated on these forms.

.2 Confirm operation as per design criteria and intent.

.3 Identify variances between design and operation and reasons for variances.

.4 Verify operation in specified normal and emergency modes and under specified load conditions.

.5 Record analytical and substantiating data.

.6 Verify reported results.

.7 Form to bear signatures of recording technician and reviewed and signed off by Commissioning Authority.

.8 Submit immediately after tests are performed.

.9 Reported results in true measured SI unit values.

.10 Provide Commissioning Authority and Consultant with originals of completed forms.

.11 Maintain copy on site during start-up, testing and commissioning period.

.12 Forms to be both hard copy and electronic format with typed written results in Building Management Manual in accordance with Section [01 78 00 – Closeout Submittals].

1.8 LANGUAGE

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

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 This Section specifies roles and responsibilities of Commissioning Training.

.2 Related Requirements

.1 General Commissioning Cx Requirements Section 01 91 13

.2 Section 01 91 31 Cx Plan.

.3 Section 01 91 33 Cx Forms.

1.2 TRAINEES

.1 Trainees: personnel selected for operating and maintaining this facility. Includes Facility Manager, building operators, maintenance staff, security staff, and technical specialists as required.

.2 Trainees will be available for training during later stages of construction for purposes of familiarization with systems.

1.3 INSTRUCTORS

.1 Commissioning Authority will provide:

.1 Descriptions of systems.

.2 Instruction on design philosophy, design criteria, and design intent.

.2 Contractor and certified factory-trained manufacturers' personnel: to provide instruction on the following:

.1 Start-Up, operation, shut-down of equipment, components and systems.

.2 Control features, reasons for, results of, implications on associated systems of, adjustment of set points of control and safety devices.

.3 Instructions on servicing, maintenance and adjustment of systems, equipment and components.

.3 Contractor and equipment manufacturer to provide instruction on:

.1 Start-up, operation, maintenance and shut-down of equipment they have installed and connected, after completion of static verification, start-up and functional performance testing.

1.4 TRAINING OBJECTIVES

.1 Training to be detailed, with duration to ensure:

.1 Safe, reliable, cost-effective, energy-efficient operation of systems in normal and emergency modes under all conditions.

.2 Effective on-going inspection, measurements of system performance.

.3 Proper preventive maintenance, diagnosis and trouble-shooting.

.4 Ability to update documentation.

.5 Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

1.5 TRAINING MATERIALS

.1 Instructors to be responsible for content and quality.

.2 Training materials to include:

.1 "As-Built" Contract Documents.

.2 Operating Manual.

.3 Maintenance Manual.

.4 Management Manual.

.5 TAB and PV Reports.

.3 Project Manager, Commissioning Manager and Facility Manager will review training manuals.

.4 Training materials to be in a format that permits future training procedures to same degree of detail.

.5 Supplement training materials:

.1 Transparencies for overhead projectors and/or PowerPoint slides.

.2 Multimedia presentations.

.3 Manufacturer's training videos.

.4 Equipment models.

1.6 SCHEDULING

.1 Include in Commissioning Schedule time for training.

.2 Deliver training during regular working hours, training sessions to be 3 hours in length.

.3 Training to be completed prior to acceptance of facility. Allow for

.1 interim training at temporary ATB

.2 training for each phase

.3 follow-up training session and system demonstration 90 days after new ATB occupancy.

1.7 RESPONSIBILITIES

.1 Be responsible for:

.1 Implementation of training activities,

.2 Coordination among instructors,

.3 Quality of training, training materials,

.2 Departmental Representative will evaluate training and materials.

.3 Upon completion of training, provide written report, signed by Instructors and attendees, and witnessed by by Cx Authority and Departmental Representative.

1.8 MECHANICAL SYSTEM TRAINING

.1 Organize and conduct training courses to instruct the Departmental Representative in the operation and preventative maintenance of equipment and systems provided at the completion of the project.

.2 Provide services of qualified personnel, including each sub-trade, each major equipment supplier and design engineer to and instruct on their equipment or systems.

.3 One-person day shall be eight hours including one half hour for breaks, and one person week shall be five person days.

.4 Submit sessions schedule and list of representatives to the Departmental Representative for approval 30 days prior to course starting date. Confirm attendance of course by written notification to all participants, followed by verbal confirmation just prior to course starting date.

.5 Submit final copies of record drawings and operating and maintenance manuals to Departmental Representative.

.6 Submit a written follow-up of all courses, complete with an attendants list to the Departmental Representative.

.7 Systems Course: conduct systems training courses addressing the following topics as applicable:

- .1 Air Systems:
  - .1 Review operation of systems and equipment:
    - .1 Air systems
    - .2 All exhaust systems
  - .2 Review equipment maintenance.
  - .3 Air system site tour (air handling units/ventilation/ fans)
    - .1 Demonstrate start/stop
    - .2 Components.
    - .3 Maintenance.
- .2 Cooling and Dehumidification Systems:
  - .1 Review operation of system and equipment
  - .2 Review condensing unit and maintenance
  - .3 Review system maintenance.
  - .4 Cooling system site tour.
  - .5 Demonstrate start/stop.
    - .1 Auto control.
    - .2 Maintenance.
- .3 Heating System:
  - .1 Review operation of system and equipment.
  - .2 Review equipment maintenance.
  - .3 Heating system site tour.
- .4 Plumbing:
  - .1 Review system operation equipment.

.2 Review equipment maintenance including:

.1 Compressed Air

.2 Fixtures

.8 Controls Course: Allow a minimum of 8 hours of instruction and an additional 8 hours of instructions to conduct the controls systems training courses as follows:

.1 Provide the services of competent instructors who will give instruction to designated personnel in the adjustment, operation and maintenance, including pertinent safety requirements of the equipment and system specified. The training shall be specifically for the system installed rather than being a general "canned" training course. The Departmental Representative shall have the right to approve/reject the instructors based on their qualifications. All equipment and material required for classroom training shall be provided by the General Contractor.

.2 Training Program: provide in two phases over a 6 month period, the time interval specified for each phase.

.1 First phase: this phase shall be for a period of 1 day prior to the 30 day test period. Operating personnel will be trained in the functional operations of the system installed and the procedures that the operators will employ for system operation. First phase training shall include the following:

.1 General EMCS Architectural (overview).

.2 System Communications (overview).

.3 Operation of computer and peripherals (overview).

.4 Operator Interface functions for control of HV AC systems (detailed).

.5 Control Logic (detailed for each system).

.6 Report Generation (overview).

.7 Colour graphics generation.

.8 Elementary preventive maintenance (detailed).

.2 Second Phase: this phase of training shall be conducted eight weeks after system acceptance for a period of one day. Training will be provided for three categories of personnel: operators, equipment maintenance personnel. The training shall include as a minimum, but not be limited to:

.1 Operator Training and Equipment Maintainer’s Training include:

.1 General equipment layout.

.2 Troubleshooting of all EMCS components.

.3 Preventive maintenance of all EMCS components.

.4 Sensors and controls maintenance and calibration

1.9 ELECTRICAL SYSTEM TRAINING

.1 Organize and conduct training courses to instruct the Departmental Representative in the operation and preventative maintenance of equipment and systems provided at the completion of the project.

.2 Provide services of qualified personnel, including each sub-trade, each major equipment supplier and design engineer to and instruct on their equipment or systems.

.3 One-person day shall be eight hours including one half hour for breaks, and one person week shall be five person days.

.4 Submit sessions schedule and list of representatives to the Departmental Representative for approval 30 days prior to course starting date. Confirm attendance of course by written notification to all participants, followed by verbal confirmation just prior to course starting date.

.5 Submit final copies of record drawings and operating and maintenance manuals to Departmental Representative. Submit a written follow-up of all courses, complete with an attendants list to the Departmental Representative.

.6 Systems Course: conduct systems training courses addressing, but not limited to the following topics as applicable:

- .1 Medium Voltage Cables and Distribution Equipment.
  - .1 Review: Medium voltage cable installation, single line diagram and medium voltage distribution equipment.
- .2 Medium Voltage Protection and Control, Metering and SCADA Systems.
  - .1 Review: Protective relays, metering systems, SCADA systems maintenance and operation.
- .3 Low Voltage Distribution Systems.
  - .1 Review: Switchboards, breakers, transformers, grounding and bonding.
- .4 Low Voltage Distribution Systems – Specialized Equipment.
  - .1 Review: Transfer switches, UPS systems, power factor correction, ship shore power supplies.
- .5 Lighting and Lighting Systems.
  - .1 Review: Lighting equipment installations, lighting controls and emergency lighting systems.
- .6 Fire Alarm and Emergency Alarm Systems:
  - .1 Review and demonstrate the operation, and maintenance of the alarms systems.
- .7 Communications Systems:
  - .1 Review communications infrastructure and inside/outside plant distribution.
  - .2 Review security camera systems infrastructure and distribution.
  - .3 Review SCADA systems infrastructure, distribution, and software.
- .8 Voltage Regulator and Power Connections
  - .1 Review operation of systems and equipment.
  - .2 Review of setting adjustment.
  - .3 Review of control software.
  - .4 Review and demonstrate bypass function. Products

1.10 NOT USED

.1 Not Used.

Part 2 Execution

2.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures and 01 74 21 - Construction/Demolition Waste Management Disposal.

.1 Construction Waste Management:

.1 Submit project Waste Management Plan Waste Reduction Workplan highlighting recycling and salvage requirements.

.2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.

1.2 SITE CONDITIONS

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

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

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

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

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 EXAMINATION

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

3.2 PREPARATION

.1 Protection of In-Place Conditions:

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

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

.3 Protect building systems, services and equipment.

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

.5 Do Work in accordance with Section 01 35 29.06 - Health and Safety Requirements .

3.3 DEMOLITION/REMOVAL:

.1 Remove items as indicated.

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

.3 Trim edges of partially demolished building elements to tolerances as defined by Departmental Representative to suit future use and new construction.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

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

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

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

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

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

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-G40.20/G40.21-04 (R2009), 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.

1.2 SUBMITTALS

.1 Submit shop drawings.

.2 Submit product data in accordance with Section 01 33 00 – Submittals:

.1 Submit manufacturer's printed product literature, specifications and data sheets.

1.3 DELIVERY, STORAGE, AND HANDLING

.1 Store materials in a location and manner to avoid damage; stack materials to prevent bending or applying stress to components; keep handling of materials on-site to a minimum.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

.1 Planks:

.1 Manufactured 12” wide x 2.5” deep interlocking, galvanized, anti-skid surface:

.1 Unistrut 2 x 12 planks.

Part 3 Execution

3.1 INSTALLATION

.1 Replace existing catwalk with metal grating planks.

3.2 CLEANING

.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 ASTM International

.1 ASTM C509-06(2011), Standard Specification for Elastomeric Cellular Preformed Gasket and Sealing Material.

.2 ASTM C920-14a, Standard Specification for Elastomeric Joint Sealants.

.3 ASTM C1193-13, Standard Guide for Use of Joint Sealants.

.4 ASTM C1311-14, Standard Specification for Solvent Release Sealants.

.5 ASTM C1330-02(2013), Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants.

.6 ASTM D2240-05(2010), Standard Test Methods for Rubber Property, Durometer Hardness.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

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

.2 Manufacturer's product to describe:

.1 Sealant.

.2 Primers.

.3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.

.3 Submit WHMIS MSDS in accordance with Section 01 35 43 - Environmental Procedures.

.3 Manufacturer's Instructions:

.1 Submit instructions to include installation instructions for each product used.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit maintenance data for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

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

.2 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove as specified in Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.5 SITE CONDITIONS

.1 Ambient Conditions:

.1 Proceed with installation of joint sealants only when:

.1 Ambient and substrate temperature conditions are within limits permitted by joint sealant manufacturer or are above 4.4 degrees C.

.2 Joint substrates are dry.

.3 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.

.2 Joint-Width Conditions:

.1 Proceed with installation of joint sealants only where joint widths are more than those allowed by joint sealant manufacturer for applications indicated.

.3 Joint-Substrate Conditions:

.1 Proceed with installation of joint sealants only after contaminants capable of interfering with adhesion are removed from joint substrates.

1.6 ENVIRONMENTAL REQUIREMENTS

.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of Material Safety Data Sheets (MSDS) acceptable to Health Canada.

.2 Ventilate area of work as directed by Departmental Representative by use of approved portable supply and exhaust fans.

Part 2 Products

2.1 SEALANT MATERIALS

.1 Do not use sealants that emit strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.

.2 When low toxicity sealants are not possible, confine usage to areas which off gas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize off gas time.

.3 Where sealants are qualified with primers use only these primers.

2.2 SEALANT MATERIAL DESIGNATIONS

.1 Urethanes one part:

.1 Non-sag: to ASTM C920.

.2 Silicones one part: to ASTM C920.

.3 Preformed compressible and non-compressible back-up materials:

.1 Polyethylene, urethane, neoprene or vinyl foam:

.1 Extruded closed cell foam backer rod.

.2 Size: oversize 30 to 50 %.

.2 Neoprene or butyl rubber:

.1 Round solid rod, Shore A hardness 70.

.3 High density foam:

.1 Extruded closed cell polyvinyl chloride (PVC), extruded polyethylene, closed cell, Shore A hardness 20, tensile strength 140 to 200 kPa, extruded polyolefin foam, 32 kg/m^3 density, or neoprene foam backer, size as recommended by manufacturer.

.4 Bond breaker tape:

.1 Polyethylene bond breaker tape which will not bond to sealant.

2.3 SEALANT SELECTION

.1 Perimeters of panel where panels meet adjacent finishes and construction: sealant type: urethanes one part.

.2 Joints in panel construction of cold room construction: as recommended by manufacturer.

.3 Perimeter of plumbing and electrical penetrations of panels: silicones unless otherwise recommended by manufacturer of panels.

2.4 JOINT CLEANER

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

.2 Primer: in accordance with sealant manufacturer's written recommendations.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for joint sealants installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 SURFACE PREPARATION

.1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.

.2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair Work.

.3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.

.4 Ensure joint surfaces are dry and frost free.

.5 Prepare surfaces in accordance with manufacturer's directions.

3.3 PRIMING

.1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and sealing.

.2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to sealing.

3.4 BACKUP MATERIAL

.1 Apply bond breaker tape where required to manufacturer's instructions.

.2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

3.5 APPLICATION

.1 Sealant:

.1 Apply sealant in accordance with manufacturer's written instructions.

.2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.

.3 Apply sealant in continuous beads.

.4 Apply sealant using gun with proper size nozzle.

.5 Use sufficient pressure to fill voids and joints solid.

.6 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.

.7 Tool exposed surfaces before skinning begins to give slightly concave shape.

.8 Remove excess compound promptly as work progresses and upon completion.

.2 Curing:

.1 Cure sealants in accordance with sealant manufacturer's instructions.

.2 Do not cover up sealants until proper curing has taken place.

3.6 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

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

.2 Clean adjacent surfaces immediately.

.3 Remove excess and droppings, using recommended cleaners as work progresses.

.4 Remove masking tape after initial set of sealant.

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

3.7 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by joint sealants installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 ASTM International

.1 ASTM A480/A480M-15, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.

.2 ASTM A484/A484M-15, Standard Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for metal wire shelving and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Plans and elevations indicating shelving layouts, number of bays, number of shelves, and anchoring devices.

.4 Samples:

.1 Submit representative sample bay of specified shelving showing finish colour and including accessories.

1.3 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

.1 Store materials indoors and in accordance with manufacturer's recommendations.

.2 Store and protect specified materials from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for recycling as specified in 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 DESIGN REQUIREMENTS

.1 Design and construct metal storage shelving to support uniform load of 360 kg per shelf.

.2 Design shelving to accommodate vertical adjustment of shelves in 50 mm increments and to permit easy assembly and adjustment without the use of tools.

2.2 MATERIALS

.1 Carbon steel.

2.3 COMPONENTS

.1 Fabricated shelving components:

.1 Posts: tubular with bolt down foot.
.2 Shelves: wire frame.
.3 Size: as indicated on drawings.
.4 Links: 'S'hooks for connecting units.

.2 Fabricated security units:

.1 Provide with casters.
.2 Posts: tubular.
.3 Shelves: wire frame.
.4 Security panel doors.
.5 Top, bottom and side panels: wire frame.

2.4 ACCESSORIES

.1 Provide post clamps for securing the posts against walls; 4 per unit.

2.5 FABRICATION

.1 Welded connections.

.2 Provide adjustable shelving.

2.6 FINISH

.1 Antimicrobial finish: carbon steel coated with zinc phosphate base and hybrid epoxy with anti-bacterial agent electrostatically applied: Proform. NSF approved.

Part 3 Execution

3.1 INSTALLATION

.1 Install metal storage shelving in accordance with reviewed layout.

.2 Brace, secure and anchor shelving units in place.

3.2 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 ASTM International

.1 ASTM A167-99(2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

.2 ASTM A240/A240M-15a, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

.3 ASTM A480/A480M-15, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.

.4 ASTM A484/A484M-15, Standard Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings

.5 ASTM A653/A653M-15, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 Underwriters' Laboratories of Canada

.1 CAN/ULC-S705.1-15, Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density, -Material – Specification.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit complete data and calculations, including, but not limited to:

.1 Manufacturers technical data for Cold Environment Rooms (CER) components and systems.

.2 Mechanical equipment showing dimensions and required clearances, weights, capacities and ratings.

.3 Load capacities/calculations of refrigeration and dehumidification systems. Include typical load factors for ventilation loads, internal heat producing equipment (average of 5 watts PSF of room area), personnel, typical pull down of product, lighting, transmission and door infiltration losses. Obtain end user requirements to confirm these load requirements.

.4 Data indicating that the dehumidification system is adequately sized to accommodate the additional air load from the building HVAC system.

.5 Electrical requirements.

.3 Shop Drawings:

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

.2 Construction details of equipment by drawings and manufacturers' literature.

.3 Roughing-in requirements for mechanical and electrical services.

.4 Refrigeration system piping drawings showing all refrigeration system components, air flows and system operation. Include pipe sizes and capacities.

.5 Mechanical system drawings showing mechanical systems, air flows and duct sizes.

.6 Electrical system schematic drawings showing all power connections to the equipment including, voltage, phase and full or rated load amperage for each electrical circuit.

.7 Installation details.

.8 Structural drawings

.4 Schedules from Sub-Contractor's Engineer:

.1 Provide Schedules S-B and S-C to Consultant (CRP – Coordinating Registered Professional).

.5 Field Review Reports: provided by professional engineer providing Schedules S-B and S-C.

.6 Submit record "As-Built" drawings.

.7 Certify in writing that each CER complies with this Specification and submit all test data indicating compliance. Include commission plan for testing systems in accordance with criteria listed in this Specification.

.8 Submit complete operating and maintenance manuals that describe proper operating procedures, maintenance and replacement parts

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for walk-in coolers for incorporation into manual.

1.4 QUALITY ASSURANCE

.1 Installers: Red Seal Refrigeration Mechanic with minimum five (5) years experience installing manufactured cold rooms.

.2 Manufacturer: company specializing in manufacture of fabricated cold rooms with minimum ten (10) years experience.

.3 Deviations from the specifications, including type of finishes as set forth herein, must be listed in detail, separate from the literature furnished with the bid such that the Owner does not have to expend excessive time in evaluating competitive bids.

1.5 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

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

.2 Store and protect walk-in freezers and coolers from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for recycling as specified in Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.6 WARRANTY

.1 Equipment shall be guaranteed for a period of one year from date of Substantial Performance, against defective materials, design and workmanship.

.2 In addition to overall warranty individual component manufacturer warranty shall include

.3 Mechanical refrigeration compressors: five (5) years.

.4 Panels or room construction: ten (10) years.

.5 Control Panels and Modules: two (2) years.

1.7 MAINTENANCE

.1 Provide Furnish maintenance, "call back" service for period 12 months from date of Substantial Performance.

.2 Perform maintenance once every 4 weeks, as required fro 12 months from Date of Substantial Performance.

.3 Provide maintenance service of consisting of examinations of units, equipment, adjustment, lubrication, cleaning, supplies, parts to maintain proper operation, except adjustments, parts repairs necessary from abuse, misuse, other cause control.

.4 Perform Work with trained, supervised employees, skilled in prefabricated controlled temperature room, refrigeration equipment maintenance during regular working hours.

Part 2 Products

2.1 PERFORMANCE REQUIREMENTS

.1 Structure: roof and wall structure shall be designed and built to accept live loads (personnel) and dead loads (equipment).

.2 Floor panels: shall withstand minimum 700 lbs/ft^2.

.3 Temperatures:

.1 Cold room #5 & #6: maintain +5 degrees C.

.2 Cold Room #4: maintain between -10 and -12 degrees C.

.3 Temperature tolerance: +/- 1 degree C.

.4 Dehumidification:

.1 Cold rooms #5 & #6 require dehumidification: to 40-60 %

.5 Alarms: provide temperature and humidity alarms; shall report to DCC system.

.6 Panic alarm: existing to remain. Re-instate alarm is rendered inoperable during demolition.

.7 Existing electrical system is connected to Emergency Power.

.8 Height: inside height clear: 2750 mm clear with minimum 2440 mm clear under fan-coil evaporator units.

.9 Provide for expansion/contraction caused by temperature parameters listed without buckling, failure of joint seals, undue stress on fastenings or other detrimental effects.

.10 Provide for floor drainage, electrical power and any other services indicated as required.

.11 Interior surfaces and comers to be constructed and assembled to provide an easily cleaned surface and prevent spaces or cracks in which bacteria or fungus may grow.

.12 Locate cooling unit as noted on the drawings, for easy access for maintenance.

.13 Provide control panels including recording dial thermometers complete with temperature read out.

2.2 MATERIALS

.1 Stainless steel sheet: A240/A240M, type 304 with No. 4 finish.

.2 Galvanized steel sheet: commercial grade to ASTM A653/A653M, with zinc coating (galvanized) to ASTM A653/A653M.

.3 Aluminum sheet: utility sheet, powder coated.

.4 Galvalume: steel sheet with aluminum zinc alloy coating with baked on polyester finish.

.5 Sealant: to ASTM C920, colour to match panel.

.6 Isolating coating: to manufacturer's recommendations.

.7 Insulation for ceiling and wall panels: to CAN/ULC-S705.1, Class 3, poured type foamed-in-place polyurethane (urethane), 100 mm thick.

2.3 FABRICATION

.1 Overall dimensions: as indicated.

.2 Panels:

.1 Nominal 4" thick. Sections shall match without distortion and shall be aligned by tongue and groove joint, with flexible vinyl gasket to assure tight fitting joints Sections shall be fastened from the inside by cam lock devices, maximum 48" apart. Finished walls shall be cleanable and without crevasses.

.2 Double wall, modular panel construction.

.3 No structural metal, wood or fiberglass material shall be used between interior and exterior skins.

.4 Interior and exterior skins shall be 0.040" thick embossed aluminum, prepainted with two coats of polyester or modified epoxy enamel.

.5 Panel insulation: self extinguishing, foamed-in-place polyurethane insulation providing a "K" factor of 0.118 BTU/ft2/°F/inch of thickness. Overall

coefficient of heat transfer ("U" Factor) shall not exceed .029 (R-34) for 4" thick walls. Insulation shall bond panel and shall have a minimum compressive strength of 28 lbs/square inch. Panels shall meet UL fire test rating of 25 or less flame spread and display label accordingly.

.6 Properly reinforced to support equipment and for wall mounted shelving loads. Reinforcement shall not violate the insulating value of the panels.

.7 Panel joints shall be secured with integral mechanical fasteners, such as cam locks. Joints shall be continuous sealed by approved gaskets or silicone sealants to provide vapour-proof and airtight joints.

.8 Wrench holes shall be closed by flush-mounted plastic or stainless caps. Furnish one wrench for each room.

.9 Ceiling panels shall be a minimum of 4" thick. Ceiling shall be properly reinforced to support equipment loads. Reinforcement shall not violate the insulation value of the panels. Ceiling panels shall be capable of withstanding a minimum 40 Ibs/sq. live load, in addition to concentrated equipment loads.

.10 Floor: Similar to wall construction, minimum of 4” thick, finished with a .080 textured aluminum surface, non-absorbent, slip resistant easily cleaned and shall meet NSF guidelines. Corners in floor panes shall be coved to avoid trapping contaminants.

.3 Doors: insulated and finished as per exterior and interior panels with 865 x 1980 mm clear door opening, reinforced to prevent door panels from twisting, racking or warping. Ensure that doors will close and seal opening.

.1 Doors shall be in fitting and semi-flush and provide a minimum clear opening of 36" x 78". Doors shall be provided with a minimum 12" x 12" insulated and sealed, three pane observation window with a !4" air space between lites. Doors shall have thermal resistance within 10% of that of wall panels.

.2 Door gaskets shall be extruded vinyl, resistant to oil, fats and sunlight and shall be easily replaceable. Gaskets shall be fitted with a magnetic steel core at sides and top of door. Provide an adjustable rubber wiper gasket at door bottom.

.3 Antisweat heaters to control condensation shall be provided as a standard item on all door jambs and view windows at rooms designed for operation below 5°C.

.4 Provide keyed cylinder lock. Lock mechanism shall be capable of release from the room's interior whether or not the door is locked.

.5 Hinges shall be polished aluminum, cam action type, self-closing, self-lubricating and edge or strap mounted. Pins shall be stainless steel and cam shall be Zytel. A minimum of two hinges shall be furnished per door. Hinges shall be adjustable for proper gasket seal.

.4 Air system shall consist of ceiling mounted conditioning modules.

.5 No commercial fan-coil units shall be used. Conditioning modules shall be custom designed, sized, and manufactured to meet the temperature ranges and uniformity requirements of each chamber. The coil shall be copper tube, aluminum fin design with aluminum housing.. The expansion valve, with strainer, heat exchanger, and inlet/outlet connections shall also be contained within this housing. Air circulation motors shall be permanently sealed. An aluminum drain pan with drain line shall be provided. Condensate lines of Type L copper tubing shall be routed out of each chamber and terminated at condensate drains located adjacent to each chamber.

.6 Where required, environmental rooms shall have low level return air ducts to insure uniformity.

.7 Service line penetration into rooms shall be properly sealed with silicone sealant.

.8 Defrost system in rooms operating below 5°C shall be hot gas with automatic control of blowers during the defrost cycle. Timing and duration of the defrost system shall be programmed and controlled through the microprocessor temperature controller. Room temperature rise shall not exceed 5°C during defrost. Freezers shall include electric defrost, drain pan heat and drain line heat trace.

2.4 CONDENSING UNIT AND REFRIGERATION SYSTEM

.1 Refrigeration System shall be an integrated systems consisting of an evaporator and condensing unit designed to operate continuously System capacity shall be sufficient to meet simultaneously and continuously: Refer to Performance Requirements specified in this section.

.2 Where noted and scheduled all Condensing Units shall be water-cooled, semi hermetic, heavy-duty, industrial type with pressure, current, and temperature safety devices, integral suction and discharge valves. Provide unit with water 3-way regulating valves to control head pressure. Unit is to be located as shown on the drawings and provided with isolation mountings where required.

.3 Condensing units shall be specifically designed and manufactured with adequate capacity to fulfill the individual room's operating temperature requirements and performance and shall be balanced with the air handling system in operation. Condensing units shall be complete and include compressor, condenser, high/low pressure control, receiver, sight glass, expansion valve, interconnecting piping, piping insulation, fused disconnect switch, motor starter and necessary equipment to achieve performance of each room.

.4 Provide refrigeration lines between compressor and room evaporator. Refrigeration system shall be evacuated by vacuum pump for initial leak testing and evacuation of moisture and air within systems. Lines shall be charged with refrigerant and rechecked with an electronic lead detector for presence of any refrigeration leaks. Provide necessary line sizes, traps, etc., for proper operation of this equipment. Suction line shall be insulated with approved insulation. No CFC refrigerants will be accepted. Rooms operating above 0°C shall use R-22 or 134A refrigerant.

2.5 COMPONENTS

.1 Cold Storage Room Evaporator Coil: copper tube, aluminum fin design with aluminum housing: minimum 8 fins per inch, minimum 4 rows deep. Air velocity shall be less than 500 fpm.

.2 Tubing: ACR type, hard drawn, cleaned and capped Type L copper tubing soldered with silver solder, except hot gas lines which shall be silver brazed. Lines shall be installed to allow for linear expansion of copper after start-up.

.3 Suction Lines: size for velocity of 500-700 fpm on horizontal runs and show a slight pitch toward condensing unit. When condensing unit is located below evaporator and there is no possibility of trapping oil, size vertical runs same as horizontal runs. When condensing unit is located above evaporator, size vertical runs for velocity of 1,000 - 1,500 fpm and install proper (shallow) "P" traps spaced not over 10' apart on all tubing risers.

.4 Hot Gas Lines: when hot gas lines are field installed remote from compressor, size tubing at same "P" trap requirements as specified above for suction lines.

.5 Liquid Lines: size liquid lines for maximum 2 psig pressure drop.

.6 Hangers: F&M ring type or Unistrut assemblies with appropriate tubing clamps to support liquid, suction and discharge lines individually. Space hangers or clamps 8' o.c. maximum.

.7 Condensate Drain Piping: 7/8" o.d. or greater, type L copper tubing piped from evaporators to open floor drain or nearest sink, rigidly supported at walls 3' o.c. maximum, installed in such a manner that leaves 1" clearance space between wall and drain and equipped with clean out tee near evaporator. Adequately condensate drain system in building. Provide chrome plated escutcheons on both sides of wall penetrations.

.8 Refrigerant Testing: pressurize and leak test entire system at not less than 100 psig, clean and dehydrate by maintaining a vacuum of 50 microns, or lower, for a five hour period. Add required charge of refrigerant, and oil if necessary, and test entire system for performance. Mark each system clearly as to refrigerant type used.

.9 Insulation: fire retardant Armstrong "Armaflex Insulation" or equal for insulating refrigeration suction lines. Use minimum 1/2" thick wall; apply during tubing, assemble wherever possible.

2.6 RELATIVE HUMIDITY CONTROL

.1 Dehumidification system design and capacity selection shall be the responsibility of room manufacturer. System must meet requirements specified in this section. Interconnecting wiring and duct work shall be provided and installed by the Controlled Environment room manufacturer.

.2 General Description: Automatic, continuous duty, dry desiccant type, rotary, non-cycling for continuous, unattended operation. The dehumidifier shall be completely factory assembled, wired and tested. It shall be self-contained and include a rotary cylinder type desiccant drum assembly filled with granular chemical desiccant. The dehumidifier shall be complete with a process air fan and motor, reactivation air heating system, access panels, filters and controls for completely automatic operation. ii.

.3 Construction: the dehumidifier shall be constructed of 16 gauge zinc grip strip steel and provided with access panels which shall be designed to allow complete internal inspection and servicing of the desiccant drum and drive assembly. The dehumidifier shall be primed and painted consistent with corrosion prevention standards. The casing shall be constructed air and vapor tight throughout.

.4 Unit shall be divided internally into two separate sections, process and reactivation. Division of the separate shall be accomplished with specially designed, long life silicone seals, assuring minimum cross leakage.

.5 Drum drive assembly shall have a positive drive arrangement for slip free rotation of the desiccant cylinder. An electronic control will allow drum rotation adjustment. Filters shall be factory mounted int he process and reactivation air inlet openings. Filters shall be of the cleanable type.

.6 Desiccant: The desiccant drum shall be fully charged with a granular, chemically inert, non-corrosive, inflammable, nontoxic desiccant. The desiccant shall be high absorption capacity silica gel.

.7 Electrical: The dehumidifier shall be provided with an electric control panel mounted on or integral to the cabinet which shall house the motor starters, overload protection devices, pilot lights, control relays, switches, safeties, and all protective fuses and necessary components to insure continuous, safe, automatic operation. Dehumidifier shall be tested and approved by a NTRL for compliance with applicable electrical standards.

2.7 CONTROLS

.1 Control Panel Enclosure: install instruments, control and major electrical components in a control console next to the door at eye level. Provide an easy access service door for front servicing of major electrical components. Front of console shall include a recessed control panel with Plexiglas cover and lock to prevent unauthorized adjustments.

.2 Temperature Controller: temperature control shall be through a fully calibrated, 100% solid state, microprocessor based, proportional controller capable of both Celsius and Fahrenheit operation. Temperature sensors shall be resistive with an initial accuracy and inter-changeability better than ± .2°C. Control sensitivity shall be better than ± ,03°C with display and set-point resolution of ,1°C (or .1°F). Temperature control shall be within ± .5°C over the ranges in the room schedule. Controller proportional output shall be both analog (0-10VCD) and digital (increase/decrease, active low). Proportional valves, solid-state heat controls as well as zero-crossing solid-state switches shall be fully supported. Temperature shall be displayed on a four (4) digit red LED read-out. Set-point and parameter entry shall be via sealed membrane switches. An RS-232 interface port shall be available for both time interval and computer (host) directed data logging. The interface port shall come complete with RS-232 connection for both time-interval and computer (host) directed data logging. All switched devices operated by the controller shall be switched by optically-isolated, individually replaceable, solid state relays.

.3 Humidity Control (where applicable): shall be fully integrated into the system temperature controller and fully support all 2-wire, 4 to 20 mA relative humidity transducers and transmitters. Controller sensitivity shall be better than ± .05% with display and set-point resolution of 1% RH. Control shall be within ± 5% over the specified range. Controller output shall be digital (increase/decrease, active low) and operate zero-crossing solid-state switches. Relative humidity shall be displayed on demand on a four (4) digit red LED readout. Set-point and parameter entry shall be via sealed membrane switches. An RS-232 interface port shall be available for both time interval and computer (host) directed data logging. See room schedule for specific type and range of humidification and dehumidification control if required.

.4 Separate adjustable temperature limit controls for high and low temperature shall be furnished. Temperature dial shall be properly identified with readable settings in degrees Centigrade. Provide two extra dry contacts each (one normally closed, one normally open) for high and low temperature limit control. An audible alarm system shall be included.

.5 Each control console shall include an electronic actuation, one-pen or two-pen temperature recorder with 10" diameter charts, seven day electric drive, calibrated in degrees Centigrade. Recorder shall be accurate to 1% of span with chart range no greater than 60°F, Honeywell DR-4300 or approved equal. Provide two-pen on rooms that include relative humidity control (see room schedule).

.6 Where auxiliary heat is required to maintain temperature uniformity within the rooms low watt density, nichrome, tubular finned heaters shall be integrated into the airflow system.

Open wire heaters are not acceptable. The heaters shall have thermal safeties attached to protect the heater. Heat shall be controlled through the primary temperature controller to give control to the desired level.

.7 Provide protocol connection interface to building management system for monitoring purposes. Monitored points shall include at a minimum:

.1 Room temperature ii. Room humidity

.2 General alarm

.3 High limit temperature alarm v. Low limit temperature alarm

.8 Provide coordination with BMS contractor for interface of the control system to the building management system.

.9 Supplier shall be responsible for wiring of all of all low voltage control wiring supplied as part of the system, to provide a complete and operational system.

2.8 LIGHTING

.1 Lighting shall be 4000lm 4000K LED source enclosed in vapor proof fixture with suitable driver for 120V/60hz operation similar to Metalux 4VT2-LD4-4-DR-L840-WL or equal..

2.9 ELECTRICAL

.1 Wiring in cold storage rooms shall be classified as Class 1 Zone 1 Group D hazard area.

.2 Provide devices, fitting conduit and materials suitable for the environment, including sub-distribution panel board for each room as necessary.

.3 Install all conduit, wire and devices in accordance with Electrical Safety Code and manufacturer's recommendations.

.4 Install wiring in rigid galvanized steel conduit with all necessary seals and fittings. Seal all conduits exiting room with EYS Series fittings complete with sealing compound.

.5 Receptacles:

.1 Provide duplex receptacles CSA configuration 5-15R, 120V, GFI 15A U-ground, interlocked delayed action circuit breaker type. Provide duplex receptacles at 4'0" centres (2' min. from adjacent wall) @ 4'0" off finished floor.

.2 Housing shall be die cast aluminum with spring door, finished in natural die-cast aluminum.

.3 Receptacles shall be pre-wired to individual junction boxed outside of hazardous area.

2.10 SERVICE REQUIREMENTS

.1 Electrical Condensing Units:

.1 The following electrical power is provided by other portions of the Work. Contractors shall notify Owner in writing if equipment requirements vary from that provided. Contractor shall incur all Costs and design fees necessary to provide differing power requirements.

.1 For remote compressor, 208v 3 phase 30 amps

.2 For lights/recorder/controls/evaporator, 120v, 15 amps, single phase.

.3 For receptacles, 120v circuits 20 amps each, four duplex receptacles per circuit maximum.

.2 Provide and coordinate with building electrical 3-phase, and 120v branch circuit panelboard and, if noted, emergency power for receptacle, lighting and equipment circuits. Control panel shall have a cooling failure relay to open all branch circuits should the room temperature exceed a preset level.

.3 Rooms shall be wired by manufacturer and shall have single point power connection; wiring and conduit between shall terminate in junction box outside cold rooms for the following:

.1 Condensation Unit.

.2 Receptacles.

.3 Lighting.

.4 Control.

.4 Wiring shall be THHN or TFIWN conductors and EMT or flexible conduit. No internal exposed conduit allowed. Power conductors (wiring) shall be sized in accordance with Canadian Electrical Code but shall not be smaller that No. 12.

.5 Individual fused switch type disconnect for condensing unit shall be as specified in Division 26.

.2 Mechanical:

.1 Refer to mechanical drawings for locations of sprinkler piping and heads.

2.11 DATA

.1 Conduit and the data outlet boxes shall be internal, imbedded in the foam insulation to provide a clean surface both internally and externally. Conduit to stub up above ceiling panel for each data outlet shown on Lab Drawings. Data outlet boxes to align with electrical outlet boxes. Data ports and cabling to be by Owner.

2.12 ACCESSORIES

.1 Provide backing and conduit for smoke detector by other portions of the Work that will have contacts for connection to remote building monitoring automation systems.

.2 Provide a VA" dia sleeve in roof of controlled temperature room for fire sprinkler piping installation near the entry to the room. Fire sprinkler piping by other portions of the Work.

Part 3 Execution

3.1 PHASING

.1 Refer to Drawings.

3.2 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for walk-in coolers installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.3 PREPARATION

.1 Proceed with Work when conditions will permit work to be installed in complete accordance with original design, accepted submittals, and manufacturer's printed instruction. Commencement of Work indicates acceptance of substrate conditions.

3.4 INSTALLATION - GENERAL

.1 Install controlled cold storage rooms in accordance with manufacturer's recommendations and final approved shop drawings. Sections shall match without distortion. Door shall close and seal without binding.

.2 Install components straight, plumb, level and true. Install service lines at right angles to walls and floors, except where required to pitch to drains.

.3 Seal or otherwise insure that fastenings to rooms do not compromise vapor barriers or insulation. Seal between all piping and sleeves.

.4 Mount mechanical and electrical equipment seismically secure with vibration isolation for rotating motors. Use wireways for exposed electrical on exposed exterior of rooms. Placement of exposed pipes/conduits shall be reviewed by Architect prior to installation. Horizontal refrigeration suction lines shall be pitched downward in the direction of flow. Liquid lines shall be pitched downward towards the liquid receiver. Install condensate drain line from evaporate condensate pan, through the wall panel to discharge into building drain. Blow dry conduit and junction boxes to eliminate condensation within junction boxes before start-up of refrigeration systems. Charge the system per manufacturer's written recommendations. After system has been installed and integrity of system established, cover refrigeration suction lines with insulation and vapor barrier.

.5 Penetrations into room shall be properly sealed with silicone sealant. Provide stainless steel esutcheon plates at visible locations. For multiple penetrations at any one location, provide a neoprone gasket that provides a minimum of Vz around each pipe and encompasses all the penetrations.

.6 Install controls and other products for a complete functional assembly.

.7 Seal panel joints on inside surfaces; apply sealant in accordance with sealant manufacturer's recommendations. Apply sealant around the exterior periphery of the floor panels between the lower metal facing and the floor substrate.

.8 Provide vertical and horizontal closure panels and strips to enclose opening between controlled temperature room and adjacent wall, building partitions, and/or ceiling. Finish to match controlled temperature room exterior.

.9 Mechanical hookups shall be by this contractor.

.10 Pressurize and leak test entire refrigeration system at not less than 100 psig, clean and dehydrate by maintaining a vacuum of 50 microns, or lower, for a 5 hour period. Add

required charge or refrigerant, and oil if necessary, and test entire system for performance. Mark each system clearly as to refrigerant type used.

.11 Provide filler panels to enclose spaces between tops of rooms and ceiling of surrounding area. Extend filler panels to underside of construction above if necessary.

3.5 CONDENSATE PIPING

.1 Condensate pipe to be furnished and installed by environmental room manufacturer and routed outside of each box. Make final connections to the building condensate drain system. Condensate pipe from an environmental room colder than 4°C shall be heat traced, and insulated. Condensate piping shall be insulated.

3.6 ELECTRICAL

.1 Provide electrical work inside cold rooms, including connections to electrical circuits located outside of cold rooms.

.2 Furnishing, installation and connection of control panel. Complete with circuit breakers for incoming service and branch circuits.

.3 Connection of interlocking control wiring between control panel and remote compressors or heaters, also between fan/coil unit and remote compressors or heaters where required.

.4 Provide a dry contact for use by building automation system that will close when any of the operating controls fail or when any of the safety devices prevent operation of conditioning equipment.

3.7 FIELD QUALITY CONTROL

.1 Testing – General:

.1 Equipment: provide all equipment for testing and perform all tests.

.2 Temperature control of ± 0.1 °C shall be the temperature at the sensing bulb and shall be the total variation in the temperature control of the rooms. It should not be confused with the temperature uniformity as noted below.

.3 Temperature uniformity of + 0.5°C refers to the temperature as measured throughout the chamber to within 12" of walls, floors and ceilings. Uniformity shall be measured by a multi-point strip chart recorder utilizing a minimum of twelve (12) thermocouples, distributed randomly throughout the room during a continuous 24-hour test period. Gradient from floor to ceiling shall be 1°C or less.

.4 Departmental Representative shall be given the option of witnessing and confirming test results. Notify owner's representative prior to test in writing.

.5 Manufacturer of controlled temperature rooms shall provide factory supervisor on job site whenever cold room installation is being performed.

.6 Manufacturer's factory representative shall instruct owner's staff in the operation of room, including controls, after completion of room start-up. The operating and maintenance manual shall indicate sequential operation, start-up and shut-down with pertinent control data and schematics.

.2 Recovery Test:

.1 Room shall recover pre-set operating temperature within five (5) minutes after door has been fully opened to 75°F ambient for a period of one (1) full minute.

.2 ii. Owner's representative shall be given the option of witnessing and confirming test results. Notify owner's representative in writing three days prior to test.

3.8 CLEANING AND PROTECTION

.1 Repair or remove and replace defective work, equipment and accessories as directed upon completion of installation.

.2 Clean exposed and semi-exposed surfaces, touch-up finish as required. Remove and refinish damaged or soiled areas.

.3 Protection: Adequately protect the work from damage until final acceptance by the Departmental Representative.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Division 1, Division 21, Division 22, Division 23 and Division 25.

.2 This section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

.3 Specifications are not intended to delegate functions or to delegate work and supply to any specific trade. The work shall include all labour, materials, equipment and tools required for a complete and working installation as described but not necessarily limited to items in the Specifications and shown on the drawings.

.4 The successful bidder covenants and agrees to indemnify and save harmless the Owner against all claims, demands or actions of every kind whatsoever made against the Owner as a result of anything done in connection with the work undertaken by the successful bidder and his sub-trades.

1.2 CODES, REGULATIONS AND BY-LAWS

.1 The Contractor shall make himself fully acquainted with all codes and by-laws as relating to his installation and equipment. Such regulations shall have precedence over the drawings and specifications and the Contractor shall be required, without extra compensation, to carry out any conditions embodied in such codes and by-laws. The Contractor must obtain and pay for all permits for the execution of his work and pay all charges incidental to such permits. This shall include all permits and fees that must be made in the Owner's name and which are necessary in order that the Contractor may complete the work of the Contract.

.2 All changes and alterations required by authorized inspectors of any authority having jurisdiction shall be carried out without charge or expense to the Owner.

.3 Before starting any work, submit the required number of copies of drawings and specifications to the authorities for their approval and comments. Pay all required fees and comply with any changes requested, but notify the Consultant immediately of such changes.

.4 Include for all local, provincial and federal taxes that are in effect at the time of bidding. The most recent codes and by-laws shall be followed. These shall supersede all codes listed in the specification.

1.3 DEFINITIONS

.1 In the Contract Documents, the following definitions apply:

.1 Owner: Means Public Works and Government Services Canada

.2 Architect: Means IBI Group

.3 Consultant: Means MCW Consultants Ltd.

.4 General Contractor / Construction Manager: Means the company carrying out the general contract work.

.5 Mechanical Contractor: Means the Trade Contractor ('Contractor') whose bid is accepted by the Owner.

.6 Work: Means the whole of the works, materials, matters and things that are required to be done, furnished and performed by the Trade Contractors under the Contract Documents.

.2 Definitions used in this Division will have the following meaning:

.1 "Concealed": Pipes, ducts in trenches, chases, furred spaces, pipe shafts, or hung ceilings.

.2 "Exposed": Regarding insulation and painting of piping, ducts will mean that they are not "concealed" as defined herein.

.3 "Piping": Includes in addition to pipe, all fittings, valves, hangers and other accessories which comprise a system.

.3 Notwithstanding any definition elsewhere in the contract documents, wherever the term "Provide" is used in relationship to equipment, ductwork, piping, in this Division, it means "Supply, Install and Connect". Whenever the term "supply" is used, it means supply only.

1.4 STANDARD OF MATERIALS AND WORKMANSHIP

.1 All materials furnished under the Contract and entering into this installation shall be new, and be furnished, delivered, erected, connected and finished in every detail. All equipment and material shall be supplied with the approval of the Consultant, and installed in strict accordance with recommendations of the manufacturer. Equipment shall have CSA, ULC, c-UL or Warnock Hersey approval label as applicable. The Contractor shall be responsible to confirm that all materials used are suitable for the use intended and meet WCB requirements.

.2 Where a manufacturer's name is mentioned, it is for the purpose of setting a standard of quality, performance, capacity, appearance and serviceability. Acceptance and approval by Departmental Representative is required prior to use of named products, their equivalent, or better.

.3 The Contractor and manufacturer's agent must assume full responsibility for ensuring that all noise levels, space, weight, connections, access, performance power and wiring requirements, are considered and costs, therefore, included in the bid. Equipment requiring greater than specified energy requirements or unduly limiting service space requirements will not be accepted.

1.5 DRAWINGS AND SPECIFICATIONS

.1 All work must be in full accordance with the complete intent of drawings and specifications, in every way and commissioned and verified for satisfactory and efficient operation, when finally accepted and delivered to the Owner.

.2 The drawings are diagrammatic and indicate the general arrangements of systems and work included in the Contract. Do not scale mechanical drawings; obtain accurate dimensions from site measurements, architectural and structural drawings.

.3 Ensure that all equipment, valves and components have adequate clearances for servicing and are readily accessible.

.4 Where variance occurs between the drawings and specifications or within either document itself, reference should be made to the Consultant for clarification, prior to bidding. Failing to do this will not relieve the Contractor of the responsibility of the intent of the specifications or provide grounds for additional costs.

.5 The mechanical drawings are not intended to show all of the structural details of the building and, therefore, must be read in conjunction with structural and architectural drawings. Be responsible to install pipe and ductwork in such a way as to conserve head room and interfere as little as possible with the use of the space through which they pass.

.6 Carefully examine the architectural, mechanical, electrical, structural, interior, landscape and civil drawings. Report any apparent interferences and omissions to the Consultant.

.7 The Field Reports and Site Instructions issued by the Consultant during construction shall form part of the documentation provided for this project.

.8 Submit detailed site layout or fabrication drawings when requested/required by the Consultant or the authorities having jurisdiction for review and approval prior to installation.

.9 If there are discrepancies or conflicts between the drawings and specification, the documents will govern in the following order:

.1 Specification
.2 Larger scale drawings
.3 Smaller scale drawings
.4 Drawings issued later.

1.6 DEVIATION FROM SPECIFICATIONS AND DRAWINGS

.1 Any deviation from the specifications and/or drawings must be referred to the Consultant before proceeding with the work. Failing to do so shall make the Contractor liable for any costs involved in the removal of piping, ductwork, equipment, and the replacement as directed by the Consultant.

.2 The Consultant shall have power to reject any work and materials which, in his judgement, are not in full accordance with the intent of the specifications and drawings.

1.7 WARRANTY

1. Replace or repair at his expense any defect in workmanship or materials which may appear within the warranty period. The one-year warranty to start after the Substantial Performance of the Project has been certified.

2. Repair or replace any material, wall finish, which might be damaged through faulty equipment or workmanship, at own expense.

3. Warranties of a longer period on equipment shall be passed on to the Owner if such are made available to the Contractor. Provide written warranty letter and include manufacturer's certificates for extended warranty items in the Maintenance Manuals.

4. This Contractor will be responsible to verify and guarantee, the performance and characteristics of any equipment installed, if, in the opinion of the Consultant, capacities and performances specified are not being achieved.

1.8 TEMPORARY SERVICES

1. Refer to DIVISION 1 regarding temporary services, Contractor's shop, storage and other such facilities.

2. Do not use any of the permanent Mechanical Systems during construction unless specific written approval is obtained from the Departmental Representative.

3. The use of permanent facilities for temporary construction services will not affect in any way the commencement day of the warranty period. Refer to DIVISION 1.

4. Where the permanent systems have been used on a temporary basis during construction, the Contractor shall arrange to clean (vacuum as required) and make good any damage or wear and tear caused by this use. Replace all filters.

1.9 COOPERATION WITH OTHER TRADES

1. Render all assistance necessary and furnish information and measurements regarding the equipment, piping, and ductwork, to all other Contractors on the job.

2. Job schedule laid down by the General Contractor/Construction Manager must be adhered to as closely as possible. Where conflicts occur, these shall be reported immediately to the General Contractor/Construction Manager so as not to unduly delay the progress of the job.

1.10 RESPONSIBILITY

1. Be responsible to see that a foreman, satisfactory to the Consultant, is maintained on the job at all times.

2. The foreman shall represent the Contractor in his absence and all directions as to the conduct of the work given to him shall be as binding as if given to the Contractor.

3. All work must be arranged so as not to interfere in any way with other work being carried out on the site.

1.11 TESTS

1. Generally, all work must remain uncovered until the required tests hereinafter mentioned, have been completed to the satisfaction of the Consultant.

2. In the event that the construction schedule requires it, prior test on portions of the work shall be arranged for, to the satisfaction of the Consultant.

1.12 SUBMITTALS

.1 Submittals: in accordance with Division 1 Requirements.

.2 The Contractor shall furnish to the Consultant at the proper time, certified shop drawings and field drawings of the various items and equipment to be supplied under the Contract, in order to make clear the work intended or to show its relation to adjacent work of other trades.

.3 Shop drawings shall be dated and include name of Project, Contractor, Supplier, Manufacturer and Consultant. Shop drawings shall be carefully reviewed by the Mechanical Contractor and bear the Mechanical Contractor's firm's, signature and date. All unsigned shop drawings shall be returned for resubmission. The Contractor shall provide a copy of the Consultants' reviewed copy to the Electrical Contractor for all equipment requiring electrical connections; the Contractor shall review requirements of the electrical work with the Electrical Contractor prior to start of rough-in work.

.4 Keep a set of shop drawings at the site office and ensure adequate copies are obtained for the maintenance manual.

.5 Shop drawings to show:

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

.6 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 or compliance to applicable codes.
- .6 Electrical data and connections.
- .7 All services points and pipe sizes as applicable.
- .8 Compliance to code ULC and CSA requirements.
- .9 Comparable field measurements to equipment specified.

.7 In addition to transmittal letter referred to Division 1: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

.8 The review of shop drawings for design concept by the Consultant shall not relieve the Contractor of his responsibility for meeting all the requirements of the contract documents including clearances required by code and for servicing.

.9 Provide site layout or fabrication drawings as requested by the Consultant.

.10 Closeout Submittals:

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

.2 Operation and maintenance manual approved by, and final copies deposited with Consultant 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:

Maintenance Manuals:

.1 Furnish copies of the operation and maintenance instructions for all mechanical equipment and systems to the Architect.

.2 The Maintenance Manuals shall also be provided on electronic files with the Record Drawings. Provide to the Consultant a hard draft copy of the manuals of the electronic file information for review prior to Building Occupancy.

.3 Each manual shall contain:

.1 Neatly type written table of contents arranged in a systematic order, following the specification format where applicable.

.2 Subcontractor's and supplier's names of the responsible principals, addresses and telephone numbers.

.3 A description of the complete mechanical systems (HVAC, Plumbing and Fire Protection) clearly describing the function and operation of each item of equipment.

.4 Complete operating instructions and procedures including start-up, break-in and normal operating instructions and sequences. These shall include instructions for summer, winter and any other special operating conditions such as normal/emergency power.

.5 Maintenance requirements including routine procedures and frequency trouble shooting, disassembly, repair and reassembly instructions.

.6 Detailed servicing and lubrication schedule complete with a list of all required lubricants. Maintenance data shall include type of seal, bearings, size of V-belts and filters, tools required, etc.

.7 Product data indicating only information pertinent to the specific product. Provide one complete set of checked shop drawings and manufacturer’s operations and maintenance data.

.8 Record control drawings and a complete type written explanation of the operation of all controls.

.9 Record Drawings of the field-installed refrigerant piping.

.10 Charts indicating the location, function and tag number of all valves. Keying shall be provided to reference these valves to the as-built flow and control diagrams.

.11 Manufacturer's representative's certificates for boiler start-up, variable speed drive start up, chiller start-up, water treatment, vibration isolation equipment installation and temperature control system.

.12 Letters itemizing all domestic, gas, sprinkler and heating/cooling piping pressure tests indicating system tested, pressure held, time of test and date. A copy of the final plumbing, backflow device test, gas and other certificates.

.13 Fire protection systems including sprinkler shop drawings, sprinkler and completed NFPA test data certificates.

.14 Warranty letter and extended warranty certificates.

.15 Pre operational pipe cleaning reports and chemical treatment.

.16 Air and water balancing reports.

.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 Manual to Consultant for approval. Submission of individual data will not be accepted unless directed by Consultant.

.2 Make changes as required and re-submit as directed by Consultant.

.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 Record drawings, to be provided to the Owner, shall be prepared by the Contractor to indicate the variations from the construction documents, including the design changes made by the Consultant during construction. The "Record Drawings" shall include, but not be limited to, the following changes and shall be recorded daily:

.1 Size, location, arrangement, route and extent of ductwork, piping, terminal units, equipment, fixtures, cleanouts, valves, rough-in, etc., above and below grade inside the building, including dimensioned locations of buried piping from grid lines.

.2 Piping Elevations
Water Lines: All water lines. Invert elevations and type of piping material used and locations to be given at each junction, changes of direction horizontally and vertically.
Sanitary and Storm Sewers: All sewers. Invert elevations and type of pipe material used and locations to be given at each manhole clean-out, including material used.
Gas Lines: All piping. Invert elevations to be given at each junction, at entry to building, at change of direction, at high and

low points.
Steam, Condensate and Hot Water Lines: All such lines. Invert elevations to be given at each junction, at the entry to each building, at changes of direction of high and low points.

.1 All services located below ground level and in or below a building slab.

.2 All valve stations, trap stations, coils, dampers and ductwork not easily accessible.

.3 All changes which affect the operation of the mechanical system.

.4 Location, tagging and numbering of all valves except individual plumbing fixtures or equipment isolation valves.

.2 The Contractor shall mark up in red, using the "Issued for Construction" drawings, the changes made during construction as they occur; including elevations and detail locations of buried and concealed services. The Contractor's site mark-up of the record drawings shall be kept at the site for periodic reviews by the Consultant.

.3 At the completion of work, the Consultant shall provide the Contractor with a clean set of the Consultant's "Final Design Drawings" prints; and the Contractor shall transfer all the Contractor's site record marked-up changes onto these drawings and submit them to the Consultant for review, prior to the occupancy review. This set of drawings to be titled "Record Site Marked-Up Drawings".

.4 The Consultant shall return to the Contractor the reviewed record site marked-up drawings, with comments and/or approval. The final CAD record drawings shall then be prepared by the Contractor and shall be provided to the Owner prior to the release of the substantial review holdback amounts related to submission of documentation.

.5 The Contractor shall obtain a set of AutoCAD files of the final design drawings from the Consultant, to be used for the preparation of the record drawings. The Contractor is to retain the services of an experienced and competent CAD draftsperson to transfer all changes from the "Record Site Marked-Up Drawings" into AutoCAD (latest version) format for the record drawings. Provide a hard copy of the finished CAD record drawings, together with the copy of the record site marked-up drawings, to the Consultant for review and comments prior to plotting of the final AutoCAD record drawings for the Owner.

.6 Upon receipt of the Consultant's comments and/or approval, complete any required changes, then submit to the Owner, through the General Contractor; the drawings are to be titled, "Record Drawings" and signed by the Mechanical Contractor. Obtain written confirmation that the following were received by the Owner:

.1 One set of CAD CDs

.2 Two sets of white prints

.7 Provide the Consultant with a CAD CD/DVD, or email the Consultant the final AutoCAD record drawings.

.8 The Contractor may be requested to sign a standard MCW/Contractor agreement entitled "Authorization to Use CAD Drawing Files", restricting the use of these CAD files for the purpose of preparing record drawings only and determining the editing procedures.

.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 Consultant for approval and make corrections as directed.

.4 Perform testing, adjusting and balancing for HVAC using as-built drawings.

.5 Submit completed as-built drawings with Operating and Maintenance Manuals.

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

1.13 SUB-CONTRACTS

.1 The Contractor, in subletting any parts of the work, shall make contracts by which his Subcontractors shall be bound by the terms of these contract documents as far as applicable to the work sublet.

.2 The Contractor shall properly direct and control his Subcontractors, being responsible for the coordination of his own work with that of his Subcontractors. Should the contract documents assign certain responsibilities to the Subcontractors, the Contractor shall not be relieved of such or any responsibilities for the entire work or any part thereof.

.3 The Contractor shall promptly transmit to the Sub-contractors all drawings and specifications bearing on their work.

.4 The Contractor shall carry the necessary insurance coverage such as comprehensive general liability, automobile and fire for all the work carried out under this contract.

1.14 LIST OF MATERIALS

.1 Furnish to the Consultant, a complete list of all suppliers and Subcontractors within 7 working days of a signed contract or letter of Intent.

.2 Substitution of equipment, other than shown on the list, will not be permitted.

.3 If the Contractor fails to submit this list, it will be assumed that all of the items specified in the specifications and shown on the drawings, will be used in the performance of the Work.

1.15 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Division 1 Specifications.

.2 Health and Safety Requirements: do construction occupational health and safety in accordance with Division 1 Specifications.

1.16 MAINTENANCE

.1 Furnish spare parts in accordance with Section 01 70 00 Execution and Closeout Requirement and as follows:

.1 One set of packing for each pump.

.2 One casing joint gasket for each size pump.

.3 One head gasket set for each heat exchanger.

.4 One glass for each gauge glass.

.5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.

.2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 70 00 - Execution and Closeout Requirement.

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

1.17 EVALUATION AND CERTIFICATION OF CHANGES IN THE WORK

.1 Refer to DIVISION 1.

.2 Extras will not be allowed for additional work or materials required to conform to the authorities having jurisdiction and the respective codes and by-laws.

.3 Extras will not be allowed for changes to run of piping and ductwork or relocation of equipment to avoid interference with other services or the building structure.

.4 Requests for extra payment based on differences in various subtrades' interpretations of who provides certain materials will not be considered.

.5 Work change evaluations shall be submitted with proper itemized break-downs from all trades which shall include the following:

.1 Cost of labour including fringe benefits and compulsory government charges and insurance.

.2 Cost of materials (less trade discounts when applicable).

.3 Rigging and equipment rental charges as applicable.

.4 All taxes and permits.

.5 Itemized sub-contractors costs in accordance with items .1 to .4 above.

.6 Cost for the preparation of the marked-up As-Built Drawings.

.7 Bond and warranty costs as applicable.

.8 Mark-up costs for profit and overhead as applicable in the Contract.

1.18 DELIVERY, STORAGE, AND HANDLING

.1 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Division 1 Specifications.

1.19 PERFORMANCE VERIFICATION OF INSTALLED EQUIPMENT

.1 Installed mechanical equipment whose performance is questioned by the Consultant, may be subject to performance verification as follows:

.1 Equipment shall be tested to demonstrate compliance with specifications. The testing procedure shall be agreed to by the Consultant and Owner.

.2 Contractor shall be responsible for maintaining systems operation while testing takes place.

.3 Should the test indicate equipment does not meet Contract Document the Contractor shall remove and replace with acceptable product/system at no cost to the Owner. In addition the Contractor shall pay for the test costs. Should the test indicate equipment meets the Contract Documents the Owner will pay for all costs.

1.20 TEMPORARY USE OF EQUIPMENT

.1 Temporary heat and use of equipment including boilers, pumps, heat exchangers, air handling equipment, heating coils, radiation, convectors, cabinet heaters, unit heaters, fans or other equipment installed may be operated for building heating during the construction period providing:

.1 Written authorization is given by the Owner's representatives.

.2 That adequate protection is provided to all moving parts against dust and moisture.

.3 That adequate clean combustion air is provided.

.4 That all safety devices on any and all equipment are operational.

.5 Proper fuel and electrical energy is available.

.6 Water treatment as specified is applied as required and maintained throughout the temporary heat period.

.7 Filters, of the quality specified, are installed on equipment requiring filtering.

.8 There has been agreement reached with the Owner’s representative that all-rotating equipment and boilers, go into the warranty period at the date of Substantial Performance of the Work.

.9 That the building is closed in from the elements to protect lines and equipment from freezing.

.10 That during the initial start-up it may be necessary to preheat the building by other means.

.11 Adequate supervision is provided for surveillance of all equipment, which is located in a non-normal fashion or in a manual mode.

.12 Fuel and other energy costs are paid by the Contractor.

.13 Factory representatives to examine the equipment to ensure that applicable warranties are in effect.

.14 Equipment damaged by construction personnel, including scrapes, scratches, dents, is repaired.

.15 Checking, cleaning, greasing of all equipment before it is turned over for final use.

.16 Upon completion of work, installation of new filters, as specified, on all equipment used in the temporary heating system.

.17 Duct cleaning to be completed after use for temporary heating and prior to balancing.

.18 The Mechanical Contractor shall be reimbursed for all costs that are incurred for refurbishment of permanent equipment that has been used for temporary use during construction.

1.21 COMPLETION OF WORK

.1 The completion of the work shall be in accordance with good trade practices and code requirements, and as outlined in Section 230593 TESTING, ADJUSTING AND BALANCING, Section 230800 – COMMISSIONING. For Substantial Performance of the Work, the following shall be completed:

.1 Completed Occupancy and Substantial Performance and Commissioning Checklists and other documentation are submitted to the Consultant as specified.

.2 All systems and equipment cleaned and painted (touch-ups); access to equipment and devices confirmed. All equipment shall be lubricated.

.3 Maintenance Manuals and As-Built Drawings submitted and approved.

.4 Balancing completed and reports submitted for review.

.5 Controls calibrated and report submitted and approved.

.6 Carry out all tests and verification required by the Authorities for building occupancy.

.7 Letters requested from selected manufacturers and professionals as specified.

.8 Demonstration and orientation is provided (or scheduled) to the Owner's representatives.

.9 Three sets of keys, operators and special tools to be turned over to the Owner’s representative.

.2 The Contractor(s) shall co-ordinate the work schedule with the [General Contractor] [Construction Manager] and to confirm the dates for the sequential occupancy of each area of the building and for the Substantial Completion of the complete project.

.3 Upon notification from the Contractor that the work has been substantially performed, the Consultant will make the Occupancy and Substantial Performance Reviews and present a list of deficiencies to the Contractor. The Contractor shall advise the Consultant when these deficiencies have been corrected and a Final Review shall then be carried out by the Consultant.

.4 In the event that there are deficiencies which are in the opinion of the Consultant, not expedient to correct, the Consultant will have the authority to deduct a reasonable sum from the contract price to compensate for the deficiency.

.5 Should it become necessary for the Consultant to re-inspect the work for deficiencies which were not corrected satisfactorily, the Contractor shall be responsible and pay for the additional time and expense incurred by the Consultant in these further reviews.

.6 Even though approval has been made on certain aspects of the project, should deficiencies arise after this approval, it will not relieve the Contractor of the responsibility of correcting these deficiencies.

.7 Progress payments beyond 95% shall not be approved until the Substantial Performance Review requirements have been completed and the related documents submitted.

.8 The holdback for deficiencies shall be two times the actual value of the item; release of deficiency holdback shall not be given until all deficiencies and final documentation are completed.

1.22 PROJECT TURNOVER AND ACCEPTANCE

1. When the systems have been commissioned and all deficiencies have been corrected and the Project completed in essence, the Contractor shall convene a meeting of his sub-trades, the Owner's representative and the Consultant, at which time the project and the operation of the system will be turned over to the Owner. Until such a meeting has been convened and accepted by all parties, the Contractor will be fully responsible for the operation and maintenance of all components and systems and shall ensure adequate and proper operation thereof. Up to and including the day of the turnover, the Contractor will be responsible for all chemical treatment, refrigerant and lubrication, necessary to operate the system in a proper fashion, but not fuel or electrical power.

2. At the time of turnover of the Project, the Contractor will present to the Owner all required adjusting tools, wrenches, brushes, keys and spares required for proper system operation. He shall also clearly explain the mechanical system operation.

3. Subsequent to this acceptance and turnover, the Owner will be responsible for maintenance and operation of the Mechanical Systems.

4. At the time of the turnover meeting, providing it is accepted by the Owner and the Consultant, the warranty period shall commence unless specific components of the system have been previously accepted by the Consultant and the Owner.

1.23 MUNICIPAL CONNECTIONS

1. Coordinate the connection of sanitary, storm, water and gas; refer to the Civil Engineer's drawings.

2. Prior to start of underground piping confirm the location of the existing services and the invert elevations and method of connections of site services with the utility/authority and/or civil engineer representatives.

1.24 PROGRESS CLAIMS

1. Refer to DIVISION 1.

2. Provide a cost breakdown for all Mechanical work in accordance with the standard breakdown format provided by the Consultant

1.25 INSTALLATIONS IN EXISTING BUILDINGS

1. The work shall include the relocation or connection onto existing equipment, piping and ductwork as indicated. Make good equipment, insulation, piping and ductwork damaged or disturbed during the work. Where asbestos insulation is present, follow WCB regulations for removal and/or encapsulating.

2. Protect all existing services encountered. Arrange work to avoid shutdowns of existing services during normal day occupancy. Where interruptions are unavoidable, obtain the Consultant's approval for timing of shutdowns.

3. Ensure that existing equipment is carefully dismantled and not damaged or lost. Do not reuse existing materials and equipment unless specifically indicated. The Contractor shall review the disposition of the existing equipment with the Owner's representative and to arrange for the removal from the site of all surplus material and equipment not retained by the Owner.

4. Where existing systems are extended to service the new addition, include for complete balancing of existing systems which may be affected by the connection of new piping or ductwork.

5. Drawings indicate known existing underground facilities; consult with the Consultant before commencing work. Once locations have been set out, assume responsibility for proper execution of work and excavation. Exercise caution for possible presence of unknown services. Record any deviations or new items on the "As-Built" Drawings.

6. Where new building control systems connect into existing systems, allow for proper calibration of work affected.

7. Allow for extra labour and material required for sequential installation of work.

8. No extra compensation shall be allowed for rerouting, resizing or work required to miss existing work and structures. Check work before fabrication and make necessary cost allowances for additional elbows and joints.

9. Where refrigerant is being taken out from existing equipment, it shall be put into containers and not vented to atmosphere.

10. The Contractor shall remove the following:
    .1 Redundant control devices.
    .2 Abandoned piping and ductwork, unless otherwise shown.

11. The Contractor is responsible to ensure compliance with the Workplace Hazardous Material Information System (WHMIS) in the performance of the Mechanical Work.

12. Coordinate with the General Contractor for openings required in existing ceilings to accommodate the new mechanical work including sprinklers. Include for access doors to service existing and new equipment and components.

13. Refer to drawings and the outline of work in each Section of the specifications for additional details on the work required for the existing mechanical systems.

    .1 Existing Services:

        .1 Before interrupting major services (such as the central boiler/air handling systems, the main domestic and fire protection cold water supply and the domestic hot water supply) notify the Consultant and Owner 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 the 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 interruptions.

.4 Services shall be restored at the end of the day unless other arrangements are made.

.2 Operation During Construction:

.1 In order to minimize operational difficulties for the Occupants, the various trades must cooperate with the Owner throughout the entire construction period and particularly, ensure that noise is minimized.

.2 Convenient access for staff and public to the facility 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 that the operation of the facility can be maintained as near to normal as possible.

.3 X-Raying:

.1 The Mechanical Contractor shall be responsible for all costs for x-raying of existing structural members. Confirm with the Structural Consultant, the location of all openings being cut or cored through existing structural members and slabs.

1.26 ACCESS DOORS AND PANELS

.1 Provide access panels required in building construction for access to any concealed mechanical equipment which, in the Consultant's opinion, requires maintenance or adjustment.

2. Such panels shall be manufactured panels, with fastening devices, appropriate to the construction involved, subject to the Consultant's approval.

1.27 LAWS, NOTICES, PERMITS AND FEES

.1 Give all necessary notices, obtain all necessary permits and pay all fees in order that the work hereinafter specified may be carried out. Furnish all certificates necessary to evidence that the work installed conforms with all applicable laws and regulations of all authorities having jurisdiction.

.2 All work shall be in accordance with the regulations of the following authoritative bodies, the codes in effect at the time of tender, and any other authorities having jurisdiction:

.1 Fire Marshall

.2 Canadian Electrical Code

.3 Local Building By-Laws

.4 Worker's Compensation Board

.5 Canadian Standards Association

.6 Mechanical Refrigeration Code B52

.7 Canadian Gas Code B-149.1

.8 2012 B.C. Building Code
.9 2010 National Building Code of Canada
.10 Boiler and Pressure Vessel Act.
.11 National Fire Protection Association
.12 IAO. Insurers Assurance Organization
.13 Underwriters' Laboratories of Canada
.14 2015 Vancouver Building Bylaw
.15 ASHRAE Standards
.16 SMACNA Standards
.17 2012 BC Fire Code

1.28 DEMONSTRATION AND INSTRUCTION TO OWNER

.1 Demonstrate to and instruct the representative designated by the Owner on the complete systems operating and maintenance procedures using the assistance of specialist subtrades and manufacturer's representatives.

.2 Submit a program for approval 14 days prior to substantial completion. When approval is obtained from the Consultant, arrange an acceptable time with the Consultant for the execution. Allow a period of one (1) day. During this period, the following systems shall be demonstrated in regards to performance and safety features (to the fullest):

.1 Air Handling Systems (Supply, Return, Exhaust)
.2 Heating Systems (H.W. Heating, D.H.W.S.)
.3 Controls System
.4 Fire Protection and Plumbing Systems
.5 Refrigeration

.3 Obtain a signed statement from the Owner certifying that the demonstration and instructions have been given to his/her satisfaction.

1.29 INSPECTION

.1 The Consultant or his/her representative shall inspect all work prior to it being concealed. All work shall be approved by all authorities having jurisdiction. All piping below ground must be approved prior to covering. All openings shall be sealed appropriately in particular in fire rated walls and floors. Sealing shall be approved prior to covering.

.2 Inspection by the Engineer does not relieve the Contractor of his/her responsibility to have Authorities having jurisdiction to inspect work prior to backfilling/boarding.

1.30 TEMPORARY FACILITIES

.1 Provide all temporary buildings and workshops that may be required for workmen, for this section on-the-site operations, storage of materials and sewer connected water closets for the use of workmen. Provide, near the site and keep open at all times during construction on the project, an office for his/her own use where all notices and instructions from the Consultant will be received and acknowledged by himself or his/her authorized representative. Accommodations shall conform in appearance to the General Contractor's.

1.31 DEMOLITION

.1 Existing Conditions:

.1 Visit and examine the site and note all characteristics and irregularities affecting the work of this section.

.2 Demolition:

.1 Completely demolish the items scheduled and remove all materials from the premises. Demolish right to the source and remove all unnecessary equipment.

.2 Carry out demolition in a manner to cause as little inconvenience to the adjacent occupied building area as possible. Coordinate the activity with the Owner and/or the Consultant.

.3 Carry out demolition in an orderly and careful manner.

.4 All coring, patching and removal of existing equipment, pipes and ductwork which may affect occupied areas of the building to be done outside of regular office hours or as scheduled with the Owner.

.3 Existing Services:

.1 Disconnect and cap all mechanical services in accordance with requirements of local authority having jurisdiction. Natural gas supply lines shall be removed by the gas company or by a qualified tradesman in accordance with gas company instructions.

.2 Building Mechanical Services: Maintain all building services during demolition/removal of existing.

.4 Protection:

.1 Prevent movement or settlement of adjacent work. Provide and place bracing or shoring and be responsible for safety and support of such work. Be liable for any such movement or settlement and any damage or injury caused.

.2 Cease operations and notify the Prime Consultant immediately for special protective and disposal instructions when any asbestos materials are uncovered during the work of this section. Follow procedures as appended herein.

.3 Prevent debris from blocking surface drainage inlets and mechanical and electrical systems which remain in operation.

.5 Salvageable Materials:

.1 Except as otherwise indicated, salvageable materials from areas of demolition shall become the property of the Owner at his/her discretion. All material removed from the building not handed over to the Owner for salvage under this project shall be removed from site.

1.32 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with General Conditions.

.2 Divert unused mental and wiring materials from landfill to mental recycling facility approved by Consultant.

.3 Dispose of unused paint material at official hazardous material collections site approved by Consultant.

.4 Do not dispose of unused paint material into sewer system, into streams, lakes, onto ground or in other locations where it will pose health or environmental hazard.

.5 Remove from site and depose of packaging materials at appropriate recycling facilities.

.6 Dispose of corrugated cardboard, polystyrene and plastic packaging materials in appropriate on-site bin recycling in accordance with site waste management program.

1.33 REQUIREMENTS FOR CONTRACTOR RETAINED ENGINEERS

.1 All professional engineers retained by the Mechanical Contracts to perform consulting services with regard to mechanical work, i.e. seismic engineer, fire protection engineer, structural engineer, are to be members in good standing with the local Association of Professional engineer, and are to carry and pay for errors and omissions professional liability insurance in compliance with requirements to the Authorities having jurisdiction.

.2 The engineer's professional liability insurance is to protect your Consultants and Sub-Consultants, and their respective servants, agents, and employees against any loss or damage resulting from the professional services rendered by your Consultants, Sub-Consultants, and their respective servants, agents, and employees in regards to the work of this Contract.

.3 Liability insurance requirements are as follows:

.1 Coverage is to be a minimum of $1,000,000.00 inclusive of any one occurrence.

.2 The insurance policy is not to be cancelled or changed in any way without the insurer giving the Owner a minimum of thirty days written notice.

.3 Liability insurance is to be obtained from an insurer registered and licensed to underwrite such insurance in the location of the work.

.4 Evidence of the required liability insurance in such form as may be required is to be issued to the Owner, the Owner's Consultant, and Municipal Authorities as required prior to commencement of your Consultants' services.

Part 2 Products

2.1 MATERIALS

.1 Materials and products in accordance with Section 01 60 00 - Product Requirements

Part 3 Execution

3.1 PAINTING REPAIRS AND RESTORATION

.1 Do painting in accordance with Section 09 91 00 - Painting.

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

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

3.2 CLEANING

.1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

.2 All debris resulting from the work shall be cleaned up as the work progresses.

.3 All materials, equipment and fixtures used on a temporary basis shall be cleaned and restored to an as new condition prior to turnover of systems to the Owner.

.4 Vacuum and remove debris from the inside of all mechanical systems including fans, ducts, coils, terminals units.

.5 Cover open pipes, ductwork and equipment to prevent entry of dust and debris.

3.3 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Section 01 40 00 – Quality Requirements.

.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.

.4 The grooved joint coupling manufacturer’s factory trained representative shall provide on-site training for the contractor’s field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the project site to ensure best practices in grooved installation are being followed. (A distributor’s representative is not considered qualified to conduct the training or field visits.)

3.4 PROTECTION

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

END OF SECTION

Part 1 GENERAL

.1 This section of the specification forms part of the Contract Documents and shall be read, interpreted and coordinated with Divisions in this specifications.

.2 Provide complete testing of the mechanical systems as required by Code and as outlined in the Contract Documents.

1.1 TESTS

1. Test all equipment and material where required by specifications or Authorities to demonstrate its proper operation. Test procedures shall be in accordance with applicable portions of CSA, ASME, ASHRAE and other recognized test codes and as field conditions permit. Provide all labour and material and pay all expenses for tests; notify the Consultant 72 hours prior to tests beings carried out.

2. Perform the following pressure tests; each test shall be itemized as to time test was performed and personnel responsible for the test; test logs to be included in the Maintenance Manuals. Minimum duration of tests is 6 hours without interruption.

   .1 All main water piping shall be tested at 1.5 times operating pressure but not less than 1380 kPa (200 psig).

   .2 Distribution domestic water plastic piping in suites to not less than 690 kPa (100 psig).

   .3 Fire protection lines to be tested to 1380 kPa (200 psig).

   .4 Tests on drainage systems shall be made by filling systems with water producing a minimum pressure of 3m (10 feet) and a maximum pressure of 8m (25 feet) water column and also check for proper grade and obstructions.

   .5 All ducts shall be tested to SMACNA Standards; leakage shall not be audible nor detected by feel.

   .6 Gas piping shall be tested to Code Requirements.

   .7 Test refrigerant piping with nitrogen to 2068 kPa (300 psi) on high pressure side and 1034 kPa (150 psi) on low side.

   .8 Prior to tests, isolate all equipment or other parts which are not designed to withstand the test pressure.

3. Prior to initial start-up of equipment a qualified tradesperson or millwright shall:

   .1 Align all V-belt drives using a straight edge.

   .2 Align shaft coupling drives using a dial indicator after all grouting and piping has been connected. Tolerance to be plus or minus .05 mm.

4. Lubricate all equipment with the exception of sealed bearings which shall be checked as follows:

   .1 Use the lubricant recommended by the manufacturer for the service.

   .2 Extend lubricating connections to outside of positions are not readily accessible.

1.2 ACTIVATION

1. Conduct performance and acceptance tests to demonstrate that the equipment and systems actually meet the specified requirements. Tests may be conducted as soon as the conditions permit. Make all changes, repairs, adjustments or replacements required as the preliminary test may indicate prior to final tests. During final test, demonstrate to the satisfaction of the Consultant that all equipment is operating as indicated without undue noise or vibration. The following shall be completed prior to the performance tests:

   .1 Place all systems in operation with all controls and safety devices functioning. Set pressure and regulating valves to code requirements.

   .2 Clean all strainers and filters; confirm that temporary strainers and filters are replaced with final specified products.

   .3 All identification and valve tagging completed.

   .4 Ensure balancing work has been completed.

   .5 SECTION 20 22 01 – DOCUMENTATION FOR COMPLETION to be reviewed with Sub-Trades; all documents to be completed prior to the Substantial Performance Review and acceptance by the Consultant.

.3 To provide a good environment for the occupants, the air systems shall be protected and then run to "flush out" chemical fumes that may be present from building products (such as furniture, carpet and equipment) as follows:

   .1 All ductwork, plenums and equipment shall be protected at all times and openings covered to minimize dust contamination of the system.

   .2 Ductwork, plenums and equipment to be cleaned prior to start-up.

   .3 The HVAC systems shall operate for two (2) weeks with temporary filters in place and maximum outside air provided. Room temperature shall be maintained at 20°C to 25°C. Refer to SECTION 23 05 02 – INDOOR AIR QUALITY.

   .4 The Mechanical Contractor shall complete the necessary pressure testing, cleaning, and lubrication equipment drive alignment, complete the manufacturer's start-up procedures for major equipment, clean systems and provide water treatment, check all safety devices and control systems.

   .5 The final system testing balancing and calibration of all components and systems are completed. Equipment and systems used on a temporary basis are checked, cleaned, repaired and lubricated.

   .6 Additional seasonal functional performance verifications will be required to confirm operation of systems during different climate season changes.

   .7 The Contractor is to ensure that the Owner's Representative has obtained adequate Orientation and Demonstration and that all tools and spare parts have been delivered to Owner.

1.3 COMPLETION OF WORK

1. Complete and submit all documents as outlined under Section 20 22 01– DOCUMENTATION FOR COMPLETION; coordinate with the Commissioning Agent for the completion of these documents.

END OF SECTION

Part 1 General

1.1 DOCUMENTS

.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 DEFINITIONS

.1 The following is a list of acronyms of organizations which may be referenced in these specifications:

AABC – Associated Air Balance Council
AMCA – Air Moving and Conditioning Association
ANSI – American National Standards Institute
ARI - Air Conditioning and Refrigeration Institute
ASHRAE – American Society of Heating, Refrigeration and Air Conditioning Engineers, Inc.
ASME – American Society of Mechanical Engineers
ASPE – American Society of Plumbing Engineers
ASTM – American Society of Testing Materials
AWWA – American Water Works Association
CEMA – Canadian Electrical Manufacturer's Association
CGA – Canadian Gas Association
CGSB – Canadian General Standards Board
c-UL – Canadian Branch of Underwriter's Laboratory
CSA – Canadian Standards Association
FM – Factory Mutual Engineering and Research Corp.
NBC – National Building Code of Canada
NEMA – National Electrical Manufacturer's Association
NFPA – National Fire Protection Association
SMACNA – Sheet Metal & Air Conditioning Contractors National Association Inc.
ULC – Underwriter's Laboratories of Canada
WH – Warnock Hersey

1.3 CODES AND STANDARDS

.1 Workmanship and material of work under Division 15 shall comply with or exceed applicable provisions including but not limited to the following codes, regulatory agencies and standards (most recent additions, including addenda and errata):

.1 BC Building Code
.2 Fire Commissioner Office of BC
.3 BC Plumbing Code
.4 National Fire Protection Association
.5 Canadian Electrical Code
.6 WorkSafe BC
.7 Local Building Code and By-Laws
.8 Canadian Standards Association
.9 Canadian Gas Association

.10 BC Electric Safety Branch
.11 BC Gas Safety Branch
.12 SMACNA and ASHRAE Standards
.13 BC Boiler and Pressure Vessel Safety Branch
.14 Waste Management Code
.15 Refrigeration Code
.16 ASHRAE/IES 90.1 - Standard
.17 Utility Company Standards
.18 Provincial Health Requirements

1.4 ACCESS DOORS

.1 Provide access doors to concealed mechanical devices for operations, inspection, adjusting and servicing with Allen head lock provide special keyed locks for access doors in accessible Public spaces. Do not locate in paneled or special finished walls without prior approval of the Architect. Prepare detail drawings showing locations and type of all access panels in coordination with other trades before proceeding with installation and submit to the Consultant for review.

.2 Provide access doors 300 mm x 300 mm (12" x 12") for hand entry; provide 600 mm x 600 mm (24" x 24") where personnel entry is required; provide access doors suitable sized for equipment servicing. **Access doors in finished public area walls and ceiling shall provide a concealed appearance with a recessed door panel to receive the finished material as follows:**

.1 Drywall – drywall insert satin finish galvanized steel with paint finish with electrostatically applied inhibitive prime coat. Continuous piano hinge to be provided with a removable safety chain to limit movement; galvanized steel drywall bead taping flange.
.2 Acoustic Tile – Acoustic tile with similar features as above, but with concealed flange.

.3 Provide manufactured access doors to match fire rating of wall or ceiling in which installed.

.4 Lay-in type ceiling tiles, properly marked, may serve as access panels.

.5 Finish shall be stainless steel where panels are installed in tiled walls such as for washrooms.

.6 Provide to suit wall surface or type of construction; factory prime coated access doors of welded 12 gauge steel, flush type with concealed hinges, lock and anchor straps.

.7 In high humidity all exposed screws shall be stainless steel; or zinc coated steel.

1.5 INSERTS

.1 Use only factory made, threaded or toggle type inserts as required for supports, and anchors, properly sized for the load to be carried.

.2 Use factory made expansion shields where inserts cannot be placed, but only as accepted by the Consultant and for light weights.

.3 Do not use explosive activated tools except with written permission of the Structural Consultant.

1.6 STRAINERS

.1 Provide where shown on the drawings, rated at 860 KPA (125 psi).

.2 Strainer baskets: Type 304 stainless steel or Monel, 1.14 mm (.045") perforations.

.3 Combination strainers and pump inlet diffusers with screens as specified above.

.4 Provide drain valve with cap on strainers.

.5 For Victaulic Piping System the standard of acceptance: Victaulic Style 732 Wye-Type.

1.7 MECHANICAL MOTORS AND ELECTRICAL CO-ORDINATION

.1 Responsibility: Unless otherwise indicated, motors, controls, conduit, and wiring shall be furnished and set in place in accordance with the following schedule:

ITEM	FURNISHED BY	SET BY	POWER CONDUIT AND WIRING	CONTROL CONDUIT AND WIRING
Equipment Motors	MC	MC	EC	MC
Motor Starters and Overload Heaters (See Note 1)	EC	EC	EC	MC
Fused and Unfused Disconnection Switches (See Note 2)	EC	EC	EC	
Line Voltage 120V or greater Control Devices and Control Wiring (See Note 3)	MC	MC	EC	MC
Duct Smoke Detectors	EC	MC/EC	EC	EC
Smoke Dampers	MC	MC	EC	EC
Sump Pumps	MC	MC	EC	EC
Heat Tracing	MC	MC	EC	MC
Relays for Fan Shutdown	EC	EC	---	EC
Automatic Flush Devices	MC	MC	EC	EC
Adjustable Speed	MC	MC	EC	MC

Drives (ASD) or (VSD)				

MC: Mechanical Contractor
EC: Electrical Contractor
NOTES:

.1 All motor starters that are to be included as a part of the mechanical equipment shall be furnished and installed under Division 21, 22, and 23. All other starters shall be furnished and installed under Division 26. Fractional HP motors shall have internal overload protection. Three-phase starters shall have three pole overload protection.

.2 Disconnect switches furnished as part of factory wired equipment under Division 21, 22, and 23 shall be wired and connected under Division 26.

.3 Division 26 shall provide line / load motor wiring from line voltage thermostats humidistats or timers to single phase motors where magnetic starters are not used.

.4 Division 21, 22, and 23 shall verify voltage, phase, and all electrical load characteristics with the electrical contractor before ordering any equipment. The Mechanical Contractor shall include in his bid the cost of any additional items that will electrical modifications to the specified equipment.

.2 Connections: Final connections to controls directly attached to ducts, piping and mechanical equipment shall be made with flexible conduit. Refer to Division 26.

.3 Motors:

.1 Provide submittals for motors with CSA approval and labelled, including maintenance data and lubrication.

.2 Use high efficiency motors throughout the project. To NEMA Premium Efficiency Standards. All motors shall be of the latest design, incorporating premium material and meeting or exceeding all of the latest requirements of CSA and EEMAC standards as apply to T frame electrical motors.

.3 Single phase motors shall have pre-lubricated sleeve or ball bearings, automatic reset overload protector. Drip proof enclosure Class A (50°C temperature rise insulation), minimum service factor 1.0).

.4 Three phase power – Squirrel Cage Motors shall be as follows:

.1 Starting Torque: Between 1 and 1 ½ times full load torque.

.2 Starting Current: Six times full load current.

.3 Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.

.4 Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.

.5 Insulation System: NEMA Class B or better.

.6 Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.

.7 Motor Frames: NEMA Standard T-Frames of steel, aluminium, or cast iron with end brackets of cast iron or aluminium with steel inserts.

.8 Thermistor System (Motor Frame Size 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter; refer to Division 16.

.9 Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for re-lubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

.10 Sound Power Levels: To NEMA MG 1.

.11 Part Winding Start Where Indicated Above 254T Frame Size: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.

.12 Two (2) speed motors shall be single winding.

.13 Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.

.14 Nominal Efficiency: As scheduled at full load and rated voltage when tested in accordance with IEEE 112.

.15 Nominal Power Factor: As scheduled at full load and rated voltage when tested in accordance with IEEE 112.

1.8 SPARE PARTS AND SPECIAL TOOLS

.1 Provide special tools and spare parts as follows for applicable equipment provided for this project:

.1 One set of casing gaskets for each size pump.

.2 One head gasket set for each heat exchanger.

.3 One set of V-belts for each piece of machinery.

.4 One glass for each gauge glass.

.5 One set of filters for each filter bank installed.

.6 Spare thermostat and sensor for each model provided.

.7 Valve spare parts as specified.

.8 Steam Trap spare parts.

.9 Identify spare parts and place in mechanical room with packaging.

.10 Provide one set of special tools required to service equipment recommended by the manufacturer mounted on a painted plywood board in the main Mechanical Room with identification labels.

Part 2 Products

2.1 INSTALLATION

.1 Install equipment, ductwork, conduit and piping in a workmanlike manner to present a neat appearance and to function properly to the acceptance of the Consultant. Install ducts and pipes parallel and perpendicular to building planes. Install piping and ductwork

concealed in chases, behind furring, or above ceiling. Install exposed system grouped to present a neat appearance. Comply with manufacturer's installation instructions.

.2 Install gauges and thermometers to permit easy observance.

.3 Install all equipment and apparatus with due allowance for wiring, maintenance, adjustment or eventual replacement.

.4 Install control devices to guarantee proper sensing. Shield elements from direct radiation and avoid placing them beyond obstructions.

.5 Include in the work all requirements of manufacturers shown on the shop drawings.

.6 Install all ceiling mounted components (Diffusers, Grilles, Sprinklers) in accordance with reflected ceiling drawings accepted by the Architect.

.7 Leave space clear and install all work to accommodate future materials and/or equipment as indicated and to accommodate equipment and/or materials supplied by other trades. Verify spaces in which work is to be installed. Install pipe and duct runs to maintain maximum headroom and clearances and to conserve space in shaft and ceiling spaces.

.8 Confirm on the site the exact location of equipment and fixtures. Confirm location of equipment supplied by other trades and mechanical requirements thereof.

.9 Seal all protrusions through fire rated enclosures to meet the requirements of the Authorities having jurisdiction.

.10 Install piping connections to pumps and all other equipment without strain at the pipe connection to this equipment. Remove, where requested by the Consultant, bolts in flanged connections or disconnect piping after the installation is complete to demonstrate that the piping has been so connected. Provide grooved couplings, unions or flanges to all pumps and equipment.

.11 Provide provisions for draining all piping including risers. Provide shut-off valves on supply and balancing valves on return piping connections on all items of equipment.

.12 Equipment Installation:

- .1 Erect equipment in a neat manner, align parts, level and adjust for satisfactory operation.
- .2 Install equipment will unions or flanges so that connections of piping and accessories can be readily carried out.
- .3 Equipment to be easily accessible for adjustment, maintenance and repair.
- .4 All equipment and drives shall be aligned properly by qualified tradesmen.
- .5 Equipment drains to be piped to drains; avoid crossing walkways.
- .6 Install equipment, rectangular cleanouts and similar items parallel to or perpendicular to building lines.
- .7 Equipment mounted on spring isolators to have Victaulic or flexible connections on piping.

.8 Provide all relief valves and indirect drains to floor drains; size and installation to code.

.9 Strainers to have capped drain valve with hose end.

.13 Progress Digital Photographs:

.1 Coordinate with the General Contractor to take progress photographs and email to the Consultant when requested for the following:

.1 Site work piping and prior to and during backfield

.2 Underground piping and ductwork below slabs

.3 Installed risers for plumbing and HVAC, including anchors and expansion joints / loops

.4 Roughed-in piping for washrooms prior to drywalling

.5 Ceiling-mounted HVAC equipment

.6 Roughed-in equipment and piping in mechanical rooms

.7 Completed installation of mechanical rooms and rooftop equipment

.8 Other equipment and/or photographs as requested by the Consultant

2.2 FIELD WELDING

.1 Refer to Section 20 06 01 PIPE WELDING.

2.3 AIR SCOOPS AND AIR VENTS

.1 Provide air scoops and air vents on water piping at all high points in the system and at each piece of equipment. Provide shut off cocks to all air vents.

.2 Provide automatic air vents on piping mains except where a possibility from water damage would occur, in which case, use manual vents.

.3 Provide manual air vents at each piece of equipment.

.4 Provide drain lines for automatic air vents located over finished areas; run drains to nearest floor drain or janitors sink.

2.4 PROTECTION

.1 Cover openings in equipment and cover equipment where damage may occur from weather to finish. Cover temporary openings in ducts and pipes with polyethylene sheets, until final connection is made. Cover all items cast into concrete floors or walls such as floor drains, cleanouts, etc., prior to pour, with heavy plastic tape or duct tape.

.2 Cover and seal, with polyethylene sheeting, all equipment, ducts, coils and motors in place during construction to prevent entry of dust, paint and debris.

.3 Each system of piping shall be blown or flushed through immediately after assembly for the purpose of removing grit, dirt, sand and other material from coils and piping. The completed piping systems shall then be cleaned as specified.

.4 Where equipment and prefabricated ductwork are stored in the building during construction they shall be protected from dirt and dust.

2.5 RIGGING OF EQUIPMENT

.1 Provide all rigging, hoisting and handling of equipment as necessary in order to place the equipment in the designated area in the building.

.2 Direct this work by qualified people normally engaged in rigging, hoisting and handling of equipment.

2.6 CONCRETE HOUSE KEEPING PADS

.1 Except as specifically indicated on the mechanical drawings or where indicated on the architectural or structural drawings as provided by other Divisions, provide all concrete work required for mechanical work (bases, curbs, anchors, thrust blocks, manholes, catch basins) in accordance with requirements of DIVISION 3.

.2 Provide in good time, all inserts, sump frames, anchors etc., required to be built into forming for mechanical services.

.3 Equipment to be supported on concrete floors to have reinforced concrete housekeeping pad; pads solidly anchored to the structural slab to meet seismic requirements as follows:

- .1 Reinforced concrete with bar or mesh reinforcing.
- .2 Minimum 4 inches (100 mm) high with cambered edges.
- .3 Seismically attracted to structural floor with 10 mm rebar dowels on 3 feet by 3 feet (900 mm x 900 mm) grid.
- .4 Drill and epoxy grout dowels 3 inches (75 mm) into concrete floor.
- .5 Provide minimum 8 inches (200 mm) edges to allow for equipment seismic restraint devices.
- .6 Provide layout field shop drawings for all housekeeping pads to the Consultant for review.

2.7 METALS

.1 Steel construction (supports, anchor bolts, platforms, braces, tie rods, etc.) required solely for the work of mechanical trades and not shown on architectural or structural drawings shall be provided by Mechanical Contractor to the acceptance of the Consultant. Prepare and submit installation field shop drawings on any steel construction for acceptance of the Consultant.

.2 All metal components shall be prime-coated and components exposed to the elements shall have painted finish.

2.8 CUTTING AND PATCHING

.1 Inform other trades in time concerning required openings. In work already finished the Contractor will perform all cutting and patching at the expense of the Mechanical Contractor obtain the approval of the Project Structural Consultant before doing any cutting.

2.9 FLASHING

.1 Flash and counter flash where mechanical equipment passes through weather or water proofed walls, floors, and roofs.

.2 Flash, vents and soil pipes projected 75 mm (3") minimum above finished roof surface with lead worked 5 mm (1") minimum into hub, 200 mm (8") minimum clear on side with minimum 600 x 600 mm (24" x 4") sheet size. Four pipes through outside walls turn flange back into wall and caulk.

.3 Flash floor drains over finished areas with lead 200 mm (8") clear on sides with minimum 600 x 600 mm 24" x 24") sheet size. Fasten flashing to drain clamp device.

.4 Provide curbs for mechanical roof installation 200 mm (8") minimum high. Flash and counter-flash with steel, soldered and made waterproofed.

.5 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 (6") into walls or to top of curbs and caulk into joints.

2.10 INSERTS, SLEEVES AND ESCUTCHEONS

.1 Coordinate the location of all openings required for the mechanical work; provide all sleeves required for ductwork, piping and access openings unless they are specifically shown on architectural and structural drawings. Improperly located openings and sleeves shall be corrected at no extra cost to the Owner.

.2 Place inserts only in portion of the main structure and not in any finishing material.

.3 Supply and locate all inserts, holes, anchor bolts and sleeves in time when walls, floors and roof are erected. All sleeves shall be large enough to allow for movement of piping including insulation and for fire stopping.

.4 Provide the following for pipe sleeves:

- .1 Through interior walls, exterior walls above grade, interior non-waterproof floors: Machine cut schedule 40 steel pipe, medium cast iron or 18 gauge galvanized steel.
- .2 Through walls below grade, waterproof floors, floors in janitor's closets, equipment rooms, and kitchens: machine cut medium cast iron, D.W.V. copper or copper sheet extended 50mm (2") above the floor and cut flush with the underside.
- .3 Ensure that cold water insulation is carried through the sleeves and sealed to code fire separation; and for acoustical purposes in critical areas.

.5 Provide the following for ductwork:

- .1 Where fire dampers are not required in poured walls; removable wood box out of required size. In block or brick walls; masonry to be built around ducting.
- .2 Where fire dampers are required; 18 gauge galvanized steel or heavier sleeves complete with steel angle framing both sides installed in accordance with requirements of Authorities. See also detail drawings.

.3 Through Equipment Room Floors, provide 100 mm (4") high concrete curbs for ductwork and any piping so spaced where sleeving is impractical.

.6 Provide grommets equivalent to Acoustic-Plumb model Acusto-Lator grommets in all critical areas; Acusto-Plumb or plastic grommets equivalent to Pipe Tytes or Greelee 712-M shall be used in other areas for pipes passing through stud partitions. Ensure no contact between copper pipe and ferrous material.

.7 For fire dampers refer to the SMACNA Standards.

2.11 SEALING OF PENETRATIONS

.1 Refer to Section 20 08 01 FIRESTOPPING AND SMOKE SEAL SYSTEMS.

.2 Through foundation walls, co-operate with the Waterproofing trade and apply and an approved flexible caulking compound Hydrotite Leak Master over ram-packed mineral wool on both sides. Over this, on both sides, apply a layer of glassfab tape imbedded in two coats of an approved mastic compound. In lieu of caulking compound a wall-link neoprene seal or equivalent can be used; Metraseal Link-seal or equivalent. For areas with high water table levels use water stop type wall sleeves.

.3 Cover sleeves and openings around exposed piping in all finished areas with chrome plated escutcheons. Cover exposed duct sleeves in finished area.

2.12 ACCESS PANELS AND DOORS

.1 Install all concealed Mechanical equipment requiring adjustment or maintenance in locations easily accessible through access panels or doors. Install systems and components to result in a minimum number of access panels.

.2 Access doors are required in walls and ductwork at all fire and balancing dampers, motorized dampers, duct mounted coils, smoke detectors, fan inlets and outlets, valves and other devices requiring access for servicing. Indicate access panels on "As-Built" drawings and note at each location the item’s equipment (or valve no.) that access is being provided for.

.3 Supply the respective Trade with panels, doors or the frames therefore, complete with all pertinent information for installation.

.4 Prepare detail drawings showing location and type of all access doors in coordination with other trades before proceeding with installation and submit for review.

.5 Size access doors to provide adequate access and be commensurate with type of structure and architectural finish.

.6 Ensure proper rating of doors in fire separations.

.7 Provide labels (white on black), attached to all access doors and access tiles listing items or equipment which access is being provided for by following this schedule; also refer to Section 20 16 01 MECHANICAL IDENTIFICATION:

.1 Cleaning and services and access - C.A.

.2 Controls, including sensors - C

.3 Dampers - D

.4 Fire dampers - F.D.

.5 Smoke dampers - S.D.

.8 Provide labels for valve tag and/or equipment information on inside of access door.

2.13 PAINTING

.1 DIVISION 21, 22 and 23 shall be responsible to prime coat all exposed ferrous metal work installed by DIVISION 21, 22 and 23 and piping and steel support structures exposed to outdoors shall be painted with additional two coats of paint. Clean up or wire brush all equipment before painting.

.2 DIVISION 21, 22 and 23 is not required to prime coat of paint exposed ductwork or piping inside of building, except in Mechanical Rooms (and other exposed areas which do not have painted finish by DIVISION 9).

.3 All mechanical work in painted finished areas is to be by painted by DIVISION 9.

.4 DIVISION 21, 22 and 23 to provide all required identification on piping and ductwork requiring colour coding as specified.

2.14 EXPOSED WORK

.1 Wherever any mechanical work is exposed in finished areas, it shall be carried out in a neat and workmanlike manner; work with the Consultant prior to installation. If unsatisfactory installation results due to not following this procedure, perform remedial work to the Consultant's acceptance. The Consultant shall have the power to reject any work that does not comply with the intent of the contract.

2.15 PIPING AND DUCTWORK SYSTEM TESTS

.1 Refer to Section 20 03 01 TESTING AND ACTIVATION, Section 23 33 00 AIR DUCT, DUCTWORK AND ACCESSORIES.

.2 Do not insulate piping systems until completed, perfected, and proven tight.

.3 Should leaks develop in any part of the piping system, remove and replace defective sections, fittings, etc.

.4 Test piping system in sections as required by the progress of work. Test equipment and material where required by specification or authority having jurisdiction to demonstrate its proper and safe operation.

2.16 GUARDS

.1 Provide guards for unprotected drives.

.2 Guards for belt drives:

.1 Expanded metal screen welded to steel frame.

.2 Minimum 1.2 mm thick sheet metal tops and bottoms.

.3 40 mm (1 1/2") dia. holes on both shaft centres for insertion of tachometer.

.4 Removable for servicing.

.3 Provide means to permit lubrication and use of test instruments with guards in place.

.4 Install belt guards to allow movement of motors for adjusting belt tension.

.5 Guard for flexible coupling:

.1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.

.2 Securely fasten in place.

.3 Removable for servicing.

.6 Unprotected fan inlets or outlets:

.1 Wire or expanded metal screen, galvanized, 19 mm mesh.

.2 Net free area of guard: not less than 80% of fan openings.

.3 Securely fasten in place.

.4 Removable for servicing.

2.17 PIPE CLEANING AND WATER TREATMENT

.1 All new piping shall be cleaned and flushed prior to being used for temporary or permanent use. Flush each system until the residue water is free of sediment. Inspect and clean sludge out at all valved drains at low points of systems and at strainers.

.2 For plumbing systems, flush piping with cold water for 30 minutes and disinfect with chlorine solution, the work shall be in compliance with AWWA Standard C-601. The system shall stand for 24 hours with the disinfectant solution then flushed thoroughly.

.3 For closed water systems and condensate piping, use alkaline chemical cleaner solution and follow the cleaning methods recommended by the manufacturer’s agent. Provide chemical feeders with three valve isolation and by-pass and chemicals for the water treatment.

.4 For steam piping systems, raise steam pressure to normal operating pressure. Hold pressure for four hours. Remove heat and allow to sit for 15 minutes. Flush steam system piping with clean water. Repeat flushing as necessary until wash water is clean and free of debris. Install corrosion coupons.

.5 Provide automatic chemical treatment for the cooling tower. Provide valved bleed line from system to drain; adjust continuous need to meet operating conditions.

2.18 IDENTIFICATION OF EQUIPMENT DUCTWORK AND PIPING

.1 Refer to Section 20 16 01 MECHANICAL IDENTIFICATION.

2.19 DRAINS

.1 Pipe all discharge from relief valves, backflow preventers, relief ports and drains to the nearest floor drain or suitable receptacle.

.2 Size of floor drain to meet the requirements of the AWWA Cross Connection Control Manual for backflow devices:

Size of Backflow Device	Size of Floor Drain
1 ¼" (32 mm)	3" (75 mm)
1 ½" (37 mm) to 2" (50 mm)	4" (100 mm)
2 ½" (62 mm) to 6" (150 mm)	6" (150 mm)
8" (200 mm) and larger	8" (200 mm)

.3 Provide 20 mm (3/4") ball valves with hose ends, caps and chains at strainers, all low pints, pumps, coils and at each piece of equipment.

.4 Provide deep seal straps (150 mm trap seal) on all air handling equipment condensate drains and on floor drains located within air handling unit plenums. Provide trap seal primers on all floor drain traps and gang traps.

.5 For all automatic air vents, provide ¼" (6mm) copper tubing to nearest drain.

2.20 CONTROL COMPONENTS

.1 Install all pipe line devices supplied by the controls sub-contractor such as flow switches, valves, and separate wells for temperature controllers and sensors.

.2 If dirt accumulates under the seats of automatic control valves during the first year's operation, remove the collected materials under the valve seats and if seat is undamaged, replace same at no additional cost to the Owner.

END OF SECTION

Part 1 General

1.1 DOCUMENTATION

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated Sections 21 , 22 and 23.

1.2 REFERENCE STANDARDS

1. The work shall be in accordance with the following standards (latest edition)except where specified otherwise:

.1 ANSI/ASME B31.1 ASME Code for Pressure Piping and Power piping.

.2 ANSI/ASME Boiler and Pressure Vessels Code.
- .1 Section I: Power Boilers.
- .2 Section V: Non-destructive Examinations.
- .3 Section IX: Welding and Brazing Qualifications.

.3 CSA W47.2 Aluminium welding qualification code.

.4 CSA W48 series Electrodes.

.5 CSA B51-M Boiler, Pressure Vessel and Pressure Piping Code.

.6 CAN/CSA-W117.2 Code for safety in welding and cutting (Requirements for welding operators).

.7 CSA W178 Qualification code for welding inspection organizations.

.8 CSA W178.2 Certifications of welding inspectors.

.9 CGSB 48-GP-2M Spot radiography of butt welds in ferrous metals.

.10 AWS B3.0 Welding procedures and performance qualifications.

.11 AWS C1.1 Recommended practices for resistance welding.

.12 AWS W1 Welding Inspection.

.13 ANSI/AWWA C206 Field welding of steel water pipe.

.14 ANSI/ASME B31.9 (ASME code for building services piping).

1.3 WELDERS QUALIFICATIONS

1. The Contractor shall ensure that all welding procedures be registered with, and approved by, authority having jurisdiction, in writing as required by code.

.1 Welding qualifications to be in accordance with CSA B51.

.2 Use qualified and licensed welders possessing certificate for each procedure to be performed from authority having jurisdiction.

.3 Furnish welder’s qualifications to Consultant and Owner’s representative.

.4 Each welder to possess identification stamp issued by authority having jurisdiction.

1.4 INSPECTOR’S QUALIFICATIONS

1. Inspectors to be qualified to CSA W178.2.

1.5 WELDING PROCEDURES

.1 Registration of welding procedures in accordance with CSA B51.

.2 Copy of welding procedures to be available for inspection at all times.

1.6 WORKMANSHIP

1. Welding to be in accordance with ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX, using procedures conforming to relevant AWS codes and special procedures specified elsewhere in Division 15.

Part 2 Execution

2.1 INSTALLATION REQUIREMENTS

1. Identification of welds:

.1 Identify each weld with welder's identification stamp.

.2 All welders shall be fully qualified an approved for such work.

.2 Backing rings:

.1 Where used, fit to minimize gaps between ring and pipe bore.

.2 Do not install at orifice flanges.

.3 Fittings:

.1 NPS 2" and smaller: install welding type sockets except for condensate piping. All buried, concealed condensate piping shall be butt welded.

.2 All welded joints (except pipe welded end-to-end) shall be made by use of forged one-piece welding flanges, caps, nozzles, elbows, branch outlets and tees, of Tube-Turn, Taylor-Forge, Ladish, Grinnell or other approved make.

.3 Cut samples shall be submitted for approval if directed.

.4 "Weld-o-Lets" may be used where standard fittings of required sizes are not available and elsewhere as approved.

.5 All such fittings shall be of a type which maintains full wall-thickness at all points, sample radius and fillets, and proper bevels or shoulders at ends.

.4 Welding Methods:

.1 All job welding shall be done by the electric arc welding.

.2 All joints to have 45 degree bevel type, pipe mill-bevelled or machine-bevelled by the Contractor.

.3 All scale and oxide removed with hammer, chisel or file and bevel file smooth and clean.

.4 Pipe lengths lined up straight with abutting pipe ends concentric.

.5 Both conductors from the welding machine shall be extended to locations at which welding work is being done. The leads from welding machine to location of welding work shall be held together with tape or other approved means so as to prevent induced current in structural steel, in piping or in other metals within the

building. The ground lead shall be connected to length of pipe through joints in pipe, structural steel of building or steel pipe supports. Provide isolation between hangers, clamps of copper piping.

.6 Weld metal thoroughly fused with base metal at all sections. Welds shall be of sound metal, free from laps, slag inclusion or other defects.

.7 Wherever welded piping connection to equipment, valves, or other units need maintenance, servicing, or require possible removal, the connecting joint shall be flanged. Pressure rating of the pipe flanges shall match the pressure rating of the flanges on the equipment to which the pipe connects.

2.2 SPECIALIST EXAMINATIONS AND TESTS

1. General:

.1 Perform examinations and tests by specialist qualified in accordance with CSA W178 andW178.2 and approved by Consultant.

.2 Refer to applicable codes and standards for consideration of type of service, temperature, pressures, accessibility of welds.

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

.2 Tests:

.1 Hydrostatically test all welds to requirements of ANSI/ASME B31.1 or B31.9.

.3 Visual examinations:

.1 Include entire circumference of weld externally and wherever possible internally.

.4 Failure of visual examinations:

.1 Upon failure of any weld by visual examination, perform additional testing as directed by Consultant.

.2 The Consultant may select at random individual welds up to a total of up to 10% of all welds, selected at random by Consultant for radiographic analysis.

.5 Radiographic Tests:

.1 ANSI/ASME B31.1 limits requirements for radiographic tests to systems operating at temperatures over 176ºC (350ºF) and 1035 kPa (150 psig). If radiographic tests are required on systems operating below these limits, the Consultant will review any leniencies in interpretation of test results.

2.3 INSPECTION AND TESTS – GENERAL REQUIREMENTS

1. Review all weld quality requirements and defect limits of applicable codes and standards with the Consultant before any work is started.

2. Formulate “Inspection and Test Plan” in cooperation with the Consultant and Owners’ Representative.

3. Provide for the inspector to visually inspect all welds during early stages of welding procedures.

4. Do not conceal welds until they have been inspected, tested and approved by the Inspector.

2.4 DEFECTS CAUSING REJECTION

1. General:

   .1 As described in ASNI/ASME B31.1 and B3.1 ASNI/ASME Boiler and Pressure Vessels Code.

2. Water systems operating at 100 psig (690 kPa) and over:

   .1 Undercutting greater than 0.8 mm adjacent to cover bead on outside of pipe.

   .2 Undercutting greater than 0.8 mm adjacent to root bead on inside of pipe.

   .3 Undercutting greater than 0.8 mm at combination of internal surface and external surface.

   .4 Incomplete penetration and incomplete fusion greater than 38 mm in any 1500 mm length of weld or as total length of several such defects plus depth of such defects being greater than 0.8 mm.

   .5 Repair all defects in excess of 0.8 mm.

   .6 Repair defects whose depth cannot be determined accurately on the basis of visual examination or radiographic tests.

2.5 REPAIR OF WELDS WHICH FAILED TESTS

1. Replacement of faulty work shall be at no cost to the Owner.

2. Re-inspection and re-tests repaired or re-worked welds are at Contractor's expense.

2.6 DOCUMENTATION

1. Submit to Consultant and Owners 3 copies of all documentation in three ring binders in regard to the welding work including welder certificates, hydrostatic and visual test data and radiographic tests.

END OF SECTION

Part1. General

1.1 RELATED DOCUMENTS

.1 Drawings and general provisions of Contract, including General and Supplementary Conditions; apply to work specified in this section.

Division 01 – General Requirements:

.1 Section 01 74 00 – Cleaning and Waste Processing
.2 Section 20 00 01 – Mechanical Work General Instructions
.3 Section 21 05 06 – Common Work Results for Fire Suppression
.4 Section 22 05 00 – Common Work Results for Plumbing
.5 Section 23 05 00 – Common Work Results for HVAC

1.2 DEFINITIONS

.1 Fire-stopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire rated wall and floor assemblies.

1.3 GENERAL DESCRIPTION OF THE WORK OF THIS SECTION

.1 Only tested fire-stop systems shall be used in specific locations as follows:

.1 Penetrations for the passage of duct, piping, and other mechanical equipment through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.

1.4 RELATED WORK OF OTHER SECTIONS

.1 Coordinate work of this section with work of other sections as required to properly execute the work and as necessary to maintain satisfactory progress of the work of other sections.

1.5 REFERENCES

.1 Test Requirements: ULC-S115-M or CAN4-S115-M, "Standard Method of Fire Tests of Through Penetration Fire Stops" and cUL listings that are published by UL in their "Products Certified for Canada (cUL) Directory. WH approved tests.

.2 International Fire-stop Council Guidelines for Evaluating Fire-stop Systems Engineering Judgments.

.3 CAN/ULC-S102-M, Standard Test Method for Surface Burning Characteristics of Building Materials.

.4 Building Codes applicable to the installation.

.5 NFPA 101 - Life Safety Code

.6 Canadian Electrical Code

1.6 QUALITY ASSURANCE

.1 A manufacturer's direct representative (not distributor or agent) to be on-site during initial installation of fire-stop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.

.2 Fire-stop System installation must meet requirements of CAN4-S115-M or ULC S-115-M tested assemblies that provide a fire rating as shown in Section 2.3 paragraph .12 and .13 outlined below.

.3 Fire-stop Systems do not reestablish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.

1.7 SUBMITTALS

.1 Submit Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of ULC or cUL fire-stop systems to be used and manufacturer's installation instructions to comply with other section of the specifications.

.2 Submit material safety data sheets provided with product delivered to job-site.

.3 At the completion of work the Fire-stopping Contractor shall submit a letter of verification that all fire-stopping has been provided to code standards.

1.8 INSTALLER QUALIFICATIONS

.1 Engage an experienced Installer who is certified, licensed, or otherwise qualified by the fire-stopping manufacturer as having been provided the necessary training to install manufacturer's products per specified requirements. A manufacturer's willingness to sell its fire-stopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.

1.9 DELIVERY, STORAGE, AND HANDLING

.1 Deliver materials undamaged in manufacturer's clearly labelled, unopened containers, identified with brand, type, and ULC, WH or cUL label where applicable.

.2 Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.

.3 Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements.

.4 Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.

.5 Do not use damaged or expired materials.

1.10 PROJECT CONDITIONS

.1 Do not use materials that contain flammable solvents.

.2 Scheduling

.1 Schedule installation of CAST IN PLACE fire-stop devices after completion of floor form work, metal form deck, or composite deck but before placement of concrete.

.2 Schedule installation of other fire-stopping materials after completion of penetrating item installation but prior to covering or concealing of openings.

.3 Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.

.4 Weather conditions: Do not proceed with installation of fire-stop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.

.5 During installation, provide masking and drop cloths to prevent fire-stopping materials from contaminating any adjacent surfaces.

Part 2 Products

2.1 FIRESTOPPING, GENERAL

.1 Provide fire-stopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the fire-stopping under conditions of service and application, as demonstrated by the fire-stopping manufacturer based on testing and field experience.

.2 Provide components for each fire-stopping system that are needed to install fill material. Use only components specified by the fire-stopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

2.2 ACCEPTABLE MANUFACTURERS

.1 Subject to compliance with through penetration fire-stop systems listed in U.L.C Fire Resistance Directory – Volume III or UL Products Certified for Canada (cUL) Directory.

2.3 MATERIALS

.1 Use only fire-stop products that have been ULC or cUL tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.

.2 Sound Transmission - Fire Stopping products shall be tested for Sound transmission class ratings in accordance with AS1M E413, "Classification for Rating Sound Insulation," using results from measurements in accordance with AS1M E90, "Test

.3 Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions."

.4 Cast-in place fire-stop devices for use with non-combustible and combustible plastic pipe (closed and open piping systems) penetrating concrete floors when future penetration is a concern.

.5 Sealants or caulking materials for use with non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing. No silicone base fire-stop are allowed to be applied on plastic pipes.

.6 Sealants or caulking materials for use with sheet metal ducts

.7 Intumescent sealants or caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe.

.8 Wall opening protective materials for use with cUL. / ULC listed metallic and specified non-metallic outlet boxes

.9 Fire-stop collar or wrap devices attached to assembly around combustible plastic pipe (closed and open piping systems) tested to 50 Pa. differential

.10 Materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes and electrical busways in raceways must be fire blocks or fire foams.

.11 Non curing, re-penetrable materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways, must be fire blocks.

.12 For penetrations through a Fire Separation wall provide a fire-stop system with a "F" Rating as determined by ULC or cUL and required by Code for combustible pipe penetrations through a Fire Separation provide a fire-stop system with a "F" Rating as determined by ULC or cUL which is equal to the fire resistance rating of the construction being penetrated.

.13 For penetrations through a Fire Wall or horizontal Fire Separation provide a fire-stop system with a "FT" Rating as determined by ULC or cUL which is equal to the fire resistance rating of the construction being penetrated.

.14 For joints provide a fire-stop system with an Assembly Rating as determined by CAN4-S115-M, ULC-S115-M or UL 2079 which is equal to the fire resistance rating of the construction being penetrated. Dynamic movement capacity is also required.

Part 3 Execution

3.1 PREPARATION

.1 Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.

.1 Verify penetrations are properly sized and in suitable condition for application of materials.

.2 Surfaces to which fire-stop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.

.3 Provide masking and temporary covering to prevent soiling of adjacent surfaces by fire-stopping materials.

.4 Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of fire-stopping.

.5 Do not proceed until unsatisfactory conditions have been corrected.

.6 Cold piping such as domestic cold water, rainwater, chilled water and insulated condenser piping shall have thermal pipe insulation carried through the fire stopping with an integral vapour barrier.

3.2 INSTALLATION

.1 Regulatory Requirements: Install fire-stop materials in accordance with ULC Fire Resistance Directory or UL Products Certified for Canada (cUL) Directory.

.2 Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration joint materials.

.1 Seal all holes or voids made by penetrations to ensure an air and water resistant seal.

.2 Review with the Consultant and Contractor prior to installation of ULC or cUL fire-stop systems that might hamper the performance of fire dampers as it pertains to duct work.

.3 Protect materials from damage on surfaces subjected to traffic.

3.3 ADJUSTING AND CLEANING

.1 Remove equipment, materials and debris, leaving area in undamaged, clean condition.

.2 Clean all surfaces adjacent to sealed holes and joints to be free of excess fire-stop materials and soiling as work progresses.

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

END OF SECTION

Part 1 General

1.1 DOCUMENTS

.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 Related Sections

.1 Section 20 00 01 – Mechanical Work General Instructions
.2 Section 21 05 06 – Common Work Results for Fire Suppression
.3 Section 22 05 00 – Common Work Results for Plumbing
.4 Section 23 05 00 – Common Work Results for HVAC

1.1 SCOPE

.3 Pipe hangers and supports.

.4 Equipment supports and platforms.

.5 Anchor bolts and steel beam clamps.

.6 Seismic restraints.

.7 Roof-top equipment, duct and piping supports.

1.2 SUBMITTALS

1. Submit shop drawings on equipment as scheduled on drawings and specified, including but not limited to:

.1 Pipe hangers and riser clamps
.2 Supports and platforms
.3 insulation shields and saddles
.4 Sway braces and anchor batts
.5 Steel beam clamps
.6 Pipe guides, slides and anchors
.7 Roof supports
.8 Seismic data
.9 Field shop drawings for miscellaneous metal

1.3 REFERENCES

1. Comply with latest editions of ANSI/ASME B31.1 and B31.9; ANSI/MSS-SP-58 and SP-69; cUL C203 and National and Local Building Codes.

2. For support of plastic piping, refer to the manufacturer's recommendations and Plumbing Code.

2.0 Products

2.1 ANCHORS

1. Mechanical Anchors tested to ACI 355.2, Qualification of Post-Installed Mechanical Anchors in Concrete

.8 Acceptable Products: Hilti or approved alternate.

.9 CAST-IN-PLACE TYPE:

.1 Cast-in Anchor – Hilti HCI-MD and Hilti HCI-WF

.10 DRILLED, MECHANICAL EXPANSION & SCREW TYPE:

.1 Hilti HSL-3 heavy duty anchor for use in concrete with compressive strength not less than 2840 psi.
.2 Hilti Kwik-Bolt 3 stud anchor for concrete (do not use in seismic restraint applications).
.3 Hilti Kwik-Bolt TZ stud anchor and Kwik-Hus EZ screw anchor for seismic restraint applications.
.4 Hilti Kwik-Hus EZ-I for threaded rod attachment applications.

.11 The use of power-actuated fasteners and drop-in anchors shall NOT be permitted for tensile loading applications as per clause 4.1.8.18(8d) of the National Building Code.

2.2 BASES, SUPPORTS AND HANGERS

1. Provide anchor bolts and templates for installation by other Divisions as applicable.

2. All structural steel work required to support mechanical equipment, piping, ductwork and seismic restraints shall be by DIVISION 21, 22 and 23 unless indicated otherwise.

3. On copper piping, provide copper plated type hanger or separate piping from hanger with an approved insulating tape or plastic coating.

4. Provide oversized hangers to pass over insulation shields on all cold and chilled water piping.

5. Riser supports: Provide anchors, guides and expansion devices for the risers as indicated on the drawings and specified under Section 23 05 16 PIPE EXPANSION AND FLEXIBLE CONNECTORS and Section 20 18 01 NOISE AND VIBRATION CONTROL. For spring mounted supports use a standard riser clamp support on each side of isolator. All riser water piping 100 mm (4”) and larger shall have resilient mounted neoprene pads at each floor. The resilient mounted supports are to be co-ordinated with the Vibration Control Supplier.

6. All hanger rods are to have machine threads, capable of vertical adjustment after pipe is where excessive lateral or axial movements may occur; provide hangers with suitable linkages to permit swing. **All ferrous hangers and supports shall be prime coated.** Provide factory coated or galvanized steel or cadmium coated hangers in covered parking areas and where exposed to the outside.

7. For heating lines 150 mm (6") and over use hangers with adjustable steel yoke and cast iron roll. For floor support use adjustable cast iron roll and stand, steel screws and concrete pier or steel support.

8. Roof Supports for Mechanical Equipment, Ductwork and Piping:

   .1 Coordinate with the Roofing Contractor for weather and water proofing for equipment, duct and pipe supports and penetrations.

   .2 Coordinate manufacturer fabricated plenums, curbs and equipment supports.

   .3 Confirm structural provisions for mechanical equipment supports and seismic restraints.

   .4 Refer to details on the drawings.

3.0 Execution

3.1 GENERAL

1. The selection of pipe hangers and supports shall be based upon the overall design concept of the piping systems, and any special requirements which may apply, as outlined in the specifications. Carefully review the surrounding structure, space and adjacent piping, ductwork and equipment before selecting the type of supports to be used.

2. Hangers, supports, anchors and restraints shall be suitable (static and dynamic loading) for service and selected in accordance with the manufacturer's recommendations and to ANSI/MSS-SP-69 standards.

3. Provide hangers and supports to secure equipment in place, prevent vibration, maintain grade, and provide for expansion and contraction.

4. Install supports of strength and rigidity to suit loading without unduly stressing building. Locate adjacent to equipment to prevent unduly stressing building. Locate adjacent to equipment to prevent under stresses in piping and equipment.

5. Fasten hangers and supports to building steel or inserts in concrete construction.

6. Provide and set sleeves required for equipment, including openings required for placing equipment.

7. Obtain approval prior to drilling for inserts and supports for piping systems and for the use of percussion type fastenings.

8. Use of piping or equipment for hanger supports is not permitted.

3.2 HANGERS AND PIPE SUPPORTS

1. Hanger and pipe supports shall be code and the reference standards and shall be in compliance with:

.1 Spacing (to MSS-SP-69; refer to Section 20 10 01 – ATTACHMENT A – MAXIMUM HORIZONTAL HANGER AND SUPPORT SPACING AND HANGER ROD DIAMETERS)

.2 Hanger Selection:

.1 Steel Ductile and Cast Iron Soil Piping Systems:

Nominal Pipe Size Space	Service	Hanger Type	Material
1/2" to 2” 12 mm to 50 mm	All Services	Adjustable Band/Ring	Carbon Steel
2.5" & over 62 mm & over	All Services	Adjustable Clevis(Heavy Duty)	Carbon Steel

.2 Copper Piping Systems:

Nominal Pipe Size	Service	Hanger Type	Material
1/2" to 2” 12 mm to 50 mm	All Services	Adjustable Band/Ring	Carbon Steel Copper Plated Plastic Dipped
2.5" to 4" 62 mm to 100 mm	All Services	Adjustable Clevis	Carbon Steel Copper Plated Plastic Dipped

2. General Notes:

.1 Plastic tape wrapped around copper pipe or on steel hanger is acceptable in lieu of copper plated hangers.

.2 For copper piping support from joist studs and/or hangers serving washrooms use Acousto-Clamps by Acousto-Plumb or equivalent.

.3 Provide a hanger support within 12” (300 mm) of each horizontal elbow.

.4 Plumbing piping shall be in accordance with the Plumbing Code.

.5 Adjust hangers to equalize loads at start-up of systems.

.6 Support from structural members; where structural bearing members do not exist or inserts are not in suitable locations, provide supplementary steel members.

.7 Install hangers to provide minimum 1 inch (25 mm) clear space between finished cover and adjacent work.

.8 Install hanger so that rod is vertical inside operating conditions. Where there is horizontal movement in suspended-type hanger, components shall be used; a maximum of a 4° vertical angle is acceptable.

3. Vertical Piping:

.1 Supports vertical piping at every other floor. Vertical drainage risers shall be supported with a riser clamp at each floor. Refer to Section 20 18 01 NOISE AND

VIBRATION CONTROL for resilient supports for waste stacks and rain water leaders for critical areas.

.2 The selection and location of riser supports shall take into consideration the entire weight of the riser and adjacent piping, and hydrostatic test load conditions, line temperature and available supporting structure. On risers subject to expansion, only one support of rigid type shall be used, unless others are shown and/or specified. Riser clamps shall have a positive means of engagement between the pipe and the riser clamps.

.3 Rigid riser clamps, when used on risers and for anchorage, to be secured to the floor slab. The steel riser clamps shall be heavy type with four (4) bolts attached solidly to the floor slab, using Hilti (or equivalent) anchor bolts. The load capacity and type of anchor bolt to be to manufacturer's recommendations. Provide field shop drawings to the Consultant for review prior to installation.

4. Underground Piping:

.1 Support from Structural Slabs: Provide stainless steel hangers.

5. Soil Piping:

.1 Support all vertical soil pipe, main vents, waste stacks and rainwater leaders at each floor level with steel or wrought iron pipe clamps. Support horizontal cast iron piping:

1. Maximum 1.5 metres (5 feet).
2. On each side of mechanical joint connections.

6. Type of Support Not Permitted:

.1 DO NOT USE PERFORATED BAND, WIRE CHAIN OR SOLID RING HANGERS for horizontal exposed piping. Do not permit copper pipe to contact steel, iron or cinder materials; use double thickness of dielectric tape and overlap 12 mm (½") on each side of contact or tape hangers. Perforated bands can be used to provide additional restraints for concealed riser pipe in plumbing walls.

7. Spring Hangers:

.1 Where significant vertical movement of the pipe occurs at the hanger locations, provide resilient supports; load and movement calculations shall be made for the proper selection of spring hangers. Vertical movement and load transfer from riser expansion to horizontal rooms shall be given consideration when applying spring hangers.

.2 Provide spring hangers on pipe work adjacent to equipment mounted on vibration isolators for a minimum of the first three points of support and where vibrations can be transmitted to occupied spaces. Refer to Section 20 18 01 NOISE AND VIBRATION CONTROL.

3.3 SEISMIC AND PIPING RESTRAINTS

1. Seismic Restraints: Refer to Section 20 18 02 SEISMIC RESTRAINTS requirements for attachment of mechanical components. Use neoprene washer/gaskets and seismic quality (marked and identified) bolts specifically designated for use for seismic restraint.

2. Anchors, guides and restraints shall be located a indicated on the drawings and/or as specified. Provide field drawings of proposed piping arrangement to the Consultant prior to fabrication.

3. For pressure piping with joints not having a restraining design, provide restraining elements such as camps, rods and/or thrust blocking to maintain integrity of the joints.

3.4 MISCELLANEOUS METAL AND PLATFORMS

1. Provide all miscellaneous steel work related to DIVISION 21, 22 and 23 (unless shown otherwise on the architectural or structural drawings), including, but not limited to:

   .1 Support of equipment and piping.

   .2 Access and Equipment Platforms.

   .3 Hangers, support, guiding and related work (including seismic restraints) for piping, ductwork, equipment, storage tanks and other HVAC, plumbing and fire protection components.

   .4 Anchor bolts secured to the structure.

2. Ceiling Platforms: Provide platforms in ceiling spaces, as required, to provide working access to ceiling-mounted equipment for servicing.

3. **Supports, anchor bolts, platforms, braces, tie rods, etc. required solely for the work of mechanical trades, and not DIVISION 21, 22 and 23 specifically shown on architectural or structural drawings, shall be provided by DIVISION 21, 22 and 23. Prepare and submit field installation and/or shop drawings on any steel construction provided by DIVISION 21, 22 and 23 for review by the Consultant prior to fabrication.**

3.5 INSULATED PIPE AND TUBE PROTECTION

1. Use oversize hangers complete with saddles for all insulated cold or chilled water piping; and hot water piping subject to expansion and contraction. Hangers for insulated piping to extend around the exterior of the insulation and pipe protection shields to ANSI/MSS-SP-69 standards. Provide H-block spacers, between hangers and/or trapeze hangers, imbedded in the insulation; refer to SECTION 20 10 01 – ATTACHMENT B.

2. Insulation protection shields shall be provided to protect the vapour barrier of insulation on cold or chilled water lines; and for hot water lines subject to expansion and contraction. Under no circumstances shall hangers, supports or guides be applied directly to horizontal pipe or tubing on vapour barriered lines.

3. Refer to Section 20 10 01 ATTACHMENT B – PROTECTION SHIELDS FOR INSULATED PIPE AND TUBING (MSS-40). Protection shields shall be galvanized sheet metal.

END OF SECTION

MAXIMUM HORIZONTAL PIPE HANGER AND SUPPORT SPACING AND HANGER ROD DIAMETERS

Min. Rod Dia.				1		2		3		4		5	6	7	8	9
Nominal Rod Diameter		Nominal Pipe / Tube Size		Steel Pipe				Copper Tube				Fire Protection	Ductile Iron Pipe	Cast Iron Soil	Glass	Plastic
				Water Service		Vapour Service		Water Service		Vapour Service						
mm	in	mm	in	m	ft.	m	ft.	m	ft.	m	ft.					
10	3/8	8	¼	2.1	7	2.4	8	1.5	5	1.5	5	Follow requirements of the National Fire protection Association (NFPA 13 and 14)	6.1 m (20') maximum spacing: minimum of one (1) hanger per pipe section close to the joint behind the bell and at change of direction and branch connections. For pipe sizes 150 mm (6") and under, installed on ANSI B31 projects, that are subjected to loadings other than weight of pipe and contents, the span should be limited to the maximum spacing for water service steel pipe	3.0 m (10') maximum spacing: minimum of one (1) hanger per pipe section close to joint on the barrel. Also at change of direction and branch connections	2.4 m (8') maximum spacing, follow manufacturer's recommendations and to code	Follow pipe manufacturer's recommendations for material and service condition and to code
10	3/8	10	3/8	2.1	7	2.4	8	1.5	5	1.8	6					
10	3/8	15	½	2.1	7	2.4	8	1.5	5	1.8	6					
10	3/8	20	¾	2.1	7	2.7	9	1.5	5	2.1	7					
10	3/8	25	1	2.1	7	2.7	9	1.8	6	2.4	8					
10	3/8	32	1¼	2.1	7	2.7	9	2.1	7	2.7	9					
10	3/8	40	1½	2.7	9	3.7	12	2.4	8	3.0	10					
10	3/8	50	2	3.0	10	4.0	13	2.4	8	3.4	11					
15	½	65	2½	3.4	11	4.3	14	2.7	9	4.0	13					
15	½	80	3	3.7	12	4.6	15	3.0	10	4.3	14					
15	½	90	3½	4.0	13	4.9	16	3.4	11	4.6	15					
18	5/8	100	4	4.3	14	5.2	17	3.7	12	4.9	16					
18	5/8	125	5	4.9	16	5.8	19	4.0	13	5.5	18					
20	¾	150	6	5.2	17	6.4	21	4.3	14	6.1	20					
20	¾	200	8	5.8	19	7.3	24									
22	7/8	250	10	6.1	22	7.9	26									
22	7/8	300	12	7.0	23	9.1	30									
25	1	350	14	7.6	25	9.8	32									
25	1	400	16	8.2	27	10.7	35									
25	1	450	18	8.5	28	11.3	37									
32	1¼	500	20	9.1	30	11.9	39									
32	1¼	600	24	9.8	32	12.8	42									

Notes: .1 For supports incorporating Type 40 shield, see Section 20 10 01 – ATTACHMENT B – PROTECTION SHIELDS FOR INSULATED PIPE AND TUBING.

.2 Does not apply where span calculations are made or where there are concentrated loads between supports such as flanges, valves, specialities, etc., or changes in direction requiring additional supports.

.3 Unbalanced forces of hydrostatic or hydrodynamic origin (thrust forces) unless restrained externally can result in pipe movement and separation of joints if the joints of the system are not of a restrained joint design. See Section 13.3

.4 Minimum rod diameter for single rigid hanger rods may be reduced one size (minimum 9.6 mm (3/8”) for double rod hangers. Trapeze and Unistrut hanger rod diameters to be sized in accordance with calculations based on dead weights and hydrostatic loads, according to the manufacturer’s information.

END OF SECTION – ATTACHMENT A

PROTECTION SHIELDS FOR INSULATED PIPE AND TUBING (MSS-40)

Nominal Pipe Size		Shield Length		Shield Thickness		
mm	**in.**	**mm**	**in.**	**Gauge**	**mm**	**in.**
15-32	½-1¼	300	12	18	1.2192	.048
40	1½	300	12	18	1.2192	.048
50-90	2-3½	300	12	18	1.2192	.048
100	4	300	12	16	1.524	.060
125-150	5-6	450	18	16	1.524	.060
200-350	8-14	600	24	14	1.905	.075
400-600	16-24	600	24	12	2.667	.105

Notes:

.1 The listed spans and shield lengths are based on insulation with a compressive strength of 103 kPa (15 psi).

.2 Protection shield gauges listed are for use with band type hangers only. For point loading, increase shield thickness and length. When shields are used with rollers, shield thickness shall be adjusted accordingly and shield lengths shall be increased to keep rolling point of contact within the middle one-third of the shield length.

.3 Shields shall be made of galvanized sheet metal of gauges indicated.

.4 Protection shields shall be provided for all piping mounted on trapeze and Unistrut type hangers, as outlined above for single hangers.

END OF SECTION – ATTACHMENT B

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for thermometers and pressure gauges in piping systems.

1.2 RELATED SECTIONS

.1 Section 01 30 00 - Administrative Requirements.

.2 Section 01 40 00 - Quality Requirements.

.3 Section 01 60 00 - Product Requirements.

.4 Section 01 70 00 - Execution and Closeout Requirement.

.5 Section 01 74 19 - Waste Management and Disposal.

.6 Section 20 04 01 – Mechanical Basic Materials and Methods.

.7 Section 20 16 01 - Mechanical Identification.

1.3 REFERENCES

.1 American Society of Mechanical Engineers (ASME).

.1 ASME B40.100-01, Pressure Gauges and Gauge Attachments.

.2 ASME B40.200-01, Thermometers, Direct Reading and Remote Reading.

.2 Canadian General Standards Board (CGSB).

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

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

1.4 SUBMITTALS

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

.2 Submit shop drawings and product data.

.3 Submit manufacturer's product data for following items:

.1 Thermometers.

.2 Pressure gauges.

Part 2 Products

2.1 GENERAL

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

.2 Ranges: as indicated.

2.2 DIRECT READING THERMOMETERS

.1 Industrial, variable angle type, liquid filled, 125 mm scale length: to CAN/CGSB14.4 and ASME B40.200.

2.3 REMOTE READING THERMOMETERS

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

2.4 PRESSURE GAUGES

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

.2 Provide:

.1 Siphon for steam service, with needle valve.

.2 Snubber for pulsating operation.

.3 Diaphragm assembly for corrosive service.

.4 Gasketted pressure relief back with solid front.

.5 Bronze stop cock.

.6 Oil filled for high vibration applications.

2.5 FLOW METERS

.1 Provide a flow meter for the Circuit Balance Valves included under Section 20 09 01 VALVES.

2.6 STATIC PRESSURE GAUGES

.1 Magnehelic – 90 mm diameter dial in case, diaphragm actuated, black figures on white background, front recalibration adjustment, (inclined type manometer and tubing, static pressure tips, and mounting assembly).

Part 3 EXECUTION

3.1 GENERAL

.1 Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units.

.2 Install between equipment and first fitting or valve.

3.2 THERMOMETERS

.1 Install thermostats in wells on all piping; provide heat conductive material inside well.

.2 Install thermometers in locations as indicated and on inlet and outlet of:

- .1 Domestic Hot Water (each system).
- .2 Chilled water supply and return.
- .3 Main AHU coils (supply and return in each coil bank).
- .4 In other locations as indicated.

.3 Install wells as indicated only for balancing purposes for terminal units.

.4 Use extensions where thermometers are installed through insulation.

3.3 PRESSURE GAUGES

.1 Install pressure gauges as indicated and at the following locations:

- .1 Suction and discharge of all pumps.
- .2 Upstream and downstream of control valves.
- .3 Both sides of pressure reducing valves.
- .4 Each heater and tank.
- .5 Fire protection lines.
- .6 Main coil banks.
- .7 In other locations as indicated the specifications and drawings.

.2 Install gauge cocks for balancing purposes and elsewhere as indicated. Provide capped valved pressure gauge cocks for all VAV heating coils and for chilled and heating coils for fan-coil units.

.3 Use extensions where pressure gauges are installed through insulation.

3.4 STATIC PRESSURE GAUGES

.1 Provide static pressure gauges at filter bank locations for each filter bank for Air Handling Units (AHU); and exhaust systems with HEPA filters installed.

3.5 NAMEPLATES

.1 Install engraved lamacoid nameplates as required to identify medium.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and requirements for the identification of piping systems, duct work, valves and controllers, including the installation and location of identification systems.

.2 Sustainable requirements for construction and verification.

1.2 REFERENCES

.1 Canadian Gas Association (CGA)

.1 CSA/CGA B149.1-10, Natural Gas and Propane Installation Code.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.

.2 CAN/CGSB-24.3-92, Identification of Piping Systems.

.3 National Fire Protection Association (NFPA)

.1 NFPA 13-1999, Standard for the Installation of Sprinkler Systems.

1.3 SUBMITTALS

.1 Product Data:

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

.3 Product data to include paint colour chips, other products specified in this section.

1.4 QUALITY ASSURANCE

.1 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

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

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Section 01 47 15 - Sustainable Requirements: Construction.

2.2 MANUFACTURER'S EQUIPMENT NAMEPLATES

.1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.

.2 Lettering and numbers raised or recessed.

.3 Information to include, as appropriate:

.1 Equipment: manufacturer's name, model, size, serial number, capacity.

.2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.3 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 or white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:

.1 Conform to following table:

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

.2 Use maximum of 25 letters/numbers per line.

.4 Locations:

.1 Terminal cabinets, control panels: use size #5.

.2 Equipment in Mechanical Rooms: use size #9.

.5 Identification for PWGSC Preventive Maintenance Support System (PMSS):

.1 Use arrangement of Main identifier, Source identifier, Destination identifier.

.2 Equipment in Mechanical Room:

.1 Main identifier: size #9.

.2 Source and Destination identifiers: size #6.

.3 Terminal cabinets, control panels: size #5.

.3 Equipment elsewhere: sizes as appropriate.

2.4 PIPING SYSTEMS GOVERNED BY CODES

.1 Identification:

.1 Natural gas: to CSA/CGA B149.1 and authority having jurisdiction.

.2 Sprinklers: to NFPA 13.

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 Consultant.

.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:

Service	**Background colour marking**	**Legend**
** Add design temperature		
++ Add design temperature and pressure		
City water	Green	CITY WATER
Chilled water supply	Green	CH. WTR. SUPPLY
Chilled water return	Green	CH. WTR. RETURN
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
Make-up water	Yellow	MAKE-UP WTR
Boiler feed water	Yellow	BLR. FEED WTR
Domestic hot water supply	Green	DOM. HW SUPPLY
Dom. HWS recirculation	Green	DOM. HW CIRC
Domestic cold water supply	Green	DOM. CWS
Storm water	Green	STORM
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Natural gas	to Codes	
Gas regulator vents	to Codes	
Compressed air (<700kPa)	Green	COMP. AIR [___] kPa
Compressed air (>700kPa)	Yellow	COMP. AIR [___] kPa
Oxygen		OXYGEN
Acetylene	Green	ACETYLENE GAS
	Yellow	PROPANE GAS
Propane		CHEMTANE
Chemtane	Yellow	ARGON
Argon	Yellow	CO2
CO2	Green	AR/CO2-75/25
Argon/CO2-75/25	Green	AR/CO2-92/8
Argon/CO2-92/8	Green	
Fire protection water	Red	FIRE PROT. WTR
Sprinklers	Red	SPRINKLERS
Steam Supply	Yellow	
Steam Condensate	Yellow	
Non Potable Water	Purple	NPW
Refrigerant Piping	Purple	REF
Fuel Oil	Yellow	

2.6 IDENTIFICATION DUCTWORK SYSTEMS

.1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.

.2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

2.7 VALVES, CONTROLLERS

.1 Brass tags with 12 mm stamped identification data filled with black paint.

.2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.8 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 EQUIPMENT

.1 Identify all mechanical equipment with lamacoid plastic plates 100 mm × 35 mm × 2.5 mm (4" × 11/4" × 1/8 thick) with bevelled edges having engraved white letters on black background giving the nature of equipment service and its number, (i.e., "Washroom Exhaust EF-1", "Pump Pl"). Provide plates with 12 mm (½") lettering for motor starters and automatic controls and 25 mm (1") lettering for equipment and terminal units. Mechanically fixed to the equipment in a conspicuous location.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 TIMING

.1 Provide identification only after painting specified Section 09 91 23 - Interior Painting has been completed.

3.3 INSTALLATION

.1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.

.2 Provide ULC and CSA registration plates as required by respective agency.

.3 Identify systems, equipment to conform to PWGSC PMSS.

3.4 NAMEPLATES

.1 Locations:

.1 In conspicuous location to facilitate easy reading and identification from operating floor.

.2 Standoffs:

.1 Provide for nameplates on hot and/or insulated surfaces.

.3 Protection:

.1 Do not paint, insulate or cover.

3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

.1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.

.2 Adjacent to each change in direction.

.3 At least once in each small room through which piping or ductwork passes.

.4 On both sides of visual obstruction or where run is difficult to follow.

.5 On both sides of separations such as walls, floors, partitions.

.6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.

.7 At beginning and end points of each run and at each piece of equipment in run.

.8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.

.9 Identification easily and accurately readable from usual operating areas and from access points.

.1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.6 FIELD QUALITY CONTROL

.1 Verification requirements in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification, include:

.1 Materials and resources.
.2 Storage and collection of recyclables.
.3 Construction waste management.
.4 Resource reuse.
.5 Recycled content.
.6 Local/regional materials.
.7 Certified wood.
.8 Low-emitting materials.

3.7 GENERAL CLASSIFICATION OF COLOR CODING:

1. Use colour numbers as outlined in CGSB Standard 1-GP-12

SERVICE	BACKGROUND COLOUR BAND PRIMARY	STENCIL COLOUR
Fire Quenching Fluids	Red	White
Toxic Corrosive Fluids	Orange	Black
Flammable Fluids / Gases	Yellow	Black
Combustible Fluids / Potable	Brown	White
Cooling / Other Water	Green	White
Compressed Air	Blue	White

The typical pipe and duct identification arrangement in the direction of flow shall be:

- Color field with lettering
- System pressure / temperature as applicable
- Direction arrow

3.8 T-BAR CEILING IDENTIFICATION

1. Provide identification for valves, damper and equipment located on T-bar ceilings (to T-bar frame) and at access doors; colour coded data dots ½" (13mm) in diameter (Avery type TR808) as follows:

Yellow	Mechanical Equipment and cleaning access
Red	Fire Protection and Fire Dampers
Green	Valves and devices
Black	Control Devices

3.9 PAINTING

1. Painting of pipe and ductwork in finished areas shall be as outlined under Section 09 90 00 PAINTING or as specified. Painting of piping in public spaces shall match the adjacent services. Piping and ductwork in finishing stairwells shall be painted. Identification shall be provides in all areas.

3.10 CONTROLS

1. Control components to be identified refer to DIVISION 25 CONTROLS and co-ordinate completion of work. Obtain list of automatically operated equipment and provide warning identification on lamacoid plate for each item as follows: **"Warning: This equipment may start at any time. Do not service without disconnecting power."**

3.11 VALVE TAG APPLICATION

1. Consecutively number separately all valves and controllers and provide list of valves and

controllers (stencilled or equivalent) on the inside of access doors indicated the valves accessed at that location co-ordinate with all trades to prevent duplication.

2. Identification coding is to start with a utility description followed by a maximum of three numerals:

Water WXXX	Natural Gas GXXX
Steam SXXX	Fire Protection FPXXX
Condensate CXXX	Compressed Air CAXXX

3. The first tag number in each series will be supplied by the Owner.

4. Provide valve identification schedules incorporating the tag schedule stating the designation number, the service function, location of tagged items and normal operating position of valves.

5. Mount, where directed by the Consultant, one copy of the valve schedules in a glazed frames.

6. Provide copies of the valve schedules for the Operating and Maintenance Manuals.

7. Indicate valve tag and description on inside of access doors to the valves.

3.12 MANUFACTURER'S NAMEPLATES

1. Each piece of equipment shall have an original factory installed metal nameplate with raised or recessed characters.

2. The nameplate shall fully describe the components as to manufacturer, size, model, serial number, voltage, cycle phase, power, pressure, volume, etc.

3. Locate nameplates so that they are easy to read. Do no insulate or paint over.

4. Provide standoffs where nameplated cannot be located on cool surfaces.

5. Ensure that regulatory registration plates are also attached to equipment – Pressure Vessel Rating, Underwriter's Laboratory Approval, CSA Approval, etc.

3.13 PROTECTIVE GUARDS

1. Provide insulation on pipe and/or ducts located lower than 1800 mm (6') over walkways; and access corridors in mechanical rooms.

2. Provide rubber corner protectors (square or round)at edges of equipment and ductwork located over walkways and access corridors.

3. The exterior of the insulation, bumpers and protectors should be covered with Seton or equivalent, and with bold yellow and black striping to make them more visible.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Seismic restraint systems for statically supported and vibration isolated equipment and systems for HVAC, plumbing and fire suppression, both vibration isolated and statically supported.

.2 Retain a Structural B.C. Registered Professional Engineer specializing in seismic design as the Specialty Seismic Engineer for design of the seismic restraints for the mechanical systems, such as equipment, piping and ductwork, including attachment devices to the structure. The Seismic Engineer shall provide Letters of Assurance to the Authorities, for his work, with a copy provided to the Consultant.

.2 Related Sections:

.1 Division 01 – General Requirements

.2 Division 21 – Fire Suppression

.3 Division 22 – Plumbing

.4 Division 23 – HVAC

1.2 REFERENCES

.1 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 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.3 National Building Code of Canada (NBC) – 2010

.4 British Columbia Building Code – Fire Suppression Systems to NFPA-13

.5 SMACNA "Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Pipe Systems" latest edition. Each trade shall maintain a copy of this manual on site, for regular reference during construction.

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 SYSTEM DESCRIPTION

.1 SRS fully integrated into, and compatible with:

.1 Structural, mechanical, electrical design of project.

.2 Systems, equipment not required to be operational during and after seismic event.

.3 During seismic event, SRS to prevent systems and equipment from causing personal injury and from moving from normal position.

.4 Designed by Professional Engineer specializing in design of SRS and registered in Province of BC.

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Section 01 47 15 - Sustainable Requirements: Construction.

2.2 SRS MANUFACTURER

.1 SRS from one manufacturer regularly engaged in SRS production.

2.3 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 RC structure:

.1 Use high strength mechanical expansion anchors.
.2 Drilled or power driven anchors not permitted.

.7 Wet pipe sprinkler systems: refer to Section 21 13 13 - Wet Pipe Sprinkler Systems.

.8 Dry pipe sprinkler systems: refer to Section 21 13 16 - Dry Pipe Sprinkler Systems.

.9 Seismic control measures not to interfere with integrity of firestopping.

.10 Provide Neoprene Washers to prevent impact shear shall be Mason Hemi-Grommet HG or Mason 0.5 FAST, or equivalent.

2.4 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.

2.5 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, 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.

2.6 SLACK CABLE RESTRAINT SYSTEM (SCS)

.1 Use elastomer materials or similar to avoid high impact loads and provide gentle and steady cushioning action.

.2 SCS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.

.3 Hanger rods to withstand compressive loading and buckling.

2.7 SERVICE UTILITIES ENTRANCE INTO BUILDING

.1 Provide flexibility to prevent breakage in the event of earthquake activity.

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 Attachment points and fasteners:

.1 To withstand same maximum load that seismic restraint is to resist and in every direction.

.2 Slack Cable Systems (SCS):

.1 Connect to suspended equipment so that axial projection of wire passes through centre of gravity of equipment.

.2 Use appropriate grommets, shackles, other hardware to ensure alignment of restraints and to avoid bending of cables at connection points.

.3 Piping systems: provide transverse SCS at 10 m spacing maximum, longitudinal SCS at 20 m maximum or as limited by anchor/slack cable performance.

.4 Small pipes may be rigidly secured to larger pipes for restraint purposes, but not reverse.

.5 Orient restraint wires on ceiling hung equipment at approximately 90 degrees to each other (in plan), tie back to structure at maximum of 45 degrees to structure.

.6 Adjust restraint cables so that they are not visibly slack but permit vibration isolation system to function normally.

.7 Tighten cable to reduce slack to 40 mm under thumb pressure. Cable not to support weight during normal operation.

.3 Install SRS at least 25 mm from equipment, systems, services.

.4 Co-ordinate connections with other disciplines.

.5 Miscellaneous equipment

.1 Provide seismic restraints for air outlets located in T-bar ceilings; by galvanized iron strap (or two 12 ASWG galvanized steel wired at opposite corners of the air outlet).

.2 Small ceiling mounted units less than 15 kg (38 lbs) can be restrained by galvanized steel straps; larger units to have seismic restraint cables.

.6 General requirements

.1 All piping and ductwork to have seismic restraints. Seismic restraints may be omitted for the following installations; also refer to the SMACNA Guidelines.

.1 Fuel gas and oil piping, medical gas piping and compressed air piping less than 25 mm (1") inside diameter.

.2 Piping in boiler, fan rooms and mechanical rooms less than 30 mm (1 1/4") inside diameter.

.3 All other piping less than 65mm (2 1/2") inside diameter.

.4 All piping suspended by individual hangers where top of pipe is suspended 300 mm (12") or less from the supporting structure member.

.5 All rectangular or oval ducts less than 750 mm (30") in largest dimension.

.6 All round ducts less than 700 mm (28") in diameter.

.7 All ducts suspended by hangers 300 mm (12") or less from top of duct to supporting structural member.

.7 At steel trusses, connect to top chords and follow truss manufacturer's instructions.

.8 Restraining devices shall be placed on all sides of equipment; ensure equipment is sufficiently rigid for seismic restraint point loading.

.9 Secure all EMCS panels and related computer equipment and compressors to withstand seismic loading.

.10 The installation of seismic restraints shall not compromise vibration isolation capabilities.

.11 For non-isolated equipment, secure the equipment to the structure by:

.1 Bolting directly to the structure.

.2 Use rigid seismic restraints.

.3 Use taught cable restraints - not slack.

.4 Design loads to NBC requirements, and Local By-Laws.

.5 Use Mason Hemi-Grommets or Mason 0.5 Fast where the diameter of hole is 1/4" (6 mm) greater than the bolt diameter.

.6 DO NOT USE SPLICE PLATES OR ANCHOR THROUGH SLOTTED ATTACHMENT POINTS.

.12 To prevent impact shear failure provide neoprene washers between attachment bolt and seismic isolators and seismic snubber restraints where the diameter of the hole is ¼" (6mm) greater than the bolt diameter.

.13 Install bolts following manufacturer's instructions such as depth of embedment and adequate edge distances including sufficient edge distances on housekeeping pads.

.14 When attaching pipe clamps to domestic cold water piping and chilled water piping provide a 100 mm (4") long, 25 mm (1") thick calcium silicate jacket between clamp and pipe. Seal and maintain the pipe insulation vapour covering over the calcium silicate insulation strip.

.15 Restraints shall be installed at least 50 mm (2") clear of all other equipment and services.

.16 All piping and ductwork supported on either side of a building expansion joint shall have provision for building motion. Building motion will be defined by the Project Structural Consultant; provide flexibility in piping joints and sleeves where pipes pass through a seismic wall or building expansion joint.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Thermal insulation for piping and piping accessories in commercial type applications.

.2 Related Sections:

.1 Division 1 General Requirements.

.2 Common Work for Fire Suppression, Section 21 05 06.

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ASHRAE Standard 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).

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

.1 ASTM A167 – Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.

.2 ASTM B209M, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate [Metric].

.3 ASTM C335, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.4 ASTM C411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.5 ASTM C449/C449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.6 ASTM C533, Calcium Silicate Block and Pipe Thermal Insulation.

.7 ASTM C547, Mineral Fiber Pipe Insulation.

.8 ASTM C795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.9 ASTM C921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.10 CAN4-S102-M – Surface Burning Characteristics of Building Materials and Assemblies.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.2 CAN/CGSB-51.53, Poly (Vinyl Chloride) Jacketting Sheet, for Insulated Pipes, Vessels and Round Ducts

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.5 Manufacturer's Trade Associations

.1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).

.6 Underwriters' Laboratories of Canada (ULC)

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

.2 CAN/ULC-S701, Thermal Insulation, Polystyrene, Boards and Pipe Covering.

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

.4 CAN/ULC-S702.2, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.3 DEFINITIONS

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - will mean "not concealed" as specified.

.2 TIAC ss:

.1 CRF: Code Rectangular Finish.

.2 CPF: Code Piping Finish.

1.4 SUBMITTALS

.1 Submittals: in accordance with Submittal Procedures specified in Division 1.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 1. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with requirement in Division 1.

.3 Shop Drawings:

.1 Submit shop drawings for all types of insulation, jackets and adhesives to be used. Include manufacturer’s catalogues and/or technical data sheets.

.4 Quality assurance submittals: submit following in accordance with requirements of submittal procedure in Division 1.

1.5 QUALITY ASSURANCE

.1 Qualifications:

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

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with requirements in Division 1.

2.2 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULC-S102.

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.3 INSULATION

.1 Mineral fibre specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/ULC-S702 [ASTM C547].

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

.4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/ULC-S702 [ASTM C547].

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to CAN/ULC-S702 [ASTM C547].

.5 TIAC Code C-2: mineral fibre blanket faced [with] [without] factory applied vapour retarder jacket (as scheduled in PART 3 of this section).

.1 Mineral fibre: to CAN/ULC-S702 [ASTM C547].

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to CAN/ULC-S702 [ASTM C547].

.6 TIAC Code A-6: flexible unicellular tubular elastomer.

.1 Insulation: with vapour retarder jacket

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: 0.034 W/mºC.

.4 Certified by manufacturer: free of potential stress corrosion cracking corrodants.

.7 TIAC Code A-2: rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.

.1 Insulation: to ASTM C533.

.2 Maximum "k" factor: to 0.034 W/mºC.

.3 Design to permit periodic removal and re-installation.

2.4 INSULATION SECUREMENT

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

.2 Contact adhesive: quick setting.

.3 Canvas adhesive: washable.

.4 Tie wire: 1.5 mm diameter stainless steel.

.5 Bands: stainless steel, 19 mm wide, 0.5 mm thick.

2.5 CEMENT

.1 Thermal insulating and finishing cement:

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

2.6 VAPOUR RETARDER LAP ADHESIVE

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

2.7 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.8 OUTDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

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

2.9 JACKETS

.1 Polyvinyl Chloride (PVC):

.1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.

.2 Colours: to match adjacent finish paint.

.3 Minimum service temperatures: -20 degrees C.

.4 Maximum service temperature: 65 degrees C.

.5 Moisture vapour transmission: 0.02 perm.

.6 Thickness: 1.3 mm.

.7 Fastenings:

.1 Use solvent weld adhesive compatible with insulation to seal laps and joints.

.2 Tacks.

.3 Pressure sensitive vinyl tape of matching colour.

.8 Special requirements:

.1 Indoor: None.

.2 Outdoor: UV rated material at least 1.3 mm thick.

.2 ABS Plastic:

.1 One-piece moulded type and sheet with pre-formed shapes as required.

.2 Colours: to match adjacent finish paint.

.3 Minimum service temperatures: -40 degrees C.

.4 Maximum service temperature: 82 degrees C.

.5 Moisture vapour transmission: 0.012 perm.

.6 Thickness: 0.75 mm.

.7 Fastenings:

.1 Solvent weld adhesive compatible with insulation to seal laps and joints.

.2 Tacks.

.3 Pressure sensitive vinyl tape of matching colour.

.8 Locations:

.1 For outdoor use ONLY.

.3 Canvas:

.1 220 gm/m^2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.2 Lagging adhesive: compatible with insulation.

.4 Aluminum:

.1 To ASTM B209.

.2 Thickness: 0.016 mm.

.3 Finish: smooth.

.4 Joining: longitudinal and circumferential slip joints with 50 mm laps.

.5 Fittings: 0.016 mm thick die-shaped fittings and covers with factory-attached protective liner.

.6 Metal jacket banding and mechanical seals: stainless steel, 19mm wide, 1.3 mm thick at [300mm spacing.

.5 Stainless steel:

.1 Type: 304.

.2 Thickness: 0.25mm.

.3 Finish: stucco embossed.

.4 Joining: longitudinal and circumferential slip joints with 50 mm laps.

.5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.

.6 Metal jacket banding and mechanical seals: stainless steel, 19mm wide, 0.5 mm thick at 300mm spacing.

2.10 WEATHERPROOF CAULKING FOR JACKETS INSTALLED OUTDOORS

.1 Caulking to: Requirement in Division 1.

2.11 ADHESIVES, MASTICS, SEALANTS AND COATINGS

1. All adhesives, mastics, sealants and coatings to be used inside the building with the insulation specified in this section shall be fire retardant and meet U.L.C. and the current B.C. Code standards, with a flame spread rating of not over 25 and smoke development not over 50.

Vapour Barrier Adhesive:	Barrier Coating:
Bakelite 230-21	Seal Coating:
Childers CP-82	Bakelite 120-09
Foster 85-20	Childers CP-50
3M 4230	Foster 20-36
Insulation Adhesive:	Insulating Coating:
Insulation Facing Adhesive:	Bakelite 120-09
Bakelite 230-39	Childers CP-50
Childers CP-82	Foster 30-36
3M 4230	Cadalag 336

2.12 INSULATION COMPONENTS

1. All insulation components shall meet the smoke and flame speed requirements of U.L.C. and the current B.C. Building Code.

Insulating Cement:
Ryder Thermokote MW High Temp or approved equivalent.

Hard Finish Cement:
E.P. One-Cote
Ryder Thermokote 1

Reinforcing Membrane:
Benjamin Foster Lag-Fab 20/10 Mesh
Childers Chil-Glas 20/10 Mesh
Flintkote Yellow Jacket 990-06 20/10 Mesh

Flexible Insulation:
Fiberglass AF300 Type II RRFR
Manson Alley Wrap FSK
Certainteed Duct Wrap #75
Knauf FSK Duct Wrap

2.13 SOUND BARRIER MATERIAL

1. Pipe Lagging: Flexible noise barrier material non-leaded 10NL or equivalent, pipe lagging resistant to water, oils, weak acids, alkalis and fungi.

2. Equipment Lagging: Flexible noise barrier material non-leaded 0-10NL-25 or equivalent

equipment covering resistant to water, oils, weak acids, alkalis and fungi.

2.14 REFRIGERANT PIIPING

1. For refrigerant and concealed domestic water lines in walls self-sealing Therma-cel, Nomaco Armaflex 2000 and Imoca-Lock are acceptable (with K value of 0.28 BTU/in/Ft^2/ºF/h); ensure joints are well sealed for cold water lines to manufacturers' recommendation. Smoke rating at 25 and Flame at 50; zero water absorption.

2.16 ANTI-CONDENSATION PAINT

1. Robson No Sweat-FX anti-condensation non-toxic paint-like coating. Refer to the manufacturer's instructions for application and thicknesses required.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PRE-INSTALLATION REQUIREMENT

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

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

3.3 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturer's instructions and this specification.

.3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Install hangers, supports outside vapour retarder jacket.

.5 Supports, Hangers:

.1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

.1 Application: at expansion joints, valves, primary flow measuring elements flanges and unions at equipment.

.2 Design: to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

.3 Insulation:

.1 Insulation, fastenings and finishes: same as system.

.2 Jacket: aluminum , SS, PVC.

3.5 INSTALLATION OF ELASTOMERIC INSULATION

.1 Insulation to remain dry. Overlaps to manufacturer's instructions. Ensure tight joints.

.2 Provide vapour retarder as recommended by manufacturer.

3.6 PIPING INSULATION SCHEDULES

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

.2 TIAC Code: A-1.

.1 Securements: SS wire bands Tape at 300 mm on centre.

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code 1501-H.

.3 TIAC Code: A-3.

.1 Securements: SS wire bands Tapeat 300 mm on centre.

.2 Seals: VR lap seal adhesive, VR lagging adhesive.

.3 Installation: TIAC Code: 1501-C.

.4 TIAC Code: C-2 with vapour retarder jacket.

.1 Insulation securements: SS wire bands Tapeat 300 mm on centre.

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code: 1501-C.

.5 Thickness of insulation as listed in following table 1.

.1 Run-outs to individual units and equipment not exceeding 4,000 mm long.

.2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

TABLE 1

Application	Temp degrees C	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)					
			Run out	to 1	1 1/4 to 2	2 1/2 to 4	5 to 6	8 & over
Boiler Feed Water		[A-1]	25	25	25	25	25	25
Hot Water Heating	60 - 94	[A-1]	25	38	38	38	38	38
Hot Water Heating	up to 59	[A-1]	25	25	25	25	38	38
Glycol Heating	60 - 94	[A-1]	25	38	38	38	38	38
Glycol Heating	up to 59	[A-1]	25	25	25	25	38	38
Domestic HWS		[A-1]	25	25	25	38	38	38
Chilled Water	4 - 13	[A-3]	25	25	25	25	25	25
Chilled Water or Glycol	below 4	[A-3]	25	25	38	38	38	38
Chilled Water Pump Casing		[A-3]	25	25	25	25	25	25
Refrigerated Drinking Water		[A-3]	25	25	25	25	25	25
Domestic CWS		[A-3]	25	25	25	25	25	25
Domestic CWS with vapour retarder		[C-2]	25	25	25	25	25	25
RWL and RWP		[C-2]	25	25	25	25	25	25
Cooling Coil cond. drain		[C-2]	25	25	25	25	25	25
Refrigerant piping		A6	25	25	25	25	50	50
Geothermal		A3	38	38	38	38	50	50
Generator exhaust pipe		A2	50	50	50	50	50	50
Heat traced fire lines		A3	-	25	25	50	50	50
All other heat traced lines		A3	25	25	25	25	25	25
Low pressure steam (ip to 140KPa)		A2	38	38	38	38	50	50
High pressure steam (over 141 KPa)		A2	38	38	50	50	50	50
Tempered domestic water		A3	25	25	25	25	25	25

.6 Finishes:

.1 Exposed indoors: PVC jacket or canvas.

.2 Exposed in mechanical rooms: canvas, aluminum, SS, or PVC jacket.

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

.4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.

.5 Outdoors: water-proof aluminum, SS or ABS jacket.

.6 Finish attachments: SS screws bands, at 150 mm on centre. Seals: wing closed.

.7 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.7 FIELD QUALITY CONTROL

.1 Verification requirements in accordance with requirements in Division 1, include:

.1 Materials and resources.

.2 Storage and collection of recyclables.

.3 Construction waste management.

.4 Resource reuse.

.5 Recycled content.

.6 Local/regional materials.

3.8 CLEANING

.1 Proceed in accordance with requirements in division.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

.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 The General Conditions, Supplements, Amendments and Mechanical Work General Instructions shall govern the fire protection sections (i.e., Sections 20 00 01) of the work (read in conjunction with the Instructions to Tenderers or Bidders).

.3 Preference shall be given to local products for all materials and supplies used in or on the construction of the building or site where price, quality and service are equal.

.4 Work required for complete building fire suppression systems to meet code requirements.

.5 Dry Pipe Sprinkler System to be installed within Cold Rooms.

1.2 RELATED WORK

.1 Electrical work for fire protection to be by Division 26

.2 Thermal insulation for piping Section 20 19 01

.3 Mechanical Work General Instructions Section 20 00 01.

.4 Mechanical Basic Materials and Methods Section 20 04 01.

.5 Mechanical Identification Section 20 16 01.

1.3 DESCRIPTION OF WORK

.1 The following fire protection systems inside and/or buried beneath and/or on the roof of the building to a point 900 mm (36") beyond the exterior face of the building are specified in the noted section:

.1 Wet Sprinkler Systems Section 21 13 13

1.4 CODES, STANDARDS AND APPROVALS

.1 Installation, workmanship and testing shall conform to the following standards:

.1 The British Columbia Building Code

.2 National Fire Protection Association #10, Standard for Portable Fire Extinguishers.

.3 National Fire Protection Association #13, Standard for the Installation of Sprinkler Systems.

.4 National Fire Protection Association #14, Standard for the Installation of Standpipe and Hose systems.

.5 Insurers' Advisory Organization (IAO) Interpretive Guides.

.2 Installation shall be subject to design approval, inspection and test of the authority having jurisdiction. All system components shall be of one manufacturer. Normally, materials and devices listed by nationally recognized fire test laboratories will be acceptable.

1.5 QUALITY ASSURANCE

.1 The detailed performance-based contract tender documents, prepared by the Consultant as the Mechanical Engineer of Record (MER), provide the information required for the Fire Protection Engineer of Record (FPER). The Consultant shall submit sealed drawings and Letters of Assurance (LOAs) B-1 and B-2 to the Authorities for the Building Permit. The LOAs shall have the notation, "Performance Specifications Only" opposite the Fire Suppression Systems headings on both the B-1 and B-2 LOAs, in accordance with Scenario 2, as outlined in the BC Building Code

.2 The Consultant's performance specifications require that the FPER retained by the Fire Suppression Contractor shall retain an FPER for the preparation of detailed design, preparation of fire protection drawings, hydraulics, calculations and LOAs B-1 and B-2 and field reviews during construction and LOA C-B (for final design) prior to occupancy.

.3 Submittals: Before commencing fire protection installation, prepare and submit for approval, complete final design calculations and working plans to the Authorities and Consultant. The FPER shall submit B-1, B-2 and C-B LOAs to the Authorities. All work with other trades, especially work by other Sections of this Division and Division 16 shall be coordinated. Failure to follow this procedure will not entitle the Contractor to extra compensation should changes be required to rectify interference problems.

.4 Arrange and pay for all inspections, examinations and tests required by Authorities. Provide copy of final certificate to the Consultant.

.5 Provide written certificate that components are compatible, and where applicable, certified for intended use by nationally recognized testing agency.

.6 All final design drawings and hydraulic calculations are to be sealed by a BC-registered Professional Engineer, including the B-1 and B-2 LOAs submitted to the Authorities for the fire suppression systems; copies shall be submitted to the Consultant**. The Sprinkler Contractor's FPER shall review the work for the fire suppression systems during construction and submit a copy of the regular field reports to the Consultant**. The Fire Suppression Systems Engineer shall attend the site review for occupancy with the Authorities, the Fire Suppression Contractor and the Consultant, and provide the C-B LOA, with a copy to be sent to the Consultant.

.7 Confirm the fire suppression water supply requirements and size the systems accordingly; the detailed information shall contain water supply available on the drawings and data sheets, including detailed computer printouts and a completed graph flow sheet indicating available water supply curve and system demand curve. System demand curve shall include for hose streams (and domestic water) demands as applicable. Review architectural, structural, electrical, interior design and mechanical

drawings to ensure no conflict with building components. The final design drawings shall be coordinated with the ceiling layouts and include the outline of complete reflecting ceiling layouts; the final drawings are to indicate the location of lights, air outlets, speakers, fire and smoke detectors, etc. All piping in finished areas to be installed in walls, drop ceilings or bulkheads as shown on the Architectural Drawings; confirm with the Architect if additional dropped ceilings and/or bulkheads are required. **Submit sample and review sprinkler head types with the Consultant prior to ordering.**

.8 Allow for all piping and sprinkler heads required to provide a complete fire protection system for the building. The Consultant's drawings indicate the general location and not complete details of the fire protection equipment and systems. Assume all responsibility to provide a complete fire protection system required for the building to meet all applicable codes and standards, and local bylaw requirements. The exact sprinkler head and piping lay-outs shall be as designed by the FPER; sprinkler head locations to be coordinated with the Architect. **The final drawings shall indicate the location and type of all fire extinguishers.**

.9 The FPER shall design and carry out site review(s) of the heat tracing required to protect the fire suppression lines against freezing. The FPER shall submit a sealed letter to the Authorities, with a copy to the Consultant, stating that the heat tracing has been installed and tested to meet Code and NFPA requirements, and in accordance with the performance specifications outlined in the Consultant's contract documents.

.10 Submit equipment shop drawings on all equipment and complete building sprinkler and standpipe information. On completion of project, submit three (3) copies of maintenance manuals in hardcover three-ring binders and include the shop drawings, record drawings, manufacturers' instructions and parts lists for all equipment, list of locations of all valves and drain points, warranty certificates. **A copy of the completed (and signed) Contractor's Material and Test Certificates and a copy of the FPER's letter confirming heat tracing compliance to be submitted to the Consultant.**

.11 Provide demonstration and instructions to the Owner's personnel after the Maintenance Manuals have been submitted.

1.6 SUBMITTALS

.1 Submit shop drawings for the following items:

- .1 Excess pressure pump.
- .2 Fire department connections.
- .3 Fire hose cabinets.
- .4 Fire protection sprinkler system.
- .5 Flow switches.
- .6 Pressure switches.
- .7 Sprinkler heads and escutcheon plates.
- .8 Supervisory switches.
- .9 Valves, fittings and couplings.
- .10 Fire Extinguishers.

1.7 MAINTENANCE DATA

.1 Provide maintenance data summarized below in English for incorporation into maintenance manual specified in Division 1.

.1 Detailed instructions for the normal maintenance of all installed equipment including operational procedures, frequency of operational checks, service instructions and trouble shooting instructions. Information provided must be suitable for incorporation into the local fire department's operation book.

.2 A copy of National Fire Protection Association #25, Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems.

.3 Local source of supply for each item of equipment indicating location.

.4 Labelling and identification schedules.

.5 Valve schedule; including location, service type and normal position for all systems.

.6 Warranties, certificates and miscellaneous reports.

.7 Manufacturer's operating and maintenance brochures, including wiring diagrams.

.8 Comprehensive description of the operation of the system including the function of each item of equipment within the system.

.9 Operating electrical switchgear schedule indicating location of equipment.

.10 Lubrication schedule indicating the recommended lubricants and grades (grease or oil) for all lubricated equipment components.

1.8 COMMISSIONING

.1 Make tests to demonstrate capabilities and general operating characteristics of equipment, as instructed by the Authorities and the Consultant.

1.9 CLEAN UP

.1 Leave systems operating with work areas clean to satisfaction of Consultant.

1.10 SPECIAL REQUIREMENTS FOR DIRECT DIGITAL CONTROL (DDC)

.1 The following equipment and systems shall include contacts and/or electronic relays as required as an integral part of the equipment supplied and installed in the Fire Protection Section of the work to allow connection from such equipment to a DDC computer terminal in a location remote from each fire protection system location.

.2 The fire protection systems and each condition to be monitored and/or controlled within each fire protection system by Division 26; for remote readout on the DDC Computer is as follows:

.1 Sprinkler systems alarm by one computer point.

.3 Sprinkler systems trouble. All systems monitored by one computer point. The separate fire annunciator panel will clarify which system and what type of trouble alarm has been encountered.

1.11 CONNECTION FEES

.1 By others.

1.12 SEISMIC PROTECTION

.1 Supply and install sway-bracing hangers on fire protection systems in accordance with NFPA #13 requirements. Generally this shall apply to all cross mains 50 mm (2") and larger, and shall apply to all feed mains including all standpipe risers. Horizontal piping shall be two-way bracing and vertical piping shall include 4-way bracing at the tops of all risers. On floor loops, sway-braces are also required at the corners of all loops.

.2 Power-driven fasteners shall not be used to attach braces to the building structure, unless ULC listed for this service in the seismic zone in which the sprinkler systems is being installed.

1.13 ELBOWS AND FITTINGS

.1 Responsibility for allowing for all elbows, fittings, nipples, drains, test connections and all accessory pipe work for a complete installation is included in this section of the work within the basic tender price.

.2 No extra cost will be considered based on failure of contractor to allow for extra fittings and pipe work as required during construction to avoid existing structure, ductwork or other obstacles whether shown on drawings or not.

Part 2 Products

2.1 ACCESS DOORS

.1 Refer to Section 20 04 01 MECHANICAL BASIC MATERIALS AND METHODS.

2.2 HANGERS AND SUPPORTS

.1 All hangers and supports shall be ULC listed and shall conform to the appropriate NFPA standards.

.2 Toggle hangers are unacceptable.

2.3 PIPE SLEEVES AND ESCUTCHEONS

.1 Non-combustible pipe penetrations through fire separations that are required to have a fire resistance rating shall be as follows:

.1 Fire-rated floor slab sleeves in wet or dry areas.

.2 Interior partitions (i.e. drywall).

.3 Interior concrete or block wall sleeves shall be steel pipe or removable plastic pipe.

.2 Pipe penetrations through separations that are not required to have a fire resistance rating shall be as follows:

.1 Interior concrete or block wall sleeves and floor slab sleeves in dry areas shall be steel pipe or removable plastic pipe.

.2 Floor slab sleeves in wet areas, outside wall sleeves and roof slab sleeves shall be steel pipe.

2.4 MISCELLANEOUS METAL RELATED TO FIRE PROTECTION SYSTEM

.1 All miscellaneous metal related to the fire protection systems including all metal back up plates and supports for all ceiling or wall supported equipment is part of this section of the work.

2.5 BACKFLOW PREVENTION STATIONS

.1 Minimum Requirements:

.1 Reduced pressure backflow preventer (RPBA) complete with O.S. and Y. inlet and outlet shut-off valves, double check valve assembly and differential relief outlet.

.2 Acceptable if specifically indicated on drawings: Double check valve assembly (DCVA) assembly complete with O.S. and Y. Inlet and outlet valves.

.3 Acceptable Products:

.1 RPBP:
65 mm 2½" - 75 mm (3"): Watts 909
100 mm 4" - 250 mm (10"): Watts 909
300 mm (12"):Watts 909

.2 DCVA:
75 mm (3") - 300 mm (12"):Watts 770

.4 Backflow prevention stations for fire service shall be listed by Underwriters' Laboratories Canada (U.L.C.).

.5 Backflow prevention station shall be in complete accordance with the manual "Cross Connection Control Manual" latest Edition, published by the Pacific Northwest Section of the American Water Works Association.

2.6 PRESSURE GAUGES

.1 ULC-listed stem mount or wall mount type with Bourdon phosphor bronze tube, brass socket, 6 mm (¼") lower connection, aluminium case in black enamel finish, chrome removable slip ring, stainless steel rotary type movement, minimum 90 mm (3½") dial of 1% of full scale range and pressure range to suit application, with lever handle cock and brass 6 mm (¼" NPT) snubber to suit service.

2.7 FIRE EXTINGUISHERS

.1 These shall be ABC-type, multipurpose dry chemical with cabinet (and/or) wall-mounted bracket where required and they shall be ULC and CSA approved and bear such labels. These extinguishers shall be provided to NFPA-10 and local authority requirements and generally but not limited to, the following areas:

.1 Mechanical rooms next to entrance doors.

.2 All electrical and elevator machine rooms at entrance door.

.3 Telephone rooms at entrance door.

.4 Emergency generator room.

.5 Public Corridors.

.6 Service Rooms.

.7 Floor Levels.

.8 Storage Areas.

.9 Amenity Areas and Study Areas

.10 Communication room.

.2 Extinguishers shall be provide at 23 m (75') maximum travel; and shorter travel where required for hazardous areas.

.3 Fire extinguishers in public areas, and on typical floor levels, shall be mounted in locked recessed type cabinets with breaker glass devices. Wall-mounted brackets are allowed in Service type Rooms.

.4 The location of recessed fire extinguishers to be co-ordinated with the Architect.

.5 Mechanical Drawings will indicate the quantity of fire extinguishers to be allowed in the base tender of the fire suppression scope or work.

.6 Provide unit price for each type of fire extinguisher in the event that additional fire extinguishers may be required.

.7 Provide a separate credit price to provide storage pressure type of fire extinguisher in lieu of the cartridge operated fire extinguishers specified.

Part 3 Execution

3.1 ACCESS DOORS

.1 Install at concealed sprinkler heads, unions, expansion joints, valves, control valves and special equipment.

.2 Locate access doors so that all concealed items are readily accessible for adjustment, operation and maintenance.

.3 Do not locate access doors in feature wall or ceiling construction without the prior approval of the Consultant. Locate in service areas wherever possible.

.4 In concealed ceiling spaces containing upright heads and exposed supply piping below the ceiling, a hole around the sprinkler head riser large enough to allow passing the entire sprinkler head through the ceiling with an oversized escutcheon plate to cover the hole is an acceptable alternative to providing an access panel.

3.2 GRADING AND DRAINING OF PIPING

.1 Grade all fire protection piping so that it can be drained through drain cocks.

.2 All sprinkler piping drains shall be piped to floor drains or to the outside of the building.

3.3 PIPING EXPANSION

.1 All piping systems, including all take-offs shall be so installed within the building that the piping and connected equipment will in no way be distorted by expansion, contraction or settling.

.2 If circumstances on the job require additional changes in direction from those shown on the drawings, the configuration shall be adjusted to suit at no extra cost.

.3 Anchors shall be installed where necessary to control expansion.

3.4 PIPE SLEEVES AND ESCUTCHEONS

.1 Supply and installation of pipe sleeves is included in this section of the work. Install chrome plated escutcheon plates on exposed piping passing through walls, floors and ceilings in finished areas. Sleeves shall be concentric with pipe.

.2 Extend sleeves 50 mm (2") above floor slabs in wet areas. Wet areas include equipment rooms, janitor's rooms, kitchen areas, utility rooms, bath areas and washrooms.

.3 Extend sleeves through outside walls to 25 mm (1") beyond the exterior face and caulk with flexible caulking compound.

.4 Where removable plastic sleeves are used they shall be removed prior to pipe penetration and the resulting hole shall be then classified as the sleeve.

.5 Extra high vertical risers for fire suppression systems with many horizontal branch takeoffs passing through sleeves set in rigid structure adjacent to the main risers, sleeves shall be set to accommodate long term structural movement to avoid imposing stress on these systems.

3.5 CORE DRILLING

.1 Arrange and pay for the cost of all core drilling for fire suppression systems in this section of the work.

.2 Verify the location of existing service runs and structural reinforcement within existing concrete floors and walls prior to core drilling and cutting. Coring and cutting of structural building components shall only take place upon the receipt of specific written approval of the structural engineer. Repairs to existing services damaged as a result of core drilling is included in this section of the work.

.3 Penetrations up to 150 mm (6") nominal pipe size in precast concrete may be cored on site by fire protection contractor. Larger penetrations shall be located and arranged for in precast work with precast manufacturer prior to shipping to construction site.

3.6 BACKFLOW PREVENTION STATIONS

.1 Pipe differential relief outlet to drain.

.2 Backflow prevention station shall be installed in complete accordance with the manual "Cross Connection Control Manual" latest Edition, published by the Pacific Northwest Section of the American Water Works Association.

.3 Complete testing of all reduced pressure principle backflow prevention devices shall be carried out under this section of the work prior to final acceptance of fire protection systems. A certificate shall be submitted duly signed and witnessed that testing was satisfactory.

3.7 PRESSURE GAUGES

.1 Provide pressure gauges at incoming line, Alarm check valves and the top of all standpipe risers.

3.8 MISCELLANEOUS METALS RELATING TO FIRE SUPPRESSION SYSTEMS

.1 Prime coat after fabrication.

3.9 LABELLING AND PAINTING

.1 All piping shall be identified throughout; for unpainted lines, use red bands with white lettering and show direction by flow arrows.

.2 All valves shall have metal tags and chain.

.3 All devices shall have Lamacoid identification to Code and NFPA-13; co-ordinate with Division 16 for zone and isolation valve identification.

.4 Outside identification to meet Local Authority requirements.

.5 Permanently attached placard at the sprinkler valve providing basic design information and Sprinkler Contractor’s name.

.6 Exposed sprinkler located piping in finished painted areas shall be painted by the General Contractor to match the adjacent finish.

.7 All piping, hangers, devices and equipment in finished exposed areas, Mechanical Rooms and Industrial Spaces shall be painted red throughout by the Fire Suppression Contractor; clean and prime coat prior to finish of two coats of fire red paint.

.8 For the purpose of painting the Fire Suppression systems the Interstitial Space shall be considered as an exposed area.

3.10 ELECTRICAL WIRING

.1 Coordinate all electrical control and monitoring requirements (NMS Division 26 – Electrical) to ensure a complete installation. Monitoring and alarm points shall also include but not be limited to indicate trouble signal; or alarm.

.1 Movement of monitored isolation valves.

.2 Flow zone switches.

.2 Coordinate with Division 16 the connection of the sprinkler system to the Owners' designated monitoring firm.

3.11 FIELD QUALITY CONTROL

.1 Comply with all testing procedures required by authorities have jurisdiction and as per N.F.P.A. Standards in presence of Authorities and Consultant as required.

.2 Provide all necessary documentation to the Authorities with copies provided for the Consultant and included in the Maintenance Manual.

3.12 TESTS AND INSPECTION

.1 Furnish all labour, materials, instruments, etc. necessary for all required tests. All work shall be subject to inspection by the local plumbing inspector or design authority. At least forty-eight (48) hours notice shall be given in advance of making the required tests.

.2 Tests on Fire Suppression systems shall consist of pressure tests and shall conform to standards of Inspection Authority as listed in separate clauses of this section of specification. Test connections for fire pumps and Siamese connection lines shall also be hydrostatically tested. Refer to Section 21 13 18.

.3 Responsibility for completing "Contractor's Materials and Test Certificate" in accordance with inspection authority test procedure is included in this section.

3.13 SCHEDULING OF WORK

.1 Review with the Construction Manager the requirements for the sequential occupancy of various areas of the building.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for wet pipe fire protection and sprinkler systems for heated areas.

.2 Sustainable requirements for construction and verification.

.2 Related Sections:

.1 Section 01 30 00 - Administrative Requirements.

.2 Section 01 40 00 - Quality Requirements.

.3 Section 01 60 00 - Product Requirements.

.4 Section 01 70 00 - Execution and Closeout Requirement.

.5 Section 01 74 19 - Waste Management and Disposal.

.6 Section 21 05 01- Common Work Results – Mechanical

.7 Section 21 13 16 - Dry Pipe Sprinkler Systems.

.8 Section 21 05 06 – Common Work Results for Fire Suppression.

.9 Code Consultants Building Report including alternative solutions as applicable to fire suppression systems.

.10 Section 20 19 01 Thermal Insulation for Piping.

1.2 REFERENCES

.1 American National Standards Institute/National Fire Prevention Association (ANSI/NFPA)

.1 ANSI/NFPA 13-2007, Installation of Sprinkler Systems.

.2 ANSI/NFPA 25-2002, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.3 Underwriter's Laboratories of Canada (ULC)

.1 CAN4 S543-M984, Standard for Internal Lug Quick Connect Couplings for Fire Hose.

1.3 SAMPLES

.1 Submit samples of following:

.1 Each type of sprinkler head.

.2 Signs.

1.4 DESIGN REQUIREMENTS

.1 Design automatic wet pipe fire suppression sprinkler systems in accordance with required and advisory provisions of NFPA 13, by hydraulic calculations for uniform distribution of water over design area.

.2 Include with each system materials, accessories, and equipment inside and outside building to provide each system complete and ready for use.

.3 Design and provide each system to give full consideration to blind spaces, piping, electrical equipment, ducts, and other construction and equipment in accordance with detailed shop drawings.

.4 Locate sprinkler heads in consistent pattern with ceiling grid, lights, and air supply diffusers.

.5 Devices and equipment for fire protection service: ULC approved for use in wet pipe sprinkler systems.

.6 Design systems for earthquake protection for buildings in seismic zones 4.

.7 Location of Sprinkler Heads:

.1 Locate heads in relation to ceiling and spacing of sprinkler heads not to exceed that permitted by NFPA 13.

.2 Uniformly space sprinklers on branch.

.8 Water Distribution:

.1 Make distribution uniform throughout the area in which sprinkler heads will open.

.2 Discharge from individual heads in hydraulically most remote area to be 100% of specified density.

.9 Density of Application of Water:

.1 Size pipe to provide specified density when system is discharging specified total maximum required flow.

.10 Sprinkler Discharge Area:

.1 Area: hydraulically most remote 139 m^2 area as defined in NFPA 13.

.11 Outside Hose Allowances:

.1 Include allowance in hydraulic calculations of 950 lpm for outside hose streams.

.12 Friction Losses:

.1 Calculate losses in piping in accordance with Hazen-Williams formula with 'C' value of 120 for steel piping, 150 for copper tubing, and 140 for cement-lined ductile-iron piping.

.13 Water Supply:

.1 Base hydraulic calculations on static pressure, flow at residual pressure at fire Hydrant shown on drawing.

1.5 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 1 Requirement .

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with submittal procedures specified in Division 1.

.2 Grooved joint couplings and fittings shall be shown on drawings and product submittals, and shall be specifically identified by the manufacturer’s style or series designation.

.3 Sprinklers shall be referred to on drawings by the manufacturer’s model or style number as published in the appropriate agency listing or approval. Trade names and other abbreviated designations are not allowed.

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Submittal Procedures specified in Division 1.

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

.2 Indicate:

.1 Materials.

.2 Finishes.

.3 Method of anchorage

.4 Number of anchors.

.5 Supports.

.6 Reinforcement.

.7 Assembly details.

.8 Accessories.

.3 Quality assurance submittals: submit following in accordance with Division 1 requirement.

.1 Test reports:

.1 Submit certified test reports for wet pipe fire protection sprinkler systems from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

.2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.3 Instructions: submit manufacturer's installation instructions.

.2 Manufacturer's Field Reports: manufacturer's field reports specified.

.4 Closeout Submittals:

.1 Submit maintenance and engineering data for incorporation into manual specified in Section 01 70 00 – Execution and Closeout Requirement and in accordance with ANSI/NFPA 20.

.2 Manufacturer's Catalog Data, including specific model, type, and size

.3 Drawings:

.1 Sprinkler heads and piping system layout.

.1 Prepare detail working drawings of system layout in accordance with NFPA 13, "Working Drawings (Plans)".

.2 Show data essential for proper installation of each system.

.3 Show details, plan view, elevations, and sections of systems supply and piping.

.4 Show piping schematic of systems supply, devices, valves, pipe, and fittings. Show point to point electrical wiring diagrams.

.2 Electrical wiring diagrams.

.4 Design Data:

.1 Calculations of sprinkler system design.

.2 Indicate type and design of each system and certify that each system has performed satisfactorily in the manner intended for not less than 18 months.

.5 Field Test Reports:

.1 Preliminary tests on piping system.

.6 Records:

.1 As-built drawings of each system.

.1 After completion, but before final acceptance, submit complete set of as-built drawings of each system for record purposes.

.2 Submit drawings on white paper similar to full size contract drawings.

.7 Operation and Maintenance Manuals:

.1 Provide maintenance data for incorporation into manual specified in Section 01 70 00 – Execution and Closeout Requirement.

.2 Provide detailed hydraulic calculations including summary sheet, and Contractors Material and Test Certificate underground and for aboveground piping and other documentation for incorporation into manual specified in Section 01 70 00 – Execution and Closeout Requirement and in accordance with ANSI/NFPA 13.

.3 Submit copy of NFPA 25 – Sprinkler system Maintenance.

1.6 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: company or person specializing in wet sprinkler systems with documented experience and approved by manufacturer.

1.7 MAINTENANCE

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 70 00 – Execution and Closeout Requirement.

.2 Provide spare sprinklers and tools as required by ANSI/NFPA 13.

Part 2 Products

2.1 ABOVE GROUND PIPING SYSTEMS

.1 Provide fittings for changes in direction of piping and for connections.

.1 Make changes in piping sizes through tapered reducing pipe fittings, bushings will not be permitted.

.2 Field welding will be permitted.

2.2 PIPE, FITTINGS AND VALVES

.1 Pipe:

.1 Black or hot dipped galvanized steel pipe to ASTM A53 and ANSI Standard B36.10.

.1 Schedule 40 standard wall pipe for pressure to 2070 kPa (300 psi).

.2 Schedule 30 pipe in sizes 200 mm (8") and larger for pressure to 2070 kPa (300 psi).

.3 Light wall pipe for welded, roll grooved or F.I.T. quarter turn locking log method pipe only shall conform to the following wall thicknesses:

up to 125 mm (5")	Schedule 10
150 mm (6")	3.40 mm (0.134")
200 mm (8") - 250 mm (10")	4.78 mm (0.188")

.2 High-strength, low carbon steel tubing to ASTM A 795, Type E, Grade A, ULC approved; with mechanical roll grooved or locking lug type fittings.

.3 Acceptable Products: American Tube Co. Inc. 'Dyna-Flow' with Victaulic 'FIT' or roll grooved fittings.

.4 ULC and FM-approved, UL-listed Schedule 5 steel tubing to ASTM A135, A795 or A53; with cold drawn steel fittings with integral synthetic 'O' rings and pipe stop at fitting mid-point; which when used to join pipe indent the wall of the pipe to provide a secure attachment of pipe and fitting.

.5 Acceptable Products: Victaulic 'Pressfit' System

.6 Copper tube, drawn, seamless to ASTM B75, seamless water tube to ASTM B88, wrought seamless and alloy type to ASTM B251, brazing filler metal (Classification BCuP-3 or BCuP-4) to AWS A5.8 and solder 95-5 (tin - antimony grade 95TA) solder to ASTM B32 of wall thickness type 'K', 'L', or 'M'.

.7 Cast or ductile iron for portion upstream of all alarm valves or the interconnection between domestic and fire protection system if the two systems are interconnected and separated by an approved backflow prevention device.

.2 Fittings:

.1 Compatible with piping material.

.2 Suitable for maximum pressures in system but not less than 1210 kPa (175 psi) working pressure.

.3 Welding fittings shall comply with the latest edition of the following standards: ANSI B16.9 and B16.25 and ASTM A234.

.4 Threaded fittings are acceptable for use on Schedule 40; reference Clause, and Schedule 30; reference Clause, steel pipe only.

.5 Grinnell "Easy Tees" fittings may be used only for individual sprinkler heads.

.6 Victaulic "Snap-Let" fittings may be used for up to 25 mm (1") branch outlets.

.7 All grooved end fittings shall be of one manufacturer and shall provide a rigid joint unless otherwise noted.

.8 For dry pipe systems, use a flush seal coupling gasket in rigid and flexible couplings where required by NFPA-13.

.9 Acceptable Products: Victaulic Style 005 F.

.3 Grooved Fittings and Couplings

.1 Grooved couplings shall be designed with angle bolt pads to provide a rigid joint unless otherwise noted.

.1 Standard of Acceptance: Victaulic Style 005 Firelock.

.2 Where flexibility is required couplings shall be Victaulic Style 75.

.2 Grooved fittings shall be manufactured from ductile iron conforming to ASTM A-536 and shall be ‘full flow’ design.

.1 Standard of Acceptance: Victaulic Firelock.

.3 For connection to ANSI Class 125/150 flanged components, grooved flange adapters cast of ductile iron conforming to ASTM A-536 or malleable iron conforming to ASTM A-47 may be used:

.1 Standard of Acceptance: Victaulic Style 741, 743 or 744.

.4 Plain End Fittings:

.1 On piping 50 mm (2”) and smaller, fittings incorporating a hardened-steel, quarter-turn locking lug may be used in conjunction with SCH-10, SCH-40 steel pipe or with high tensile ASTM A-795 Dynaflow or equivalent steel pipe.

.1 Standard of acceptance: Victaulic FIT System. Threaded Lightwall pipe is not acceptable with the FIT system.

.2 An approved SCH-5 piping system may be used providing that it meets the following criteria:

.1 Pipe must conform to ASTM A-53, A-135 OR A-795.

.2 Fittings shall be cold drawn carbon steel completed with integral synthetic O-ring.

.3 Standard of Acceptance: Victaulic Pressfit.

.5 Pipe hangers:

.1 ULC listed for fire protection services in accordance with NFPA.

.6 Gate Valve - 1210 kPa (175 psi) - Underwriters' Laboratories Canada (ULC) listed:

.1 12 mm (½") - 50 mm (2"): Jenkins 305-U, Crane 459, Nibco T-104-0, Kennedy.

.2 65 mm (2½") and larger: Jenkins 825, Crane 467, Nibco F-607-0TS and F-607-RW, Kennedy, Darling 52 FM.

.7 Butterfly/Ball Valve - 1210 kPa (175 psi) - ULC listed or UL and FM approved:

.1 12 mm (½") - 50 mm (2"): Milwaukee BB-SCS Butterball slow close butterfly valve with indicator and integral supervisory switch, Nibco KT-505-8.

.2 50 mm (2") - 75 mm (3"): Victaulic Style 727 grooved end fireball complete with factory-installed supervisory switch, Nibco, Sprink Inc.

.3 100 mm (4") - 200 mm (8"): Victaulic Style 708 grooved end complete with factory-installed supervisory switch, Nibco, Sprink Inc.

.4 100 mm (4") - 300 mm (12"): Demco Series NE-H with tapped lug end design, Grinnell or Mission, Nibco L-002-N6 complete with gear operator and indicator, Pratt IBV.

.8 Check Valve - 1210 kPa (175 psi) - ULC listed:

.1 65 mm (2½") and larger: Jenkins 477, Crane 375, Mission, Nibco F-908-W, Victaulic 717, Kennedy.

.2 Provide spool piece to ensure full check valve opening where adjacent an alarm or gate valve.

.9 Alarm Valve - ULC listed: Viking, Grinnell, Automatic, Star, Astra, Central, Reliable.

.10 Solenoid valves shall be ULC listed.

.11 Where working pressure exceeds 1035 kPa (150 psi) use 2070 kPa (300 psi) valves.

.12 All drain valves shall be provided with hose end adaptors, auxiliary drains shall be provided with a drum drip.

.13 Grooved Valves:

.1 If a grooved end sprinkler system is to be used, grooved end valves shall be incorporated into the system. All grooved end valves shall be of one manufacturer.

.2 Grooved Isolation / Control Valves: Where a grooved piping system is installed, grooved end isolation/control valve may be used. Valves shall be supervised by a factory installed double throw / double flow supervisory switch.

.1 Standard of Acceptance: Victaulic Style 705, 708 and Style 727.

.3 Grooved Check Valve: Where grooved piping system is installed, grooved and check valves capable of installation in horizontal as well as vertical positions shall be used.

.1 Standard of Acceptance: Victaulic Style 717.

.4 Bolted Mechanical Branch Connections: Branch connections may be provided by rubber-gasketed, bolted, mechanical branch connections.

.1 Standard of Acceptance: Victaulic Style 920, 925, 929.

2.3 SPRINKLER HEADS

.1 General: to ANSI/NFPA 13 and ULC listed for fire services.

.2 Sprinklers shall be glass bulb type, die-cast body, with hex-shaped wrench boss integrally cast into the sprinkler body to reduce the risk of damage during installation.

.1 Wrenches shall be provided by the sprinkler manufacturer that directly engage the boss on the sprinkler. Basis of Design: Victaulic Company

.3 Sprinklers with rubber O-rings are not permitted.

.4 Sprinkler Head Type:

.1 Type A: upright bronze.
.2 Type B: pendant chrome link and lever type.
.3 Type C: pendant chrome glass bulb type.
.4 Type D: recessed chrome glass bulb fusible link type with ring and cup.
.5 Type E: flush chrome link and lever type.
.6 Type F: side wall chrome link and lever type.

.5 Provide nominal 1.2 cm orifice sprinkler heads.

.1 Release element of each head to be of temperature rating or higher as suitable for specific application.
.2 Provide polished chromium-plated pendent sprinklers below suspended ceilings.
.3 Provide corrosion-resistant sprinkler heads and sprinkler head guards in accordance with NFPA 13.
.4 Deflector: not more than 75 mm below suspended ceilings.
.5 Ceiling plates: not more than 25 mm deep.
.6 Ceiling cups: not permitted.

2.4 ALARM CHECK VALVE

.1 Alarm check valve to ANSI/NFPA 13 and ULC listed for fire service.

.2 Provide variable pressure type alarm valve complete with retarding chamber, alarm test valve, alarm shutoff valve, drain valve, pressure gages, accessories, and appurtenances for proper operation of system.

.3 Valve internal components shall be replaceable without removing the valve from the installed position.

.4 Basis of Design: Victaulic Series 751 alarm valve with Series 752 retarding chamber.

2.5 WATER MOTOR ALARMS

.1 Provide alarms approved weatherproof and guarded type, to sound locally on flow of water in each corresponding sprinkler system.

.2 Mount alarms on outside of outer walls of each building at location as directed.

.3 Provide separate drain piping directly to exterior of building.

.4 Basis of Design: Victaulic Series 760

2.6 FLOW SWITCHES

.1 ULC listed flow switches suitable for 24 volts D.C. each with one set of normally open and one set of normally closed contacts, time delay feature and paddle indicator specifically chosen and ULC listed for size of pipe in which switch is mounted.

.2 Flow switch test drain points 25 mm (1") valve with 25 mm (1") brass bull plug immediately downstream of flow switch for each flow switch in addition to normal inspector's test connections required by NFPA requirements.

.3 Sight glass assembly for visual test of each flow switch as required by NFPA-13 complete with drain. The Victaulic 'Testmaster' is an acceptable alternate to the sight glass assembly.

.4 Flow switches shall be manufactured specifically for use in sprinkler systems.

2.7 PRESSURE SWITCHES

.1 ULC-listed pressure switches where shown on drawings. Pressure switches shall be suitable for 24 volt DC contact rating unless otherwise specified.

2.8 SUPERVISORY SWITCHES

.1 ULC-listed supervisory switches, type Potter or Victaulic OSYS-B complete with "J" hooks (on gate valves of OS&Y type) Potter PIVS-C (or NRS valves) or "Potter" BF (on butterfly valves) complete with two sets of SPDT contacts or one set of normally open contacts and one set of normally closed contacts.

.2 Switches shall be suitable for 24 volt DC contact rating, unless otherwise specified.

.3 Looped cable devices are not acceptable.

.4 Approved valves with integral and/or factory-installed indicators and supervisory controls are acceptable products.

2.9 FIRE DEPARTMENT CONNECTION

.1 Provide connections approximately 1.5 m above finish grade, location as indicated.

.2 To ANSI/NFPA 13 and ULC S543 listed, 100mm Siamese type.

.3 Siamese Connection: Two-way brass body, with integral drop-ing clapper inlets and female NPT outlets; polished chrome plated finish. Basis of Design: Guardian Fire Equipment Model 6026/6029.

.4 Identification plate: Cast aluminum construction with lettering “AUTO SPKR” and “FIRE DEPARTMENT CONNECTION”.

.5 Thread specifications: compatible with local fire department.

.6 At the low point near each fire department connection, install a 90-degree elbow with drain connection to allow for system drainage to prevent freezing. Basis of Design: Victaulic #10-DR.

2.10 PRESSURE GAUGES

.1 ULC listed and to Section 20 14 01 - METERS, GAUGES AND THERMOMETERS.

.2 Maximum limit of not less than twice normal working pressure at point where installed.

2.11 PIPE SLEEVES

.1 Provide pipe sleeves where piping passes through walls and floors.

.2 Secure sleeves in position and location during construction.

.3 Provide sleeves of sufficient length to pass through entire thickness of walls and floors.

.4 Provide 2.5 cm minimum clearance between exterior of piping and interior of sleeve or core-drilled hole.

.1 Firmly pack space with mineral wool insulation.

.2 Seal space at both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to firm but pliable mass.

.3 In fire walls and fire floors, seal both ends of pipe sleeves or core-drilled holes with ULC listed fill, void, or cavity material.

.5 Sleeves in Masonry and Concrete Walls, Floors, and Roofs:

.1 Provide hot-dip galvanized steel, ductile-iron or cast-iron sleeves.

.2 Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in core-drilled hole are completely grouted smooth.

.6 Sleeves in Other Than Masonry and Concrete Walls, Floors, and Roofs:

.1 Provide 0.61 mm thick galvanized steel sheet.

2.12 ESCUTCHEON PLATES

.1 Provide split hinge type metal plates for piping passing through walls, floors, and ceilings in exposed spaces.

.2 Provide polished chromium-plated finish on copper alloy plates in finished spaces.

.3 Provide paint finish on metal plates in unfinished spaces.

2.13 INSPECTOR'S TEST CONNECTION

.1 Locate inspector's test connection at hydraulically most remote part of each system, provide test connections approximately 3 m above floor for each sprinkler system or portion of each sprinkler system equipped with alarm device.

.2 Provide test connection piping to location where discharge will be readily visible and where water may be discharged without property damage.

.3 Provide discharge orifice of same size as corresponding sprinkler orifice.

.4 Basis of Design: Victaulic TestMaster-II Style 720.

2.14 SIGNS

.1 Attach properly lettered Bilingual and approved metal signs to each valve and alarm device to ANSI/NFPA 13.

.2 Permanently fix hydraulic design data nameplates to riser of each system.

2.15 ANTIFREEZE

.1 Antifreeze loops to ANSI/NFPA 13, locations as indicated.

2.16 SPARE PARTS CABINET

.1 Provide metal cabinet with extra sprinkler heads and sprinkler head wrench adjacent to each alarm valve. Number and types of extra sprinkler heads as specified in NFPA 13.

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, inspect and test to acceptance in accordance with ANSI/NFPA 13 and ANSI/NFPA 25.

3.3 PIPE INSTALLATION

.1 Install piping straight and true to bear evenly on hangers and supports. Do not hang piping from plaster ceilings.

.2 Keep interior and ends of new piping and existing piping thoroughly cleaned of water and foreign matter.

.3 Grooved joints shall be installed in accordance with the manufacturer’s published installation instructions. Gaskets shall be molded and produced by the coupling manufacturer, and shall be suitable for the intended service. The coupling manufacturer’s factory trained representative shall provide on-site training for the contractor’s field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the project site to ensure best practices in grooved installation are being followed. (A distributor’s representative is not considered qualified to conduct the training or field visits.)

.4 Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter.

.5 Inspect piping before placing into position.

.6 Provide expansions joints or flexible couplings as necessary.

3.4 SPRINKLER HEADS – GENERAL

.1 Install escutcheons for heads flush with wall or ceiling surface.

.2 Install all piping to provide maximum headroom; provide protection on heads subject to damage.

.3 Provide sprinkler heads to code requirements including but not limited to the following areas and as required by code, as applicable to this project:

.1 Top and bottom of all service and elevator shafts.

.2 In stairwells to code at each level.

.3 Exterior canopies, loading docks, balconies, overhangs and platforms to code (with dry side wall type heads of not covered by dry sprinkler heads).

.4 Mechanical and elevator equipment rooms.

.5 Electrical closets and rooms; with appropriate shields.

.6 Under solid overhead doors and ducts.

.7 Pipe chases and concealed spaces and access as required by code.

.8 Sprinkler coverage and water heads curtains as outlined in the Equivalency Report.

.9 Concealed ceiling spaces with combustible components.

.10 Provide closed spaced sprinklers and smoke baffles.

.4 Provide protection cages for sprinkler heads as follows:

.1 In mechanical rooms for sprinkler heads located lower than 2400 mm (8’) and near equipment requiring servicing.

.2 In heated Loading Dock and Equipment Storage Areas for sprinkler heads located 3000 mm (10’) and lower.

.3 All sprinkler heads in the Interstitial space.

.5 Protection of sprinkler heads shall be provided to prevent painting and/or cleaning during construction. The Sprinkler Contractor shall inspect all sprinkler heads prior to the Occupancy Review to ensure that the sprinkler heads have not been painted or damaged; the Sprinkler Contractor shall also ensure that all pendant-type sprinkler heads are adequately secured and flush with ceiling finishes.

3.5 ELECTRICAL CONNECTIONS

.1 Provide electrical work associated with this section under Section 26 05 00 - Common Work Results - for Electrical.

.2 Provide fire alarm system under Section 28 31 00 - Fire Alarm System.

.3 Provide control and fire alarm wiring, including connections to fire alarm systems, in accordance with National Electrical Code.

.4 Provide wiring in rigid metal conduit or intermediate metal conduit.

3.6 DISINFECTION

.1 Disinfect new piping.

.2 Fill piping systems with solution containing minimum of 50 parts per million of chlorine and allow solution to stand for minimum of 24 hours.

.3 Flush solution from systems with clean water until maximum residual chlorine content is not greater than 0.2 part per million or residual chlorine content of domestic water supply.

.4 Obtain at least two consecutive satisfactory bacteriological samples from piping, analyzed by certified laboratory, and submit results prior to piping being placed into service.

3.7 BURIED PIPING SYSTEM

.1 Bury tape with printed side up at depth of 30 cm below the top surface of earth or top surface of subgrade under pavements.

3.8 FIELD PAINTING

.1 Clean, pretreat, prime, and paint new systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories.

.2 Apply coatings to clean, dry surfaces, using clean brushes.

.3 Clean surfaces to remove dust, dirt, rust, and loose mill scale.

.4 Immediately after cleaning, provide metal surfaces with 1 coat of pretreatment primer applied to minimum dry film thickness of 0.3 ml, and one coat of zinc chromate primer applied to minimum dry film thickness of 1.0 ml.

.5 Shield sprinkler heads with protective covering while painting is in progress.

.6 Upon completion of painting, remove protective covering from sprinkler heads.

.7 Remove sprinkler heads which have been painted and replace with new sprinkler heads.

.8 Provide primed surfaces with following:

.1 Piping in Finished Areas:

.1 Provide primed surfaces with 2 coats of paint to match adjacent surfaces.

.2 Provide valves and operating accessories with 1 coat of red alkyd gloss enamel applied to minimum dry film thickness of 1.0 mil.

.3 Provide piping with 50 mm wide red enamel bands self-adhering red plastic bands spaced at maximum of 6 m intervals throughout piping systems.

.2 Piping in Unfinished Areas:

.1 Provide primed surfaces with one coat of red alkyd gloss enamel applied to minimum dry film thickness of 1.0 mil in attic spaces, spaces above suspended ceilings, pipe chases, mechanical equipment room, and spaces where walls or ceiling are not painted or not constructed of a prefinished material.

3.9 FIELD QUALITY CONTROL

.1 Site Test, Inspection:

.1 Perform test to determine compliance with specified requirements in presence of Consultant.

.2 Test, inspect, and approve piping before covering or concealing.

.3 Preliminary Tests:

.1 Hydrostatically test each system at 200 psig for a 2 hour period with no leakage or reduction in pressure.

.2 Flush piping with potable water in accordance with NFPA 13.

.3 Piping above suspended ceilings: tested, inspected, and approved before installation of ceilings.

.4 Test alarms and other devices.

.5 Test water flow alarms by flowing water through inspector's test connection. When tests have been completed and corrections made, submit signed and dated certificate in accordance with NFPA 13.

.4 Formal Tests and Inspections:

.1 Do not submit request for formal test and inspection until preliminary test and corrections are completed and approved.

.2 Submit written request for formal inspection at least 15 days prior to inspection date.

.3 Repeat required tests as directed.

.4 Correct defects and make additional tests until systems comply with contract requirements.

.5 Furnish appliances, equipment, instruments, connecting devices, and personnel for tests.

.6 Authority of Jurisdiction, will witness formal tests and approve systems before they are accepted.

.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.

3.10 CLEANING

.1 Proceed in accordance with Division 1 Requirement.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.\

3.13 FLUSHING OF SPRINKLER SYSTEM

.1 Underground mains and Siamese supply lines shall be flushed *before* connecting to sprinkler systems.

.2 Flush pipe lines until effluent is clear and free of debris.

.3 Rate of flushing flows shall be as indicated in NFPA-13.

.4 Provide proper drainage for this flushing operation.

3.14 Flow Switches

.1 Provide tight pipe drain connection to open discharge outside building at grade level or other acceptable discharge point acceptable to the Authority having Jurisdiction.

3.15 Supervisory Switches

.1 Install on all valves supplying the sprinkler system inside the building wall.

.2 Conduct tests on each to ensure the indication of a "trouble" condition and the location thereof on the annunciator panel.

3.16 Excess Pressure Pump

.1 Conduct tests by starting manually and observing the pressure gauges in each sprinkler zone on the system side. The pressure shall be 172 kPa (25 psi) to 207 kPa (30 psi) above the static supply pressure at the highest point.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- Division 01 – General Requirements.
- Section 20 00 01 – Mechanical Work Instructions
- Section 20 04 01 – Mechanical Basic Materials & Methods

1.2 SUBMITTALS

.1 Provide all submittals as outlined under Section 20 22 01 – Mechanical Common Work Results.

1.3 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.

.2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

.3 Completion of documents as outlined in Section 20 00 70 Documentation for Completion.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Waste Management and Disposal:

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

1.5 SCOPE OF WORK

.1 The work under this section shall include all layouts, materials, equipment, tools and plants required for the installation, testing and putting into proper operation the complete plumbing and drainage as specified hereinafter. In general, the major divisions of the work are as follows:

1. Sanitary drainage and vents.
2. Service hot and cold water distribution.
3. Plumbing fixtures, water heaters and backflow preventers.
4. Seismic restraints.

.2 All ferrous metal work buried underground shall be protected with one coat tar primer and one coat tar enamel prior to installation (Standard AWWA C203).

.3 Provide cathodic protection for all underground steel gas piping; confirm requirements with local authorities.

2.1 VALVES

.1 Refer to Section 20 05 01 – PIPE FITTINGS AND VALVES.
.2 Equipment Connections and PIPE AND FITTINGS.
.3 Equipment Connections

1. All fittings 50 mm (2") and below connecting to equipment: Use unions, extra heavy duty pattern, having ground joints, brass seats and diagonal screws.
2. Connections to equipment 65 mm (2 1/2") and above: Grooved couplings or flanged, standard weight provided with ring gaskets.

.4 Pipe & Fittings

1. Sanitary and Storm Drainage - Internal and within 1.0 m (3'0") of building line.

.1 Buried:

- All sizes to be cast iron pipe to be Grey iron class 4000 with black bituminous protective coating.
- PVC sewer pipe (SDR) with stiffness 320 kPa or ABS (where permitted by Code).

.2 Joints:

- M.J. with S.S. worm gear and band clamps and full length corrugated S.S. sheathed over neoprene sleeve; ASTM D-735-61 Grade R615 B2; Titan MJ Coupling, or equivalent.
- Code approved PVC or ABS pipe joints to Manufacturer recommendations.
- For buried pipe only, mechanical joints with neoprene or butyl rubber compression gaskets to ASTM C564.

.3 Suspended:

- 50 mm (2") and larger: Coated cast iron, class 4000, with M.J. joints.
- 30 mm (1-1/4") and 40 mm (1-1/2"): D.W.V. copper with soldered cast bronze drainage fittings; 50/50 solder to ASTM B32 type 50A.

2. Vent Piping

.1 D.W.V. grade copper with soldered cast bronze drainage fittings or cast iron with M.J. joints.
.2 Wet vent stacks: Cast iron only.

3. Drip Drains

.1 Use standard weight galvanized steel piping with standard weight galvanized malleable fittings or drainage grade copper tubing with copper drainage fittings with non lead 50-50 solder.

2.2 FLOOR DRAINS

.1 Provide cast iron body floor drains with drainage flange, reversible membrane clamping collar, seepage openings and adjustable square nickel bronze strainers. Provide required options to suit site architectural and structural details.

.2 Acceptable manufacturers:

1. Washroom floor drains:
   Jay R. Smith 2005Y-A05NB-P
   Zurn ZN-415-B5-P
   Ancon FD-100-C-A5-1-7
2. Heavy duty floor drains:
   Jay R. Smith 2005Y-A59NB-P
   Zurn ZXN-415-A5-P
   Ancon FD-100-C-5-1-7
3. Funnel floor drains:
   Jay R. Smith 2005Y-AP/3591-NB
   Zurn ZN-415-BF-P
   Ancon FD-100-C-EG-1-7
4. Hub drains:
   Jay R. Smith 2005Y/2645-NB
   Zurn ZN-415-S
   Ancon DF-100-C-DD-1

.3 Provide waterproof membrane for drains in showers, washrooms, mechanical rooms and other wet areas located above finished spaces.

2.3 AREA DRAINS

.1 Provide cast iron body with flashing flange and clamp collar, seepage openings and adjustable 200 mm (8") dia. heavy-duty tractor grate with square nickel bronze top.

.2 Acceptable manufacturers:
Jay R. Smith 2320Y-NB
Zurn ZN-556
Ancon FD-320-M-1

2.4 CLEANOUTS

.1 Provide cast iron ferrule with gas tight seal, threaded plug and adjustable covers suitable for the specified floor finish. All floor covers shall be set FLUSH with the finished floor.

1. Carpeted Floor Areas – Cast iron cleanout with round nickel-bronze adjustable top and carpet marker. Acceptable manufacturers:
   Jay R. Smith 4020S-Y
   Zurn ZN-1504
2. Finished Floor Area – Cast iron cleanout with round scoriated nickel bronze adjustable top. Acceptable manufacturers:

Jay R. Smith 4020S
Zurn ZN-1502

3. Tile Floor – Cast iron cleanout with round nickel bronze adjustable recessed top for tile. Acceptable manufacturers:
   Jay R. Smith 4140S
   Zurn ZN-1508
4. Mechanical Rooms & Unfinished Areas – Cast iron cleanout with round adjustable extra heavy-duty cast iron top. Acceptable manufacturers:
   Jay R. Smith 4220S
   Zurn Z-1500

2.5 FIXTURES & BRASS

.1 Refer to Section 22 42 03 – PLUMBING FIXTURE AND TRIM.

2.6 PRESSURE RELIEF, REGULATING VALVES

.1 Provide pressure relief and regulating valves where indicated and required by Code.

.2 Pressure reducing valves shall be provided with isolation valves, strainer, inlet and discharge pressure gauge and bypass with ball or globe valve.

.3 Provide parallel valves for lines 62 mm (2½") and over; pressure reducing valves 75 mm (3") and over shall be Watts PV-10M or equivalent.

2.7 TRAP SEAL PRIMERS

.1 All brass, with integral vacuum breaker, 12 mm (½“) solder ends, 12 mm (½“) drip line connection.

2.8 BACKWATER VALVES (SEWER)

.1 Coated extra heavy cast iron body with bronze seat, revolving bronze flapper and threaded cover for pipe sizes up to 150 mm (6"). For pipe sizes over 150 mm (6") use plastic valves.

.2 Provide concrete access pit with steel checker plate cover.

2.9 BACKFLOW PREVENTERS

.1 Protect water distribution system against contamination in accordance to code and the PNWS/AWWA-1995 Cross Connection Control Manual. Provide reduced pressure backflow preventers, on domestic water lines to heating and cooling systems, kitchen hoods, irrigation connections and similar applications. Vacuum breakers and double check valves may be used on lines where permitted by the Authorities.

.2 Reduced pressure backflow preventers shall be tested by a certified tradesman and completed forms included in the Maintenance Manual and at the device enclosed in a plastic envelope.

.3 Provide the required cross connection control devices as outlined in the Table 4-4 from the PNWS-AWWA Cross Connection Control Manual

2.10 CORROSION PREVENTION

1. Provide V-line insulating dielectric couplings for prevention of galvanic corrosion at specific points where connections are required between copper, brass or bronze and black or galvanized steel piping.

2.11 TRAP AND SEAL PRIMERS

.1 All brass, with integral vacuum breaker, 12 MM (1/2") solder ends, 12 MM (1/2") drip line connection.

3.0 EXECUTION

3.1 FIXTURES INSTALLATION

.1 Install all fixtures, drains, cleanouts, etc., as per manufacturer's requirements; refer to the architectural drawings for locations and cabinet details. Provide flashing for shower drains to code requirements. Every fixture drain shall have minimum slope of 2%.

.2 Connect fixtures, complete with supplies and drains, separately trapped, supported level and square.

.3 Provide escutcheon plates for all lines penetrating wall surfaces including lines inside cabinets; ensure openings are sealed with non-hardening sealant and neatly finished prior to the installation of the escutcheon plates. For Guest Rooms provide acoustic sleeve for rough-in and an acoustic escutcheon by Acoustic Plumb; confirm selection of colour with the Consultant (Model AE Ivory or AEC Chrome plated).

.4 Shower heads shall be secured, counter mounted lavatories, urinals and floor mounted water closets shall be caulked (GE SCS-1200 or Dow Corning 780 or equivalent).

.5 Clean strainers on aerators prior to occupancy.

.6 Make necessary site adjustments to water conserving fixture supplies to provide proper flows at top of riser zones.

.7 Insulate piping under handicapped lavatories.

.8 Drainage installation for fixtures installations:

1. Bathtubs shall have metal waste and overflow drainage lines.
2. Showers with plastic drains shall be connected to cast iron line drains; connections to be located in the slab.
3. Water closets shall have cast iron drains; connections to be located in the slab where applicable.
4. Provide proper block outs in the slab for the shower and water closets connections located in the slab; fire stopping to be provided to code requirements.

3.2 PIPE INSTALLATION

.1 Ensure adequate protection of piping to prevent freezing; do not locate piping in outside walls where the design temperature is below -15°C. For pipe located in outside walls, in moderate temperature zones, protect with rigid insulation (Atlas AC Foam at R=20 (3.5 RSI)). Water lines exposed to outdoor conditions to be heat traced and insulated.

.2 General: Install straight, parallel and close to walls and ceilings, with specified pitch. Use standard fittings for direction changes.

.3 Install groups of piping parallel to each other; spaced, to permit application of insulation, identification, and service access on trapeze hangers.

.4 Install eccentric reducers in horizontal piping to permit drainage and eliminate air pockets.

.5 Where pipe sizes differ from connection sizes of equipment, install reducing fittings close to equipment. Reducing bushings are not permitted.

.6 Provide water, waste and other plumbing connections as required, including shut-off valves with unions or flanges to all equipment installed under this contract or by other trades. Ensure adequate space for servicing. Extend drain piping to discharge into hub or funnel drains. Do not pipe across floor in access walkways. For cooling coil drain pan condensate lines connected to rain water leaders, the condensate lines shall be dropped vertically a minimum of one floor before connecting into the storm line; provide a check valve on the condensate line at the connection.

.7 Ream pipes and tubes and clean off scale and dirt, inside and outside, before assembly; remove foreign material from piping.

.8 Domestic hot and cold water supply and return piping shall be installed within the building so that piping and equipment will in no way be strained or distorted by expansion or contraction.

.9 On longer horizontal runs and risers runs and risers where it is not possible to provide adequately for expansion and contraction by way of off-sets or expansion loops, it will be the responsibility of this Contractor to install all necessary expansion fittings complete with anchors and guides.

.10 Provide suitable guards where lines are exposed to vehicle traffic.

.11 Ensure roof vents are located further than 4m (12 feet) away from openings and air intakes.

.12 Refer to Section 20 04 01 – MECHANICAL BASIC MATERIALS AND METHODS.

3.3 CLEANOUTS

.1 Provide and set clean-out plugs in all drain and soil pipe lines where obstructions might be found, at changes of direction, and as required by Plumbing Code. All such cleanouts shall be full size for pipes up to 100 mm (4") in diameter and not less than 100 mm (4") for larger pipes.

.2 All cleanouts shall be provided with heavy brass ferrules; provide access doors in finished

walls, floors and ceilings.

.3 Outside cleanouts located in traffic areas to have concrete pads; cleanouts located in landscaped areas can have plastic finish were permitted by Code.

.4 All pipe cleanouts are to be readily accessible. They shall be exposed in unfinished areas or of the floor or wall type in finished areas. Cleanouts in ceiling voids will only be accepted when, in the opinion of the Consultant, they cannot be terminated at floor level or wall line. Where cleanouts are installed in ceiling voids, a 600 mm × 600 mm (24" × 24") access panel shall be located beneath each cleanout.

3.4 SEALING OF OPENINGS

.1 Refer to Section 20 04 01 – MECHANICAL BASIC MATERIALS AND METHODS.

3.5 BURIED DRAINAGE LINES

.1 Drainage lines up to 100 mm (4") shall grade at minimum 2% with 150 mm (6") and larger pipe at 1%, unless indicated otherwise on the drawings.

.2 Plug or cap pipe and fittings to keep out debris during construction

.3 Lay pipe in proper compacted bedding material; do not lay pipe with water in trench.

.4 Provide cleanouts as required and located to allow for easy access.

.5 When buried lines are within a 45° slope from footings, encase pipe within concrete.

.6 Plastic drain lines are to be wrapped in 6 mil poly covering or within sleeve when encased in concrete.

.7 Provide backwater valves where required by Code, complete with access.

3.6 ABOVE GRADE DRAINAGE LINES

.1 Make joints on cast iron drainage pipes with gasket material suitable for service and with stainless steel clamp type mechanical fastener.

.2 Cast iron soil pipe with mechanical joints shall be supported by means of two hangers located on each side of joint.

.3 Fittings for copper drainage lines shall be recessed drainage pattern type. Joints in copper drainage tube shall be made in accordance with the manufacturer's recommendations, using soft lead free solder Silvabrite 100, or equivalent.

.4 Vent piping passing through the roof with minimum 150 mm (6") above roof and flashed with 15 kg/m² (3 psf) lead; flashing shall be taken to the top of the vent piping and provided with an approved separate telescoping flashing cap. For cold climates increase size of vent passing through roof.

.5 Plastic drainage lines shall be assembled in accordance with the manufacturer's instructions (a

copy shall be kept at site); adapt to approved, non-plastic material prior to penetration above the slab.

.6 Provide drain piping arrangement shall allow for sud zones on drain lines serving clothes washers.

.7 Provide additional sleeves through the slab bands as outlined on the drawings and as required to suit site conditions.

.8 Provide direct drain to nearest floor drain, or other acceptable service drain from all reduced pressure back flow preventers.

3.7 WATER PIPING

.1 Make reductions in horizontal water piping with eccentric reducing fittings installed to provide drainage and eliminate air pockets; allow 0.2% slope on water lines for drainage and provide drain valves with hose end and cap with chain at low points. Provide riser and zone isolation valves.

.2 Install three elbow swing or swivel joints to connect risers to mains. Provide for proper expansion and contractions of hot water lines using pipe loops or offsets as required complete with anchors and guides on piping.

.3 All water piping run in concrete floor slabs, including pipe to trap primers, shall be encased and pipes passing through concrete floor slabs shall be sleeved and firestopped.

.4 For pipes passing through studs, ensure opening is three (3) times the size of the diameter of the pipe passing through the stud in the vertical plane.

.5 Joints in copper pressure pipe shall be with manufactured type solder fittings using 95-5 solder and flux or Silvabrite 100; extracted type tees are not allowed. Flux shall be full strength when applied and not diluted. Joints for plastic piping shall be in accordance with the manufacturer's recommendations with a copy to be kept at the site.

.6 Wherever dissimilar metals are jointed or supported, the piping shall have non-conducting type connections and hangers to prevent galvanic corrosion. Brass adapters and valves are acceptable for pipe connections.

3.8 VALVE INSTALLATION

.1 Provide shutoff valves as indicated on drawings; mount valve with stems upright or horizontal, not inverted. Provide drain valves with cap at low points of systems where required. Provide isolation valves in main lines and vertical risers to permit isolation of zones for servicing; provide drain valves with cap for drainage of lines.

.2 Provide good access to pressure reducing valve stations to facilitate adjustment and maintenance. Provide isolation valves, strainer and pressure gauges.

3.9 PROTECTION OF ELECTRICAL EQUIPMENT

.1 For plumbing drain lines running over telephone and electrical equipment provide sheet metal protective pans and drained to nearest drain. Water lines are to be fully encased in another pipe.

3.10 SOUND CONTROL

.1 The following procedures shall be used for this project, batt insulation is to be provided by the General Contractor:

1. Ensure that piping does not come in direct contact with structure, electrical lines, studs or wall board; maintain minimum 9 mm (3/8") clearance or provide resilient insulation.
2. Use cast iron vertical riser lines with mechanical neoprene joints for main waste and vent stacks. For critical areas, mount riser supports on resilient 6 mm (¼") thick pads, Mason "Super W" or equivalent. Place clamps parallel to wall to avoid contact with studs or wall board.
3. Avoid direct connection of branch lines across a plumbing chase or party wall in back-to-back arrangements.
4. Attach pipes to separate wood plates attached solidly to studs on side of bathroom being served; use wingback elbows or equivalent.
5. Pipes penetrating walls should be clear of wallboard by 3 mm (1/8") to 6 mm (¼") and caulked with non-hardening approved type mastic.
6. Manufactured water hammer arrestors shall be installed adjacent to any quick-acting solenoid valves and flush valves.
7. Water and drainage piping suspended from structure within living spaces shall have oversized hangers and to accommodate pipe insulation between hanger and pipe; provide sheet metal protection shield between hanger and insulation. The furred spaces containing the pipes shall be lined with R-12 batt insulation with an additional layer of drywall installed to the ceiling. No penetrations are permitted into the ceiling space.
8. Vertical sanitary and storm drainage stacks shall terminate in two 45° bends or large radius 90° bend where space permits.
9. Be responsible to review all piping arrangements to ensure conformity to the above requirements prior to the installation of the wall board.
10. For hot water, domestic water lines and chilled water mains 75 mm (3") or larger, installed over critical areas provide additional sound protection.
11. All plumbing chases and wall cavities containing pipes shall contain R-12 batt insulation. Care should be taken not to compress the bolt between the pipe and gypsum wall board.

3.11 DRAINS

.1 Pipe all discharge from relief valves backflow preventers relief ports and drains to the nearest floor drains or suitable receptacle; size of floor drain to meet the requirements of the AWWA Cross Connection Control Manual:

Size of Backflow Device	Size of Floor Drain
32 mm (1¼")	75 mm (3")

37 mm (1½") to 50 mm (2")	100 mm (4")
62 mm (2½") to 150 mm (6")	150 mm (6")
200 mm (8") and larger	200 mm (8")

.2 Provide 20 mm (¾") ball valves with hose ends, caps and chains at strainers, all low points pumps, coils and at each piece of equipment.

.3 For automatic air vent located over finished areas, provide 6 mm (¼") copper tubing to nearest drain.

3.12 TESTS

.1 All work shall be tested to Code requirements and to the satisfaction of Authorities and the Consultant; include for all costs.

.2 Test all gravity drainage piping by filling to a minimum of 3 m (10') head and maximum 8 m (25') water column for six hours. Also, check for proper grading and for obstructions.

3.13 WATER SERVICE

.1 Provide water meter with strainer upstream and three valve bypass of size indicated on the drawings. Provide water pressure gauge with isolation valve on incoming service line. Meter to have remote reader with conduit and wiring under Division 26; locate reader near main entrance.

.2 The domestic water service lines shall be injected with a water solution with chlorine content to at least 25 ppm and allowed to stand for 24 hours or 50 ppm for 6 hours. Disinfection shall be to AWWA C-601 requirements.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Refer to Division 01 – General Requirements.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME) latest editions as required by Code.

- .1 ANSI/ASME B16.15, Cast Bronze Threaded Fittings, Classes 125 and 250.
- .2 ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
- .3 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- .4 ANSI/ASME B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500.

.2 ASTM International Inc.

- .1 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .2 ASTM B88M, Standard Specification for Seamless Copper Water Tube.

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

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

.4 Canadian Standards Association (CSA International)

- .1 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings.

.5 Department of Justice Canada (Jus)

- .1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).

.6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

- .1 Material Safety Data Sheets (MSDS).

.7 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).

- .1 MSS-SP-67, Butterfly Valves.
- .2 MSS-SP-70, Gray Iron Gate Valves, Flanged and Threaded Ends.
- .3 MSS-SP-71, Gray Iron Swing Check Valves, Flanged and Threaded Ends.
- .4 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.

.8 National Research Council (NRC)/Institute for Research in Construction

- .1 NRCC 38728, National Plumbing Code of Canada (NPC).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

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

.3 Closeout Submittals:

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 CROSS CONNECTION CONTROL

.1 All installations shall be in accordance with the recommendations contained in the latest edition of the Cross Connection Control Manual published by Pacific Northwest Section of the American Water Works Association. Refer to Attachment A with this section.

.2 Double check valve assemblies and reduced pressure principle backflow prevention devices shall have approval from the Foundation for Cross Connection Control, University of Southern California.

.3 Following installation, a test report completed by a certified tester shall be submitted to the Owner, indicating satisfactory operation of each device.

.4 Tests are to be conducted in the period 30 to 60 days prior to date of Substantial Completion.

.5 Provide one repair kit for every cross connection control device installed.

Part 2 Products

2.1 PIPE AND FITTINGS

.1 Above ground water pipe inside the building:

1. Ductile iron Class 2 pipe with cement motor lining with seal coat to AWWA C106 or C151 for cut grooved fittings. Ductile iron pressure coupling to ANSI/AWWA C-606 for cut grooved ductile iron pressure pipe with synthetic rubber gasket, plated carbon steel bolts, alkyd phenolic primer and protective enamel finish.

   Acceptable Product:

   .1 Victaulic Style 31 Couplings and Style 307 Transition Couplings

2. Type 'L' hard drawn seamless copper tubing to ASTM B88 or copper pipe to ASTM B42. All type 'L' copper water tubing shall be certified by the Canadian Standards Association or Warnock Hersey Professional Services Ltd. to ASTM B88.

3. Cold Water:

.1 Type 'L' hard drawn seamless copper tubing to ASTM B88 or copper pipe to ASTM B42. All type 'L' copper water tubing shall be certified by the Canadian Standards Association or Warnock Hersey Professional Services Ltd. to ASTM B88.

4. Hot Water:

.1 Type 'K' hard drawn seamless copper tubing to ASTM B88 or copper pipe to ASTM B42.

.2 Above ground copper water pipe fittings inside the building:

1. Use of the 'T-Drill' system of joining copper piping is unacceptable.
2. Cast brass or wrought copper solder joint pressure fittings with 95/5 Sn/Sb or Silvabrite 100 solder joints; or
3. Cast bronze or wrought copper roll grooved pressure fittings with grooved mechanical pipe connector couplings.

Acceptable Product:

.1 Victaulic Copper Connection Couplings, Fittings and Flange Adaptors.4

4. Exception: Where compression fittings are required they shall be to ANSI B16.22-1973.

2.2 VALVES

.1 Gate Valves:

1. 65 mm (2½") and larger, flanged ends, cast iron body, solid wedge disc, bronze or stainless steel trim, rising stem, outside screw and yoke.

Acceptable Product:

.1 Crane 465-1/2, Grinnell 6020A, Jenkins 404, Kitz 72, Lunkenheimer 1430C, Neuman-Hattersley 504, Nibco F617-0, Red & White / Toyo 421A.

.2 Ball Valves:

1. 50 mm (2") and smaller, brass two piece body, blow-out proof stem, PTFE seats, brass chrome plate ball, lever handle operator, 1035 kPa (150 psi) rating.

Acceptable Products:

.1 Solder joint type: Red & White / Toyo 5049A, Apollo, Crane, Jenkins, Kitz, Lunkenheimer 746FS or 747FS, Neuman-Hattersley, Nibco, Watts, Worcester.

.2 Threaded joint type: Red & White / Toyo 5044A, Apollo-70 Series, Crane 93-TF, Grinnell 3700 full port, Jenkins-1101-T, Kitz 58, Lunkenheimer 746F or 747F, Neuman-Hattersley 1969AT, Nibco T-580-BR, Watts B-6000, Worcester 4211-RT.

.3 Butterfly Valves: (in lieu of gate valves or as specified)

1. 65 mm (2½") and larger, 1,380 kPa (200 psig) rating, wafer style or threaded lug style cast iron body, EPDM seat liner, bronze disc, 403 stainless steel stem, 10 position lever lock handle operator on 150 mm (6") diameter and smaller, handwheel worm gear operator on 200 mm (8") diameter and larger, for installation between Class 125 / 150 flanges.

   Acceptable Products:

   .1 Wafer style: Red & White / Toyo Fig. 917BESL/G, Center Line L200W/G200W (EPDM)
   .2 Lug style: Red & White / Toyo Fig. 918BESL/G, Center Line L200L/G200L (EPDM)

.4 Globe Valves: (for throttling, bypass and make-up applications)

1. 50 mm (2") and smaller, bronze body, bronze or stainless steel trim, 860 kPa (125 psi) rating.

   Acceptable Products:

   .1 Solder joint type with bronze bevel type disc: Crane 1320, Grinnell 3200, Jenkins 300P, Kitz 12, Lunkenheimer 2125, Neuman-Hattersley A41SE, Nibco S-211-B, Red & White / Toyo 212.
   .2 Threaded joint type with composition type disc: Crane 7, Grinnell 3210, Jenkins 106A, Kitz 09, Lunkenheimer 2942, Neuman-Hattersley 13, Nibco T-211-Y, Red & White / Toyo 220.

2. 65 mm (2½") and larger, flanged ends, cast iron body, bronze or cast iron bevel-type disc, bronze or stainless steel trim, rising stem, outside screw and yoke.

   Acceptable Products:

   .1 Crane 351, Grinnell 6200A, Jenkins 2342, Kitz 76, Lunkenheimer 3731, Neuman-Hattersley 731, Nibco F-718-B, Red & White / Toyo 400A.

.5 Check Valves: (for horizontal installation)

1. 50 mm (2") and smaller, threaded joint type, bronze body, bronze or stainless steel swing disc holder with Teflon disc, 860 kPa (125 psi) rating.

   Acceptable Product:

   .1 Crane 37, Grinnell 3330, Jenkins 4092, Kitz 22, Lunkenheimer 2144, Neuman-Hattersley A60AT, Nibco T-413-B, Red & White / Toyo 236.

2. 65 mm (2½") and larger, flanged ends, cast iron body, bronze or cast iron swing disc, bronze or stainless steel trim, 860 kPa (125 psi) rating.

   Acceptable Product:

   .1 Crane 373, Grinnell 6300A, Jenkins 587, Kitz 78, Lunkenheimer 1790C, Neuman-Hattersley 651, Nibco F-918-B, Red & White / Toyo 435A.

.6 Drain Valves and Hose Bibbs:

1. Hose Bibbs: Lockshield globe type with bronze body and trim suitable for maximum system operating pressure.

   Acceptable Products:

   .1 Dahl 2316.

2. Drain Valves: Globe type with bronze or stainless steel body and trim composition disc.

   Acceptable Products:

   .1 Crane 7, Jenkins 106A, Kitz 09, Lunkenheimer 2942, Nibco T-235-Y, Red & White / Toyo 221.

2.3 VACUUM BREAKERS

.1 Pressure type:

1. CSA approved, mechanically independent spring loaded poppet type check valve with a downsteam spring loaded air inlet valve, with upstream and downstream isolation valves and test cocks.

   Acceptable Products:

   .1 Cla-Val 27, Conbraco 40-500, Febco 765, Watts 800, Wilkins 720A, SMR

.2 Atmospheric type:

1. CSA approved, bronze body, chrome plate finish where exposed.

   Acceptable Products:

   .1 Conbraco 38-100; Febco 710 / 715A; Watts 288A, 288AC; Wilkins 30; Rainbird; SMR.

.3 All vacuum breakers shall be sized in accordance with the following table:

Pipe Size mm (in.)	Pressure Type Size mm (in.)	Atmospheric Type Size
12 – 25 (½ - 1)	12 (½)	Full Pipe Size
30 – 40 (1¼ - 1½)	19 (¾)	Full Pipe Size
50 – 75 (2 - 3)	25 (1)	Full Pipe Size

2.4 BACKFLOW PREVENTION STATIONS

.1 Double check valve assembly (DCV), factory assembled station to CSA B64.5.

Acceptable Products:

1. Watts Series 709; Ames 3000 Series; Beeco #FDC, #2, CXm F-72; Cla-Val D, D2; Conbraco 400-100; Hersey #1; Neptune 550, DHC; Febco 805; Wilkins 950, MBD-10.

.2 Reduced pressure principle backflow prevention device (RPPD), with inlet and outlet shut-off valves, double check valve assembly, differential relief outlet and repair/maintenance kit to CSA B64.10-M1984.

Acceptable Products:

1. Watts Series 909; Ames 4000 Series; Beeco #FRP-11, #6CM; Cla-Val RP; Conbraco 40-200; Febco 835B, 825; Neptune 575; Wilkins 575, MBC-8, MBC-10.

2.5 STRAINERS

.1 Sized on a 4 to 1 ratio of basket open area to connecting pipe cross-sectional area, 'Y' pattern, 304 stainless steel screen.

.2 6 mm (¼") to 50 mm (2"), threaded ends, bronze body, 1034 kPa (150 psi) rating.

Acceptable Products:

1. Red & White / Toyo 380, Crane 988-1/2, Armstrong, Muessco, Conbraco, Sarco (Canada), Kitz.

.3 65 mm (2½") and larger, flanged ends, cast iron body, 860 kPa rating.

Acceptable Products:

1. Red & White / Toyo 381A, Crane 989-1/2, Armstrong, Muessco, Sarco (Canada), Kitz.

2.6 PRESSURE GAUGES

.1 Refer to SECTION 15170 METERS, GAUGES AND THERMOMETERS.

2.7 WATER HAMMER ARRESTORS

.1 Bellows or piston style with stainless steel casing and welded stainless steel nesting bellows if of the bellows style.

Acceptable Products:

1. Zurn Z-1700 Series bellows style, Jay R. Smith, Ancon, Amtrol, Watts; Precision Plumbing Products Inc. piston style.

2.8 THERMOMETERS

.1 Refer to SECTION 15170 METERS, GAUGES AND THERMOMETERS.

2.9 TEMPERATURE AND PRESSURE RELIEF VALVES

.1 Design: Watts A.S.M.E. rated.

.2 Acceptable Products: Cash Acme.

2.10 PIPE JOINTS

.1 Solders and fluxes having a lead content shall not be used.

.2 All copper to iron and flanged adaptors shall be brass, not copper.

.3 All unions or similar interconnections between dissimilar metals may be dielectric couplings.

Acceptable Products:

1. Epco Dielectric Pipe Fittings.

.4 Contractor can use Victaulic products as follows to code requirements:

1. Transitions between grooved ducts iron and grooved copper shall be by a Victaulic Style 47GG Grooved X by Grooved Dielectric Water Way.
2. Victaulic Series 300 BFV for isolation.
3. Monitored check valves Series 705W BFV and 717 PPS coated check valves with a 07 coupling complete with flush seal gasket for potable water.
4. For copper systems series 608 BFV.
5. For 65mm (2-1/2”) and larger ductile pipe Victaulic Series 732 PPS coated wye strainer.

2.11 AIR VENTS

.1 Design: Automatic float type, 1035 kPa (150 psi) max. operating pressure.
.2 Acceptable Products: Armstrong 11-AV, Maid-o-Mist 71, Taco 426, Amtrol.

2.12 TRAP SEAL PRIMERS

.1 Provide flow actuated type priming device piped to nearest fixture so that device will introduce regulated amount of water into trap whenever fixture is used.

Acceptable Products:

1. Watts A200-T, Zurn, Ancon, Jay R. Smith

.2 Provide pressure actuated type priming device piped where the nearest fixture is remote to the floor drain requiring trap priming.

Acceptable Products:

1. Precision Plumbing Products Model P-1

2.13 MIXING VALVE FOR 82°C (180°F) HOT WATER SYSTEM

.1 Provide a 20 mm (3/4") temperature control mixing valve for 1.26 lps (20 USgpm) at 55 kPa (8 psi) pressure differential reverse acting with 1.22 metre (4') capillary and 9.5 mm x 100 mm (3/8" x 4") copper bulb, standard adjustment dial range 0oC to 150oC (32oF to 300oF).
.2 Provide for control air to mixing valve from control air system.
.3 Acceptable Products:

1. Powers 591-6610, Flowrite with Accritem II 74-1258.

2.14 WATER METER

.1 The water meter shall be supplied by the Contractor.
.2 Provide water meter with strainer upstream and three valve bypass of size indicated on the drawings. Provide water pressure gauge with isolation valve on incoming service line. Meter to have remote reader with conduit and wiring under Division 16; locate reader near main entrance.
.3 Acceptable Products:

1. Up to 50 mm (2"): Schlumber Neptune T-10 Meter with ProRead ARB
2. Greater than 50 mm (2"): Neptune Tru/Flo Compound Meter with ProRead ARB, Neptune High Performance Turbine Meter
3. Rockwell, Hersey

3.0 EXECUTION

3.1 CONCEALED SUPPLY PIPING

.1 Concealed water supply piping to plumbing fixtures, trim items, equipment, hose bibbs, etc. shall be installed using cast brass 90 degree drop ear elbow or drop ear tees as the piping design dictates.
.2 Blocking shall be provided within the concealed space and the elbows and tees shall be secured to the blocking using brass screws to provide a rigid installation.

3.2 VALVE INSTALLATION

.1 General:

1. Where possible, disassemble solder end joint valves before soldering.
2. Where disassembly and the subsequent reassembly are impossible, the contractor shall give special regard to solder jointing in order not to damage, melt or deform and valve parts.

.2 Shut Off Valves:

1. Install shut-off or isolation valves whether shown on the drawings or not at the following locations:

   .1 At the base of each building riser.
   .2 At each main branch supply point; provide a valve on each outlet leg from the tee or cross.
   .3 At each single plumbing fixture (i.e. normally this requirement is satisfied by the provision of the angle valve specified with the specific fixture).
   .4 At each single piece of equipment.
   .5 At all points as indicated on the drawings.
   .6 At all points where the plumbing code requires same.

.3 Balancing Valves:

1. Install balancing valves in hot water recirculating branch mains and branch connections to return mains whether indicated on drawings or not.

.4 Pressure Reducing Valves:

1. Pressure reducing valve stations, as a minimum shall consist of the following:

   .1 A high flow or main pressure reducing valve; which shall be one pipe size smaller than the incoming or outflowing building service, and shall be provided with a strainer, a reducer and a shut off valve on the inlet side and a reducer and a shut off valve on the outlet side.
   .2 A low flow pressure reducing valve; which shall be 25 mm (1") in size, and shall be provided with a strainer and a shut off valve on the inlet side and a shut off valve on the outlet side.
   .3 A bypass around both pressure reducing valves with a normally closed globe valve; which shall be of the same pipe size as the incoming or outflowing building service, and a pressure gauge on each side of the globe valve.
   .4 Where a pressure reducing valve with integral low flow bypass is used the piping, fittings and accessories shall be arranged as described in and above.

2. Set main pressure reducing valve at 415 kPa (60 psi) outlet pressure.
3. Set small flow pressure reducing valve at 35 kPa (5 psi) higher outlet pressure than main pressure reducing valve.

.5 Drain Valves:

1. Install drain valves 18 mm (¾") minimum, or line size where the piping is smaller than 18mm (¾").
2. Install a hose-end adaptor on the discharge side of each drain valve or pipe to drain where indicated.

3.3 BACKFLOW PREVENTION STATION INSTALLATION

.1 Install at each fixture or item of equipment where contamination of the water system can occur.

.2 Pipe differential relief outlet to drain.

.3 Backflow prevention station shall be in complete accordance with the manual "Cross Connection Control" First Edition, September 1977 published by the B.C. Section of the American Water Works Association.

.4 Complete testing of all reduced pressure principle backflow prevention devices shall be carried out under this section of the work prior to final acceptance of plumbing systems. A certificate shall be submitted duly signed and witnessed that testing was satisfactory.

3.4 STRAINER INSTALLATION

.1 Install strainer blow-off connections.

.2 Blow-off connections shall be full drain connection size and shall include:

1. Up to 50 mm (2") - nipple and cap (hot services).
2. 65 mm (2½") and larger - nipple, globe valve and nipple (hot services).
3. All sizes (cold services) - plug the blow-off connection only.

3.5 FLANGES AND UNIONS

.1 Provide on all connections to pumps, reducing valves, control valves, fixtures, and equipment.

.2 Connections up to and including 50 mm (2") size shall be all bronze union, 1,035 kPa (150 psi) rating with ground seat; larger connections shall be flanged.

3.6 PRESSURE GAUGES

.1 Install pressure gauge at all pump suction and discharge points and at each pressure reducing station inlet and outlet.

3.7 WATER HAMMER ARRESTORS

.1 Size in accordance with the Plumbing and Drainage Institute PD1-WH-201 sizing procedures.

.2 Install on branch lines to flush valves, solenoid valves, self-closing faucets, quick closing valves and on refrigeration, kitchen and laundry equipment incorporating solenoid valves.

3.8 PIPE JOINTS

.1 Install dielectric type couplings where copper piping and accessories connect to plumbing equipment such as steel storage tanks or pressure reducing stations.

.2 Where the water service enters the building terminate at the edge of the building and excavation with a Smith Blair standard sleeve coupling having stainless steel nuts and bolts. Bridge the excavation with ductile iron pipe.

3.9 AIR VENTS

.1 Install at all high points in domestic hot water recirculation system.

.2 Install on tees and not on horizontal piping or radiused elbows.

.3 Install 12 mm (½") minimum isolating gate valve ahead of each air vent.

.4 Pipe all air vent discharge connections separately to nearest building drain using 6 mm (¼") hard drawn copper.

3.10 TRAP SEAL PRIMERS VALVES

.1 Provide floor drain trap primers in water closet rooms and other areas in accordance with the plumbing code and as designated on the drawings.

.2 Locate at locations that are readily accessible by the building maintenance staff.

3.11 TESTING AND INSPECTION

.1 Testing shall consist of hydraulic pressure testing at 1,400 kPa (200 psi) for 8 hours.

3.22 PERFORMANCE VERIFICATION

.1 Scheduling:

.1 Verify system performance after pressure and leakage tests and disinfection are completed, and Certificate of Completion has been issued by authority having jurisdiction.

.2 Procedures:

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

.2 TAB HWC in accordance with Section 20 00 50 – Testing, Adjusting and Balancing.

.3 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.

.4 Sterilize HWS and HWC systems for Legionella control.

.5 Verify performance of temperature controls.

.6 Verify compliance with safety and health requirements.

.7 Check for proper operation of water hammer arrestors. Run selected outlet for 10 seconds, then shut off water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.

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

.3 Reports:

.1 Om accordance with Section 01 91 13 – General Commissioning (Cx) Requirements: Report, using report forms as specified in Section.
.2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

3.23 OPERATION REQUIREMENTS

.1 Co-ordinate operation and maintenance requirements including, cleaning and maintenance of specified materials and products with Section 23 05 01 – Installation of Pipework.
.2 Operational requirements in accordance with Section 01 47 19 – Sustainable Requirements: Operation, include:
.1 Cleaning materials and schedules.
.2 Repair and maintenance materials and instructions.

3.24 CLEANING

.1 Clean in accordance with Section 01 74 11 – Cleaning.
.2 Waste Management: separate waste materials for reuse and recycling in accordance with Sections 01 74 21 – Construction/Demolition Waste Management and Disposal

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Refer to Division 01 – General Requirements.

1.2 REFERENCES

.1 ASTM International Inc.

.1 ASTM B32-08, Standard Specification for Solder Metal.

.2 ASTM B306-02, Standard Specification for Copper Drainage Tube (DWV).

.3 ASTM C564-03a, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

.2 Canadian Standards Association (CSA International).

.1 CSA B67-1972(R1996), Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.

.2 CAN/CSA-B70-06, Cast Iron Soil Pipe, Fittings and Means of Joining.

.3 CAN/CSA-B125.3-05, Plumbing Fittings.

.3 Green Seal Environmental Standards (GSES)

.1 Standard GS-36-00, Commercial Adhesives.

.4 South Coast Air Quality Management District (SCAQMD), California State

.1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

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

Part 2 Products

2.1 SUSTAINABLE MATERIAL

.1 Sustainable Requirements: materials and products in accordance with Section 01 47 15 Sustainable Requirements: Construction.

.2 Adhesives and Sealants: in accordance with Section 07 92 00 - Joint Sealants.

.1 Maximum VOC limit of g/L to SCAQMD Rule 1168 GSES GS-36

2.2 COPPER TUBE AND FITTINGS

.1 Above ground sanitary, storm and vent Type DWV to: ASTM B306.

.1 Fittings.

.1 Cast brass: to CAN/CSA-B125.3.

.2 Wrought copper: to CAN/CSA-B125.3.

.2 Solder: lead free, 95:5, type TA, to ASTM B32.

2.3 CAST IRON PIPING AND FITTINGS

.1 Buried sanitary, storm and vent minimum NPS 3, to: CAN/CSA-B70, with one layer of protective coating of black bituminous protective coating.

.1 Joints:

.1 Mechanical joints:

.1 Neoprene or butyl rubber compression gaskets: to ASTM C564 or CAN/CSA-B70.

.2 Stainless steel clamps.

.2 Above ground sanitary, storm and vent: to CAN/CSA-B70.

.1 Joints:

.1 Mechanical joints:

.1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

Part 3 Execution

3.1 APPLICATION

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

3.2 INSTALLATION

.1 Install in accordance with Provincial Plumbing Code and local authority having jurisdiction.

3.3 TESTING

.1 Pressure test buried systems before backfilling. Test to a minimum of 3 meters and a maximum of 10 meters of water column.

.2 Hydraulically test to verify grades and freedom from obstructions.

3.4 PERFORMANCE VERIFICATION

.1 Cleanouts:

.1 Ensure accessible and that access doors are correctly located.

.2 Open, cover with linseed oil and re-seal.

.3 Verify that cleanout rods can probe as far as the next cleanout, at least.

.2 Test to ensure traps are fully and permanently primed.

.3 Storm water drainage:

.1 Verify domes are secure.

.2 Ensure weirs are correctly sized and installed correctly.

.3 Verify provisions for movement of roof system.

.4 Ensure that fixtures are properly anchored, connected to system and effectively vented.

.5 Affix applicable label (storm, sanitary, vent, pump discharge etc.) c/w directional arrows every floor or 4.5 m (whichever is less).

3.5 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

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

3.6 GENERAL REQUIREMENTS

.1 All drains, traps and waste pipes from urinals shall be cast iron.

.2 All cleanouts and drainage lines passing through water proofed floors, including washrooms, shall have clamping collars and flashing.

.3 Built up floor sinks, showers, floor drains and cleanouts shall have flashing membrane and must be clamped. Flashing can be lead or choraloy lining material.

.4 Set all drains at lowest point to obtain proper drainage; confirm slopes of finished surfaces prior to rough-in.

3.7 ABOVE GRADE DRAINAGE LINES

.1 Install piping parallel and close to walls and ceilings to conserve headroom and space; and grade as indicated and to code.

.2 Make joints on cast iron drainage pipes with gasket material suitable for service and with stainless steel clamp type mechanical fastener.

.3 Cast iron soil pipe with mechanical joints shall be supported by means of two hangers located on each side of joint.

.4 Fittings for copper drainage lines shall be recessed drainage pattern type. Joints in copper drainage tube shall be made in accordance with the manufacturer's recommendations, using soft lead free solder Silvabrite 100, or equivalent.

.5 Vent piping passing through the roof with minimum 6" (150 mm) above roof and flashed with 3 psf (15 kg/m2) lead; flashing shall be taken to the top of the vent piping and provided with an approved separate telescoping flashing cap. For cold climates, increase size of vent passing through roof.

.6 Provide additional sleeves through the slab bands as outlined on the drawings and as required

to suit site conditions.

.7 Provide direct drain to nearest floor drain, or other acceptable service drain from all reduced pressure back flow preventors.

3.8 CLEANOUTS

.1 Provide and set clean-out plugs in all drain and soil pipe lines where obstructions might be found, at changes of direction, and as required by Plumbing Code. All such cleanouts shall be full size for pipes up to 100mm (4") in diameter and not less than 100mm (4") for larger pipes.

.2 All cleanouts shall be provided with heavy brass ferrules; provide access doors in finished walls, floors and ceilings.

.3 Outside cleanouts located in traffic areas to have concrete pads; cleanouts located in landscaped areas can have plastic finish were permitted by Code.

.4 All pipe cleanouts are to be readily accessible. They shall be exposed in unfinished areas or of the floor or wall type in finished areas. Cleanouts in ceiling voids will only be accepted when, in the opinion of the Consultant, they cannot be terminated at floor level or wall line. Where cleanouts are installed in ceiling voids, a 24" × 24" access panel shall be located beneath each cleanout.

3.9 BACKFLOW PREVENTOR AND EQUIPMENT DRAINS

.1 Pipe all discharge from relief valves backflow preventors relief ports and drains to the nearest floor drains or suitable receptacle; size of floor drain to meet the requirements of the AWWA Cross Connection Control Manual:

Size of Backflow Device	Size of Floor Drain
1¼ " (32mm)	3" (75mm)
1½ " (37mm) to 2" (50mm)	4" (100mm)
2½ " (62mm) to 6" (150mm)	6" (150mm)
8" (200mm) and larger	8" (200mm)

.2 Provide 20 mm (¾") ball valves with hose ends, caps and chains at strainers, all low points pumps, coils and at each piece of equipment.

.3 For automatic air vent located over finished areas, provide ¼"(6mm) copper tubing to nearest drain.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for plumbing specialties and accessories.

.2 Sustainable requirements for construction and verification.

.2 Related Sections:

.1 Section 01 30 00 - Administrative Requirements.

.2 Section 01 40 00 - Quality Requirements.

.3 Section 01 60 00 - Product Requirements.

.4 Section 01 70 00 - Execution and Closeout Requirement.

.5 Section 01 74 19 - Waste Management and Disposal.

.6 Section 21 05 01- Common Work Results – Mechanical.

1.2 REFERENCES

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

.1 ASTM A126-95(2001), Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.

.2 ASTM B62-02, Specification for Composition Bronze or Ounce Metal Castings.

.2 American Water Works Association (AWWA).

.1 AWWA C700-02, Cold Water Meters-Displacement Type, Bronze Main Case.

.2 AWWA C701-02, Cold Water Meters-Turbine Type for Customer Service.

.3 AWWA C702-1-01, Cold Water Meters-Compound Type.

.3 Canadian Standards Association (CSA International).

.1 CSA-B64 Series-01, Backflow Preventers and Vacuum Breakers.

.2 CSA-B79-94(R2000), Floor, Area and Shower Drains, and Cleanouts for Residential Construction.

.3 CSA-B356-00, Water Pressure Reducing Valves for Domestic Water Supply Systems.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Material Safety Data Sheets (MSDS).

.5 National Research Council (NRC)/BC Office of Housing and Construction Standards

.1 British Columbia Plumbing Code (BCPC) - 2012.

.6 Plumbing and Drainage Institute (PDI).

.1 PDI-G101-96, Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data.

.2 PDI-WH201-92, Water Hammer Arresters Standard.

1.3 SUBMITTALS

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

.2 Co-ordinate submittal requirements and provide submittals required by Section 01 47 15 - Sustainable Requirements: Construction.

.3 Product Data:

- .1 Submit manufacturer's printed product literature, specifications and datasheet for fixtures and equipment.
- .2 Indicate dimensions, construction details and materials for specified items.
- .3 Submit WHMIS MSDS in accordance with Section 01 47 15 - Sustainable Requirements: Construction and Section 02 81 01 - Hazardous Materials. Indicate VOC's for adhesive and solvents during application and curing.

.4 Shop Drawings:

- .1 Submit shop drawings to indicate materials, finishes, method of anchorage, number of anchors, dimensions, construction and assembly details and accessories for following: soap dispensing system.

.5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.6 Instructions: submit manufacturer's installation instructions.

.7 Manufacturers' Field Reports: manufacturers' field reports specified.

.8 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals, include:

- .1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.
- .2 Details of operation, servicing and maintenance.
- .3 Recommended spare parts list.

1.4 QUALITY ASSURANCE

.1 Pre-Installation Meetings:

- .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations in accordance with Section 01 32 00 – Project Management and Coordination
  - .1 Verify project requirements.
  - .2 Review installation and substrate conditions.
  - .3 Co-ordination with other building subtrades.
  - .4 Review manufacturer's installation instructions and warranty requirements.

.2 Construction requirements: in accordance with Division 1 General Requirements.

.3 Verification: contractor's verification in accordance with Division 1 General Requirements.

Part 2 Products

2.1 MATERIALS

.1 Materials and resources in accordance with Sustainable Requirements stipulated in Division 1 General Requirements.

2.2 FLOOR DRAINS

.1 Floor Drains and Trench Drains: to CSA B79.

.2 Refer to Plumbing Fixture Schedule shown on Drawings.

2.3 CLEANOUTS

.1 Cleanout Plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.

.2 Access Covers:

.1 Wall Access: face or wall type, stainless steel round cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.

.2 Floor Access: round cast iron body and frame with adjustable secured nickel bronze top and:

.1 Plugs: bolted bronze with neoprene gasket.

.2 Cover for Unfinished Concrete Floors: cast iron round, gasket, vandal-proof screws.

.3 Cover for Terrazzo Finish: polished nickel bronze with recessed cover for filling with terrazzo, vandal-proof locking screws.

.4 Cover for Tile and Linoleum Floors: polished nickel bronze with recessed cover for linoleum or tile infill, complete with vandal-proof locking screws.

.5 Cover for Carpeted Floors: polished nickel bronze with deep flange cover for carpet infill, complete with carpet retainer vandal-proof locking screws.

2.4 WATER HAMMER ARRESTORS

.1 Stainless steel or Copper construction, bellows or piston type: to PDI-WH201.

2.5 BACK FLOW PREVENTERS

.1 Double check valve assembly (DCVA), factory assembled station to CSA B64.5.

Acceptable Products:

1. Watts Series 709; Ames 3000 Series; Beeco #FDC, #2, CXm F-72; Cla-Val D, D2; Conbraco 400-100; Hersey #1; Neptune 550, DHC; Febco 805; Wilkins 950, MBD-10.

.2 Reduced pressure principle backflow prevention device (RP), with inlet and outlet shut-off valves, double check valve assembly, differential relief outlet and repair/maintenance kit to CSA B64.10.
Acceptable Products:
1. Watts Series 909; Ames 4000 Series; Beeco #FRP-11, #6CM; Cla-Val RP; Conbraco 40-200; Febco 835B, 825; Neptune 575; Wilkins 575, MBC-8, MBC-10.

2.6 VACUUM BREAKERS

.1 Breakers: to CSA-B64 Series, vacuum breaker atmospheric.

2.7 BACKWATER VALVES

.1 Coated extra heavy cast iron or galvanized body with bronze seat, revolving bronze flapper and threaded cover.

.2 Access:

.1 Surface access.

.2 Access pipe with cover: maximum 300 mm depth.

.3 Steel housing with gasketted steel cover.

.4 Concrete access pit with cover, as indicated.

2.8 WATER MAKE-UP ASSEMBLY

.1 Complete with reduced pressure backflow preventer, pressure gauge on inlet and outlet, pressure reducing valve to CSA B356, pressure relief valve on low pressure side and gate valves on inlet and outlet.

2.9 TRAP SEAL PRIMERS

.1 Brass, with integral vacuum breaker, NPS1/2 solder ends, NPS1/2 drip line connection.

2.10 STRAINERS

.1 860 kPa, Y type with 20 mesh, monel, bronze or stainless steel removable screen.

.2 NPS2 and under, bronze body, screwed ends, with brass cap.

.3 NPS2 1/2 and over:

.1 Cast ductile iron body to ASTM A536, Grade 65-45-12, grooved ends. Basis of Design: Victaulic Series 732 / W732

.2 Cast steel body to ASTM A278M, Class 30, flanged connections cast iron body, flanged ends, with bolted cap.

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 INSTALLATION

.1 Install in accordance with British Columbia Plumbing Code, and local authority having jurisdiction.

.2 Install in accordance with manufacturer's instructions and as specified.

3.3 CLEANOUTS

.1 Install cleanouts at base of soil and waste stacks, and rainwater leaders, at locations required code, and as indicated.

.2 Bring cleanouts to wall or finished floor unless serviceable from below floor.

.3 Building drain cleanout and stack base cleanouts: line size to maximum NPS4.

3.4 WATER HAMMER ARRESTORS

.1 Install on branch supplies to fixtures or group of fixtures.

3.5 BACK FLOW PREVENTORS

.1 Install in accordance with CSA-B64 Series, where indicated and elsewhere as required by code.

.2 Pipe discharge to terminate over nearest drain or service sink.

3.6 BACKWATER VALVES

.1 Install in main sewer lines; where indicated and at weeping tile connection in pit provided at building cleanout.

.2 Install in access pit as indicated.

3.7 TRAP SEAL PRIMERS

.1 Install for floor drains and elsewhere, as indicated.

.2 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space, to approval of Consultant.

.3 Install PEX tubing to floor drain.

3.8 STRAINERS

.1 Install with sufficient room to remove basket.

3.9 WATER MAKE-UP ASSEMBLY

.1 Install on valved bypass.

.2 Pipe discharge from relief valve to nearest floor drain.

3.10 START-UP

.1 General:

.1 Requirements: General Requirements, supplemented as specified herein.

.2 Timing: start-up only after:

.1 Pressure tests have been completed.
.2 Disinfection procedures have been completed.
.3 Certificate of static completion has been issued.
.4 Water treatment systems operational.

.3 Provide continuous supervision during start-up.

3.11 FIELD QUALITY CONTROL

.1 Verification requirements in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification, include:

.1 Materials and resources.
.2 Storage and collection of recyclables.
.3 Construction waste management.
.4 Resource reuse.
.5 Recycled content.
.6 Local/regional materials.
.7 Wood.
.8 Low-emitting materials.

3.12 TESTING AND ADJUSTING

.1 General:

.1 In accordance with Section 01 91 13- General Commissioning (Cx) Requirements: General Requirements, supplemented as specified.

.2 Timing:

.1 After start-up deficiencies rectified.
.2 After certificate of completion has been issued by authority having jurisdiction.

.3 Application tolerances:

.1 Pressure at fixtures: +/- 70 kPa.

.2 Flow rate at fixtures: +/- 20%.

.4 Adjustments:

.1 Verify that flow rate and pressure meet design criteria.

.2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.

.5 Floor drains:

.1 Verify operation of trap seal primer.

.2 Prime, using trap primer. Adjust flow rate to suit site conditions.

.3 Check operations of flushing features.

.4 Check security, accessibility, removeability of strainer.

.5 Clean out baskets.

.6 Vacuum breakers, backflow preventers, backwater valves:

.1 Test tightness, accessibility for O&M of cover and of valve.

.2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.

.3 Verify visibility of discharge from open ports.

.7 Access doors:

.1 Verify size and location relative to items to be accessed.

.8 Cleanouts:

.1 Verify covers are gas-tight, secure, yet readily removable.

.9 Water hammer arrestors:

.1 Verify proper installation of correct type of water hammer arrester.

.10 Pressure regulators, PRV assemblies:

.1 Adjust settings to suit locations, flow rates, pressure conditions.

.11 Strainers:

.1 Clean out repeatedly until clear.

.2 Verify accessibility of cleanout plug and basket.

.3 Verify that cleanout plug does not leak.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Refer to Division 01 – General Requirements.

.2 Refer to Division 20 – Mechanical – General.

1.2 SUBMITTALS

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

.2 Shop drawings to show:

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

.3 Shop drawings and product data accompanied by:

- .1 Detailed drawings of bases, supports, and anchor bolts.
- .2 Acoustical sound power data, where applicable.
- .3 Points of operation on performance curves.
- .4 Certification of compliance to applicable codes.

.4 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

.5 Closeout Submittals:

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Operation and maintenance manual approved by, and final copies deposited with Consultant 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 Valves schedule and flow diagram.
  - .6 Colour coding chart.
- .4 Maintenance data to include:
  - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
- .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 20 00 50 - Testing, Adjusting and Balancing.

.6 Approvals:

.1 Submit copies of draft Operation and Maintenance Manual to Consultant for approval.

.2 Make changes as required and re-submit as directed by Consultant.

.7 Site records:

.1 Consultant will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur.

.2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.

.3 Use different colour waterproof ink for each service.

.4 Make available for reference purposes and inspection.

.8 As-built 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 Consultant for approval and make corrections as directed.

.4 Perform testing, adjusting and balancing for HVAC using as-built drawings.

.5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

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

1.3 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.

Part 2 Products

2.1 MATERIALS

.1 Materials and products in accordance with Section 01 47 15 - Sustainable Requirements: Construction.

.2 Do verification requirements in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification.

Part 3 Execution

3.1 PAINTING REPAIRS AND RESTORATION

.1 Do painting in accordance with Section 09 91 23 - Interior Painting.

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

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

3.2 CLEANING

.1 Contractor shall cap duct during construction and maintain duct cleanliness. Any duct cleaning required will be done by the contractor at no additional cost.

3.3 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS.

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.4 DEMONSTRATION

.1 Consultant will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

.2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

.3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.

.4 Instruction duration time requirements as specified in appropriate sections.

3.5 PROTECTION

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

END OF SECTION

Part 1 GENERAL

.1 In the interest of providing an acceptable indoor environment for the occupants of a new building, it is required that the air systems be used to "flush out" chemical fumes that may be present from building products, furniture, carpets and equipment.

.2 Refer to Section 23 08 03 EQUIPMENT AND DUCT CLEANING; the cleaning work is to be completed prior to flush out procedures.

Part 2 EXECUTION

2.1 The Contractor is required to keep the ductwork systems including plenums and equipment debris free and take all necessary measure to minimize dust contamination into systems. All openings and grilles shall be covered until the space is cleaned of dust and debris and walls ready for painting; protection shall meet SMACNA Guidelines Duct Cleanliness for New Construction:

.1 Intermediate Level for the Building including Level 2 Laboratories.
.2 Advanced Level for Systems for Clean Rooms.

2.2 After all HVAC systems have been cleaned and balanced, the Control Contractor shall adjust the controls and dampers on all systems for a period of two (2) calendar weeks to achieve the following conditions:

.1 Fans to run continuously complete with temporary filters in place.
.2 Systems to run on 100% outside air or to the highest percentage that can be tolerated by the system capacity and the freeze protection.
.3 Room temperature to be maintained at:

.1 Heating to 20°C
.2 Cooling to 25°C
.3 Night setback to 15°C
.4 Variations from these standards must be approved by the Consultant.

2.3 At the end of the two (2) week period, the Controls Contractor shall readjust the controls to return the air systems to the design conditions established by the Consultant.

Part 3 REPORT

3.1 The Controls Contractor shall provide a letter to the Consultant for inclusion in the Operating and Maintenance Manuals stating the dates of the "flushing" period and the approximate percentage of outside air used.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Division 01 – General Requirements

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

Part 2 Execution

2.1 APPLICATION

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

2.2 CONNECTIONS TO EQUIPMENT

.1 In accordance with manufacturer's instructions unless otherwise indicated.

.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

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

2.3 CLEARANCES

.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, components.

2.4 DRAINS

.1 Install piping with grade in direction of flow except as indicated.

.2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.

.3 Pipe each drain valve discharge separately to above floor drain. Discharge to be visible.

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

2.5 AIR VENTS

.1 Install manual air vents at high points in piping systems.

.2 Install isolating valve at each automatic air valve.

.3 Install drain piping to approved location and terminate where discharge is visible.

2.6 DIELECTRIC COUPLINGS

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

.2 Locations: where dissimilar metals are joined.

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

.4 Over NPS 2: isolating flanges.

2.7 PIPEWORK INSTALLATION

.1 Screwed fittings jointed with Teflon tape.

.2 Protect openings against entry of foreign material.

.3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.4 Assemble piping using fittings manufactured to ANSI standards.

.5 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.

.1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.

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

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

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

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

.10 Group piping wherever possible and as indicated.

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

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

.13 Provide for thermal expansion as indicated.

.14 Valves:

.1 Install in accessible locations.

.2 Remove interior parts before soldering.

.3 Install with stems above horizontal position unless otherwise indicated.

.4 Valves accessible for maintenance without removing adjacent piping.

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

.6 Install butterfly valves on chilled water and related condenser water systems only.

.7 Install butterfly valves between weld neck flanges to ensure full compression of liner.

.8 Install plug cocks or ball valves for glycol service.

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

.15 Check Valves:

.1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and elsewhere as indicated.

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

2.8 SLEEVES

.1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.

.2 Material: schedule 40 black steel pipe.

.3 Construction: foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.

.4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.

.5 Installation:

.1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.

.2 Other floors: terminate 25 mm above finished floor.

.3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.

.6 Sealing:

.1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.

.2 Elsewhere: Provide space for firestopping. Maintain fire rating integrity.

.3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.

.4 Ensure no contact between copper pipe or tube and sleeve.

2.9 ESCUTCHEONS

.1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.

.2 Construction: one piece type with set screws. Chrome or nickel plated brass or type 302 stainless steel.

.3 Sizes: outside diameter to cover opening or sleeve. Inside diameter to fit around pipe or outside of insulation if so provided.

2.10 PREPARATION FOR FIRE STOPPING

.1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to Section 07 84 00 - Fire Stopping and Section 20 01 84 – Fire Stopping and Smoke Seals.

.2 Uninsulated unheated pipes not subject to movement: No special preparation.

.3 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe movement without damaging fires topping material or installation.

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

2.11 FLUSHING OUT OF PIPING SYSTEMS

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

.2 Before start-up, clean interior of piping systems in accordance with requirements of Section 23 08 02 – Cleaning and Start-up of Mechanical Piping Systems.

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

2.12 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

.1 Advise Consultant 48 hours minimum prior to performance of pressure tests. Refer to Section 20 03 01 – Testing and Activation.

.2 Pipework: test as specified in relevant sections of heating, ventilating and air conditioning work.

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

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

.5 Conduct tests in presence of Consultant.

.6 Pay costs for repairs or replacement, retesting, and making good. Consultant to determine whether repair or replacement is appropriate.

.7 Insulate or conceal work only after approval and certification of tests by Consultant.

2.13 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Electrical motors, drives and guards for mechanical equipment and systems.

.2 Supplier and installer responsibility indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.

.3 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 22 and 23. Refer to Division 26 for quality of materials and workmanship.

.4 Sustainable requirements for construction and verification.

.2 Related Sections:

.1 Section 01 30 00 - Administrative Requirements.

.2 Section 01 40 00 - Quality Requirements.

.3 Section 01 60 00 - Product Requirements.

.4 Section 01 70 00 - Execution and Closeout Requirement.

.5 Section 01 74 19 - Waste Management and Disposal.

.6 Section 21 05 01- Common Work Results – Mechanical.

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

.1 ASHRAE 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).

.2 Electrical Equipment Manufacturers' Association Council (EEMAC)

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.2 Shop Drawings: submit drawings stamped.

.3 Quality Control: in accordance with Section 01 45 00 - Quality Control.

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

.2 Instructions: submit manufacturer's installation instructions.

.1 Consultant will make available 1 copy of systems supplier's installation instructions.

.4 Closeout Submittals

.1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

.1 Regulatory Requirements: work to be performed in compliance with applicable Provincial /Territorial regulations.

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Section 01 47 15 - Sustainable Requirements: Construction.

2.2 GENERAL

.1 Motors: high efficiency, in accordance with local Hydro company standards and to ASHRAE 90.1.

2.3 MOTORS

.1 Provide motors for mechanical equipment as specified.

.2 Motors under 373 W (1/2 HP) : speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.

.3 Motors 373 W (1/2 HP) and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees C, 3 phase, 600V, unless otherwise indicated.

2.4 TEMPORARY MOTORS

.1 If delivery of specified motor will delay completion or commissioning work, install motor approved by Consultant for temporary use. Work will only be accepted when specified motor is installed.

2.5 BELT DRIVES

.1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.

.2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.

.3 For motors under 7.5 kW (10 HP): standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.

.4 For motors 7.5 kW (10 HP) and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.

.5 Correct size of sheave determined during commissioning.

.6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.

.7 Motor slide rail adjustment plates to allow for centre line adjustment.

.8 Supply one set of spare belts for each set installed in accordance with Section 01 78 00 - Closeout Submittals.

2.6 DRIVE GUARDS

.1 Provide guards for unprotected drives.

.2 Guards for belt drives;

- .1 Expanded metal screen welded to steel frame.
- .2 Minimum 1.2 mm thick sheet metal tops and bottoms.
- .3 38 mm dia holes on both shaft centres for insertion of tachometer.
- .4 Removable for servicing.

.3 Provide means to permit lubrication and use of test instruments with guards in place.

.4 Install belt guards to allow movement of motors for adjusting belt tension.-

.5 Guard for flexible coupling:

- .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
- .2 Securely fasten in place.
- .3 Removable for servicing.

.6 Unprotected fan inlets or outlets:

- .1 Wire or expanded metal screen, galvanized, 19 mm mesh.
- .2 Net free area of guard: not less than 80% of fan openings.
- .3 Securely fasten in place.
- .4 Removable for servicing.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Fasten securely in place.

.2 Make removable for servicing, easily returned into, and positively in position.

3.3 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS.

.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 Verification requirements in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification, include:

- .1 Materials and resources.
- .2 Storage and collection of recyclables.
- .3 Construction waste management.
- .4 Resource reuse.
- .5 Recycled content.
- .6 Local/regional materials.
- .7 Certified wood.
- .8 Low-emitting materials.

3.4 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.

.2 The TAB Contractor (Testing, Adjusting and Balancing Agency) shall fully coordinate its work with the Construction Agent/Contractor, Controls Contractor Commissioning Agent and Mechanical Contractor, and shall provide the necessary correspondence to them related to the testing, adjusting and balancing work, with copies provided to the Consultant.

.3 The TAB Contractor shall schedule regular visit(s) to the site during construction to become fully acquainted with the installations and personnel involved with the project; site visits should correspond with site trade meetings. Provide written comments to the Mechanical Contractor with a copy to the Consultant of any items that require attention on related to the TAB contract.

.4 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.

.5 Refer to Section 23 08 00 Mechanical Systems Commissioning for additional requirement.

1.2 SCOPE

.1 The extent of systems and equipment requiring testing, adjusting and balancing work required by this Section are generally indicated on the drawings and on schedules.

.2 Testing, adjusting and balancing specified in this Section shall include, but not be limited to, the following systems:

- .1 Air handling systems including, supply, return and exhaust.
- .2 Hydronic system including heating, glycol, chilled water and geothermal water systems.
- .3 Air distribution ductwork including supply, return and exhaust including are outlets.
- .4 Exhaust systems.
- .5 Fan-coil and VAV terminal units.
- .6 Smoke evacuation systems as applicable.
- .7 Operation of Variable Frequency Drives (VFDs) shall be coordinated with the Controls Contractor.
- .8 Coordinate with Controls Contractor the setting of automatically controlled dampers, thermostats, valves and other devices.
- .9 Domestic hot water circulation.
- .10 Process and laboratory water systems.
- .11 General and laboratory hood exhaust systems.

.12 Demonstrations and Instruction to Owner's personnel regarding the balancing of systems.

1.3 QUALITY ASSURANCE

.1 Qualifications: A specialist with at least 5 years of experience in those testing, adjusting and balancing requirements similar to those required for this project, who is not the installer of the system to be tested and is otherwise independent of the project.

.2 Codes and Standards: Provide testing, adjusting and balancing conforming CSA, ASME and to American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), SMACNA and AABC and the following:

.1 American National Standards Institute (ANSI): Comply with the following:

.1 S1.4 Specifications for Sound Level Meters

.2 S1.11 Specification For Octave-Band and Fractional-Octave-Band Analogue and Digital Filters

.2 American Society of Heating, Refrigerating, and Air Conditioning Engineers (AHSRAE) - HVAC Applications and ANSI / ASHRAE III, latest addition: Comply with ASHRAE recommendations pertaining to measurements, instruments, and testing, adjusting, and balancing.

.3 SMACNA or AABC: Comply with the current editions of SMACNA'S "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or with AABC MN-1 "National Standards," as applicable to mechanical air and hydronic distribution systems, and associated equipment and apparatus.

.3 In addition hold back sums retained or withheld pursuant to the provisions of this Contract, a separate amount will be withheld from payments to the TAB Contractor until such time as the balancing work and deficiencies have been completed and the final report is accepted.

.4 Calibration of testing Instruments: All measurement instruments used for testing, adjusting, balancing, and commissioning shall be calibrated. The time between the most recent calibration data and the final test report date shall not be over one year.

.5 The TAB Contractor shall identify items related to the balancing work that are installed incorrectly, require correction, or have not been installed in accordance with contract drawings and specifications, pertaining to HVAC systems that would affect the balancing work. The TAB Contractor is required to provide written reports of all deficiencies and proposed recommendations to the Construction Manager, LEED Commissioning Agent, Mechanical Contractor, and the Consultant.

.6 The General Contractor shall cooperate with the testing and balancing agency in the following manner:

.1 Provide sufficient time before final completion dates so that tests and balancing can be accomplished.

.2 The various system installers, suppliers and contractors shall provide all required materials, labour and tools to make corrections or revisions when required without undue delay. Install balancing dampers as required by testing and balancing agency.

.3 The Mechanical Contractor shall put all heating, ventilating and air conditioning systems and equipment into full operation and shall continue the operation of the same during each working day of testing and balancing.

.4 The TAB Contractor shall be kept informed of any major changes made to the system during construction, and shall be provided, for review, with a complete set of "Issued for Construction" drawings, including site instructions and mechanical change orders issued during construction.

.5 The General Contractor shall make space and facilities available to the Testing and Balancing Agency to enable their work to progress. The schedule of work of other trades shall be coordinated to avoid conflicts with the balancing work.

.6 The Mechanical Contractor shall adjust fan drives, change blade pitch angles, change sheaves and belts as directed by the Balancing Agency at no cost to the Owner.

.7 The Control Contractor shall make adjustments, in co-operation with the Balancing Agency, to control systems to facilitate the testing, adjusting and balancing process and setting of dampers linkages and valves operators and review damper and valve operation through full range of operation.

.8 The Mechanical Contractor shall employ a journeyman millwright to check the alignment of any V-belt drives and/or shaft couplings after they have been adjusted during the balancing process. Belt tension to be checked for proper adjustment.

.9 The Mechanical Contractor shall provide all instrument test ports and pipe wells required for balancing purposes.

1.4 SUBMITTALS

.1 Conform to the Submittals requirements of Division 1.

.2 Forms: Prior to start of work the TAB Contractor shall deliver to the Consultant a complete sample copy of standard forms (based on ASHRAE, SMACNA or AABC format) for testing and balancing work associated with the project. These forms shall serve as specific guidelines for producing final test report. Hybrid or non-standards forms are acceptable when approved by the Consultant. Data shall include, but not be limited to, a title page with building information, instrument lists, air flows, water flows, temperatures, sound levels, capacities, nameplate data and other information requested in this Section.

.3 Test Instruments: Prior to start of work, submit to the Consultant a list of all test instruments which will be used for the testing and balancing of all systems; include manufacturer's name and model No. for each instrument.

.4 Test Reports: Provide six (6) certified test reports, signed by the certified balancing technician who performed the work and by the balancing supervisor. The final reports shall be sealed and signed and include identification and types of instruments used, and their most recent calibration date. Provide two electronic diskettes, one to the Owner and one to the Consultant.

.5 Maintenance Data: Include, in maintenance manuals, copies of TAB certified test reports and identification of instruments.

.6 Qualifications: The Testing and Balancing Contractor shall submit the certified individual qualifications of all persons responsible for supervising and performing the actual work and the name of the certifying engineer or technologist with at least five years' experience in TAB work.

1.5 AGENDA

.1 The TAB Contractor's preliminary site review report(s) and agenda shall be submitted and approved prior to the start of testing and balancing work.

.1 A review of drawings, specifications and the documented changes during the construction. The TAB Contractor to carry out site visits to review the installation, and submit reports indicating any deficiencies in the systems that would preclude the proper adjusting, balancing, and testing of the systems.

.2 The agenda shall include a general description of each air, glycol and water system with its associated equipment and operation cycles for heating and cooling.

.3 The agenda shall include a list of all air and water flow measurements to be performed at all mechanical equipment.

.4 The agenda shall incorporate the proposed selection points for sound measurements, including typical spaces as well as sound sensitive areas selected by the Consultant.

.5 The agenda shall also include specific test procedures and parameters for determining specified quantities (e.g. flow, drafts and sound levels) from the actual field measurements to establish compliance with contract requirements. Samples of forms showing application of procedures and calculations to typical systems shall be submitted.

.6 Specific test procedures for measuring air quantities at terminals shall specify type of instrument to be used, method of instrument application and factors for:

.1 Air terminal configuration.

.2 Flow direction (supply or exhaust).

.3 Velocity corrections.

.4 Effective areas applicable to each size and type of air terminal.

.5 Density and altitude corrections.

.7 The agenda shall include identification and types of measurement instruments to be used, and their most recent calibration date.

.8 Provide mobile radios and smoke devices required for testing, balancing and commissioning of systems.

1.6 JOB CONDITIONS

.1 General: Do not proceed with testing, adjusting and balancing work until the following conditions have been met:

.1 Work has been completed and is operable. Ensure that there is no latent residual work yet to be completed on the tested equipment.

.2 Work scheduled for testing, adjusting and balancing is to be clean and free from debris, dirt and discarded building materials. [Equipment and ductwork has been cleaned as per Section 23 08 03 – EQUIPMENT AND DUCT CLEANING.]

.3 All architectural openings (doors, windows, and other openings), which may affect the operation of the system to be tested, adjusted, and balanced, are at their normal status.

.4 The Mechanical Contractor has completed the Start-up and Activation procedures form (one for each HVAC System) refer to Section 20 03 01 – TESTING AND ACTIVATION; completed forms to be reviewed by the TAB Contractor.

.5 All related mechanical systems which may affect the operation of the system to be tested, adjusted, and balanced shall be at their normal operating conditions.

.6 Distribution System check for proper damper and valve clearances, free movement, seating, pinning to dampers and valves, spindle position of valves and damper blades in multi-leaf dampers. Alignment of control linkages, rigidity, lubrication and free movement.

PART 2 Products

2.1 TEST HOLES

.1 Instrument test ports shall be provided in ducts, housings and pipes as necessary for the proper air and water measurements and to balance systems. At each location where ducts or plenums are insulated, test ports shall be provided with an approved extension with plug fitting.

.2 Coordinate instrument test port locations with the Sheet Metal Contractor; refer to Section 23 33 00 – AIR DISTRIBUTION DUCTWORK AND ACCESSORIES.

2.2 PATCHING MATERIALS

.1 Material: Seal, patch and repair ductwork, piping and equipment drilled or cut for testing purposes.

.1 Plastic plugs with retainers may be used to patch drilled holes in ductwork and housings.

.2 Piping shall be capped with materials the same as the piping system.

.3 Insulation shall be neatly hemmed with metal or plastic edging, leaving test points visible for future testing.

2.3 TEST INSTRUMENTS

.1 Utilize instruments and equipment of type, precision, and capacity as recommended in the ASHRAE and/or SMNACA Standards and/or AABC manual.

.2 All instruments used for measurements shall be accurate and calibration histories for each instrument shall be available for examination. Each test instrument shall be calibrated by an approved laboratory or by the manufacturer. A representative has the right to request instrument recalibration, or the use of other instruments and test methodology, where accuracy of readings is questionable.

.3 Permanently installed measuring instruments, such as temperature and pressure gauges, shall be checked against the calibrated standard instruments. Any device which does not

meet specification requirements shall be replaced or recalibrated; coordinate with the Mechanical Contractor.

.4 The TAB Contractor may employ manufactured enclosure type cones, capable of air volume direct readings, for all diffuser/grille/register air flow measurements. The readout meters shall meet calibration requirements.

Part 3 EXECUTION

3.1 PROCEDURES AND INSTRUMENTS, GENERAL

.1 All systems and components thereof shall be adjusted to perform as required by drawings and specifications. Consult with the Consultant regarding temperature drop/rise in the heating and/or cooling systems and for the general intent of the design prior to start of balancing.

.2 Operating tests of heating and cooling coils, fans, and other equipment shall be of not less than four hours duration after stabilized operating conditions have been established. Capacities shall be based on temperatures and air and water quantities measured during such tests.

.3 Method of application of instrumentation shall be in accordance with the approved agenda.

.1 All instruments shall be applied in accordance with the manufacturer's certified instructions.

.2 All labour, instruments, and appliances required shall be furnished by the TAB Contractor.

.3 Permanently installed instruments used for the tests (e.g., flow meters and Btu meters) shall not be installed until the entire system has been cleaned and ready for operation. **Complete air balancing before commencing water balance where heating/cooling coils are installed in the air system.**

.4 Permanently marked final settings on valves, dampers and other adjustment devices. Set and lock all memory stop balancing devices.

.5 Seal all holes used for flow and pressure measurements.

.6 Check and co-ordinate field set controllers with the Control Contractor. Verify that room thermostats/sensors are controlling properly.

3.2 AIR SYSTEM PROCEDURES

.1 Adjust all air handling systems to provide approximate design air quantity to or through, each component, and to maintain stable and comfortable interior temperatures, free of drafts or stagnant conditions. Adjusting and balancing of all systems should be conducted during periods of the year approximating maximum seasonal operation.

.2 Equalizing extractor devices shall be adjusted to provide uniform velocity across the inlets (duct side for supply) of terminals prior to measuring flow rates**. Ensure flexible**

ductwork connected to diffusers is correctly supported for proper and even flow to the diffusers. Confirm that VAV terminal units have a straight portion of ductwork to the unit, as specified and recommended by the manufacturer; report any deviations to the Consultant.

.3 Flow adjusting (volume control) devices shall be used to balance air quantities (i.e. proportion flow between various terminals comprising system) to the extent that their adjustments do not create objectionable air motion or sound (i.e. in excess of specified limits).

.1 Balancing between runs (sub mains, branch mains, and branches) generally shall be accomplished by flow regulating devices.

.2 Restrictions imposed by flow regulating devices in or at terminals shall be minimal.

.3 Final measurements of air quality shall be made after the air terminal has been adjusted to provide the optimum air patterns of diffusion.

.4 Total air system quantities, generally, shall be varied by adjustment of fan speeds. Damper restriction of a system's total flow may be used only for systems with direct-connected fans (without adjustable pitch blades), provided that system pressure is less than 1/2-inch W. G. and proper room sound level criteria are met.

.5 Where air quantity measuring devices are specified in other sections such systems shall be used as a cross-check of portable measuring equipment.

.1 Except as specifically indicated herein, Pitot tube traverses of entire cross-sectional area of duct shall be made of main ducts (with capacity of 5000 cfm (2360 l/s) or greater to measure air flow therein. Pitot tubes, associated instruments, traverses, and techniques shall conform to the ASHRAE "Handbook Fundamentals".

.2 For ducts less than 5000 cfm (2360 l/s), the air flow in the duct can be determined by totalling air volume of individual terminals served.

.3 Where branch duct design air quantity is less than l000 cfm (470 l/s), air quantity may be determined by measurements of air outlets.

.6 Instrument test holes shall be in a straight duct, as far as possible downstream from elbows, bends, take-offs, and other turbulence generating devices, to optimize reliability of flow measurements.

.1 For rectangular ductwork at 6 inch (150 mm) spacing for ducts up to 36 inch (900 mm) and 12 inch (300mm) for larger ducts.

.2 For round ducts at two locations at mid points and 90° apart.

.7 Generally, measurement of flow rates by means of velocity meters applied to individual terminals, with or without cones or other adapters, shall be used only for balancing. Measurement of air quantities at each type of air terminal (inlet and outlet) shall be determined by the method approved for the balancing agenda. Such tests, including hoods and special equipment, shall be conducted in conformance with applicable ASHRAE or SMACNA standards and shall be made at no cost.

.8 Air motion and distribution shall be as specified and indicated on drawings and required for occupant comfort. The TAB Contractor at no additional cost shall, in addition to air

motion measurements; carry out sample smoke tests when requested by the Consultant to demonstrate the air distribution from air terminals.

.9 Perform the following tests, and balance each system in accordance with the following requirements:

.1 Test and adjust fan RPM to design requirements.

.2 Test and record motor full load amperes; record motor data.

.3 Make Pitot tube traverse of main supply ducts and obtain design flow at fans.

.4 Test and record system pressures, suction and discharge.

.5 Test and adjust system for design recirculated airflow.

.6 Test and adjust system for design flow of outside air.

.7 Test and record entering air temperatures at all coils.

.8 Test and record leaving air temperatures at all coils.

.9 Adjust all supply, return and exhaust air ducts to proper design flow.

.10 Adjust all zones to proper design flow, supply and return.

.11 Test and adjust duct systems and diffuser, grille, and/or register to within 10% of design requirements and 5% at equipment and terminal units.

.12 Special areas, identified by the Consultant, shall be balanced to achieve proper airflow/pressure requirements.

.13 Each grille, diffuser and register shall be identified as to location and area.

.14 Size, type and manufacturer of VAV boxes and fan-coil units, diffusers, grilles, registers and all tested equipment shall be identified and listed. Manufacturer's ratings on all equipment shall be used to make required calculations.

.15 Readings and tests of diffusers, grilles and registers shall include required airflow and test resultant airflow after adjustment.

.16 The TAB Contractor, in cooperation with the Control Contractor’s representative, to confirm setting adjustments of automatically operated dampers to operate as specified, indicated, and/or noted, including the outdoor air damper operation; for mixed air application verify minimum outdoor air damper position. The TAB Contractor shall check all controls requiring adjustment by control devices. Room thermostats / sensors shall be checked for cooling and heating response. The TAB Contractor shall coordinate the testing and adjustment of VFDs, in conjunction with the Controls Contractor.

.17 All diffusers, grilles and registers shall be adjusted to minimize drafts in all areas.

.18 Adjust overall system balances to allow all self-closing exterior doors to close from any open position. Maximum interior air pressure in a 100% outside air intake mode shall not exceed 0.05" (13Pa) static pressure relative to the outside air pressure.

.19 As part of the work of this contract, the TAB Contractor shall assist the Mechanical Contractor to make any changes in the pulleys, belts and dampers or the addition of dampers required for the correct balance of systems at no additional cost to Owner.

.20 After air balancing is completed and RPM determined, the Mechanical Contractor shall provide fixed pitch pulleys on motors over 7.5 HP (5.5 kw).

.21 All mixing boxes, VAV air valves, control dampers, smoke dampers and similar devices which operate at 100% shut off shall be tested for leakage.

.22 Variable Air Volume Fan Systems: The primary balancing mode is 100% outside air with all terminal boxes on a full call for cooling. Also check and record performance at minimum outside air with all terminal boxes on call for full cooling and at minimum outside air with all terminal boxes on call for full heating. Verify that the systems are operating on a stable part of the fan curves in each mode. Record final duct static controller settings.

.23 Fan-coil Systems – Balance and measure ventilation air to each fan-coil unit. Balance supply air from fan-coil units to air outlets and supply of outdoor air to fan coil units.

.24 Provide certification for smoke control pressurization of stairs and vestibules as required by Code, as applicable to the project.

.25 Temporarily pre-load air systems to simulate 50% of clean/dirty filter operation. Cover entire area of filters with blanket materials to achieve this effect.

.26 Differential Air Flows and Pressures

.1 Adjust supply and exhaust air quantities to provide for proper pressure relationships as indicated on the drawings and/or determined by the Consultant as follows:

.1 Building to be in positive pressure related to the outside at the Ground Floor Level [and Atria] area. A range of a minimum of 0.05" (12.5 Pa) to a maximum of 0.10" (25 kPa) to be obtained in both heating and cooling seasons.

.2 Negative pressures to the Laboratory Areas.

.2 Exit doors and elevator shafts shall be checked for air flow, under both heating and cooling conditions, so that exterior conditions do not cause excessive or abnormal pressure conditions.

.3 The Balancing Agency shall review the minimum negative and position pressure relationship required for room pressure control for the project. The method to achieve the directional airflow is to be via the control of the supply and exhaust air flows. The differential pressures are to be determined by adjustments of the control air devices to meet site conditions.

.4 The pressure relationship shall be maintained throughout the full range of air delivery rates. Coordinate the balancing with the Control Contractor in regard to the setting of Volume Control Air Valves, VAV terminal limits and the fume hood exhaust valves.

.27 Building pressure conditions:

.1 Adjust HVAC systems, equipment, controls to ensure specified pressure conditions during design conditions at all times.

.2 TAB procedures:

.1 Adjust supply and exhaust air quantities to provide for proper pressure relationships as indicated on the drawings and/or determined by the Consultant as follows:

.1 Building to be in positive pressure related to the outside at the Ground Floor Level area. A range of a minimum of

0.05" (12.5 Pa) to a maximum of 0.10" (25 kPa) to be obtained in both heating and cooling seasons.

.2 Exit doors and elevator shafts shall be checked for air flow, under both heating and cooling conditions, so that exterior conditions do not cause excessive or abnormal pressure conditions.

.3 The Balancing Agency shall review the minimum negative and position pressure relationship required for room pressure control for the project. The method to achieve the directional airflow is to be via the control of the supply and exhaust air flows. The differential pressures are to be determined by adjustments of the control air devices to meet site conditions.

.28 Zone pressure differences:

.1 Adjust HVAC systems, equipment, controls to establish specified air pressure differentials, with systems in every possible combinations of normal operating modes.

3.3 AIR SYSTEM DATA

.1 The certified report shall include forced air handling and exhaust system: the data listed below:

.1 Equipment:

.1 Installation data

.1 Manufacturers and model

.2 Size

.3 Arrangement, discharge and class

.4 Motor HP, voltage, phase, cycles, and full load amps

.5 Location and local identification data

.6 Bearing and Filters information

.7 Pulley and belt data

.2 Design data

.1 Data listed in schedules on drawings and specifications

.3 Fan recorded (test) data

.1 Airflow

.2 Static pressure

.3 Rpm

.4 Motor operating amps

.5 Motor operating bhp

.4 Filter data

.1 Static pressure drops across each filter bank

.2 Duct Systems:

.1 Duct air quantities for supply, return, exhaust and outdoor air:

.1 Duct size(s)

.2 Number and locations of Pitot tubes (pressure measurements)

.3 Sum of velocity measurements

.4 Recorded (test) airflow

.5 Design airflow

.2 Individual air terminals

.1 Terminal identification supply or exhaust, location and number designation.

.2 Type size, manufacturer and catalogue identification applicable factor for application, velocity, area, etc., and designated area.

.3 Design and recorded velocities (state "core" "inlet" etc., as applicable).

.4 Design and recorded quantities - airflow (deflector vane or diffusion cone settings).

.3 Fire Dampers

.1 Operational drop test to be carried out for each fire damper; provide certified report with listing of each fire damper tested.

.2 Each damper to be checked for closure, accessibility and installation. The test schedule shall be certified by the TAB Contractor.

3.4 CAPACITY VERIFICATION

.1 Air coil capacities shall be verified from air side measurement data. Capacities of coils shall be the difference of the energy carried by the air between the upstream and downstream coils.

.2 The measured air flow rate for the fan may be used for air coil capacity calculations providing no ducted bypassing of coil is occurring.

.3 Water / water heat exchanger equipment capacity shall be verified by measuring the flow rate and temperature differential of the water.

.4 Capacity verification shall be performed after air and water systems have been balanced.

.5 False load shall be applied if the upstream air or water does not meet the specified conditions at the time of test.

.6 After air and water flow are balanced, and with the temperature controls set to produce design cooling, measure and record all data necessary to compile a complete report to demonstrate the acceptability of the various mechanical systems. Include the following data in the Balancing Report:

.1 Outside dry bulb and wet bulb temperature during tests.

.2 Inside dry bulb and wet bulb temperatures in six (6) selected areas of the conditioned space, room or area selected by the Consultant.

.3 Dry bulb temperature of air entering and leaving all coils.

.4 Temperature of water entering and leaving each water coil.

.5 Temperature at all thermometer well locations.

.6 Temperature of water entering and leaving each heat pump water chilling unit condenser and evaporator.

.7 Temperature of water entering and leaving each heat exchanger.

.8 Suction and discharge pressure and shut off head of each circulating water pump and domestic water pump.

.9 Certification: Certification shall include checking of adherence to TAB agenda, of calculations, of procedures, and evaluation of final summaries.

3.5 SOUND TEST PROCEDURES

.1 Sound level measurements shall be taken at times when the building is unoccupied, or when activity in surrounding areas and background noise level in areas tested are at a minimum and relatively free from sudden changes in noise levels.

.1 Measurements shall be taken with all equipment turned off, except that being tested.

.2 The required sound levels shall be measured at any point within a room not less than 6 feet from an air terminal or room unit, and not closer than 3 feet from any floor, wall, or ceiling surface.

.2 Sound levels shall be measured with a sound meter complying with ANSI S1.4. The “A” scale shall be used to measure over all sound levels for each of the eight octave bands.

.3 The certified report shall record data on sound levels, taken at each selected location, as follows:

.1 Certified report shall record all sound data, and their locations, after final adjustments of air and water systems involves:

.2 Source of sound and location.

.3 Diagram or description of relationship of sound source to measuring instrument.

.4 "A" scale readings equipment being tested turned off (ambient) equipment being tested turned on (operating conditions).

.5 Readings at each specified octave band frequency equipment being tested turned off (ambient) equipment being tested turned on (operating conditions).

.6 "Equipment Components" of sound (noise) levels with applicable calculations per "Sound Test Procedures”.

.7 Graph showing relationship between pressure levels specified and recorded readings (use ASHRAE NC charts).

.4 Subsequent to any correctional construction work, such as acoustic corrections, measurement shall be made to verify that specified sound levels (NC) have been achieved).

3.6 CERTIFIED REPORTS

.1 Provide a hard copy of the preliminary Balance Report or an e-mailed copy to the Mechanical Contractor and Consultant a minimum of one week prior to the Occupancy Review.

.2 Provide six (6) copies of the final reports and two (2) electronic diskettes, covering air and water system performance and sound level readings prior to the Substantial Performance

Review for the project. Final reports shall be sealed by a Professional Engineer or Certified Technologist.

.3 Types, serial numbers, and dates of calibration of all instruments shall be included.

.4 Reports shall contain a summary sheet to identify items not conforming to contract requirements, or obvious installation of design deficiencies.

.5 Forms used for Balancing Reports shall conform to industry standards and shall include all pertinent information for full evaluation of systems balancing. Reports are to be completed and are to contain the following:

.1 Name of Balancing Agency and Personnel

.2 Name of Project, Mechanical Contractor and date of balancing.

.3 Identification of systems and floor plan drawing schematics; maximum sheet size of 11"x 17".

.4 Static pressure and volume measurements at each component.

.5 List of outlets and room numbers with (design and actual) volumes.

.6 Temperature readings (mixed air, outdoor supply, water, etc.) under varying conditions.

.7 Nameplate and measured electrical characteristics.

.8 Fan, pump and system pressure drops; and pump and fan curves.

.9 Duct and filter traverses.

.10 Fan and motor speed and starting times.

.11 Pressure differential levels for critical areas such as Smoke Control.

.12 Operational test of all fire/smoke dampers.

.6 Submit a Statutory Declaration to the Owner, with a copy to the Consultant, stating that the testing and balancing has been completed prior to Occupancy and that complete factual reports have been distributed. The Declarations shall include a statement that all work and contractual deficiencies related to the balancing work have been completed by the Mechanical Contractor, and that follow-up testing and balancing has been completed after the corrections of all outstanding work and deficiencies.

3.7 FINAL TESTS, INSPECTIONS AND ACCEPTANCE

.1 Tests shall be made to demonstrate that capacities and performance of air and water systems comply with contract requirements.

.1 Prior to the Substantial Performance, the Consultant shall randomly select up to [20] outlets for the Testing and Balancing Contractor to recheck; random selection of data (water and air quantities, air motion, and sound levels) recorded in the certified report.

.2 Measurement and test procedures shall be the same as approved for work forming basis of certified report.

.2 If random tests elicit a measured flow deviation of 5 percent or more from the values in the preliminary Balancing Report, then a further 10 random checks shall be carried out. If the 30 tests indicate unacceptable results, then the report shall be automatically rejected. In the event the report is rejected, all related equipment and systems shall be readjusted and

tested, new data recorded, new certified reports submitted, and new inspection tests made, all at no additional cost.

.3 The settings of all valves, splitters, dampers and other adjustment devices shall be permanently marked by the Testing and Balancing Contractor so that adjustment can be restored if disturbed at any time.

.4 Schedule with the Owner and Consultant and allow for [two (2)] site visits during the warranty period to make minor seasonal adjustments after occupancy that may be required; each visit to be a minimum of six (6) hours. Submit report of findings to the Owner and Consultant after each site visit.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and methods for pressure testing ducts over 5 m in length, forming part of a supply, return or exhaust ductwork system directly or indirectly connected to air handling equipment.

.2 Sustainable requirements for construction and verification.

.2 Related Sections:

.1 Section 01 30 00 - Administrative Requirements.

.2 Section 01 40 00 - Quality Requirements.

.3 Section 01 60 00 - Product Requirements.

.4 Section 01 70 00 - Execution and Closeout Requirement.

.5 Section 01 74 19 - Waste Management and Disposal.

.6 Section 23 05 00 - Common Work Results – HVAC

1.2 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.2 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 01 33 00 - Submittal Procedures.

.2 Co-ordinate submittal requirements and provide submittals required by Section 01 47 15 - Sustainable Requirements: Construction.

.3 Test Reports: submit certified test reports from independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties. Include pressure test information and results as follows:

.1 Submit proposed report form and test report format to Consultant for approval at least three months before proposed date of first series of tests. Do not start tests until approval received in writing from Consultant.

.2 Prepare report of results and submit to Consultant within 24 hours of completion of tests. Include:

.1 Schematic of entire 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.

.3 Include test reports in final TAB report.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Instructions: submit manufacturer's installation instructions.

.6 Manufacturer's field reports specified.

Part 2 Products

2.1 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.

.6 Smoke bombs for visual inspections.

.2 Test apparatus: accurate to within +/- 3 % of flow rate and pressure.

.3 Submit details of test instruments to be used to Consultant at least three months before anticipated start date.

.4 Test instruments: calibrated and certificate of calibration deposited with Consultant no more than 28 days before start of tests.

.5 Re-calibrated every six months thereafter.

2.2 EQUIPMENT LEAKAGE TOLERANCES

.1 Equipment and system components such as VAV boxes, duct heating leakage: 2 %.

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:

.1 Fittings, branch ducts, tap-ins.

.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 Small duct systems up to 250 Pa: leakage 2%.

.2 VAV box and duct on downstream side of VAV box: leakage 2%.

.3 Large low pressure duct systems up to 500 Pa: leakage 2%.

.4 Duct systems up to 1000 Pa pressure classification, including upstream side of VAV boxes: leakage 1%.

.3 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

3.4 TESTING

.1 Test ducts before installation of insulation or other forms of concealment.

.2 Test after seals have cured.

.3 Test when ambient temperature will not affect effectiveness of seals, and gaskets.

.4 Flexible connections to VAV boxes.

3.5 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services.

.1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its product[s] and submit written reports, in acceptable format, to verify compliance of Work with Contract.

.2 Manufacturer's Field Services: provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, at stages listed:

.1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.

.2 Twice during progress of Work at 25% and 60% complete.

.3 Upon completion of the Work, after cleaning is carried out.

.4 Obtain reports, within 3 days of review, and submit, immediately, to Consultant.

.2 Verification requirements in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification, include:

.1 Materials and resources.

.2 Storage and collection of recyclables.

.3 Construction waste management.

.4 Resource reuse.

.5 Recycled content.

.6 Local/regional materials.

.7 Certified Wood.

.8 Low-emitting materials.

.3 Performance Verification:

.1 Consultant to witness tests and to verify reported results.

.2 To be certified by same TAB agency approved by Consultant 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

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 30 00 - Administrative Requirements.

.2 Section 01 40 00 - Quality Requirements.

.3 Section 01 60 00 - Product Requirements.

.4 Section 01 70 00 - Execution and Closeout Requirement.

.5 Section 01 74 19 - Waste Management and Disposal.

.6 Section 23 05 00 - Common Work Results – HVAC

1.2 REFERENCES

.1 Definitions:

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - means "not concealed" as previouslydefined.

.3 Insulation systems - insulation material, fasteners, jackets, and other accessories.

.2 TIAC Codes:

.1 CRD: Code Round Ductwork,

.2 CRF: Code Rectangular Finish.

.2 Reference Standards:

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE/IESNA 90.1-04, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 ASTM International Inc.

.1 ASTM B209M-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

.2 ASTM C335-05ae1, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.

.3 ASTM C411-05, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C547-07e1, Standard Specification for Mineral Fiber Pipe Insulation.

.6 ASTM C553-02e1, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

.7 ASTM C612-04e1, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

.8 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.9 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.4 Green Seal Environmental Standards (GSES)

.1 Standard GS-36-00, Commercial Adhesives.

.5 South Coast Air Quality Management District (SCAQMD), California State

.1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

.6 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).

.7 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102-03, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

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

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

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

.1 Description of equipment giving manufacturer's name, type, model, year and capacity.

.2 Details of operation, servicing and maintenance.

.3 Recommended spare parts list.

.3 Shop Drawings:

.1 Provide drawings.

.4 Samples:

.1 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed.

.2 Mount sample on 12 mm plywood board.

.3 Affix typewritten label beneath sample indicating service.

.5 Manufacturers' Instructions:

.1 Provide manufacture's written duct insulation jointing recommendations. and special handling criteria, installation sequence, cleaning procedures.

1.4 QUALITY ASSURANCE

.1 Qualifications:

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

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Section 01 47 15 Sustainable Requirements: Construction.

2.2 FIRE AND SMOKE RATING

.1 To CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.3 DUCTWORK EXTERNAL WRAP

.1 Products (Ductwork External Thermal Wrap)

.1 Flexible blanket fibreglass insulation with a minimum K valve of (0.29 BTU/inFt^2°F/h) at 24°C (75°F) and 12 kg/m; (0.75 lbs/cu.ft.) density and with factory applied flame retardant foil-scrim-kraft vapour barrier facing. (Concealed application and round ducts).

.2 Fibrous glass board insulation with a maximum K value of 0.035 w/m°C (0.24 BTU/in Ft^2/°F/h) at 24°C (75°F) and 48 kg/m; (3.0 lbs/cu.ft) density (Exposed application).

2.4 DUCT LINER

.1 General:

.1 Fibrous glass duct liner: air stream side faced with neoprene coating or matt facing. The airstream surface facing shall be treated with an EPA-registered anti-microbial agent to aid in the prevention of fungal and bacterial growth as per ASTM C1338-621 and 622.

.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50 when tested in accordance with CAN/ULC-S102.

.3 Also refer to SECTION 15800 AIR DISTRIBUTION DUCTWORK AND ACCESSORIES.

.2 Rigid:

.1 Use on flat surfaces.

.2 25 mm (1") thick, to CGSB 51-GP-10M, fibrous glass rigid board duct liner. For duct liners on outdoor roof exposed exhaust ductwork and plenums, and for supply and return ductwork liners to Air Handling Units (AHUs), the duct liner to be 50 mm (2") thickness.

.3 Density: 36 kg/m3 minimum for the 25 mm (1") thick liners and 48 kg/m³ for the 50 mm (2") liners.

.4 Thermal resistance to be minimum 0.76 m²°C/W for 38 mm thickness 1.51 m²° C/W for 50 mm thickness when tested in accordance with ASTM C177, at 24°C mean temperature

.3 Flexible:

.1 Use on concealed rectangular and on round or oval surfaces.

.2 25 mm thick, to CGSB-51-GP-11M, fibrous glass blanket duct liner.

.3 Density: 24 kg/m3 minimum.

.4 Thermal resistance to be minimum 0.37 m2.°C/W for 12 mm thickness 0.74 m2.°C/W for 25 mm thickness 1.15 m²°C/W for 38 mm thickness 1.51 m²°C/W to 50 mm thickness when tested in accordance with ASTM C177, at 24°C mean temperature.

2.5 ADHESIVE

.1 Meet requirements of ANSI/NFPA 90A and ANSI/NFPA 90B.

.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 29°C to plus 93°C.

2.6 FASTENERS

.1 Weld pins 2.0 mm diameter, length to suit thickness of insulation. Metal retaining clips, 32 mm square.

2.7 JOINT TAPE

.1 Poly-Vinyl treated open weave fibreglass membrane 50 mm wide.

2.8 SEALER

.1 Meet requirements of ANSI/NFPA 90A and ANSI/NFPA 90B.

.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 68°C to plus 93°C.

2.9 metal PERFORATED DUCT LINERS

.1 Perforated duct liners on air side of supply, exhaust and return fans to be galvanized steel 26 gauge.

2.10 METAL PROTECTION

.1 Provide metal liner weather proof protection for exposed ducts with thermal insulation.

2.11 JACKETS

.1 Canvas:

.1 220 gm/m^2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.2 Lagging adhesive: compatible with insulation.

.1 Maximum VOC limit 50 g/L to SCAQMD Rule 1168 or GSES GS-36.

2.12 ACCESSORIES.

.1 ULC Listed Canvas Jacket:

.1 220 gm/m^2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.2 Contact adhesive: quick-setting

.1 Maximum VOC limit 50 g/L to SCAQMD Rule 1168 or GSES GS-36.

.3 Canvas adhesive: washable.

.1 Maximum VOC limit 50 g/L to SCAQMD Rule 1168 or GSES GS-36.

.4 Tie wire: 1.5 mm stainless steel.

PART 3 EXECUTION

3.1 GENERAL

.1 Do work in accordance with recommendations of SMACNA duct liner standards as indicated in SMACNA HVAC Duct Construction Standards, Metal and Flexible, except as specified otherwise.

.2 Where ducts have interior lining for acoustical or thermal treatment then no additional duct insulation is required on the outside of the duct.

.3 Provide canvas recovering for exposed thermally insulated ductwork including Mechanical Rooms, Storage Rooms and service corridors.

.4 Ductwork and plenums shall have duct liners as specified and where shown crosshatched on the drawings. The liner shall be neatly cut to fit and firmly pressed in place leaving no gap or breaks. Fasteners shall not compress the liner more than 3 mm (1/8”).

.5 Duct sizes shown on the drawings are in side finished clear dimensions with a duct liner in place.

.6 Pressure test ductwork prior to immediately ductwork.

3.2 DUCTWORK EXTERNAL THERMAL WRAP

.1 Execution (Ductwork External Thermal Wrap)

.1 Premium / Custom Alternate

.2 Use scored or Tank Wrap rigid insulation with integral vapour barrier on round ductwork 600 mm diameter and larger. Use flexible insulation with integral vapour barrier on ductwork smaller than 600 mm diameter. At all joints and breaks, apply vapour barrier tape or apply strips of duct insulation facing materials using duct facing adhesive.

.3 Apply treated fabric jacket over insulation using fabric adhesive.

.4 Finish fabric jacket with one (1) coat of fabric coating.

.5 Premium / Custom Alternate

.6 Use rigid insulation with an integral vapour barrier. Adhere vapour barrier tape or adhere strips of duct insulation facing material using duct insulation facing adhesive over all joints and breaks in barrier, and at all corners. Where mechanical fasteners penetrate duct insulation facing material, adhere vapour barrier tape or strips of duct insulation facing material with facing adhesive. Ensure duct hangers and supports are outside of vapor barrier.

.7 Apply treated fabric jacket over insulation using fabric adhesive.

.8 Finish fabric jacket with one (1) coat of fabric coating for exposed ductwork.

.9 Concealed ductwork can be wrapped with flexible duct insulation with foil cover and wire wrapped.

.2 For AHUs, the supply ductwork to be thermally wrapped to the unit. The outside air ductwork to have interior liners.

.3 The steam to steam humidifier heat exchangers to have thermal insulation 50 mm thick.

3.3 DUCT INSULATION LINER

.1 Fasten to interior sheet metal surface with 100% coverage of adhesive.

.2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 425 mm on centres. Where pins penetrate the liner surface, and at all leading edges, corners, joints, edges and breaks point up the liner adhesive, apply a layer of glasfab and finish with a second layer of adhesive.

3.4 JOINTS

.1 Seal all butt joints, exposed edges, weld pin and clip penetrations and all damaged areas of liner with joint tape and sealer. Install joint tape in accordance with manufacturer's recommendations, and as follows:

.1 Bed tape in sealer.

.2 Apply two coats of sealer over tape.

.2 Protect leading and trailing edges of each duct section with sheet metal nosing having 15 mm overlap and fastened to duct.

3.5 PERFORATED METAL DUCT LINERS

.1 Provide perforated metal duct liners on supply, exhaust and return ducts from AHUs where indicated. Extent of acoustical lining and silencers to be reviewed by the Acoustical Consultant.

.2 The Laboratory General Exhaust and Atria smoke exhaust duct to have 1" thick insulated duct liner with perforated metal duct liners at the roof level.

3.6 INSULATION THICKNESS

.1 The ductwork, plenums and branch run-outs shall be thermally insulated in accordance with the following Table:

TABLE – DUCTWORK INSULATION

Location	Ductwork Type	Insulation Type	Thickness	
			Mm	Inches
Exposed Ducts Within Mechanical Rooms for AHUs	Outside Air Supply Air Return Air Exhaust Air	Rigid Duct Liner Thermal None None	38 25	1 ½ 1
Exposed Duct Within Building	Outside Air Supply Air Return Air Exhaust Air	Rigid Duct Liner Thermal None None	50 25	2 1
Concealed Duct Within Building	Outside Air Supply Air Return Air Exhaust Air	Thermal Thermal None None	50 25	2 1
Ducts in Unheated Building Areas	Supply Air Return/Exhaust Air	Thermal Thermal	50 25	2 1
Ducts Outside of Building (i.e. Roof)	All Ducts	Liner	50	2
Exhaust ducts (last 3m to outside)	Exhaust	Thermal or Liner	25	1
VAV Ductwork	Supply Supply	Flexible Duct Liner (See Note 2) Thermal	25 25	1 1
Fan Coil Ductwork	Supply/Return Supply	Flexible Duct Liner (See Note 2) Thermal	25 25	1 1

.1 Acoustical liners as indicated on drawings for fan coils and VAV units to have 25 mm (1 inch) on supply; and return plenums to fan-coil units. The unlined supply ductwork to have thermal insulation.

.2 Laboratory Fume Hood Exhaust ducts at Roof Level to have exterior thermal insulation (25 mm) 1 inch thick with metal protective cover. Laboratory General

and Atria Exhaust ducts to have (25 mm) 1 inch duct liner with perforated metal linear.

3.7 METAL PROTECTION

.1 Provide water and weather proof sheet metal protection on the fume hood roof mounted exhaust ducts over the thermal insulation.

3.8 Supply ductwork from all AHUs shall be thermally wrapped except at silencers locations regular letters and where duct has interior duct liners.

3.9 CLEANING

.1 Clean in accordance with Section 01 74 11 – Cleaning.

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

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

END OF SECTION

Part 1 General

.1 This Section of the Specification forms part of the Contract Documents and shall be read, interpreted and coordinated with all other parts.

.2 Related work to other sections include:

.1 Section 01 91 13 – General Commissioning Requirements.

.2 Section 01 91 31 – Commissioning Plan

.3 Section 01 91 33 – Commissioning Forms

.4 Sections 01 91 41 – Commissioning Training

.5 Section 23 08 01 Performance Verification Mechanical Piping Systems

.6 Section 23 08 02 Cleaning and Start-Up of Mechanical Piping Systems

.7 Section 23 05 93 Testing, Adjusting and Balancing

.8 Coordination of electrical interface items with the equipment and controls, including work specified in Division 26 related to mechanical systems.

.3 The Commissioning Team shall include the Commissioning Authority, Contractor's Commissioning Agent, Mechanical Contractor, Controls Contractor, the Balancing Contractor, Fire Protection Contractor, and other selected trades persons, manufacturers' representatives; the Consultants, and Owner's representatives who will also participate in the commissioning process.

.4 Building Commissioning work is a joint team effort to ensure that all mechanical equipment, controls, and systems function together properly to meet the design intent and to document system performance parameters or fine-tuning of control sequences and operational procedures. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, and performance testing and verification.

.5 The Commissioning Authority will have responsibility for coordinating and directing each step of the commissioning process; and for recommending acceptance or non-acceptance to the Consultant and Owner.

.6 The Commissioning Agent's scope of work for the HVAC, Plumbing and Fire Protection Systems, is but not limited to, the following:

.1 Review of related Contract Documents and submit comments to the Consultant.
.2 Develop and submit a commissioning plan with detailed checklists and schedule.
.3 Schedule and coordinate a construction site meeting soon after construction has started.

.4 Record and distribute commissioning meeting minutes.

.5 Review of shop drawings and site installations.

.6 Confirm that Start-up Activation has been carried to code and industry standards.

.7 Participate in Start-up / Activation process; issue deficiency lists.

.8 Overview of Balancing; and Controls System installation.

.9 Detailed review of Systems Operation prior to the Substantial Review.

.10 Coordinate the Orientation and Demonstration Session(s) for the Owners.

.11 Follow-up visits during the Warranty period and submit reports to the Contractor, Owner and Consultant after each visit.

.12 Submit a final report at the end of the Warranty period.

.7 The Contractor and Commissioning Agent shall submit the names of representatives of the Commissioning Team for the Consultant's review at an early stage of construction. Within ninety (90) days after award of his contract the Commissioning Agent shall submit detailed descriptions of test and verification procedures with a schedule, to the Contractor, Owner and Consultant, for the commissioning work of systems and components. The Commissioning Agent shall be responsible for conducting commissioning meetings and issuing minutes and action lists to the Contractors and Consultants.

.8 The Contractor and his sub-trades shall be responsible for the actual system Functional Performance testing. Documentation of this testing and any changes to the approved test procedures must be approved by the Commissioning Agent.

.9 The Commissioning plan shall contain the information necessary to document the commissioning process as it progresses from the pre-start checks, to start-up and initial operation, and finally to functional performances verifications of all systems. The Commissioning Plan shall include procedures and detailed checklist relevant to:

.1 Initial Meeting: The Contractor and Commissioning Agent to schedule the initial meeting prior to installation of mechanical systems.

.2 System Readiness and Start-up: This includes typical checks for pressure testing, cleaning, lubrication, equipment drive alignment, motor rotation check safety devices and control point check.

.3 Initial Operation: The Contractor and Commissioning Agent complete the testing, balancing and calibration of all components and systems. The systems are operated through the specified modes of operation; tests carried out on life and safety systems including emergency conditions.

.4 Functional Performance Verification: All equipment and systems are operated through the entire specified sequence of operation so that the Consultant may witness and verify acceptable operation on a selected or total basis. There maybe two separate periods required –one during the heating season and one during the cooling season.

.5 Orientations and Demonstration: This is provided to the Owner's representative(s) after all the above phases are completed.

.6 Warranty Period: The follow-up shall consist of regular site visits with a minimum of 3 visits during the Warranty Period with reports submitted to the Owner, Contractor and Consultant.

Part 2 Commissioning Process

.1 A commissioning scoping meeting of all members of the commissioning scoping meeting of all members of the commissioning team shall be held at a time and place designated by the Owner or his representative. The purpose of the meeting will be to familiarize all parties with the requirements of the commissioning process, and to ensure that the responsibilities of each party are clearly understood.

.2 There are two distinct types of tests for which the Contractor is responsible.

.1 The first type is the Pre-functional Performance Test. These tests ensure that all equipment and systems are installed in accordance with the Specifications, Drawings, and manufacturers' requirements.

.2 The second type of test is the Functional Performance Test. These tests ensure that all equipment and systems operate in accordance with design intent. These are dynamic tests, and test the systems through all possible modes of operation.

.3 The functional performance testing shall be done during two separate periods – one during the cooling season and one during the heating season. The cooling testing period shall occur as soon as the weather conditions permit to test the cooling systems. The heating testing period shall occur as soon as weather conditions make it practical to test warm-up, zone reheat, and economizer functions.

2.1 SYSTEM START-UP AND TESTING

.1 Operating equipment and systems shall be tested in presence of Commissioning Agent (and the Consultant at his option) to demonstrate compliance with specified requirements.

.2 Notify Commissioning Agent, in writing, fourteen (14) days prior to tests scheduled under requirements of this Section.

.3 Testing shall be conducted under specified design operating conditions as recommended or approved by Commissioning Agent and Consultant.

.4 All elements of systems shall be tested to demonstrate the total systems satisfy all requirements of these Specifications. Testing shall be accomplished on hierarchical basis. Test each piece of equipment for proper operation, followed by each subsystem, followed by entire system, followed by any interfaces to other major systems.

.5 All special testing materials and equipment shall be provided by Contractor.

2.2 TEST PROCEDURE DEVELOPMENT AND TEST DOCUMENTATION

.1 Within 90 (ninety) days after award of the Contract, the Contractor shall prepare and submit to Commissioning Agent and Consultant for review, a detailed description of test procedures which the Contractor proposes to perform to demonstrate conformance of completed systems to these Specifications.

2.3 PRE-FUNCTIONAL PERFORMANCE TEST

.1 Coordinate schedules for start-up of various equipment and systems. The pre-functional performance tests need be performed once only-prior to the initial seasonal functional performance testing.

.2 Each system shall be checked for proper installation, shall be adjusted, and shall be calibrated to verify that it is ready to function as specified.

.3 All system elements shall be checked to verify that they have been installed properly and that all connections have been made correctly. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence or other conditions which may cause damage.

.4 Verify that tests, meter readings and specific electrical characteristics agree with those required by equipment or system manufacturer.

.5 All discrete elements and sub-systems shall be adjusted and shall be checked for proper operation. Verify wiring and support components for equipment are complete and tested.

.6 Verification of complete and proper installation shall be completed prior to starting Functional Performance Tests.

.7 Pre-functional performance tests shall be documented in a checklist format for each system/piece of equipment. Each checklist shall be dated and initialled by the Contractor.

2.4 FUNCTIONAL PERFORMANCE TEST

.1 The objective of these is to demonstrate that each system is operating and complying with specified performance requirements through all possible modes of operation.

.2 A functional Performance Test shall be performed on each complete system. Each function shall be demonstrated to satisfaction of the Commissioning Agent on a paragraph-by-paragraph basis of Contractor's written test procedure, developed to demonstrate conformance to requirements of Contract Specifications and the Design Intent Document.

.3 Each functional performance test shall be witnessed and signed off by the Commissioning Agent and Consultant upon satisfactory completion.

.4 Actual testing program shall be conducted in accordance with prior approved procedures and shall be documented as required hereinafter.

.5 Notify Commissioning Agent at least two weeks prior to date of functional performance tests. Schedule each of the two seasonal functional performance test periods over a single block of days.

2.5 SCOPE OF WORK

.1 Commissioning of systems is concluded when all mechanical systems are in full working order and acceptable for use prior to the Occupancy and Substantial Performance Review.

The commissioning work shall include, but not limited to confirmation of the following by the Mechanical Contractor and Commissioning Agent:

.1 Confirmation that start-up procedures have been completed by the Contractors, such as:

- .1 Lubrication
- .2 Chemical cleaning of piping systems
- .3 Charging systems
- .4 Chemical treatment
- .5 Adjusting and aligning drives
- .6 Checking equipment rotation
- .7 Adjusting vibration isolation
- .8 Duct and equipment cleaning
- .9 Equipment start up
- .10 Certification of special systems
- .11 Seismic restraints installed

.2 Confirmation of any sound level issues.

.3 Confirmation of balancing of the air and water systems.

.4 All automatic control valves/dampers and automatic temperature control devices have been checked out and are functional; co-ordinate with the Controls Contractor.

.5 Set-up, review and test alarm and protective devices with the Sprinkler and Electrical Contractors.

.6 Assist in trouble shooting and resolution of problems.

.7 Complete the work detailed on the lists required by the commissioning process.

.8 Confirmation of completion of Manufacturer's equipment commissioning procedures carried out by Sub-Trades/Technicians / Manufacturer representatives.

.9 Verification of all systems functional performance tests.

.10 Review of the Record Drawings and Maintenance Manuals.

.11 Owner's Orientation and Demonstration schedule confirmed.

.12 Follow-up visits during the warranty period.

2.6 COMMISSIONING CHECKLISTS AND REPORTS

.1 The design of the project checklists, to be prepared by the Commissioning Agent, should be such that the items to be checked are identified and the steps taken in functional performance testing are clearly listed. The documentation should be such that the process can be repeated in the future with similar results obtained. A draft of the Commissioning report and check lists to be submitted to the Consultant for review prior to start of work.

Part 3 Execution

3.1 GENERAL DOCUMENTATION

.1 The Contractor shall record and maintain detailed inspection and testing data. The data record shall be comprehensive and concise.

.2 All data must be recorded as soon as possible during the course of the inspection and testing.

.3 All documentation shall have the date, time, and names of persons participating in the inspection and testing.

.4 All test instruments shall be documented for valid calibration.

.5 The recording work sheets, inspection check lists, and performance testing plans must all be approved by the Consultant and Commissioning Agent prior to the start of functional performance testing.

3.2 THE COMMISSIONING AGENT SHALL PREPARE AND SUBMIT THE FOLLOWING REPORTS

.1 Interim Report. Submit after completion of initial commissioning period. Report shall document tests performed, and modifications to tests, comparison to TAB and other agency tests, and verification of compliance with design intent for ambient conditions under which initial commissioning was performed.

.2 Final Report. Submit after completion of seasonal commissioning. Report shall verify performance of mechanical equipment and systems during each seasonal commissioning process. Document any field modifications to the testing process and why these modifications were made.

3.3 FUNCTIONAL PERFORMANCE TEST PERSONNEL

.1 The following personnel are to be present during functional performance testing:

.1 The Contractor together with selected mechanical and controls subcontractors as relevant to specific test.

.2 Commissioning Agent.

.3 Owner’s representative, Consultant, and Architect may be present for some or all of functional performance testing.

3.4 VERIFICATION

.1 Commissioning functional performance tests shall begin after mechanical systems equipment and systems, along with related equipment, systems, structures, and areas are complete.

.2 Verify test air balance (TAB) readings for at least 10 percent of the supply (maximum and minimum primary air), return, and exhaust diffusers, registers, and grilles. If more than one-fifth of these readings differ from the documented TAB readings by more than 10 percent, then the TAB shall be repeated in entirety.

.3 Verify that the total mechanical systems are performing to provide conditions through all possible modes of operation as outlined in the Design Intent Document (provided by the Consultants). The verification testing procedures shall address all operating characteristics of all mechanical equipment and systems for that system.

.4 Verify with the Controls Contractor the calibration all sensors and controllers, and verify proper operation of all valves, actuators, relays and other controlled devices. The Controls Contractor shall provide a calibration report with a separate page documenting the calibration of each sensor and controlled device.

3.5 FUNCTIONAL PERFORMANCE TEST CHECKLIST

.1 The Contractor and Commissioning Agent shall prepare the detailed checklists to organize and document the functional performance testing. A separate checklist is required for each of the equipment/systems. The sample checklist shall be provided to the Consultant for review as an example of the level of detail and logical approach required in the functional performance test checklists.

3.6 RESULTS

.1 The Commissioning Agent shall document the functional performance test results obtained. If any tests have to be modified to accommodate as-built conditions, these modifications must be documented. All documentation shall be submitted to the Consultant for approval.

.2 If specified equipment and system performance is not verified, the Commissioning Agent will coordinate remedial action required and reschedule the functional performance test

.3 At the completion of the commissioning process the: Contractor and the Commissioning Agent shall submit the following to the Consultant:

.1 A letter certifying that all work specified under this contract is complete, clean and operational in accordance with the specification and drawings and submission of all documents.

.2 As-Built Drawings and Maintenance Manuals reviewed and submitted.

.3 A letter from the testing and balancing agency certifying that all necessary data for inclusion in operating and maintenance manuals has been received.

.4 A list of all alarm and protective devices tested, with the final operating settings confirmed.

.5 Four (4) copies of the final Commissioning Report and completed checklists.

.6 Written confirmation that the Owner's representatives have received orientation and demonstration instructions

.4 Demonstrate the operation of the system to the Owner’s representatives, minimum length of final seminar to be [to be confirmed] hours; the operating and maintenance manuals shall be available for the demonstration period. The seminar shall be attended by the Contractor and Sub-trades, Consultant, Suppliers, Balancing Contractor, Control Contractor; also the Sprinkler Contractor and Electrical Contractor for all or part of the seminar. This demonstration shall include but not be limited, to:

.1 Location of and opening/closing of typical access panels.

.2 Operation of all automatic control dampers and automatic temperature control devices.

.3 Operation of all alarm and protective devices.

.4 Proper response of all air valves to thermostats and volume adjustment controls.

.5 Operability of randomly selected fire dampers.

.6 Duct and Equipment Cleaning

.7 Operation of all equipment and systems under each mode of operating, and failure, including but not limited to:

.1 Complete plumbing systems.

.2 HVAC equipment and systems.

.3 Exhaust fans.

.4 Supply fans.

.5 Fire protection systems and smoke systems.

.6 Fire dampers locations (typical).

.7 Heating and cooling systems.

.8 Valve locations, tagging and identification

.9 Energy conservation management.

.10 Confirm tools and spare parts handed to the Owners.

.5 The Commissioning Agent shall carry out following visits and provide reports, during the Warranty Period; prior to the visits confirm date of visits with the Contractor, Owner and the Consultant. After each visit forward a copy of the report to the Contractor, Owner and Consultant.

.1 Within one month of Occupancy to confirm that all deficiencies have been completed and that the Owner's Operations personnel (or a maintenance firm) are properly maintaining and operating the mechanical systems.

.2 The next site visit to be within 6 months and a review of the mechanical systems operations and maintenance carried out including seasonal adjustments in the operation of the mechanical system.

.3 At the end of the warranty period do a final report and identify any outstanding mechanical and/or user complaints.

END OF SECTION

Part 1 General

.1 This section of the specification forms part of the Contract Documents and is to be read, interpreted and co-ordinated with all other parts.

1.2 SCOPE OF WORK

.1 The Cleaning Contractor shall review the site conditions and schedule his work with the Contractor; he shall co-ordinate his work with all trades. Confirm sequential Occupancy with the Construction Manager.

.2 The Cleaning Contractor shall confirm access openings and shall provide additional openings as required for his work as required for the work and shall reseal and make good any duct or insulation damaged in the process of this work. Access doors shall be properly sealed upon completion of the work.

.3 All for all cuttings, patching and making good of all ceiling, walls and other surfaces as required to perform the system cleaning. Provide access doors in ceilings and walls to gain access to the duct access doors.

.4 The systems that are included in the cleaning contract to be as follows all new work.

- .1 All supply and return fans and related duct and plenum systems.
- .2 All exhaust fans and ductwork.
- .3 Terminal heating units.
- .4 All relief/exhaust ductwork.
- .5 Mechanical rooms, including all equipment.

.5 All components within each system shall be thoroughly cleaned to the Consultants satisfaction; the work shall consist of not be limited to the following:

- .1 Intake and relief louvers and related ductwork.
- .2 Bird screens
- .3 Dampers, coils and humidifiers
- .4 Filter frames
- .5 Fans and motors – complete assembly
- .6 All plenum surfaces
- .7 All supply, return and exhaust air grilles, registers and diffusers
- .8 All ductwork, silencers and turning vances.
- .9 All reheat coils including coils in terminal units
- .10 Ceiling around air outlets as required.

.6 The Cleaning Contractor shall review the drawings and specifications for mechanical and plumbing systems in order to be fully acquainted with the scope of work and requirements before submitting his tender. No consideration will be granted for any misunderstanding of work to be done resulting from failure to inspect the Contract Documents.

.7 Spot checks will be made by the Consultant and Commissioning Agent during the cleaning process to review that the required cleaning has been carried out. The Cleaning Contractor shall provide inspection devices (i.e. periscopes and/or for video borescope devices) to permit internal ductwork inspections.

.8 The Cleaning Contractor shall refer to Section 23 31 13 DUCTWORK for the cleaning of ductwork for Clean Spaces; co-ordinate the final cleaning with the Sheet Metal Trade to meet the intent of the cleaning of the Clean Spaces.

1.3 WARRANTY

.1 The work shall be warranted by the Cleaning Contractor that the work has been carried out to the intent of the specification and trade standards. The Cleaning Contractor shall redo any work that is not satisfactory, to the Owner and Consultant, at the Cleaning Contractor's own expense.

.2 Any chemical utilized in this project shall have a MSDS (Material Safety Data Sheet) which shall be submitted to the Consultant before product usage.

Part 2 Products

2.1 CLEANING EQUIPMENT

.1 Provide all equipment and materials for cleaning, repairing, inspection of the work specified.

2.2 DUCT ACCESS DOORS

.1 Fabricate rigid and close fitting doors of galvanized steel with sealing gaskets and suitable quick fastening locking devices. Install minimum 25 mm (1") thick insulation with suitable sheet metal cover frame for insulated ductwork.

.2 Fabricated with two butt hinges and two sash locks.

.3 Access door size shall be a minimum 300 mm × 300 mm (12" × 12") or 50 mm (2") smaller than duct dimension.

2.3 STAINLESS STEEL ACCESS DOORS

.1 All access doors installed in ducts connected to stainless steel ductwork shall be constructed of 18-8 type stainless steel.

.2 Material thickness and construction details except fabrication and installation shall be same as specified for galvanized steel doors and frames.

.3 All seams and installation joining of stainless steel doors and frames shall be heliarc welded completely air tight and water tight, with exposed welds ground smooth.

Part 3 Execution

3.1 GENERAL

.1 The Cleaning Contractor shall confirm the required ductwork access doors with the Sheet Metal Trade. Generally access doors are to be minimum 300 mm × 300 mm (12" × 12") and are required as follows; the Cleaning Contractor shall provide additional access doors as maybe required to complete his work. The access system shall be reusable to allow for future inspection and cleaning.

.1 At 40-foot intervals for all ducts.

.2 At base and top of duct risers.

.3 All fire and smoke dampers.

.4 On both sides of coils and turning vanes.

.5 On both sides of fans.

.6 All locations of internally duct mounted equipment or devices, such as automatic dampers, VAV boxes, dampers and damper motors and controls.

.2 Remove cheese cloth and/or filters from air outlets that were provided for the temporary use of the air systems. Isolate items to be cleaned so as not to contaminate unprotected work.

.3 Cleaning shall be by high capacity power vacuum and high pressure compressed air; wire brushing and/or non-toxic cleaning shall be used where dirt or scale cannot otherwise be removed.

.4 The Cleaning Contractor shall coordinate the work for and provide labour for removing and replacing filter media. If systems have been operated for temporary use the Cleaning Contractor will coordinate the removal the temporary filters and replacement with new media after cleaning the system: the new media shall be provided to the Cleaning Contractor.

.5 The ductwork and equipment shall be cleaned so that all dirt, grease and construction dust is removed at the time of cleaning. Co-ordinate proper procedures with the Contractor and Construction Manager to ensure that systems are maintained in a clean state prior to occupancy. In areas where construction may be ongoing, seal all air outlets after the systems have been cleaned.

.6 The cleaning work should be scheduled prior to final balancing. If the balancing has been completed the Cleaning Contractor shall mark balancing damper positions before cleaning and return them to their original position after the cleaning is completed.

3.2 DUCTWORK CLEANING PROCESS

.1 Prior to any work being started on the system, filter media shall be installed behind every supply grille or diffuser, if deemed necessary by the Consultant. This will act as a safety net for contamination which may be disturbed during cleaning. After a settling down period of two to five days, the filter media will be removed.

.2 Each aspect of the system shall be cleaned regardless of the size, type or configuration. Dirt clinging to the sides or top of ducts must be removed and left as clean as the bottom. Spiral ducting should be as clean as flat.

.3 Air systems must not be shut down without prior approval. Shutdown of systems to be arranged with minimum two days' notice.

.4 Duct-mounted coils shall be hand washed (air or water) on both coil faces carefully to avoid damage to tubes and fins. Thoroughly clean both coil faces ensuring contaminants are removed. Where necessary remove corrosion from around coil frames; prime paint with top coat affected area; hand brush coil fins to restore them to original condition.

.5 Duct-mounted volume, fire and zone dampers sets are to be marked to their current setting, then inspected and cleaned. External moving parts are to be treated with approved dry lubricant material. After cleaning, dampers shall be returned to their original setting. The Cleaning Contractor shall indicate locations of all damaged dampers on drawings.

.6 Whenever the grilles and/or diffusers are removable, they shall be removed, vacuum cleaned, washed, dried and then replaced. Contractor shall take care as to not disturb the damper setting.

.7 Mixing boxes, fan-coils and terminal units shall be vacuum cleaned thoroughly. Hand wash coils, utilizing procedures specified herein.

.8 Procedures must be followed to ensure that no contamination from within the ductwork will enter the conditioned air space during the internal cleaning operations.

.9 All coils shall be combed out at completion of work.

.10 The Cleaning Contractor shall bring to the attention of the Contractor and Consultant any damaged lines prior to the start of his work. Work where internal ducting insulation is fragile or damaged, the Cleaning Contractor shall coat, fog seal, repair, remove, and/or replace. If insulation is exposed without neoprene, coil or approved facing, Contractor shall coat surface with sealer.

3.3 INSPECTIONS

.1 The Cleaning Contractor shall perform a full inspection of the duct interior and ductwork accessories including air valves, ductwork liners, duct-mounted coils, filters, dampers, humidifiers and all other appurtenances within the ductwork system.

.2 Random visual inspections shall be carried out by the Consultant and Commissioning Agent. The surfaces will be considered clean when all foreign material capable of particulating and visible to the naked eye are removed. For critical areas (such as clean area, biosafety laboratories, etc.), the inspections shall entail the use of a white cloth wiped inside the ducting. If this white cloth is darkened then the ducting shall be deemed to be dirty.

.3 Any ductwork found to be dirty shall be redone through its entire length at no extra cost.

.4 A cleaning report shall be submitted which shall include pictures of ductwork conditions before and after cleaning.

3.4 REPORTS

.1 After completion of the work, the Cleaning Contractor shall provide FOUR (4) copies of a certificate stating that all systems have been cleaned as specified and that all access panels are in place. This certificate shall be placed in the Operating and Maintenance Manuals and one copy to the Consultants.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation of high-pressure metallic ductwork, joints and accessories.

.2 Sustainable requirements for construction and verification.

.3 Related Sections:

.1 Section 01 30 00 - Administrative Requirements.
.2 Section 01 40 00 - Quality Requirements.
.3 Section 01 60 00 - Product Requirements.
.4 Section 01 70 00 - Execution and Closeout Requirement.
.5 Section 01 74 19 - Waste Management and Disposal.
.6 Section 23 05 00 - Common Work Results – HVAC
.7 Section 23 05 94 - Pressure Testing of Ducted Air Systems.

1.2 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-[04a], Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process. (Metric).

.3 Department of Justice Canada (Jus).

.1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
.2 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Material Safety Data Sheets (MSDS).

.5 Sheet Metal Air Conditioning Contractors' National Association (SMACNA).

.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible, [95 (Addendum No. 1, (1997)].
.2 SMACNA HVAC Air Duct Leakage Test Manual, 1st Edition [1985].
.3 SMACNA IAQ Guideline for Occupied Buildings under Construction, 1st Edition [1995].

1.3 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

.2 Co-ordinate submittal requirements and provide submittals required by Section 01 47 15 - Sustainable Requirements: Construction.

.3 Submit Indoor Air Quality (IAR) Management Plan in accordance with Section 01 47 15 - Sustainable Requirements - Construction.

.4 Product Data: submit WHMIS MSDS - in accordance with Section 01 47 15 - Sustainable Requirements: Construction and Section 02 61 33 - Hazardous Materials for the following:

- .1 Sealants.
- .2 Tape.
- .3 Proprietary joints.
- .4 Fittings.

.5 Submit Indoor Air Quality (IAQ) Management Plan in accordance with Section 01 47 15 - Sustainable Requirements: Construction.

.6 Submit shop drawings for:

- .1 Flexible Connectors.
- .2 Sealants and Adhesives.
- .3 Duct Access Panels and Doors.
- .4 Backdraft dampers.
- .5 Fire/Smoke Dampers.
- .6 Ductwork and Fittings including standards to be used.
- .7 Other Shop Drawings as requested by the Consultant.

.7 Submit samples of shop fabricated assemblies as requested by the Consultant.

.8 Fabrication drawings as requested by the Consultant.

.9 Fabricated hoods and related hanging details.

1.4 QUALITY ASSURANCE

.1 Certification of Ratings:

- .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

.2 Sustainable Requirements:

.1 Construction requirements: in accordance with Section 01 47 15 - Sustainable Requirements: Construction.

.2 Verification: contractor' verification in accordance with Section 01 47 17 - Sustainable Requirements: Contractor' Verification.

.4 Inspect building construction, shafts, plenums, equipment rooms to ensure compatibility for the HVAC system installation and performance; report deviations or concerns to the Consultants for review.

.5 The Contractor shall follow SMACNA "Duct Cleanliness for New Construction Guidelines" to ensure better air quality and control of system contamination. A copy of the Guidelines to be kept at the Contractor's site office for reference. The Guidelines outlines the requirements for:

.1 Duct Access Doors.

.2 Job site cleanup and good housekeeping,

.3 Proper site storage and protection during construction. Protect products against dirt, water, chemical and mechanical damage. Do not install damaged components – remove from site.

.4 Protection of ductwork openings.

.5 Protection of systems during temporary operation.

.6 Cleanliness of ductwork and equipment at the completion of construction to B-Intermediate Level for the HVAC and C – Advanced Level for biosafety level laboratories of systems.

.7 Refer to Section 23 08 03 EQUIPMENT AND DUCT CLEANING.

1.5 INDOOR AIR QUALITY (IAQ) MANAGEMENT PLAN

.1 Develop and implement an Indoor Air Quality (IAQ) Management Plan in accordance with Section 01 47 15 - Sustainable Requirements: Construction for construction and preoccupancy phases of building.

.2 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings under Construction.

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Section 01 47 15 - Sustainable Requirements: Construction.

2.2 DUCTWORK

.1 Material:

.1 Galvanized steel with Z90 designation zinc coating lock forming quality: to ASTM A653/A653M.

.2 Thickness: to SMACNA.

.2 Construction - round and oval.

.1 Ducts: factory fabricated, spiral wound, with matching fittings and specials to SMACNA.

.2 Transverse joints up to 900mm: slip type with tape and sealants.

.3 Transverse joints over 900mm: Vanstone.

.4 Fittings:

.1 Elbows: smooth radius five-piece (for 90 degrees); three-piece (for 45 degrees). Centreline radius: 1.5 x diameter.

.2 Branches: conical transition with conical branch at 45 degrees and 45 degrees elbow.

.3 Construction - rectangular:

.1 Ducts: to SMACNA.

.2 Transverse joints: welded; proprietary duct joints SMACNA seal Class A and B.

.3 Fittings:

.1 Elbows: smooth radius; centreline radius 1.5 x width of duct. No vanes.

.2 Branches: with conical branch at 45 degrees and 45 degrees elbow.

.4 Firestopping:

.1 50 x 50 x 3 mm retaining angles around duct, on both sides of fire separation.

.2 Firestopping material must not distort duct.

2.3 SEAL CLASSIFICATION

.1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
2500	[A]
1500	[A]
1000	[A]
750	[B]
Up to 750	[C]

.2 Seal classification:

.1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.

.2 Class B: longitudinal seams, transverse joints and connections made airtight with gaskets sealant tape or combination thereof.

.3 Class C: transverse joints and connections made air tight with gaskets, sealant, tape or combination thereof. Longitudinal seams unsealed.

2.4 SEALANT

.1 Oil resistant, water-borne polymer type flame resistant high velocity duct sealing compound.

2.5 TAPE

.1 Polyvinyl treated, open weave fibre glass, 50 mm wide.

2.6 HANGERS AND SUPPORTS

.1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping Equipment.

.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 SMACNA.

.3 Hangers: galvanized steel angle with galvanized steel rods to ASHRAE and SMACNA following table.

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

.4 Upper hanger attachments:

.1 For concrete: manufactured concrete inserts.

.2 For steel joist: manufactured joist clamp or steel plate washer.

.3 For steel beams: manufactured beam clamps:

2.7 FITTINGS

.1 Fabrication: to SMACNA.

.2 Radiused elbows.

.1 Rectangular: standard radius; or short radius with single thickness turning vanes Centreline radius: 1.5 times width of duct.

.2 Round: smooth radius, five piece. Centreline radius: 1.5 times diameter.

.3 Mitred elbows, rectangular:

.1 To 400 mm: with single thickness turning vanes.

.2 Over 400 mm: with double 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 radius elbows.

.7 Obstruction deflectors: maintain full cross-sectional area.

.1 Maximum included angles: as for transitions.

2.8 FIRE STOPPING

.1 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00 - Firestopping.

.2 Fire stopping material and installation must not distort duct.

2.9 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 duct joint. Proprietary manufactured flanged duct joint to be considered to be a class A seal.

2.10 STAINLESS STEEL

.1 To ASTM A480/A480M, Type 304/316.

.2 Finish: No. 4.

.3 Thickness, fabrication and reinforcement: to SMACNA.

.4 Joints: to SMACNA; be continuous inert gas welded.

.5 Application; Laboratory exhaust system.

2.11 ALUMINUM

.1 To SMACNA]. Aluminum type: 3003-H-14.

.2 Thickness, fabrication and reinforcement: to SMACNA.

.3 Joints: to SMACNA; Typical standard flanged slip and drive connections with appropriate sealants will be allowed.

.4 Application: high humidity airflows.

2.12 BLACK STEEL

.1 To ASTM A635/A635M.

.2 Thickness: 1.2 mm.

.3 Fabrication: ducts and fittings to SMACNA.

.4 Reinforcement: to SMACNA.

.5 Joints: continuous weld.

2.13 CROSS BREAKING OF SHEET METAL

.1 All ductwork greater than 300 mm (12") shall be cross-broken with the exception of internally lined ducts.

2.14 DEFLECTORS IN SHEET METAL DUCTS

.1 Where obstructions pass through ductwork, provide air stream deflectors to minimize interference with the movement of air. Ductwork at these deflectors shall be increased in size to maintain equivalent area around the deflectors.

2.15 FLEXIBLE FAN CONNECTIONS

.1 All inlet and outlet connections on fan equipment shall be installed with flexible connections. These connections shall be not less than 100 mm (4") wide, construction of neoprene coated synthetic flexible fabric. The flexible connection shall be fastened to the fan inlet and outlet by a galvanized iron band provided with tightening screws.

.2 For smaller fans and fan powered VAV units the connections can be 75 mm (3”) wide.

.3 Acceptable Manufacturer: Duro Dyne.

2.16 DUCTS THROUGH ROOFS

.1 Where ducts pass through roofs, galvanized angle iron or stainless steel frames shall be provided and bolted to the curb around the openings. Provide proper weather and water proof flashing and insulation and vapour barrier to prevent condensation on warm duct surfaces.

2.17 DUCT SUPPORTS

.1 For ducts up to 450 mm (18") in width; hangers shall be placed on not more than 2.4 m (8') centres; ducts 480 mm (19") and above in width, on not more than 1.2 m (4') centres.

.2 Hangers on ducts up to 914 mm (36") in width shall be galvanized band iron 25 mm x 13 mm (1" x 1/2"). On ducts 940 mm (37") and above in width, hangers shall be galvanized iron angles, not less than 25mm x 25mm x 3mm (1" x 1" x 1/8"). Use stainless steel hangers for stainless steel ductwork.

.3 Each duct hanger shall be attached to expansion bolt inserts of adequate size, which shall be driven into, the concrete slab above.

.4 Wherever it may be necessary to support ducts from the floor, this shall be done with galvanized iron or stainless steel angles of adequate size.

2.18 DUCTWORK CONSTRUCTION

.1 Duct hangers shall be constructed from galvanized or stainless steel metal fastened to underside of the structure. Do not use perforated band iron. For larger ducts use angle irons and steel rods.

.2 All ducts, plenums, and casings, unless shown otherwise on the drawings, shall be constructed of galvanized steel or stainless steel sheets to SMACNA Standards; or minimum gauges as specified below if SMACNA Standards of gauges and construction are not used.

TYPE	MAXIMUM DIMENSION	GAUGE	JOINT TYPE
Rectangular with "Pittsburgh" longitudinal seam	Up to 30" (750 mm)	24	"S" and drive
	31" to 50" (775 to 1275 mm)	22	1□" bar slip or standing "T" at 60" O.C. maximum
	51" to 60" (1300 to 1500 mm)	20	1" bar slip or standing "T" at 60" O.C. maximum
	61" to 88" (1525 and over)	18	As above except provide 1□" x 1□" x 3/16" angle reinforcement at 30" O.C.
Round Ductwork	Up to 22" (550 mm)	24	Spiral duct and fittings for all sizes
	24" to 36" (600 mm to 900 mm)	22	
	38" to 50" (950 mm to 1500 mm)	20	
	52" to 80" (1300 mm to 2000	18	

	mm)		

Notes: SMACNA Pressurization classifications for the project are.

.3 Supply and return air ductwork to the AHUs to be at 4" WG (1000 Pa)

.4 Laboratory exhaust ductwork at 4" WG (1000 Pa).

.5 General exhaust ductwork at 2" WG (500 Pa)

.6 Ductwork downstream of VAV and Fan Coil Units at 1" WG (250 Pa).

.7 Lap metal duct joints in direction of air flow: hammer down edges and slips to leave smooth duct interior. Do not use self-tapping screws.

2.19 DEFLECTOR VANES

.1 Where shown on the drawings and/or in square elbows and in elbows where radius is not full, sheet metal deflector vanes shall be installed the full height of the duct in which the deflector is installed with a maximum weight of No. 18 gauge.

.2 Baffles

.1 Baffles, where required to reduce problems of air stratification, shall be provided and installed by this sub-contractor.

.2 Coordinate the installation of baffles with the Consultant.

.3 Duct Sealing

.1 Sealant to be water resistant, fire resistive and compatible with mating materials. Use high velocity polymer type sealant for supply ductwork and supplied to manufacturers recommendation.

.2 Seal all transverse joints in supply, return and exhaust ductwork with high velocity duct sealer. ULC flame rated at 5 and 0 smoke development.

.4 Instrument Test Ports

.1 Flange type with quick lock caps and chain with gasket seal; Duro Dyne IP-1 or IP-2 or equivalent.

.2 Provide were required for air balancing co-ordinate with the Balancing Contractor.

.5 Flanged Fittings

.1 Provide soft elastomer butyl with adhesive backing or extruded forms of sealants at flanged joints; material to be compatible to environment within the duct.

2.20 BALANCING DAMPERS

.1 Balancing dampers shall be installed in each branch connection as directed and/or shown on the drawings.

.2 Balancing dampers shall be constructed of not less than 22 gauge material. Where installed in ducts up to 300 mm (12") deep, dampers shall be single blade, and in ducts greater than 300 mm (12") dampers shall be multi-blade, each blade being not wider than 225 mm (9").

.3 All dampers shall have external indicator and locking device; Duro Dyne K-145 or equivalent.

.4 Provide volume extractor for branch to grilles located within 1m (3') of duct. Extractors to be gang-operated parallel vanes, fully adjustable with remote operators.

2.21 ACCESS DOORS

.1 Access doors where indicated and required, shall be constructed of No. 22 gauge material. Provide an iron stiffening frame, so constructed that the door can be operated without twisting or distortion. Double cam lock latches on access doors 18 inches (450 mm) and larger for hinged doors.

.2 Doors in insulated ductwork shall be of double panel construction with an insulating filler not less than 25 mm (1") thick.

.3 The duct opening shall be rimmed with a continuous reinforcing galvanized bar or angle against which the door will close. To ensure a minimum of air leakage, gasket materials shall be held to the angle by an adhesive.

.4 Acceptable Manufacturer of locking devices for ductwork: Duro Dyne SL-1.

.5 Acceptable manufacturer of Plenum Door Handles: Duro Dyne SP-20.

2.22 ACOUSTIC LINING

.1 Refer to Section 23 07 13 DUCTWORK INSULATION. All acoustical information to have neoprene coating or mat face finish.

.2 Duct acoustic lining where shown on drawing for fan-coils and VAV units, shall be 25mm (1") thick (or as noted on the drawings and as specified) with neoprene coating or mat face finish. This material shall have a density of 25kg/m^3 (1.5 lbs/cu. ft.). Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range – 29°C to 93°C. The airstream surface mat facing shall be treated with an EPA registered anti-microbial agent to aid in prevention of fungal and bacteria growth; as per ASTM C1338-621 and 622.

.3 Duct sizes to increase accordingly to maintain equivalent free area.

.4 Duct liners shall be installed in accordance with the latest edition of SMACMA Standards. Liner shall be installed with the surface treatment exposed to the air stream. All interior surfaces of all ductwork and fittings shall be completely covered with duct liner, without interruptions or gaps, except where required by Code (as in areas for fire dampers or electric heaters).

.5 Adhesive shall be applied to the sheet metal with a minimum coverage of 90%. Unless factory coated, all transverse edges and exposed longitudinal joints of the duct liner shall be coated. Adhesive shall be designed for duct liner application and shall meet the requirements of ASTM C916.

.6 All transverse joints shall be firmly butted without gaps. All rips and tears on the air stream surface shall be repaired by coating damaged areas with approved adhesive, or coating, or shall be replaced.

.7 Mechanical fasteners shall be used to secure the duct liner to the sheet metal and shall be spaced in accordance to SMACNA or minimum 300mm (12") on centre. Fasteners shall be spot welded perpendicular to the duct surface and shall not compress the insulation more than 3mm (1/8"). Longitudinal corner joints shall be overlapped and compressed.

.8 Metal nosing (either channel or "Z" profile), or integrally formed from the duct wall, shall be securely installed over transverse liner edges facing the air stream at fan discharge and at any interval of lined duct preceded by unlined duct.

.9 AHU Supply, Outside Air, Return and Exhaust Ductwork Acoustical Insulation on the Drawings:

.1 For all AHU supply air ductwork, provide 50mm (2”)-thick acoustical insulation 48 kg/m³ (3.0 lbs/cu.ft.) inner liner of nominal 23% open perforated galvanized metal to prevent fibre erosion.

.2 Outside air ductwork in mechanical rooms to have 38mm (1½”)-thick acoustical liners.

.3 Return and exhaust air ductwork to have 38mm (1½”)-thick acoustical duct liners.

2.23 LOUVRES

.1 Refer to Section 23 37 13 DIFFUSERS, GRILLES AND LOUVERS.

2.24 FLEXIBLE DUCTWORK

.1 Flexible ductwork where indicated on the drawing shall be equal to Flexmaster trilaminate aluminium foil, interlocked by metal Helix flexible ductwork bearing ULC Class 1 label.

.2 Flexible ductwork to supply diffusers to have thermal and acoustical insulation.

.3 Maximum 1.5m (5'-0) flexible ductwork shall be used for ceiling supply outlet connections.

.4 Connect each end with stainless steel screw operated drawbands. Support flexible duct to maintain smooth shape without sagging and provide smooth 90° bend.

2.25 FIRE AND SMOKE DAMPERS AND CEILING DAMPERS

.1 Dampers shall be ULC, cUL or WH labelled and listed units " type "B" or "C" gravity or spring type. Use type "A" only where mounted directly behind supply or return grilles. Fusible links to have melting point 28°C (50°F) above maximum operating temperature.

.2 Do not use asbestos in any form in the construction of fire dampers or ceiling dampers.

.3 Ceiling dampers shall be labelled and be rated for both steel duct and flexible duct installations.

.4 Combination smoke/fire dampers (low leakage type and with elevated temperature classification) shall be galvanized steel and ULC 20 l8 certified. Provide electric motor and industrial grade damper indicator switch, as required. Fire/Smoke dampers shall be constructed and tested in conformance with UL-555 and UL-555S. Smoke damper to close on power failure unless noted otherwise.

.5 All dampers shall have factory installed sleeves. Where required and/or detailed provide Thermal Blankets controlled Air CK-2000 – 1/8 inch (3mm) thick, over the sleeve between the fire damper and the fire separation/enclosure.

.6 All fire and smoke dampers shall have duct access doors for servicing with sash type latches. Nailor Series 0800 or equivalent.

.7 A mock-up of the motor and damper arrangement for the smoke dampers shall be provided for review by the Consultant prior to installation.

.8 Provide fire stop flaps for air outlets located in rated ceilings.

.9 Submit manufacturer's installation details as part of fire damper shop drawings.

2.26 BACKDRAFT DAMPERS

.1 Provide backdraft dampers on all exhaust fans and as indicated on drawings. For automatic gravity operated multi or single leaf with sealed edges, the dampers to be linked together with adjustment devices to allow for varying static pressure.

2.27 FILTER SECTIONS

.1 Refer to Section 23 44 00 AIR FILTERS.

2.28 GRILLES AND DIFFUSERS

.1 Refer to Section 23 37 13 Diffusers, Grilles and Louvres.

2.29 SHEET METAL HOODS

.1 Where indicated, provide shop fabricated stainless steel hoods and hood supports; sizes as shown on the drawings.

.2 Hoods to be made of 20 gauge type 302 stainless steel with No. 4 finish with concealed and rounded edges. Weld all joints, grind smooth and buff exposed joints to finish off sheet.

2.30 SOUND TRAPS

.1 Sound traps can be shop fabricated with 26 gauge galvanized sheet metal with one inch (25 mm) acoustical insulation liner.

.2 Size and configuration as indicated on the drawings.

2.31 FLAT OVAL DUCTWORK AND FITTINGS

.1 Ductwork: factory fabricated as manufactured by United Sheet Metal, spiral uniseal through 500 mm minor axis, 24 gauge for up to 600 mm major axis.

.2 Fittings: United Uniform with continuous weld, 1.0 mm for up to 90 mm major axis.

.3 Elbows: easy bend.

.4 Transitions: OTR-10 reinforcement, installed in accordance with manufacturer's recommendations.

.5 Accessories: manufactured by United Sheet Metal.

Part 3 Execution

3.1 DUCTWORK

.1 The ductwork installation will be free from pulsation, chatter, vibration, or objectionable noises. Should any of these defects appear after the system is in operation, they shall be corrected by removing, replacing or reinforcing the work as directed by the Consultant at the site.

.2 Where ducts are required to be transformed or divided due to the structural conditions of the building, the required area shall be maintained. Allowance and provision shall be made in the tender for any of these changes; however, before proceeding with this work, approval must be received from the Consultant.

.3 Duct sizes shown on drawings are inside clear dimensions; for acoustically lined ductwork duct size shall be increased accordingly. Acoustical duct lining shall be provided as follows:

.1 Where shown on the drawings and where required to maintain acceptable sound levels within occupied spaces.

.2 All supply and return air plenums for rooftop equipment.

.3 Plenums under roof mounted exhaust fans.

.4 Upstream and downstream of minimum of 15 feet (5m) from all supply, return and exhaust fans with motors ½ HP (.35 kW) and larger.

.4 Support duct with galvanized as stainless steel hangers and allow for expansion and contraction; support duct risers at each floor. All ducts shall be complete within themselves; single partition between ducts not allowed. Branch duct connections shall be 45° entry or extractor; square to round or conical connectors from plenums.

.5 Check duct spaces for possible interference with structural or other elements and confirm ceiling space clearances prior to fabrication. Take site measurements and make necessary changes and offsets to ductwork as necessary with no additional costs to the Owner. Prefabricated duct made up without site measurements will be the Contractor's responsibility; confirm sizes shown on the drawings by site measurements.

.6 All tees, bends and elbows shall be constructed with a minimum radius of 1.5 times width of the duct centerline. Where not possible, provide turning vanes to SMACNA Standards. Changes in duct sizes shall be gradual, not exceeding 20 degrees flare unless otherwise noted. Provide bracing to prevent rattling or breathing. Where configuration of ductwork is changed, use SMACNA table of equivalent rectangular and round ductwork; confirm change of duct configuration with Consultant.

.7 All supply, return and exhaust ductwork shall be sealed with duct sealer as the duct work is assembled in accordance with SMACNA Standards. Supply ductwork shall be tested for leaks prior to insulating or concealing ductwork. Open corners will not be accepted. Ductwork shall be tested and free of audible leaks in a quiet ambient.

.8 Protect and cover all duct and equipment openings during construction. All ductwork and equipment shall be cleaned at completion of work; vacuum equipment, ductwork, coils and plenums if dirty and if used for temporary heating.

.9 Install instrument test ports in ducts where required to accommodate testing and balancing instrument.

.10 Ensure that all ducts are sealed and water tight at connections to be outside air outlets (i.e. hoods and louvers).

3.2 MOTORIZED DAMPERS

.1 Install motorized dampers provided by others; ensure installation is free of distortion and binding of linkages. Thoroughly seal around frame.

.2 Refer to Division 25 CONTROLS.

3.3 ACCESS DOORS

.1 Provide properly sized and sealed access doors for inspection and cleaning; generally to be located as follows:

.1 At 40 foot intervals for all ducts.
.2 At base and top of duct risers.
.3 All fire and smoke dampers.
.4 On both sides of coils and turning vanes.
.5 On both sides of fans.
.6 All locations of internally duct mounted equipment or devices, such as automatic dampers, VAV boxes, coils, electric duct heaters, dampers and damper motors and controls.

.2 Access doors in insulated ductwork shall have insulation provided with metal cover and frame.

.3 Access doors for components shall have sash type latches.

.4 Access doors for round ducts to be Nailor Model Series 0890, or equivalent.

.5 Provide full size access doors to all large outside air plenums.

3.4 AIR FILTERS

.1 Refer to Section 23 44 00 HVAC AIR FILTRATION.

.2 All supply and make-up air systems shall have filters.

.3 Provide filter frame and media on outside intake openings into electrical and elevator rooms. Ensure all filter frame edges are tightly sealed.

.4 Confirm that all filters are easily accessible.

.5 Provide clean new set of filters for all equipment used during construction.

.6 Provide Magnehelic gauges on all air handling units.

.7 Provide spare filters as specified.

3.5 GRILLES AND DIFFUSERS

.1 Refer to Section 23 37 13 DIFFUSERS, REGISTERS AND GRILLES.

.2 Confirm location, symmetry, size and finish of all air outlets and with the architectural drawings and reflected ceiling plan, prior to start of work.

.3 All visible sheet metal ductwork behind air outlets to be painted matt black.

.4 Allow for minimum one diameter radius for flexible ducts connected to diffusers; maximum length of flexible ducts to be 6 feet (1800 mm).

.5 Provide cable or metal strap seismic restraints connected to the structure or duct for diffusers mounted in T-bar ceilings with flexible ductwork.

.6 Provide additional baffles for the corridor supply air outlets as required to assist in balancing of the system; review type of baffles with the Consultant prior to installation.

3.6 FIRE/SMOKE DAMPERS

.1 Provide fire/smoke dampers with duct access doors as indicated, to NFPA 90A and Code requirements, and installed to SMACNA Standards and with retaining angles with break away duct connections on both sides of the wall. Co-ordinate with the General Contractor to confirm rating and location of fire walls and partitions requiring fire dampers prior to duct installation; report any discrepancies to the Consultant.

.2 Firestopping to consist of retaining angles and fire separation; retaining angles for ductwork to be installed on each side of fire separation to SMACNA standards. Provide thermal blankets to maintain fire rating where required.

.3 At each point where ducts pass through non-rated partition walls, the space around the ducts shall be sealed to code requirements and for sound controls.

3.7 BALANCE DAMPERS

.1 Provide balancing dampers on all supply, return and exhaust branches where taken from larger ducts and plenums. Do not use splitter dampers. Coordinate balancing work with the Balancing Contractor and provide new pulleys as required to meet air quantities specified.

.2 Provide air extractors where side wall grilles are located less than 900mm (3') from the duct.

3.8 OUTSIDE OPENINGS AND DUCTWORK

.1 Provide weatherproof outside openings required for air intakes, vents and exhaust outlets, ensure proper flashing for a weatherproof installation; the duct or plenum shall be sealed and caulked to the exterior outlets, including insulation and vapour barriers.

.2 Air ducts exposed to the outdoors to be water tight; provide sheet metal weather protection covers over flexible connections and damper motors exposed to the outdoors.

.3 All air ductwork and covers exposed to the outdoors shall be proper jointed and sealed and weather proofed; expressed ducts shall be prime-coated and painted by the Mechanical Contractor with color selected by the Architect.

3.9 FANS

.1 Refer to Section 23 34 00 FANS.

.2 **Ensure that flexible fan connections are installed properly and do not impede free area of duct.**

3.10 CLEANING OF SYSTEMS

.1 Refer to Section 23 08 03 EQUIPMENT AND DUCT CLEANING.

.2 All duct systems and equipment shall be cleaned at the completion of the work.

3.11 BALANCING

.1 Refer to Section 23 05 93 TESTING, ADJUSTING AND BALANCING.

3.12 FLEXIBLE DUCTWORK

.1 Install flexible ductwork where indicated on the drawings and as specified.

.2 Provide intermediate supports for flexible ducts so that sagging does not occur. Very sharp turns and reduction in the area of the duct will not be permitted.

.3 Connect to ductwork, diffusers, and terminal units with stainless steel worm drive clamps, adjustable clamps or duct straps applied over two wraps of duct tape. Do not use nylon straps.

.4 Provide insulated ductwork for high and medium pressure ducts. Uninsulated ducts may be used for run-outs to diffusers unless otherwise noted.

.5 Provide separate cable support to all diffusers in suspended ceilings, secured back to structure.

3.13 DUST COLLECTION SYSTEMS

.1 The ductwork shall be manufactured and installed as recommended by ASHRAE, SMACNA and the Industrial Ventilation Manual, current edition, published by the American Conference of Governmental Industrial Hygienists.

.2 Ducts shall be constructed of black iron welded sheet steel of 1.2 mm thickness. Duct elbows radius shall be minimum of R/D - 2.0 of seven sections and of smooth construction. Branches shall enter the main duct at 30° and at the side.

3.14 INTERNALLY INSULATED DUCTWORK

.1 Install in accordance with SMACNA Figs. 2-22 through 2-25.

.2 For low pressure ductwork use metal nosing on leading and following edges. Ensure butt insulation joints fit tightly and apply adhesive/sealant to edges just prior to joining of duct sections.

.3 For high pressure ductwork install as per low pressure and provide perforated metal lining.

.4 Provide perforated metal lining in plenums and 3 m downstream of fans, where shown on drawing.

3.15 WATERTIGHT DUCT

.1 Provide watertight duct for:

.1 Dishwasher exhaust.
.2 Fresh air intake.
.3 Minimum 3000 mm from duct mounted humidifier in all directions.
.4 Kitchen exhaust duct.
.5 As indicated.

.2 Form bottom of horizontal duct without longitudinal seams.

.1 Solder; weld joints of bottom and side sheets.
.2 Seal other joints with duct sealer.

3.16 FIELD QUALITY CONTROL

.1 Verification requirements in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification, include:

.1 Materials and resources.
.2 Storage and collection of recyclables.
.3 Construction waste management.

.4 Resource reuse.

.5 Recycled content.

.6 Local/regional materials.

.7 Low-emitting materials.

3.17 CLEANING

.1 Proceed in accordance with Section 01 74 11 – Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.18 LEAKAGE TESTS

.1 Refer to Section 23 05 94 – Pressure Testing of Ducted Air Systems

.2 In accordance with SMACNA HVAC Air Duct Leakage Test Manual. The leakage classification for Seal Class “A” as outlined in Section 4 of the SMACNA HVAC Air Duct Leakage Test Manual shall be used to identify a permissible leakage rate.

.3 Perform leakage tests in sections.

.4 Perform trial leakage tests, as indicated to demonstrate workmanship.

.5 Do not install additional ductwork until trial tests have been achieved.

.6 Test section minimum of 3o m long with no less then 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 SUMMARY

.1 Section Includes:

.1 Balancing dampers for mechanical forced air ventilation and air conditioning systems.

.2 Sustainable requirements for construction and verification.

.2 Related Sections:

.1 Section 01 30 00 - Administrative Requirements.

.2 Section 01 40 00 - Quality Requirements.

.3 Section 01 60 00 - Product Requirements.

.4 Section 01 70 00 - Execution and Closeout Requirement.

.5 Section 01 74 19 - Waste Management and Disposal.

.6 Section 21 05 01 - Common Work Results – Mechanical.

1.2 REFERENCES

.1 Sheet Metal and Air Conditioning National Association (SMACNA)

.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-1985.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

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

.2 Instructions: submit manufacturer's installation instructions.

.1 onsultant will make available 1 copy of systems supplier's installation instructions.

Part 2 Products

2.1 GENERAL

.1 Manufacture to SMACNA standards.

2.2 SPLITTER DAMPERS

.1 Fabricate from same material as duct but one sheet metal thickness heavier, with appropriate stiffening.

.2 Double thickness construction.

.3 Control rod with locking device and position indicator.

.4 Rod configuration to prevent end from entering duct.

.5 Pivot: piano hinge.

.6 Folded leading edge.

2.3 SINGLE BLADE DAMPERS

.1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.

.2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm.

.3 Locking quadrant with shaft extension to accommodate insulation thickness.

.4 Inside and outside nylon end bearings.

.5 Channel frame of same material as adjacent duct, complete with angle stop.

2.4 MULTI-BLADED DAMPERS

.1 Factory manufactured of material compatible with duct.

.2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.

.3 Maximum blade height: 100 mm.

.4 Bearings: self-lubricating nylon.

.5 Linkage: shaft extension with locking quadrant.

.6 Channel frame of same material as adjacent duct, complete with angle stop.

.7 Maximum leakage : 5 % at 500 Pa.

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.

.2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.3 Locate balancing dampers in each branch duct, for supply, return and exhaust systems.

.4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.

.5 Dampers: vibration free.

.6 Ensure damper operators are observable and accessible.

.7 Corrections and adjustments conducted by Engineer.

3.3 FIELD QUALITY CONTROL

.1 Tests:

.1 Tests to cover period of not less than 2 days and demonstrate that system is functioning as specified.

.2 Verification requirements in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification, include:

.1 Materials and resources.
.2 Storage and collection of recyclables.
.3 Construction waste management.
.4 Resource reuse.
.5 Recycled content.
.6 Local/regional materials.
.7 Low-emitting materials.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Operating dampers for mechanical forced air ventilation and air conditioning systems.

.2 Sustainable requirements for construction and verification.

.2 Related Sections:

.1 Section 01 30 00 - Administrative Requirements.

.2 Section 01 40 00 - Quality Requirements.

.3 Section 01 60 00 - Product Requirements.

.4 Section 01 70 00 - Execution and Closeout Requirement.

.5 Section 01 74 19 - Waste Management and Disposal.

.6 Section 21 05 01 - Common Work Results – Mechanical.

1.2 REFERENCES

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

.1 ASTM A653/A653M-04a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.2 Indicate the following:

.1 Performance data.

.2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

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

.2 Instructions: submit manufacturer's installation instructions.

.1 Consultant will make available 1 copy of systems supplier's installation instructions.

.3 Closeout Submittals

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 MULTI-LEAF DAMPERS

.1 Opposed blade type as indicated.

.2 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, extruded aluminum frame.

.3 Pressure fit self-lubricated bronze bearings.

.4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.

.5 Performance:

.1 Leakage: in closed position less than 2% of rated air flow at 500 Pa differential across damper.

.2 Pressure drop: at full open position less than 25 Pa differential across damper at 7m/s.

.6 Insulated aluminum dampers:

.1 Frames: insulated with extruded polystyrene foam with RSI 0.88.

.2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI 0.88.

2.2 BACK DRAFT DAMPERS

.1 Automatic gravity operated, multi leaf, aluminum construction with nylon bearings, centre pivoted, spring assisted or counterweighted.

2.3 RELIEF DAMPERS

.1 Automatic multi-leaf aluminum dampers with ball bearing centre pivoted and counter-weights set to open at 500 Pa static pressure.

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.

.2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.

.3 Seal multiple damper modules with silicon sealant.

.4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.

.5 Ensure dampers are observable and accessible.

3.3 FIELD QUALITY CONTROL

.1 Verification requirements in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification, include:

- .1 Materials and resources.
- .2 Storage and collection of recyclables.
- .3 Construction waste management.
- .4 Resource reuse.
- .5 Recycled content.
- .6 Local/regional materials.
- .7 Low-emitting materials.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Fire and smoke dampers, and fire stop flaps.

.2 Sustainable requirements for construction and verification.

.2 Related Sections:

.1 Section 01 30 00 - Administrative Requirements.

.2 Section 01 40 00 - Quality Requirements.

.3 Section 01 60 00 - Product Requirements.

.4 Section 01 70 00 - Execution and Closeout Requirement.

.5 Section 01 74 19 - Waste Management and Disposal.

.6 Section 21 05 01 - Common Work Results – Mechanical.

1.2 REFERENCES

.1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)

.1 ANSI/NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.3 Underwriters Laboratories of Canada (ULC)

.1 CAN4-S112-M1990, Fire Test of Fire Damper Assemblies.

.2 CAN4-S112.2-M84, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.

.3 ULC-S505-1974, Fusible Links for Fire Protection Service.

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.2 Indicate the following:

.1 Fire dampers.

.2 Smoke dampers.

.3 Fire stop flaps.

.4 Operators.

.5 Fusible links.

.6 Design details of break-away joints.

.2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

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

.2 Instructions: submit manufacturer's installation instructions.

.1 Consultant will make available 1 copy of systems supplier's installation instructions.

.3 Closeout Submittals:

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

.1 Certificates:

.1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.5 MAINTENANCE

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Provide following:

.1 6 fusible links of each type.

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Section 01 47 15 - Sustainable Requirements: Construction.

2.2 FIRE DAMPERS

.1 Fire dampers: arrangement Type A, B, C, listed and bear label of ULC/UL, meet requirements of Fire Commissioner of Canada (FCC), ANSI/NFPA 90A and authorities having jurisdiction. Fire damper assemblies fire tested in accordance with CAN4-S112.

.2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.

.1 Fire dampers: 1-1/2 hour fire rated unless otherwise indicated.

.2 Fire dampers: automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.

.3 Top hinged: offset single damper, round or square; multi-blade hinged or interlocking type; [roll door type; guillotine type; sized to maintain full duct cross section.

.4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.

.5 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.

.6 Equip fire dampers with steel sleeve or frame installed disruption ductwork or impair damper operation.

.7 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.

.8 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.

.9 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition of floor slab depth or thickness.

.10 Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed.

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 ANSI/NFPA 90A and in accordance with conditions of ULC listing.

.2 Maintain integrity of fire separation.

.3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.

.4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.

.5 Co-ordinate with installer of firestopping.

.6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.

.7 Install break-away joints of approved design on each side of fire separation.

3.3 FIELD QUALITY CONTROL

.1 Verification requirements in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification, include:

.1 Materials and resources.
.2 Storage and collection of recyclables.
.3 Construction waste management.
.4 Resource reuse.
.5 Recycled content.
.6 Local/regional materials.
.7 Low-emitting materials.

3.4 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Supply, return and exhaust grilles and registers, diffusers and linear grilles, for commercial and residential use.

.2 Sustainable requirements for construction and verification.

.2 Related Sections:

.1 Section 01 30 00 - Administrative Requirements.

.2 Section 01 40 00 - Quality Requirements.

.3 Section 01 60 00 - Product Requirements.

.4 Section 01 70 00 - Execution and Closeout Requirement.

.5 Section 01 74 19 - Waste Management and Disposal.

.6 Section 23 05 00 - Common Work Results – HVAC.

1.2 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.

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.2 Indicate following:

.1 Capacity.

.2 Throw and terminal velocity.

.3 Noise criteria.

.4 Pressure drop.

.5 Neck velocity.

.2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

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

.2 Instructions: submit manufacturer's installation instructions.

.1 Consultant will make available 1 copy of systems supplier's installation instructions.

1.4 MAINTENANCE

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Include:

.1 Keys for volume control adjustment.

.2 Keys for air flow pattern adjustment.

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Section 01 47 15 - Sustainable Requirements: Construction.

2.2 GENERAL

.1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.

.2 Frames:

.1 Full perimeter gaskets.

.2 Plaster frames where set into plaster or gypsum board and as specified.

.3 Concealed fasteners.

.3 Concealed manual volume control damper operators.

.4 Colour: as directed by Consultant.

2.3 MANUFACTURED UNITS

.1 Grilles, registers and diffusers of same generic type, products of one manufacturer.

2.4 DIFFUSERS AND GRILLES

.1 Grilles, registers and diffusers of the same generic type to be product of one manufacturer unless shown otherwise.

.2 Meet capacity, pressure drop, terminal velocity, throw, sound level, neck velocity, colour and construction details as indicated.

.3 Ensure that the items supplied will be compatible with ceiling or wall construction.

.4 Provide complete with appropriate mounting frames and volume damper with concealed operator for each outlet.

.5 All air outlets installed in fire rated ceilings or partitions shall be backed with approved fire dampers or stops.

.6 Air outlets shall be factory custom painted white unless noted otherwise.

.7 Air outlets in high humidity spaces shall be made of aluminium.

.8 Wall and ceiling supply grilles for air conditioning supply air to have two way blades for adjustment of air patterns.

.9 Linear grilles to be bar core type with balancing dampers and with type of margin specified.

.10 Linear slot diffusers shall be soiled extruded aluminium with suitable border style and mounting frame to suit architectural finishes. Provide adjustable tear drop extruded aluminium air pattern devices for supply diffusers.

.11 Provide opposed blade balancing dampers on all return and exhaust grilles as specified. Provide dampers on supply outlets except for ceiling outlets where accessible balancing dampers are provided on individual branch lines to the supply outlets.

.12 Floor and sill grilles to be capable of supporting 90 kg (200 lb) point load weight between supports with negligible deflection and be heel and/or pencil proof to suit application.

.13 Ceiling diffusers shall be provided with stabilizing grids where air approach to the diffusers is not linear. For diffusers installed higher than 3.6m (12') provide adjustable cones.

Part 3 Execution

3.1 DIFFUSERS AND GRILLES

.1 Confirm location, symmetry, size and finish of all air outlets and with the mechanical and architectural drawings including the reflected ceiling plan, prior to start of work. Review any discrepancies with the Consultant.

.2 All visible sheet metal ductwork behind air outlets to be painted matt black.

.3 Provide proper supports and allow for minimum one diameter radius for flexible ducts connected to diffusers where the visible ducts are shown on the drawings, the maximum length of flexible ducts to be 5 feet (1500 mm).

.4 Provide cable or metal strap seismic restraints connected to the structure for diffusers or grills mounted in T-bar ceilings with flexible ductwork.

.5 Install air outlets in accordance with manufacturers' instructions.

.6 Install stainless steel or cadmium plated screws in countersunk holes where fastenings are visible; match colour of head with air outlet finish.

.7 Provide concealed safety chain on each grille, register and diffuser located over activity areas (i.e. gymnasium and activity areas).

.8 Provide special keys to Owners for volume control and for air flow adjustments as applicable.

3.2 CLEANING

.1 Proceed in accordance with Section 01 74 11 – Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

.1 RELATED SECTIONS

.1 Section 01 30 00 – Administrative Requirements.
.2 Section 01 40 00 – Quality Requirements.
.3 Section 01 60 00 – Product Requirements.
.4 Section 01 70 00 – Execution and Closeout Requirement.
.5 Section 01 74 19 – Waste Management and Disposal.
.6 Section 20 03 01 – Testing and Activation.
.7 Section 23 05 93 – Testing Adjusting and Balancing.
.8 Section 21 05 01 – Common Work Results – Mechanical.
.9 Section 23 08 00 – Commissioning.

.2 REFERENCES

.1 Air-Conditioning and Refrigeration Institute (ARI)

.1 ARI 210/240-1994, Standard for Unitary Air Conditioning and Air-Source Heat Pump Equipment.

.2 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)

.1 ANSI/NFPA 90A-1999, Installation of Air Conditioning and Ventilating Systems.

.3 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

.1 ASHRAE Standard 15-2001, Safety Standard for Refrigeration Systems.

.2 ASHRAE Standard 90-2010, Energy Standard for Buildings.

.4 Canadian Standards Association (CSA International)

.1 CAN/CSA-C273.3-M91(R2001), Performance Standard for Split-System Central Air-Conditioners and Heat Pumps.

.2 CAN/CSA-C656-M92(R1998), Performance Standard for Single Package Central Air Conditioners and Heat Pumps.

.5 Environment Canada, (EC) / Environmental Protection Services (EPS)

.1 EPS 1/RA/2-1996, Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.

.2 Environment Canada-1994, Ozone-Depleting Substances Alternatives and Suppliers List.

1.3 SUBMITTALS

.1 Submit manufacturer's performance data including refrigerant piping schematics, connection drawings, electrical data, installations and maintenance manuals.

1.4 WARRANTY

.1 The units shall be warranted by the manufacturer for a period of 18 months for date of shipment or 12 months from start-up. The warranty shall include parts supply.

.2 Provide extended warranty as specified.

Part 2 Products

2.1 SPLIT SYSTEM AIR CONDITIONING UNIT AND HEAT PUMPS (UP TO 20 TONS)

The units to be as indicated on the drawings and shall have the following:

.1 General:

.1 CSA certification.
.2 Standard 5-year warranty on compressors.
.3 Designed to function as year round air conditioning system.
.4 Fully charged, factory wired and tested prior to shipment.
.5 System shall consist of fan module, evaporator coil section, heater module, [economizer module] and remote compressor / condenser with
.6 Field installed refrigerant piping as indicated on the schedule.
.7 [Provide heat pump units as indicated].

.2 Indoor Sections:

.1 Casing insulated with 1" (25 mm) neoprene coated liner.
.2 Constructed of galvanized steel.
.3 Access panels for servicing.
.4 D.I. forward curved fan.
.5 Resiliently mounted multi-speed fan motor.
.6 Filter rack and filters. [MERV]
.7 Evaporative coil section complete with expansion valve, fittings, and condensate drain pan.
.8 Control panel complete with 24-volt transformer and circuit.
.9 [Electric heater section complete with controls].
.10 Economizer section as indicated.
.11 Provide auxiliary electric heater for defrost control.

.3 Outdoor Sections:

.1 Condenser coil with fan and vinyl coated coil protection grille.
.2 Hermetic compressor with internal vibration isolation.
.3 Provide all control and safety devices, service valves, reversing valve, crankcase heater, solid state time guard, liquid line filter/dryer, moisture indicator, sight glass, liquid line solenoid valve, and anti-cycling device.
.4 Start assist for single-phase compressor motors.
.5 Time and temperature defrost control for heat pumps.
.6 Heat pressure control on units without economizer to allow for proper operation of units -10°C (50°F).
.7 Capacity starter and relays.

.8 Seismic restraint mounting connections.

.4 Operating Controls (as specified on drawings):
.3 Provide space thermostat for cooling units for electrical rooms

2.2 REFRIGERATION PIPING

.1 Refrigerant Piping and Fittings shall be:

.1 Refrigerant Piping: ACR copper ASTM-88 Type L hard drawn deoxidized and dehydrated. Equipment connections can be Type K soft temper copper with Silfos or flared joints. Piping shall be kept clean at all times.
.2 Fittings: Wrought copper ASTM-75 with bronze alley (Silfos) joints.
.3 General: Provide a complete refrigeration piping system by a certified Refrigeration Mechanic regularly employed in commercial and industrial refrigeration.
.4 Shop Drawings: Prepare and submit layout drawings, including refrigerant piping and accessories, and control arrangements for review by the Consultant prior to starting work. Size piping equivalent to a maximum of 1.1°C temperature drop and in accordance with ASHRAE Standards. Size all suction and hot gas piping, using double risers where necessary, to ensure oil entrainment under minimum load.
.5 Refrigeration Circuits: Provide strainer/driers, sight glasses, moisture indicators, shut-off valves, thermal expansion valves, solenoid valves, receiver, refrigerant, oil, safety accessories, etc. as required for a complete and working installation.
.6 Valves and Specialties: Seal cap type, brass with Teflon seats; acceptable manufacturers: Superior, Mueller, Henry, and Frick.
.7 Check Valves: Type CK-1 as manufactured by Refrigeration Specialties or Frick.
.8 Thermal Expansion Valves: Filter/driers, solenoid valves, moisture indicators: Sporlan or equivalent.
.9 Controls: Provide all control wiring and motor control interlocks as described on the drawings and as required by the equipment manufacturer's installation instructions to achieve required operating sequences and maximum equipment protection.

2.3 FAN-COIL UNITS

.1 General: Unit capacity certified in accordance with ARI Standard 440-93. UL and CSA labelled and approved. Units to include chassis, coil(s), fan wheel(s), fan casing, fan board and motor(s). Exposed units to have cabinet cover. The unit to be acoustically and thermally insulated.

.2 Cabinet: Painted 16 gauge (1.6 mm) steel with rounded exposed corners and edges, easily removed panels, internal insulation with front, inlet and outlet grilles or ducted as indicated. Provide hinged access doors as required to valves.

.3 Coils: Evenly spaced aluminium fins mechanically bonded to copper tubes complete with vents and drain plugs. Working pressure at 300 psig (2069 kPa) at 93°C water temperature.

.4 Fans: Centrifugal forward curved double width metal fan wheels statically and dynamically balanced; direct driven with sleeve bearings and resiliently mounted for quiet operation. Fans and housing to be corrosive resistance.

.5 Motor: Multi-speed, tapped wound, permanent split capacitor type with permanently lubricated bearings, built-in thermal overload protection and resilient rubber insulation mounting. Provide quick disconnect motor plug.

.6 Drain Pan: Non-corrosive drain pan (ABS or equivalent) positively sloped to drain; insulated with closed-cell insulation.

.7 Filters: Removable 1" (25mm) thick glass fibre throw-away [or permanent washable type filters.]

.8 Control: Provide 3 position speed switch factory wired and CSA-approved. Provide remote key operated wall mounted disconnect switch for ceiling mounted units. Provide thermostats as indicated.

.9 Access Doors: Provide ceiling access panel of 18 gauge steel with tamper proof screw fasteners and safety chain. Panels to have channels frame for rigidity.

Part 3 Execution

3.1 REFRIGERATION SYSTEMS

.1 General: Provide shop drawings and pipe schematics for refrigeration systems to Consultant prior to start of work.

.2 Piping: Install piping, components and equipment in accordance with schematics, code and standard industry practice. During brazing procedures, charge piping with inert gas to prevent scale formation.

.3 Pressure Tests: Prior to application of insulation and dehydration, test all systems under pressure with nitrogen for 24 hours minimum until no pressure drop occurs. If leads are detected, repeat test procedure after repairs. Test high side at 2100 kPa (300 psi) and low side at 1050 kPa (150 psi).

.4 Dehydration: Evacuate system to dehydrate and hold for 24 hours minimum a vacuum of 99.9 kPa (29" HG). Break vacuum with refrigerant operating charge, monitor moisture indicators and change or replace filter/driers, or filter drier cores until moisture is eliminated.

.5 Tests: Start-up system, monitor operation and perform all tests to ensure system operates to manufacturer'' requirements and issue certificate to the Consultant and include copy in the Maintenance Manual.

.6 Instructions: Instruct Owner in proper operating and maintenance procedures.

3.2 EQUIPMENT START-UP

.1 Follow manufacturer's instructions and have manufacturer's representative present to certify the installation and refrigerant piping schematics.

.2 The Qualified Refrigerant Tradesman shall complete a separate checklist for each split system installation. Refer to Section 15 Attachment.

.3 Check each item of equipment to ensure proper electrical connections, etc., and to verify proper operation.

.4 Complete commissioning check lists and forward to the Consultant.

3.3 MISCELLANEOUS DRAIN CONNECTIONS

.1 Coordinate with the Plumbing Trade the installation of condensate drain line. Provide drain connection on all equipment including cooling coil drain pans including over-flow connections. For equipment installed in ceiling spaces run condensate a minimum of one floor before connecting into a storm line. Provide check valve in horizontal position . Check valve to be installed minimum 1.5m (5'-0") below indoor unit at connection to storm line. Condensate piping to be insulated.

3.4 PIPE INSULATION

.1 Refer to SECTION 20 19 01 PIPING INSULATION.

3.5 AIR BALANCING

.1 Air balancing indoor unit to air quantities shown on mechanical drawings.

3.6 INDOOR/OUTDOOR UNIT SUPPORTS

.1 Support indoor units from structure with rubber grommets for units up to 1.5 tons and spring isolators for units larger than 1.5 tons.

.2 Outdoor units to be mounted on concrete curbs attached to building structure.

3.7 INTERLOCK

.1 Interlock indoor and outdoor units.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 00 01 10 – Table of Contents.

.2 Section 01 32 00 – Construction Schedule.

.3 Section 01 33 00 – Submittal Procedures.

.4 Section 01 45 00 – Quality Control.

.5 Section 01 60 00 – Product Requirements.

.6 Section 01 74 00 – Construction Waste Management Requirements.

.7 Section 01 77 00 – Closeout Submittals.

.8 Section 01 79 00 – Demonstration and Training.

.9 Section 01 91 13 – General Commissioning Requirements.

.10 Section 01 91 31 – Commissioning Plan

.11 Section 01 91 33 – Commissioning Forms

.12 Sections 01 91 41 – Commissioning Training

.13 Division 23 – HVAC.

.14 Division 28 – Electronic Safety and Security.

1.2 REFERENCES

.1 Codes and Standards

.1 CSA C22.1, Canadian Electrical Code, Part 1 (latest Edition), Safety Standard for Electrical Installations.

.2 National Building Code.

.2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)

.1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.

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.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.

.1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

.3 Language operating requirements: provide identification nameplates and labels for control items in English.

1.5 SUBMITTALS

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

.2 Shop drawings:

.1 Submission shall include but not limited to lighting switches, occupancy sensor, receptacles, faceplate and other special equipment.

.2 If changes are required, notify Consultant of these changes before they are made.

.3 All digital shop drawing submittals are to have a high enough DPI setting to ensure legibility. Illegible shop drawings will be returned immediately for resubmittal at the discretion of the Engineer.

.3 Quality Control: in accordance with Section 01 45 00 - Quality Control.

.1 Provide CSA-certified equipment and material.

.2 Where CSA-certified equipment and material is not available, submit such equipment and material to authority having jurisdiction or inspection authorities for special approval before delivery to site.

.3 Submit test results of installed electrical systems and instrumentation.

.4 Permits and fees: in accordance with General Conditions of contract.

.5 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.

.6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Consultant.

1.6 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.

.2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor licenses or apprentices, as per the conditions of Provincial Act respecting manpower vocational training and qualifications.

.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:

.1 In accordance with Section 01 32 16 - Construction Progress Schedule - Bar (GANTT) Charts.

1.7 DELIVERY, STORAGE AND HANDLING

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

1.8 SYSTEM STARTUP

.1 Instruct Consultant and operating personnel in operation, care and maintenance of systems, system equipment and components.

.2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

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.

Part 2 Products

2.1 MATERIALS AND EQUIPMENT

.1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.

.2 Material and equipment to be CSA-certified; where CSA-certified material and equipment is not available, obtain special approval from authority having jurisdiction and inspection authorities before delivery to site and submit such approval, as described in Section 01 33 00 – Submittal Procedures.

.3 Factory-assembled control panels and component assemblies.

2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

.1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

2.3 WARNING SIGNS

.1 Warning Signs: in accordance with requirements of inspection authorities.

.2 Porcelain enamel signs, minimum size 175 x 250 mm.

2.4 WIRING TERMINATIONS

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

2.5 EQUIPMENT IDENTIFICATION

.1 Identify electrical equipment with nameplates and labels as follows:

.1 Nameplates: lamicoid, 3-mm-thick plastic engraving sheet, black face, white lettering, accurately aligned and engraved into core mechanically attached with self tapping screws or red face with white lettering for emergency supplies.

.2 Sizes as follows:

NAMEPLATE SIZES

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

.2 Labels: embossed plastic labels with 6-mm-high letters, unless specified otherwise.

.3 Wording on nameplates and labels to be approved by Consultant prior to manufacture.

.4 Allow for minimum of twenty-five (25) letters per nameplate and label.

.5 Nameplates for terminal cabinets and junction boxes to indicate system and voltage.

.6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.7 Terminal cabinets and pull boxes: indicate system and voltage.

2.6 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, numbered 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 coding: to CSA C22.1.

2.7 FINISHES

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

.1 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.

Part 3 Execution

3.1 INSTALLATION

.1 Do complete installation in accordance with CSA C22.1, except where specified otherwise.

.2 Coordinate all rough-in, equipment installation and equipment location requirements with other consultants' drawings and equipment schedules.

3.2 NAMEPLATES AND LABELS

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

3.3 CONDUIT AND CABLE INSTALLATION

.1 Conceal conduit as much as possible.

.2 Surface conduit is acceptable in service room or lab.

3.4 LOCATION OF OUTLETS

.1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.

.2 Do not install outlets back-to-back in wall; allow minimum of 150 mm horizontal clearance between boxes.

.3 Change location of power and data outlets at no extra cost or credit, providing distance does not exceed 3,000 mm, or as indicated on drawings, and information is given before installation.

.4 Locate light switches on latch side of doors.

.1 Locate disconnect devices in mechanical room on latch side of door.

3.5 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

.3 Install electrical equipment at following heights to the centre line unless indicated otherwise.

- .1 Local switches: 1,067 mm.
- .2 Wall receptacles:
  - .1 General: 450 mm.
  - .2 Above top of continuous baseboard heater: 200 mm.
  - .3 Above top of counters or counter splash backs: 150 mm.
  - .4 In mechanical rooms: 1,067 mm.
- .3 Panelboards: as required by Code or as indicated.
- .4 Telephone and interphone outlets: 450 mm.
- .5 Wall mounted telephone and interphone outlets: 1,200 mm.
- .6 Fire alarm stations: 1,200 mm.
- .7 Fire alarm horns: 2,100 mm.
- .8 Television outlets: 450 mm.

3.6 FIELD QUALITY CONTROL

.1 Conduct following tests in accordance with Section 01 45 00 - Quality Control.

- .1 Circuits originating from branch distribution panels.
- .2 Lighting and its control.
- .3 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
- .4 Systems: fire alarm system and communications.
- .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 1,000 V instrument.
  - .3 Check resistance to ground before energizing.

.2 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

3.7 CLEANING

.1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

3.8 PROGRESS CLAIM

.1 Contractor to provide cost breakdown in accordance with the following and utilize same for all progress claim submittals.

END OF SECTION 26 05 00

Part 1 General

1.1 RELATED WORK

.1 This Section of the Specification is to be read, coordinated and implemented in conjunction with all other parts of the Contract Documents.

1.2 REGULATORY REQUIREMENTS

.1 Restraints shall meet the requirements of the 2010 National Building Code.

.2 The Seismic Engineer should be able to provide a proof of professional insurance. The Seismic Engineer should be familiar with SMACNA, ECABC & NFPA guidelines as well as 2010 National Building Code requirements.

.3 The Contractors Seismic Representative shall submit original signed “Letters of Assurance” “Schedules B1, B2 and C-B”.

.4 The above requirements shall not restrict or supplant the requirements of any local bylaws, codes, or other certified agencies which may have jurisdiction over all or part of the installation.

1.3 SCOPE

.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 Provide restraint on all equipment and machinery, which is part of the building electrical services and systems, to prevent injury or hazard to persons and equipment in and around the structure. Restrain all such equipment in its normal position in the event of an earthquake.

.3 The total electrical seismic restraint design and field review and inspection will be by a B.C. registered professional structural Engineer who specializes in the restraint of building elements. Contractor to allow for coordination, provision of seismic restraints, as well as all costs for the services of the Seismic Restraint Engineer. This Engineer, herein referred to as the Seismic Engineer, will provide normal engineering functions as they pertain to seismic restraint of electrical installations.

.4 The Contractor shall be aware of, and comply with, all current seismic restraining requirements and make provision for those that may come into effect during construction of the project. Make proper allowance for such conditions in the tender.

.5 Provide seismic restraints on all equipment, and/or installations or assemblies, which are suspended, pendant, shelf mounted, freestanding and/or bolted to the building structure or support slabs.

.6 The Seismic Engineer shall provide inspections during and after installation. The Contractor shall correct any deficiencies noted without additional cost to the contract.

.7 Include all costs associated with the Seismic installation and certification in the base tender.

1.4 SHOP DRAWINGS & SUBMITTALS

.1 Submit shop drawings of all seismic restraint systems including details of attachment to the structure, either tested in an independent testing laboratory or approved by the Seismic Engineer.

.2 Submit all the proposed types and locations of inserts or connection points to the building structure or support slabs. Follow the directions and recommendations of the Seismic Engineer.

Part 2 Products

2.1 SLACK CABLE SYSTEMS

.1 Slack cable restraint systems shall be as designed and supplied by approved manufacturer.

.2 Slack cable restraints shall be provided on suspended and shelf mounted transformers along with associated equipment and assemblies connected to them at the points of vertical support (4 points). The restraint wires shall be oriented at approximately 90o to each other (in plan), and tied back to the ceiling slab or its structure at approximately 45o to the slab or basic structure. The restraints shall be selected for a 1 g earthquake loading, i.e. each wire shall have a working load capacity equal to the weight of the transformer. The anchors in the structure shall be selected for a load equal to the weight of the transformers at a 45o pull.

.3 Slack cable systems to allow normal maintenance of equipment and shall not create additional hazard by their location or configurations. Contractor shall rectify any such installations at no additional cost, all to the satisfaction of the Client and inspection authority having jurisdiction.

.4 Coordinate requirements of slack cables with suppliers prior to installation.

Part 3 Execution

3.1 GENERAL

.1 All seismic restraints systems shall conform to local authority having jurisdiction and all applicable code requirements.

3.2 CONDUITS

.1 Provide restraint installation information and details on conduit and equipment as indicated below:

.2 Vertical Conduit:

.1 Attachment - Secure vertical conduit at sufficiently close intervals to keep the conduit in alignment and carry the weight of the conduits and wiring. Stacks shall be supported at their bases and, if over 2 stories in height, at each floor by approved metal floor clamps.

.2 At vertical conduit risers, wherever possible, support the weight of the riser, at a point or points above the center of gravity of the riser. Provide lateral guides at the top and bottom of the riser, and at intermediate points not to exceed 9.2 m o.c.

.3 Riser joints shall be braced or stabilized between floors.

.3 Horizontal Conduits:

.1 Supports - Horizontal conduit shall be supported at sufficiently close intervals to keep it in alignment and prevent sagging.

.2 EMT tubing - tubing shall be supported as per CEC (approximately 1.2 m intervals for tubing).

.4 Provide transverse bracing at 12.2 m o.c. maximum unless otherwise noted. Provide bracing at all 90o bend assemblies.

.5 Provide longitudinal bracing at 24.4 m o.c. maximum unless otherwise noted.

.6 Do not brace conduit runs against each other. Use separate support and restraint system.

.7 Support all conduits in accordance with the capability of the pipe to resist seismic load requirements indicated.

.8 Trapeze hangers may be used. Provide flexible conduit connections where conduits pass through building seismic or expansion joints, or where rigidly supported conduits connect to equipment with vibration or seismic isolators.

.9 A conduit system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.

.10 Provide large enough conduit sleeves through walls or floors to allow for anticipated differential movements with firestopping where required.

.11 It is the responsibility of the contractor to ascertain that an appropriate size restraint device be selected for each individual piece of equipment. Review with Seismic Engineer and submit shop drawings to the Client for his reference.

3.3 FLOOR MOUNTED EQUIPMENT

.1 Bolt all equipment, e.g. transformers, switchgear, generators, motor control centres, free standing panelboards, control panels, capacitor banks, etc. to the structure. Design anchors and bolts, as recommended by the Seismic Engineer.

.2 Provide flexible conduit connections between floor mounted equipment to be restrained and its adjacent associated electrical equipment.

3.4 LIGHT FIXTURES

.1 Fluorescent fixtures in suspended ceilings shall be hung independently of the ceiling system. Fixtures shall be secured to concrete or structural deck above by at least two taught cables which are connected to the fixture at diagonal points.

.2 Surface and recessed style fixtures shall be hung independently of the ceiling system. Fixtures shall be secured to concrete or structural deck above by taught cables.

.3 Seismic restraint cables shall be secured into the concrete or structural deck above.

.4 Cables shall be corrosion resistant and approved for the application.

END OF SECTION 26 05 00.02

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for wire and box connectors.

1.2 RELATED SECTIONS

.1 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2No.18-98, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.

.2 CSA C22.2No.65-93 (R1999), Wire Connectors.

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

.1 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

.3 National Electrical Manufacturers Association (NEMA)

1.4 WASTE MANAGEMENT AND DISPOSAL

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

.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 in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused wiring materials from landfill to metal recycling facility as approved by General Contractor.

Part 2 Products

2.1 MATERIALS

.1 Pressure type wire connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.

.2 Fixture type splicing connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

.3 Bushing stud connectors: to EEMAC 1Y-2 to consist of:

.1 Connector body and stud clamp for stranded and round copper conductors.
.2 Clamp for stranded round copper conductors.
.3 Stud clamp bolts.
.4 Bolts for copper conductors.
.5 Sized for conductors, tubes and bars as indicated.

Part 3 Execution

3.1 INSTALLATION

.1 Remove insulation carefully from ends of conductors and:

.1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
.2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2No.65.
.3 Install fixture type connectors and tighten. Replace insulating cap.
.4 Install bushing stud connectors in accordance with EEMAC 1Y-2.

END OF SECTION 26 05 20

Part 1 General

1.1 RELATED REQUIREMENTS

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

.2 Section 26 05 20 – Wire and Box Connectors 0 – 1000 V.

.3 Section 26 05 22 – Connectors and Terminations.

1.2 REFERENCES

.1 CSA C22.1-12 Canadian Electrical Code, part 1.

.2 CSA X32 – Safety Standard for Electrical Installations.

1.3 PRODUCT DATA

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

1.4 DELIVERY, STORAGE AND HANDLING

.1 Packaging Waste Management: remove for reuse of pallets, crates and packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 BUILDING WIRES

.1 Conductors: stranded for 8 AWG and larger. Minimum size: 12 AWG.

.2 Copper conductors: size as indicated, with 600 and 1,000 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE, Jacketed.

.3 Copper conductors used in slab, under slab and below grade to be RWU90, jacketed.

2.2 ARMOURED CABLES

.1 Conductors: insulated, copper or aluminium, size as indicated.

.2 Armour: interlocking type fabricated from galvanized steel strip.

.3 Maximum length of AC90 cable shall be 3 m for lighting and 4 m for wiring devices (at final drops).

.4 Type: ACWU90 – PVC jacket over armour meeting requirement of FT-4.

.5 Connectors: anti short connectors.

2.3 FIRE ALARM SYSTEM CONDUCTORS

.1 Fire alarm system conductors shall be run in non-combustible conduit.

.2 Fire alarm initiating device conductors within a floor area shall be run individually in non-combustible conduit.

2.4 CONTROL CABLES

.1 Type: LVT: with minimum size #18 AWG soft annealed copper conductors, sized as indicated:

.1 Insulation: thermoplastic.

.2 Sheath: thermoplastic jacket and armour of closely wound aluminum wire.

.2 Type: low energy 300 V control cable: stranded, annealed copper conductors sized as indicated LVT: soft annealed copper conductors, sized as indicated:

.1 Insulation: PVC 40 degrees C.

.2 Shielding: wire over each pair or group over conductors.

.3 Overall covering: PVC jackets, polyethylene jackets.

.3 Type: 600 V stranded annealed copper conductors, sizes as indicated:

.1 Insulation: PVC RW75, R90, cross-linked polyethylene type R90 (x-link).

.2 Shielding: non-magnetic tape wire over each pair of conductors.

.3 Overall covering: thermoplastic jacket PVC.

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 one test using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

.1 Lay cable in cable trays in accordance with Section 26 05 36 - Cable Trays for Electrical Systems.

.2 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).

.3 Cable Colour Coding: to Section 26 05 00 Common Work Results for Electrical.

.4 Conductor length for parallel feeders to be identical.

.5 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.

.6 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.

.7 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be dedicated circuits only.

.8 Provide numbered wire tags for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.3 INSTALLATION OF BUILDING WIRES

.1 Install wiring as follows:

.1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

3.4 INSTALLATION OF CONTROL CABLES

.1 Install control cables in conduit or cable troughs.

.2 Ground control cable shielding.

END OF SECTION 26 05 21

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.2 Section 26 05 00 - Common Work Results - Electrical.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)

.1 ANSI/IEEE 837-1989(R1996), Qualifying Permanent Connections Used in Substation Grounding.

.2 Canadian Standards Association, (CSA International)

1.3 WASTE MANAGEMENT AND DISPOSAL

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

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

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

.4 Divert unused metal materials from landfill to metal recycling facility as approved by Client.

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

Part 2 Products

2.1 EQUIPMENT

Part 3 Execution

3.1 EQUIPMENT GROUNDING (BONDING)

.1 Install grounding connections to typical equipment included in, but not necessarily limited to following list:- motor starters, control panels, distribution panels, lighting fixtures, receptacles, cable tray.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

.4 Disconnect ground fault indicator during tests.

END OF SECTION 26 05 28

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.2 WASTE MANAGEMENT AND DISPOSAL

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

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

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

.4 Divert unused metal materials from landfill to metal recycling facility as approved by Client.

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

Part 2 Products

2.1 SUPPORT CHANNELS

.1 U shape, size 41 x 41 mm, 2.5-mm-thick, surface mounted or suspended or set in poured concrete walls and ceilings.

Part 3 Execution

3.1 INSTALLATION

.1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors.

.2 Secure equipment to poured concrete with expandable inserts.

.3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.

.5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.6 Fasten exposed conduit or cables to building construction or support system using straps.

- .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
- .2 Two-hole steel straps for conduits and cables larger than 50 mm.
- .3 Beam clamps to secure conduit to exposed steel work.

.7 Suspended support systems.

- .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
- .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .3 Support cable trays by 6mm dia threaded rod hangers, and as directed by manufacturer.

.8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.10 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Consultant.

.12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION 26 05 29

Part 1 General

1.1 RELATED SECTIONS

.1 26 05 00 – Common Work Results – Electrical.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1, Canadian Electrical Code, Part 1, 2012.

Part 2 Products

2.1 SPLITTERS

.1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.2 Terminations: main and branch lugs and connection blocks to match required size and number of incoming and outgoing conductors as indicated.

.3 Spare Terminals: minimum three spare terminals or double lugs on each connection or double lug block sized less than 400 A.

2.2 JUNCTION AND PULL BOXES

.1 Construction: welded steel enclosure.

.2 Covers Flush Mounted: 25 mm minimum extension all around.

.3 Covers Surface Mounted: screw-on flat covers.

2.3 CABINETS

.1 Construction: welded sheet steel as indicated hinged door, handle, latch lock two keys and catch.

Part 3 Execution

3.1 SPLITTER INSTALLATION

.1 Mount plumb, true and square to building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.

.3 Install terminal block as indicated.

.4 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

3.3 IDENTIFICATION

.1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical.

.2 Identification Labels: size 2 indicating system name, voltage and phase or as indicated (junction boxes to be colour coded only).

END OF SECTION 26 05 31

Part 1 General

1.1 RELATED SECTIONS

.1 26 05 00 – Common Work Results for Electrical.

.2 26 27 26 – Wiring Devices

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1, Canadian Electrical Code, Part 1.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

.1 Size boxes in accordance with CSA C22.1, as amended for BC.

.2 102 mm square or larger outlet boxes as required.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 GALVANIZED STEEL OUTLET BOXES

.1 One-piece electro-galvanized construction.

.2 Single and multi-gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.

.3 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.

.4 102 mm square or octagonal outlet boxes for lighting fixture outlets.

.5 Extension and plaster rings for flush mounting devices in finished plaster walls.

2.3 MASONRY BOXES

.1 Electro-galvanized steel masonry single and multi-gang boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

.1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 FLOOR BOXES

.1 Concrete tight electro-galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brass faceplate. Device mounting plate to accommodate short or long ear duplex receptacles. Minimum depth: 73 mm for receptacles and communication outlets.

.2 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 16, 21 and 27 mm conduit. Minimum size: 73 mm deep.

2.6 CONDUIT BOXES

.1 Cast FS or FD boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

2.7 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE

.1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63 mm with two double clamps to take non-metallic sheathed cables.

2.8 FITTINGS - GENERAL

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

Part 3 Execution

3.1 INSTALLATION

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

.4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.

.5 Vacuum clean interior of outlet boxes before installation of wiring devices.

.6 Identify systems for outlet boxes as required.

.7 Ensure that there is insulation behind outlet boxes mounted in exterior walls to prevent condensation through boxes.

.8 Coordinate outlet location and mounting heights for counters, benches splashbacks and built-in units. Refer to Architectural details and/or shop drawings. Coordinate mounting height to coordinate with heating units.

.9 Provide non-combustible material in outlet boxes which penetrate a fire separation.

.10 Where a vapour barrier is installed as part of any wall construction, provide proper "Vapor-Hats" or pre-flanged outlet boxes.

END OF SECTION 26 05 32

Part 1 General

1.1 RELATED SECTIONS

.1 26 05 00 – Common Work Results – Electrical.

.2 26 05 32 – Outlet Boxes, Conduit Boxes and Fittings.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA C22.2 No. 18-98(R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.

.2 CSA C22.2 No. 45-M1981(R2003), Rigid Metal Conduit.

.3 CSA C22.2 No. 56-04, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.

.4 CSA C22.2 No. 83-M1985(R2003), Electrical Metallic Tubing.

.5 CSA C22.2 No. 211.2-M1984(R2003), Rigid PVC (Unplasticized) Conduit.

.6 CAN/CSA C22.2 No. 227.3-05, Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).

1.3 LOCATION OF CONDUIT

.1 Drawings do not show all conduits. Those shown are in diagrammatic form only.

.2 Conduit shall be of the type as follows:

.1 Exposed in ceiling - E.M.T. - walls below 1500 mm -rigid steel

.2 Exposed in mechanical and electrical rooms - E.M.T.

.3 Concealed in ceiling cavities - E.M.T. or B.X. (final drop only)

.4 Drops to luminaries -

.5 Connection to electrical or mechanical equipment that vibrates - flexible conduit. (water proof where subject to damp or wet conditions)

Part 2 Products

2.1 CONDUITS

.1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded (RS).

.2 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.

.3 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.

.4 Rigid PVC conduit: to CSA C22.2 No. 211.2, complete with fittings of same manufacturer.

.5 Flexible metal conduit (FC): to CSA C22.2 No. 56, liquid-tight flexible metal (LTFC).

.6 Electrical non-metallic tubing (ENT).

2.2 CONDUIT FASTENINGS

.1 One hole straps to secure surface conduits 50 mm and smaller.

.1 Two hole steel straps for conduits larger than 50 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits.

.4 Threaded rods, 6 mm diameter, to support suspended channels.

2.3 CONDUIT FITTINGS

.1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.

.2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.

.3 Steel connectors and couplings (in dry area) for EMT.

.1 Standard fittings are acceptable.

.2 Set screws are acceptable.

Part 3 Execution

3.1 INSTALLATION

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Conceal conduits except in mechanical and electrical service rooms.

.3 Horizontal conduit runs in the walls are not permitted.

.4 Surface mount conduits except where concealed.

.5 Use ENT conduit embedded in concrete slabs for lighting and general purpose receptacle circuits only. Mechanical and kitchen load circuits shall not be embedded.

.6 Use electrical metallic tubing (EMT) except in cast concrete.

.7 Use rigid PVC conduit underground.

.8 Use flexible metal conduit for connection to motors in dry areas, connection to recessed incandescent fixtures without prewired outlet box and connection to surface or recessed fluorescent fixtures.

.9 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.

.10 Minimum conduit size for lighting and power circuits: 21 mm.

.11 Bend conduit cold:

.1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.12 Mechanically bend steel conduit over 21 mm diameter.

.13 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.14 Remove and replace blocked conduit sections.

.1 Do not use liquids to clean out conduits.

.15 Dry conduits out before installing wire.

.16 All telephone, intercom and other multimedia conduits to be 1" unless otherwise noted.

.17 Provide bell ends to conduit where terminate into pull pit.

3.2 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on suspended or surface channels.

.5 Do not pass conduits through structural members except as indicated.

.6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

.7 All conduits serving mechanical and electrical emergency systems associated with high-rise building requirements shall be protected from fire exposure to a minimum of two homes.

3.3 CONCEALED CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Do not install horizontal runs in masonry walls.

.3 Do not install conduits in terrazzo or concrete toppings.

3.4 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION 26 05 34

Part 1 General

1.1 SECTION INCLUDES

.1 Switches, receptacles, wiring devices, cover plates and their installation.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

.3 Section 26 05 00 – Common Work Results - Electrical.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA-C22.2 No.42-99(R2002), General Use Receptacles, Attachment Plugs and Similar Devices.

.2 CSA-C22.2 No.42.1-00, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).

.3 CSA-C22.2 No.55-M1986(July 2001), Special Use Switches.

.4 CSA-C22.2 No.111-00, General-Use Snap Switches (Bi-national standard, with UL 20, twelfth edition).

1.4 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

.2 Provide 2 sample of each wiring device for review.

1.5 WASTE MANAGEMENT AND DISPOSAL

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

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

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

.4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Client.

Part 2 Products

2.1 SWITCHES

.1 15 A, 120V single pole, double pole, three-way switches decora, specification grade.

.2 Manually-operated general purpose ac switches as indicated and with following features:

.1 Terminal holes approved for No. 10 AWG wire.
.2 Suitable for back and side wiring, c/w ground terminal.
.3 White toggle operated.

.3 Acceptable material: Pass & Seymour CS15AC1W (1 way) , CS15AC3W (3-way).

2.2 RECEPTACLES

.1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A U ground, Specification grade with following features:

.1 White nylon face.
.2 Suitable for No. 10 AWG for back and side wiring.
.3 Break-off links for use as split receptacles.
.4 Back and side wired.
.5 Acceptable material: Pass & Seymour CR15W

.2 Single receptacles CSA type 5-15 R, 125 V, 15 A U ground with following features:

.1 White nylon face.
.2 Suitable for No. 10 AWG for back and side wiring.
.3 Four back wired entrances, 2 side wiring screws.

.3 Other receptacles with ampacity and voltage as indicated:

.1 Ground fault interrupter receptacles: duplex receptacle with Class A ground fault interrupter, test, and reset buttons.
.2 Weatherproof receptacles: as above with spring loaded, self-closing, weatherproof, lexan cover.

2.3 COVER PLATES

.1 Cover plates for recepacles shall be 0.032” thick stainless steel.

.2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.

.3 Nylon cover plates, thickness 2.5 mm for light switch mounted in flush-mounted outlet box.

.4 Weatherproof double lift spring loaded polycarbonate complete with gaskets for duplex receptacles as indicated.

.5 Bench top receptacle outlet box shall be die-cast aluminum finish similar to WIREMOLD 525 series with all necessary accessories for 2 duplex receptacles, 1 duplex receptacle or 1 208V simplex receptacle.

Part 3 Execution

3.1 INSTALLATION

.1 Switches:

.1 Install single throw switches with handle in "UP" position when switch closed.

.2 Install switches in gang type outlet box when more than one switch is required in one location.

.3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results – Electrical, as indicated.

.2 Receptacles:

.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.

.2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results - Electrical.

.3 Cover plates:

.1 Protect cover plate finish with paper or plastic film until painting and other work is finished.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

END OF SECTION 26 27 26

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for fused and non-fused disconnect switches.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.3 Section 26 05 00 - Common Work Results - Electrical.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CAN/CSA C22.2 No.4-M89 (R2000), Enclosed Switches.

.2 CSA C22.2 No.39-M89 (R2003), Fuseholder Assemblies.

1.4 SUBMITTALS

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

1.5 HEALTH AND SAFETY

.1 Do construction occupational health and safety in accordance with General Project Health and Safety Requirements.

1.6 WASTE MANAGEMENT AND DISPOSAL

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

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

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

.4 Separate for reuse and recycling and place in designated waste containers waste in accordance with Waste Management Plan.

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

Part 2 Products

2.1 DISCONNECT SWITCHES

.1 Fusible and non-fusible, amps disconnect switch in CSA Enclosure, CAN/CSA C22.2 No.4 size as indicated.

.2 Provision for padlocking in off switch position by one lock.

.3 Mechanically interlocked door to prevent opening when handle in ON position.

.4 Fuses: size as indicated, in accordance with drawing requirement.

.5 Fuseholders: to CSA C22.2 No.39 relocatable and suitable without adaptors, for type and size of fuse indicated.

.6 Quick-make, quick-break action.

.7 ON-OFF switch position indication on switch enclosure cover.

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.

.2 Indicate name of load controlled on size 4 nameplate.

Part 3 Execution

3.1 INSTALLATION

.1 Install disconnect switches complete with fuses if applicable.

END OF SECTION 26 28 23

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 – Common Work Results - Electrical.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.2 ICES-005-07, Radio Frequency Lighting Devices.

.3 Underwriter's Laboratories (UL)

.4 Underwriters' Laboratories of Canada (ULC)

.5 Illuminating Engineering Society of North America (IESNA)

1.3 QUALITY ASSURANCE

.1 Provide mock-ups in accordance with Section 01 45 00 - Quality Control.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 60 00 - Common Product Requirements.

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

.3 Packaging Waste Management: remove for reuse and return pallets, crates, paddling and packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.4 Divert unused metal materials from landfill to metal recycling facility.

Part 2 Products

.1 SUPPLY BY OWNER.

2.1 INSTALLATION

.1 Locate and install luminaires as indicated.

.2 Provide adequate support to suit ceiling system.

2.2 WIRING

.1 Connect luminaires to lighting circuits:

.1 Install flexible or rigid conduit for luminaires as indicated.

2.3 LUMINAIRE SUPPORTS

.1 For suspended ceiling installations support luminaires independently of ceiling.

2.4 LUMINAIRE ALIGNMENT

.1 Align luminaires mounted in continuous rows to form straight uninterrupted line.

.2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

2.5 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

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

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

END OF SECTION 26 50 00

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - Electrical.

.2 Division 27, Division 28 and Division 23.

1.2 REFERENCES

.1 National Building Code 2010

.2 Underwriter's Laboratories of Canada (ULC)

.1 CAN/ULC-S524, Installation of Fire Alarm Systems.
.2 ULC-S525, Audible Signal Appliances for Fire Alarm.
.3 CAN/ULC-S526, Visual Signal Appliances, Fire Alarm.
.4 CAN/ULC-S527, Control Units.
.5 CAN/ULC-S528, Manual Pull Stations.
.6 CAN/ULC-S529, Smoke Detectors.
.7 CAN/ULC-S530, Heat Actuated Fire Detectors.
.8 CAN/ULC-S536, Inspection and Testing of Fire Alarm Systems.
.9 CAN/ULC-S537, Verification of Fire Alarm Systems.

1.3 SYSTEM DESCRIPTION

.1 The Electrical Subcontractor shall supply and install additions and modifications to the existing fire alarm system as herein specified and as shown on the drawings.

.2 This section of the specification includes the furnishing, installation, connection and testing of alarm initiating devices, alarm notification appliances, auxiliary control devices and wiring as shown on the drawings and specified herein, required to form a complete, operative, coordinated system.

1.4 SHOP DRAWINGS

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

1.5 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for fire alarm system for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

.2 Include:

.1 Instructions for complete fire alarm system to permit effective operation and maintenance.

.2 Technical data - illustrated parts lists with parts catalogue numbers.

.3 Copy of approved shop drawings with corrections completed and marks removed except review stamps.

.4 List of recommended spare parts for system.

1.6 EXTRA MATERIALS

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Include:

.1 20 spare glass rods for manual pull box stations if applicable – N/A.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal, and with the Waste Reduction Workplan.

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

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

Part 2 Products

2.1 FIRE ALARM SYSTEM

.1 System Description

.1 The existing fire alarm system is a single stage system.

.2 Alarm Initiating Devices

.1 Smoke Detectors

.1 The contractor shall furnish and install ionization / photoelectric smoke detectors as shown on the plans and provide:

.1 Field adjustable sensitivity.

.2 Latch into alarm.

.3 Connection for remote smoke indicator if shown.

.4 Test feature.

.5 Integral alarm LED

.6 24 VDC operation.

.2 The smoke detector shall be of an unipolar, dual chamber ionization type. Separate base complete with terminals.

.2 Heat Detectors

.1 The contractor shall furnish and install heat detectors as shown on the plans and provide:

.1 135°F fixed temperature and rate of rise.

.3 Manual Stations

.1 The contractor shall furnish and install manual non-coded single stage pull station as shown on the plans.

.3 Signaling Devices

.1 Vibrating Bells/ Horn Speaker

.1 Bells shall be of approved type in accordance with ULC Standards ULC-S525.

.2 The bell units shall be a surface unit.

.3 All bells shall be painted to match surrounding surfaces.

Part 3 Execution

3.1 INSTALLATION

.1 The Fire Alarm system shall be installed according to CAN/ULC-S524 latest edition and the applicable provision of the authority having jurisdiction.

.2 Wiring

.1 The power supplies to the Fire Alarm system shall be taken from panels connected as close to the main service as possible.

.2 All wiring shall be installed in conduit and to conform to the requirements of the Canadian Electrical Code, Part 1 and applicable Provincial Codes. Wiring shall be sized in accordance with Class 2 requirements, but shall be protected from mechanical injury and other conditions such as moisture, excessive heat or corrosive action in accordance with Class 1 requirements. Conductors shall be solid copper. The minimum size of any conductor shall be:

.1 For alarm receiving circuits and remote annunciator, #18 Awg for five or more conductors in a cable, #18 Awg, three or four conductors in a cable and #14 Awg for one to two conductors in a cable. In no case shall the wire resistance in these circuits exceed 50 ohms.

.2 For signal circuits #14 Awg for on or two conductors in a cable or #18 Awg for three or four conductors in a cable. In no case shall the voltage drop to any signal exceed 10%. Each signal CCT shall have spare capacity to add six extra signaling devices with no modifications required to the wiring or the control panel.

.3 Temperature rating of cable shall be 85 degrees C.

.4 Fire Alarm System Testing, Verification and Certification

.1 Fire alarm system shall be verified in compliance with ULC standard No. CAN/ULC-S537-04.

.2 When the fire alarm system is complete, make a complete verification and inspection of all installed fire alarm equipment including each and every component such as manual stations, signals, products of combustion detectors, control equipment, etc. with a competent and qualified member of the system manufacturer's personnel. The contractor shall retain a

professional engineer, registered in the province of British Columbia (preferably the design Engineer) to supervise and coordinate the verification. The verification must be sealed by the supervising Engineer. Ensure the following:

.1 That the system is complete in accordance with the contract documents. That the system is installed in accordance with manufacturer's recommendations and all other governing requirements.

.2 That the regulations concerning the supervision of components have been adhered to (e.g. stations, detectors, bells, etc.) and are properly wired and supervised.

.3 Perform any changes necessary as a result of sub-paragraphs 1 and 2 above in accordance with the system manufacturer's directions.

.4 On completion of the verification inspection and testing, obtain from the system manufacturer and forward to the Consultant a certificate of liability insurance and verification certificate together with detailed inspection reports listing each and every system component, its location in the building and its acceptability.

.5 The verification certificate and inspection report shall be prepared and signed by the manufacturer confirming that the system is installed and in accordance with the sub-paragraphs 1 and 2 above.

.6 The certificate of liability insurance shall be registered for this project and shall be supplied to the Owner to show satisfactory proof of the manufacturer's liability coverage for both his project and personnel.

.7 Ensure that all costs for the above testing, verification, certification and Professional Engineering Supervision are included in the tender price.

.5 Requirements

.1 When testing, verification and certification procedures specified above are complete, arrange for the system manufacturer to visit the site and demonstrate proper operation and maintenance of the fire alarm system to designated members of the Owner's staff.

.2 Supply and turn over to the Owner a sufficient quantity of identified keys for the central control facility.

.3 Confirm the exact location of all system components with the Consultant prior to roughing-in.

.4 Quantities for components shall be as per the floor plans and or riser diagrams.

.5 Be responsible for ensuring that the nomenclature of annunciator's identification nameplates, are verified with the

Owner's and authorities and that the necessary approvals have been obtained prior to ordering.

3.2 FIELD QUALITY CONTROL

.1 The complete system shall be tested and verified in accordance with CAN/ULC-S537-M36, "Standard for the Verification of Fire Alarm System Installations". The manufacturer shall conduct all testing and provide necessary technical personnel. The Electrical Subcontractor to provide necessary manpower to facilitate testing.

END OF SECTION 28 31 00

BRITISH COLUMBIA | Ministry of Finance

CERTIFICATE OF EXEMPTION CONTRACTOR

under the *Provincial Sales Tax Act*

Responsibilities for Sellers and Eligible Contractors:

Sellers – this certificate allows you to collect the information and declaration required under the *Provincial Sales Tax Act* (the Act) in order to provide a PST exemption to your customer.

If you do not receive a completed and signed certificate or the required information and declaration before the sale, you must charge and collect PST. Failure to do so may result in an assessment, penalty and interest.

Eligible Contractors – you are responsible for ensuring that you meet all the requirements for the exemption under the Act. If you complete the certificate but you do not qualify for the exemption, you are responsible for paying the PST.

General Instructions:

- Refer to **Page 2** for detailed instructions.

Freedom of Information and Protection of Privacy Act (FOIPPA)
The personal information on this form is collected for the purpose of administering the *Provincial Sales Tax Act* under the authority of both this Act and section 26 of the FOIPPA. Questions about the collection or use of this information can be directed to the Manager, Program Services, PO Box 9442 Stn Prov Govt, Victoria, BC V8W 9V4. (Telephone: toll-free at 1 877 388-4440)

PART A – CERTIFICATION OF ELIGIBLE PERSON (*see Page 2*)

NAME OF CORPORATION, ASSOCIATION, PARTNERS, INDIAN BAND OR INDIVIDUAL	MAILING ADDRESS (*including postal code*)
Public Works Gov. Canada	219 - 800 Burrard Street Vancouver, B.C. V6Z 0B9

I certify that I have entered into a contract with the eligible contractor named below for the supply and installation of affixed machinery or improvements to real property and if I were to purchase the tangible personal property identified below I would be exempt from PST because (*check (✓) one and complete the appropriate section*):

1. ☐ I am eligible for the **Production Machinery and Equipment** (PM&E) exemption under the Act.

2. ☐ I am a **status Indian** or authorized representative of an Indian band and the items being purchased would be exempt from PST under section 87 of the *Indian Act* (Canada). If you are representating an Indian band, attach written authorization from an official of the band that you are authorized to act on behalf of the Indian band.

	BAND NAME	STATUS CARD NUMBER
Indian and Indian Bands		
Indian Bands Only	NAME OF REPRESENTATIVE	

3. ☐ I am a **qualifying aquaculturist** under the Act. — AQUACULTURE LICENCE NUMBER

4. ☐ I am a **qualifying farmer** under the Act. — PROPERTY TAX FOLIO NUMBER / ADDRESS OF FARM

5. ☐ I am eligible for a PST exemption under the **Consular Tax Exemption Regulation**. — DIPLOMATIC / CONSULAR IDENTITY CARD NUMBER | EXPIRY DATE YYYY / MM / DD

I certify that the Government of Canada has entered into a contract with the eligible contractor named below for the supply and installation of affixed machinery or improvements to real property.

6. ☑ I am an **authorized representative of the Government of Canada**. — PST NUMBER: PST-1000-5001

By signing this form, I certify that the above information is correct.

FULL LEGAL NAME OF INDIVIDUAL SIGNING FORM	SIGNATURE	DATE SIGNED YYYY / MM / DD
Patrick Truong	X Patrick Truong	2015/12/15

PART B – CERTIFICATION OF ELIGIBLE CONTRACTOR (*see Page 2*)

FULL LEGAL NAME	MAILING ADDRESS (*including postal code*)

Description of all items of tangible personal property (goods) being purchased (*if you require more space, attach an additional document*):

I certify that the tangible personal property (TPP) identified above is being acquired to fulfill a contract for the supply and installation of affixed machinery or improvements to real property that meets the requirements of (*check (✓) one*):

7. ☐ **Customer is the eligible person identified in Part A:** the contract is with the eligible person identified in Part A, or — ELIGIBLE CONTRACTOR'S PST NUMBER

8. ☐ **Customer pays the PST:** you have a written agreement with your customer that they will pay PST on the TPP described above and the agreement sets out the purchase price of the TPP. You must be registered for PST before supplying this TPP to your customer. You may only use this certificate in advance of receiving your PST number.

By signing this form, I certify to the best of my knowledge that the above information and any attached information is correct. I acknowledge that if I make a false statement to avoid paying tax, the *Provincial Sales Tax Act* charges a fine of up to $10,000 and/or imprisonment up to two years, in addition to a penalty of 25% of the tax due and an assessment for the tax that should have been paid.

FULL LEGAL NAME OF INDIVIDUAL SIGNING FORM	SIGNATURE	DATE SIGNED YYYY / MM / DD
	X	