Public Works and Government Services Canada

Requisition Number: 39903-180402/A

MERX I.D. Number: _____

SPECIFICATIONS for:

Canadian Food Inspection Agency
AHU Replacement/ Exhaust Manifold

Project No: 39903 – 180402
24 August 2017
Issued for Tender

APPROVED BY:

_____ _____
Regional Manager, AES Date

_____ _____
Construction Safety Coordinator Date

TENDER:

_____ _____
Project Manager Date

CONSULTANTS – SEAL & SIGNATURE

Discipline	Seal/Signature/Date
Architectural Consultant Chernoff Thompson Architects	

Discipline
Structural Consultant

Seal/Signature/Date

Read Jones Christoffersen Ltd. (RJC)

CONSULTANTS – SEAL & SIGNATURE

Discipline	**Seal/Signature/Date**
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Electrical Consultant
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Rex Dimaano, P.Eng
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July 13, 2017

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Urban Systems Ltd.	 2017-07-18

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1.0 GENERAL

1.1 TAXES

.1 Pay all taxes properly levied by law (including Federal, Provincial and Municipal).

1.2 FEES PERMITS AND CERTIFICATES

.1 Pay all fees and obtain all permits. Provide authorities with plans and information for acceptance certificates. Provide inspection certificates as evidence that that work conforms to requirements of Authority having jurisdiction.

1.3 WORK PLAN

.1 Construct work to accommodate continued use of premises in immediate surrounding areas.

.2 Do not close off usage of facilities such as roadways, walkways and building access unless alternate usage has been provided with prior approval by Departmental Representative.

1.4 HOURS OF WORK

.1 All work which generates excessive noise and vibration, including cutting and coring, removal of floor slab shall be executed outside of the normal operating hours, or Saturday and Sunday.

.2 All other work, except for that noted in Clause 1.4.4 may be executed during the normal operating hours:
Monday through Friday – 08:00 to 16:00 hours.

.3 All work conducted during or outside of normal operating hours will be subject to restrictions outlined in sections 01 14 00 and 01 51 00, including security arrangements.

.4 Working hours for lab staff is varied. Refer to Appendix A. No interruptions to staff or work in rooms will be allowed during this time, except as approved in advance by the Departmental Representative.

.5 Work in corridors shall only occur outside of normal working hours.

.6 Any interior welding or exterior welding where there may be a risk of re-entrainment must occur on off hours.

1.5 WORK SCHEDULE

.1 Carry out work as follows:

.1 Within 10 working days after Contract award, provide a “phasing bar chart” and a schedule showing anticipated progress stages and final completion of the work within the time period required by the Contract documents. Indicate the following:

.1 Submission of shop drawings, product data, SDS sheets and samples.

.2 Commencement and completion of work of each section of the specifications or trades for each phase as outlined.

.3 Final completion date within the time period required by the Contract documents.

.4 Clearly indicate the work of the schedule into two compartments:

.1 Air Handling Unit Replacement indicating AHU-101 & 102 and AHU-103 systems as separate sub-components.

.2 Exhaust Manifold work split on Penthouse basis – North; Centre; South.

.5 Clearly indicate all anticipated shut downs for all systems, by specific days and times.

.6 Clearly indicate mobilization time frames for each portion of the work.

.7 Clearly indicate the time for approval by the Departmental Representative of a shut down time frame.
.8 Completion of all preparatory site works for the installation of the new AHUs.
.9 Preparatory commissioning and TAB times frames for the AHU in advance of the change over.
.10 Clearly indicate time frames for all cutting of the floors in the main mechanical building.
.11 Completion of the Exhaust Manifold Fan installation in advance of the change overs of fans and fumehoods.
.12 Preliminary commissioning and TAB of the Exhaust Manifold Fan installation in advance of change overs of fans and fumehoods.
.13 Start and completion of each fumehood and/or fan exhaust changeover.
.1 Listed by fumehood number and fan number, and room number affected.
.2 Include time allocated for the Owner's fumehood certification agency to complete their testing and certification of each fumehood.
.14 Clearly indicate time frames for removal of existing fans and ductwork, by fan and/or area of work.

.2 Do not change approved Schedule without notifying Departmental Representative.

.3 Phase the construction work to accommodate the restrictions of venting fans and fumehoods as indicated on drawings and as indicated in Appendix A. Keep fumehoods and venting operational to suit CFIA's requirements and reduce times that fumehoods and venting are not operational to a minimum.

.4 Interim reviews of work progress based on work schedule will be conducted as decided by Departmental Representative and schedule updated by Contractor in conjunction with and to approval of Departmental Representative.

1.6 COST BREAKDOWN

.1 Before submitting the first progress claim, submit a breakdown of the Contract price in detail as directed by the Departmental Representative and aggregating Contract price. After approval, the cost breakdown will form the basis of progress payments.

.2 For financial reporting and administration purposes, submit a cost breakdown for AHU Replacement Project and a cost breakdown for the Exhaust Manifold Project. Progress payments shall be invoiced on the basis of each individual project.

1.7 DOCUMENTS REQUIRED

.1 Maintain one copy each of the following at the job site:
.1 Contract drawings.
.2 Contract specifications.
.3 Addenda to Contract documents.
.4 Copy of work schedule.
.5 Reviewed shop drawings.
.6 Change orders.
.7 Other modifications to Contract.
.8 Field test reports.
.9 Reviewed samples.
.10 Manufacturer's installation and application instructions.
.11 One set of record drawings and specifications for "as-built" purposes.
.12 National Building Code of Canada 2010.

.13 Current construction standards of workmanship listed in technical Sections.
.14 Building Safety Plan.

1.8 REGULATORY REQUIREMENTS

.1 Contractor is to apply for permits using documents provided for by the Departmental Representative, at the City of Burnaby. All costs related to the building permit, application, and fees are to be included in the Contractor's work.

.2 Provide inspection authorities with plans and information required for issue of acceptance certificates.

.3 Furnish inspection certificates in evidence that the work installed conforms with the requirements of the specification.

1.9 CONTRACTOR'S USE OF SITE

.1 Use of site:
.1 The facility holds the operation of various laboratories within the site and work is to be carried out without interruption unless scheduled during the normal work hours.
.2 Assume responsibility for assigned premises for performance of this work.
.3 Be responsible for coordination of all work activities on site, including the work of other contractors engaged by the Departmental Representative.
.4 Cooperate with and coordinate construction/demolition activities with building manager.
.5 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.
.6 The Contractor in performing the work assigned under the Contract shall ensure that there is no undue interference in the operation of the CFIA's operations. Prior to commencement of work, the Contractor shall liase with the Departmental Representative to ensure planned work procedures meet the CFIA's requirements.

.2 Perform work in accordance with Contract documents. Ensure work is carried out in accordance with approved schedules.

.3 Do not unreasonably encumber site with material or equipment.

.4 The Contractor must abide by the Departmental Representative's requirements for protection and security of the occupied property and operations during the performance of the Work. The Contractor will confine its activities to immediate areas of the Work and to within the bounds established by the Departmental Representative. The contractor shall take all necessary precautions to fully protect those portions of the existing building(s) to remain, against damage during demolition or installation of new Work.

.5 The Contractor shall perform the Work so as to not endanger the health or safety of staff. All emergency exit routes must be maintained during construction.

.6 The Contractor shall not disrupt existing building or site services or cause inconvenience to the CFIA's staff without Departmental Representative's prior written approval.

.7 The Contractor shall arrange for proper security badges with the Departmental Representative identifying its own staff and any of its Subcontractors.

.8 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.

.9 At completion of operations the condition of existing work which is specified to remain must be equal to or better than that which existed before new work started.

.10 Obtain and pay for use of additional storage or work areas needed for work under this contract.

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

1.10 EXAMINATION

.1 Examine site and be familiar and conversant with existing conditions likely to affect work.

1.11 EXISTING SERVICES

.1 Where Work involves breaking into or connecting to existing services, carry out work as directed in Section 01 14 00 – Work Restrictions.

.2 Record locations of maintained, re-routed and abandoned service lines.

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

.4 Contractor is responsible for removing, relocating, and reinstalling all sensors, lights, wiring, equipment, ceiling, ceiling tiles, and building finishes back to original condition and function.

1.12 LOCATION OF EQUIPMENT AND FIXTURES

.1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.

.2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space, and in accordance with manufacturer's recommendations for safety, access and maintenance.

.3 Inform Departmental Representative of impending installation and obtain his approval for actual location.

.4 Submit field drawings or shop drawings to indicate the relative position of various services and equipment when required by the Departmental Representative and/or as specified.

1.13 CUTTING AND PATCHING

.1 Cut existing surfaces as required to accommodate new work.

.2 Remove items so shown or specified.

.3 Do not cut, bore, or sleeve load-bearing members.

.4 Make cuts with clean, true, smooth edges. Make patches inconspicuous in final assembly.

.5 Fit work airtight to pipes, sleeves, ducts and conduits.

.6 Conceal pipes, ducts and wiring in raised floors, wall and ceiling construction of finished areas except where indicated otherwise.

.7 Patch and make good surfaces cut, damaged or disturbed, to Departmental Representative's approval. Match existing material, colour, finish and texture.

.8 Making good is defined as matching construction and finishing materials and the adjacent surfaces such that there is no visible difference between existing and new surfaces when viewed from 1.5 metres in ambient light, and includes painting the whole surface to the next change in plane.

1.14 SETTING OUT OF WORK

.1 Assume full responsibility for and execute complete layout of work to locations, lines and elevations indicated.

.2 Provide devices needed to lay out and construct work.

.3 Supply such devices as templates required to facilitate Departmental Representative's inspection of work.

1.15 ACCEPTANCE OF PREPARED WORK OR SUBSTRATE SURFACES

1 Contractor shall examine surfaces prepared by others and job conditions which may affect his work, and shall report defects to the Departmental Representative. Commencement of work shall imply acceptance of prepared work or substrate surfaces.

1.16 QUALITY OF WORK

.1 Ensure that quality workmanship is performed through use of skilled tradesmen, under supervision of qualified journeyman.

.2 In cases of dispute, decisions as to standard or quality of work rest solely with the Departmental Representative, whose decision is final.

1.17 WORKS COORDINATION

.1 Coordinate work of sub-trades:
- .1 Designate one person to be responsible for review of contract documents and shop drawings and managing coordination of Work.

.2 Convene meetings between subcontractors whose work interfaces and ensure awareness of areas and extent of interface required.
- .1 Provide each subcontractor with complete plans and specifications for Contract, to assist them in planning and carrying out their respective work.
- .2 Develop coordination drawings when required, illustrating potential interference between work of various trades and distribute to affected parties.
  - .1 Pay particularly close attention to overhead work above ceilings and within or near to building structural elements.
  - .2 Identify on coordination drawings, building elements, services lines, rough-in points and indicate location services entrance to site.
- .3 Facilitate meeting and review coordination drawings. Ensure subcontractors agree and sign off on drawings.
- .4 Publish minutes of each meeting.
- .5 Plan and coordinate work in such a way to minimize quantity of service line offsets.
- .6 Submit copy of coordination drawings and meeting minutes to Departmental Representative for information purposes.

.3 Submit shop drawings and order of prefabricated equipment or rebuilt components only after coordination meeting for such items has taken place.

.4 Work cooperation:
- .1 Ensure cooperation between trades in order to facilitate general progress of Work and avoid situations of spatial interference.
- .2 Ensure that each trade provides all other trades reasonable opportunity for completion of Work and in such a way as to prevent unnecessary delays, cutting, patching and removal or replacement of completed work.
- .3 Ensure disputes between subcontractors are resolved.

.5 Departmental Representative is not responsible for, or accountable for extra costs incurred as a result of Contractor's failure to coordinate Work.

.6 Maintain efficient and continuous supervision.

1.18 APPROVAL OF SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

.1 In accordance with Section 01 33 00, submit the requested shop drawings, product data, SDS sheets and samples indicated in each of the technical Sections.

.2 Allow sufficient time for the following:
- .1 Review of product data.
- .2 Approval of shop drawings.
- .3 Review of re-submission.
- .4 Ordering of approved material and/or products. Refer to individual technical sections of specifications.

1.19 PROJECT MEETINGS

.1 Contractor shall arrange project meetings and assume responsibility for setting times.

.2 The contractor shall provide the meeting facilities and issue a meeting agenda 3 days prior to the meeting to Departmental Representative for review.

1.20 TESTING AND INSPECTION

.1 Particular requirements for inspection and testing to be carried out by testing service or laboratory approved by the Departmental Representative are specified in Sections 01 45 00.

.2 The Contractor will appoint and pay for the services of testing agency or testing laboratory as specified, and where required for the following:
- .1 Inspection and testing required by laws, ordinances, rules, regulations or orders of public authorities.
- .2 Inspection and testing performed exclusively for Contractor's convenience.
- .3 Testing, adjustment and balancing of mechanical and electrical equipment and systems.
  - .1 Mill tests and certificates of compliance.
  - .2 Tests specified in the contract documents to be carried out by Contractor which may be under the Departmental Representative's supervision.

.3 Within 15 working days after Contract award provide a list of proposed testing services or testing laboratories for Departmental Representative’s approval.

.4 The Departmental Representative may require, and pay for, additional inspection and testing services not included in paragraph 1.20.2.

.5 Where tests or inspections by designated testing laboratory reveal work is not in accordance with

the Contract requirements, Contractor shall pay costs for additional tests or inspections as the Departmental Representative may require to verify acceptability of corrected work.

.6 Contractor shall furnish labour and facilities to:
.1 Notify Departmental Representative in advance of planned testing.

.7 Where materials are specified to be tested, deliver representative samples in required quantity to testing laboratory.

.8 Pay costs for uncovering and making good work that is covered before required inspection or testing is completed and approved by Departmental Representative.

.9 Provide Departmental Representative with 2 copies of testing laboratory reports as soon as they are available.

1.21 AS-BUILT DOCUMENTS

.1 Keep one set of current white prints of all contract drawings and all addenda, revisions, clarifications, change orders, and reviewed shop drawings in the site office; and have them available at all times for inspection by the Consultant.

.2 As the Work progresses, maintain accurate records to show all deviations from the Contract documents. Note on as-built specifications, drawings and shop drawings as changes occur.

.3 At completion of the Work, transfer all deviations, including those called up by addenda, revisions, clarifications, shop drawings and change order, to a set of Issued for Construction drawings. Submit the 'red-marked' as-built set to the Owner, in hard copy and in PDF.

.4 Refer to Section 01 78 00 – Close-out Submittals.

1.22 CLEANING

.1 Refer to Section 01 74 11 - Cleaning.

1.23 DUST CONTROL

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

.2 Protect furnishings and equipment within work area with 0.102 mm thick polyethylene film during construction. Remove film during non- construction hours and leave premises in clean, unencumbered and safe manner for normal daytime function.

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

1.24 ENVIRONMENTAL PROTECTION

.1 Prevent extraneous materials from contaminating air beyond construction area, by providing temporary enclosures during work.

.2 Do not dispose of waste or volatile materials into water courses, storm or sanitary sewers.

.3 Ensure proper disposal procedures in accordance with all applicable territorial regulations.

1.25 MAINTENANCE MATERIALS, SPECIAL TOOLS AND SPARE PARTS

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

individual technical sections of specifications.

1.26 ADDITIONAL DRAWINGS

.1 The Departmental Representative may furnish additional drawings for clarification. These additional drawings have the same meaning and intent as if they were included with drawings referred to in the Contract Documents.

1.27 BUILDING SMOKING ENVIRONMENT

.1 Smoking within the building and within 7.5m of all air intakes is not permitted.

.2 A 'No Smoking' sign to be put up by Contactor.

1.28 SYSTEM OF MEASUREMENT

.1 The metric system of measurement (SI) will be employed on this Contract.

1.29 FAMILIARIZATION WITH SITE

.1 Before submitting tender, visit site as indicated in tender documents and become familiar with all conditions likely to affect the cost of the work.

1.30 SECURITY REQUIREMENTS

.1 Refer to Section 01 14 00.

1.31 LANDSCAPE REMIATION

.1 Contractor to make good all areas of existing landscape including planting, grass, ground cover and hard surfaces at areas affected by the Work of the contract or areas used by the Contractor in executing the work of the project.

.2 Only documented clean material will be accepted on the site as fill.

END OF SECTION 01 00 10

1.0 GENERAL

1.1 FACILITY OPERATIONS AND SECURITY PROCEDURES

.1 All construction staff shall become thoroughly familiar with and abide by all provisions and requirements of CFIA's: Operations, Safety and Security Procedures and Restrictions. Comply with requirements of Appendix D Burnaby Laboratory Facility Orientation for Construction and Service Contractors.

.2 Cooperate and coordinate construction/demolition activities with Departmental Representative.

1.2 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.

.2 Provide hoarding plan that close off the project construction area and scaffolding plan, if any, for Departmental Representative to review 5 business days prior to installation.

.3 All access to and/or the building will require commissionaire's attendance during normal hours or after hours. Refer to sentence 1.7.

1.3 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 as per Departmental Representatives direction and as specified in 1.7 Security.

.4 Closures: protect work temporarily until permanent enclosures are completed.

.5 Portions of the existing complex will be occupied by the public and government staff during entire construction period.

.6 Coordinate with Departmental Representative in scheduling operations to minimize conflict and to facilitate use of space.

.7 Do not use stairwells or elevators for construction use or for moving workers and materials. Provide exterior stair wells, elevators, or other methods for access to the roof. Coordinate locations with the Departmental Representative.

.8 Storage areas inside the building will not be provided. Limited space outside will be made available for storage.

.9 At any time due to critical laboratory testing requirements, contractors may be asked to relocate to another section of the facility.

1.4 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

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

1.5 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 3 working days 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.

.1 Optimize and plan shut-downs so that services are restored in time for normal facility operation hours. Coordinate all shut-downs with utility providers and facility users.

.2 Contractor shall be held responsible for damages to facility equipment as the result of service shut-downs.

.3 Contractor shall be held responsible for any and all unscheduled shut-downs of building utilities and services.

.4 Contractor will not be allowed to connect to Departmental Representative's existing data and communication services.

.5 Submit a "Fire Alarm Bypass" request to Departmental Representative 72 hours in advance for approval.

.6 Obtain permission from Departmental Representative for access to restricted areas outside the construction zones 24 hours in advance.

.7 Minimize duration of interruptions, and where required, provide temporary services to maintain critical systems.

.8 Establish location and extent of service lines in area of work before starting work. Notify Departmental Representative of findings.

.9 Provide temporary services, when directed by Departmental Representative to maintain critical systems.

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

.11 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in a manner approved by authorities having jurisdiction.

.12 Record locations of maintained, re-routed and abandoned service lines.

.13 Provide GPR scan of existing floor slab for any underslab services prior to demolition of floor slab.

.3 Provide for personnel and vehicular traffic.

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

1.6 SPECIAL REQUIREMENTS

.1 Carry out noise and vibration generating Work outside the normal operating hours the facility.

.1 Means and procedures of controlling and isolating construction noise affecting occupied areas shall be responsibility of the Contractor and approved by the Departmental Representative.

.2 Submit schedule in accordance with Section 01 32 16.07 - 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 All contractors and their personnel will be required to sign in when they arrive on site, each day, and will be required to sign a form outlining the building's safety requirements and a confidentiality

agreement.

.5 Keep within limits of work and avenues of ingress and egress.

.6 Deliver materials at scheduled times coordinated with and approved by Departmental Representative.

.7 Refer to Section 01 00 10

1.7 SECURITY

.1 All work within the facility will require full-attendance commissionaires in respect of working hours. The Contractor shall make minimum 48 hours advance arrangements with PWGSC for access and security. All security costs will be paid for by CFIA.

.2 All access to secured areas such as all base building electrical and mechanical rooms, roof and roof penthouse, and other normally secured services rooms will need escort by Commissionaires during and after normal office hours.

.3 Sufficient advanced notice should be given for off-hours work through the scheduling review process during regular construction meetings and a minimum of 72 hours notice should be given.

.4 If Contractor fails to show-up for off-hours work or cancels at the last minute, any costs incurred by CFIA to have Commissionaires on-site will be charged to the contractor.

1.8 BUILDING SMOKING ENVIRONMENT

.1 Comply with smoking restrictions. Smoking is not permitted within the facility.

1.9 NOISE CONTROL

.1 Means and procedures of controlling and isolating construction noise affecting occupied areas shall be responsibility of the contractor and approval of Departmental Representative.

.2 Level of work noise must be maintained at a level no greater than 87 dBA, over an eight-hour period.

.3 If work noise level exceeds 87 dBA, reduce noise either by using engineering devices to reduce or by shortening the duration of exposure.

.1 Refer to Table of maximum duration of exposure to sound levels higher than 87dBA permitted by Canada Occupational Health and Safety Regulations:

Sound Level in dBA	Maximum Duration of Exposure in Hours per Employee per 24-Hour Period		Sound Level in dBA	Maximum Duration of Exposure in Hours per Employee per 24-Hour Period
87	8.0		104	0.16
88	6.4		105	0.13
89	5.0		106	0.10
90	4.0		107	0.080
91	3.2		108	0.064
92	2.5		109	0.050
93	2.0		110	0.040
94	1.6		111	0.032
95	1.3		112	0.025
96	1.0		113	0.020
97	0.80		114	0.016
98	0.64		115	0.013
99	0.50		116	0.010
100	0.40		117	0.008
101	0.32		118	0.006
102	0.25		119	0.005
103	0.20		120	0.004

1.10 CONSTRUCTION PHASING

.1 To maintain CFIA facilities operational during construction is of upmost priority. To achieve this goal, various construction works cannot be implemented at the same time.

.2 Construction phasing plan and schedule must be submitted for approval by Departmental Representative prior to implementation. Phasing criteria are as follows:

.1 Refer to Appendix A CFIA ACIA Exhaust Manifold Phasing for restrictions to hours of work; shutdown limitations; work which cannot be implemented at the same time.

.3 Phasing of work to be coordinated with laboratory science representative. Through the course of the project, it is possible that due to laboratory program testing requirements, contractors may be asked to relocate to another section of the facility to conduct work. It is imperative that the “out of service time” for the whole building or systems that are to be modified or replaced under this project be minimized as much as possible. Program operations and time frames will govern the particular allotted time frame for construction

1.11 WORK OR SITE WITHIN OCCUPIED SPACE

.1 CFIA Laboratories: Protocol to enter space and lines of communication

All contractors requesting access to tenant spaces are required to submit a request a minimum of one week in advance to the Departmental Representative. The request shall include: Purpose of the visit/duration/date and time. Request must be in writing. The CFIA Facility contact will forward the request to the tenant occupying the space. Contractors should wait for confirmation before making the arrangements to visit the site, or carry out any construction work within the occupied tenant space.

.2 Contractor to submit a forecast/schedule of work a minimum of two weeks before the work is to be undertaken.

1.12 HOT WORK PERMIT

.1 Any hot work must be provided with 48 hours' prior notice by completing a hot work permit application.

1.13 AFTER HOURS WORK

.1 Contractor to make a request for after-hours work in writing and coordinated at least (1) one week before work is undertaken.

END OF SECTION 01 14 00

1.0 GENERAL

.1 This section includes the following:

.1 Coordination of Work under administration of Departmental Representative.

.2 Scheduled Pre-construction and Site meetings.

.3 Project planning and construction schedule.

.4 Site progress monitoring and control.

1.1 DESCRIPTION

.1 Coordinate and manage construction schedule, submittals, use of site, temporary utilities, construction facilities, quality control program, and construction Work, with progress of Work of subcontractors, other contractors and Departmental Representative.

1.2 PRE-CONSTRUCTION MEETING

.1 Pre-construction Meeting:

.1 Within 10 days after award of Contract, Departmental Representative will arrange pre-construction meeting.

.2 Departmental Representative, Contractor and representatives from Canadian Food Inspection Agency (CFIA) will be in attendance.

.3 Departmental Representative will establish time and location of meeting and notify parties concerned.

.4 The Departmental Representative will chair the meeting, record minutes and issue minutes to all attendees.

.1 Agenda of meeting is generally as follows:

.1 Project team introductions including main construction personnel, PWGSC personnel, CFIA representatives and consultants.

.2 Communication protocol for submittals.

.3 Start date on site.

.5 Construction Organization and Start-up:

.1 Comply with Departmental Representative's allocation of mobilization areas of site; for access, traffic, and parking facilities.

.2 During construction coordinate use of site and facilities through Departmental Representative's procedures for intra-project communications: Submittals, reports and records, schedules, coordination of drawings, recommendations, and resolution of ambiguities and conflicts.

.3 Comply with instructions of Departmental Representative for use of temporary utilities and construction facilities.

.4 Coordinate layout of construction barriers with Departmental Representative.

1.3 PROJECT PLANNING

.1 Plan construction activities, submittals and field reviews ahead of time for efficient and effective management to ensure timely completion of project.

.2 Contractor to provide 2 weeks look ahead schedule at every bi-weekly site meeting.

1.4 SCHEDULES

.1 Submit preliminary construction schedule to Departmental Representative during Pre-Construction meeting.

.2 After review, revise and resubmit schedule. Submit final full schedule within 2 weeks after Pre-Construction meeting.

.3 During progress of Work revise and resubmit as directed by Departmental Representative.

1.5 CONSTRUCTION SITE MEETINGS

.1 During course of Work and prior to project completion, Departmental Representative will request Construction Site Meetings as required.

.2 Departmental Representative will record minutes of meetings and circulate to attending parties and affected parties not in attendance.

.3 Agenda to include following:
- .1 Review, approval of minutes of previous meeting.
- .2 Review of Work progress since previous meeting.
- .3 Review work to be carried out until the next meeting.
- .4 Field observations, problems, conflicts.
- .5 Review of Health and Safety including any incidents, near misses, and WorkSafe BC visits.
- .6 Problems which impede construction schedule.
- .7 Review of off-site fabrication delivery schedules.
- .8 Corrective measures and procedures to regain projected schedule.
- .9 Revision to construction schedule.
- .10 Progress schedule, during succeeding work period.
- .11 Review submittal schedules: expedite as required.
- .12 Update of Red Line As-Built Drawings.
- .13 Maintenance of quality standards.
- .14 Review proposed changes for effect on construction schedule and on completion date.
- .15 Other business.

1.6 WALK THROUGH FIELD REVIEW BY DEPARTMENTAL REPRESENTATIVE

.1 Departmental Representative will carry out the following:
- .1 Walk-through field review of the work with contractor's representatives.
- .2 Preparation and distribution of the Walk-through field review Reports. Reports will be distributed within 5 days of field review.

1.7 SUBMITTALS

.1 Submit requests for interpretation of Contract Documents, and obtain instructions through Departmental Representative.

.2 Process substitutions through Departmental Representative.

.3 Deliver closeout submittals for review and inspections, for transmittal to Departmental Representative.

1.8 CLOSEOUT PROCEDURES

.1 Notify Departmental Representative when Work is considered Substantially Complete. Contractor to prepare list of defects, deficiencies and incomplete work prior to inspection by Departmental Representative. Follow procedures as outlined in Section 01 78 00 – Closeout Submittals.

.2 Accompany Departmental Representative on preliminary inspection to determine items listed for completion or correction.

.3 Comply with Departmental Representative's instructions for correction of items of Work listed in deficiency list.

.4 Notify Departmental Representative of instructions for completion of items of Work determined in Departmental Representative's final inspection.

END OF SECTION 01 31 00

1.0 GENERAL

1.1 ADMINISTRATIVE

.1 Schedule and administer site meetings throughout the progress of the work on a regular basis or at the call of Departmental Representative.

.2 Prepare and distribute agenda at least three (3) days prior to the meetings.

.3 Distribute written notice of each meeting seven (7) days in advance of meeting date to Departmental Representative.

.4 Preside at meetings.

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

1.2 PRE- CONSTRUCTION MEETING

.1 Within 15 days after award of Contract: Departmental Representative will request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.

.2 Attendance will include, but is not limited to, the Departmental Representative, AAFC representatives, Growth Chamber Supplier and Contractor.

.3 Departmental Representative to establish time and location of preconstruction meeting, Contractor to notify parties concerned a minimum of 4 working days before meeting.

.4 Departmental Representative will chair the meeting, record minutes and issue minutes.

.5 Agenda to include:

- .1 Introduction of official representative of participants in the Work.
- .2 Start date on site.
- .3 Communication Protocol for 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 51 00 - Temporary Utilities.
- .5 CFIA Security requirements.
- .6 Site safety in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.
- .7 Communication Protocol for proposed changes, change orders, procedures, approvals required.
- .8 Owner's Work.
- .9 Record drawings in accordance with Section 01 78 00 - Closeout Submittals.
- .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.

1.3 PROGRESS MEETINGS

.1 During course of Work and two weeks prior to Project Completion, schedule progress meetings bi-weekly.

.2 Attendance to include but is not limited to Departmental Representative, CFIA representatives and

Contractor.

.3 Agenda to include, at a minimum, the following:
- .1 Review, approval of minutes of previous meeting.
- .2 Review of Health and Safety including any incidents, near misses, and WorkSafe BC visits.
- .3 Review of Work progress since previous meeting.
- .4 Coordination discussions with AAFC
- .5 Construction schedule review.
- .6 Review of off-site fabrication delivery schedules.
- .7 Corrective measures and procedures to regain projected schedule.
- .8 Request for Information (RFI) log review.
- .9 Engineering Disciplines Reviews.
  - .1 Architectural
  - .2 Mechanical
  - .3 Electrical
- .10 Change order log review.
- .11 Review submittal schedule.
- .12 Review updated as built.
- .13 Review and resolve site issues.
- .14 New business.

END OF SECTION 01 31 19

1.0 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.

.10 Incorporate requirements and information for phasing and specific activities as described in Section 01 11 55.

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.

.5 Clearly show sequence and interdependence of construction activities and indicate:

.1 Start and completion of all items of Work, their major components and interim milestones completion dates.

.2 Activities for procurement, delivery, installation and completion of each major piece of

equipment, materials and other supplies, including:
- .1 Time for submittals, re-submittal and review.
- .2 Time for fabrication and delivery of manufactured products for Work.
- .3 Interdependence of procurement and construction activities.

.3 Include sufficient detail for project activities to assure adequate planning and execution of work. Activities should generally range in duration from 3 to 15 days each.

.4 Provide level of detail for project activities such that sequence and interdependency of Contract tasks are demonstrated to allow coordination and control of project activities. Show continuous flow from left to right.

.5 Ensure activities with no float are calculated and clearly indicated on logical CPM construction network system as being whenever possible, continuous series of activities throughout length of project to form critical path.

1.3 SUBMITTALS

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

.2 Submit to Departmental Representative within 28 working days after Award of Contract Project schedule in form of Bar (GANTT) Chart for planning, monitoring and reporting of project progress.

1.4 REVIEW OF THE SCHEDULE

.1 Allow 10 working days for Departmental Representative to review proposed schedule. Make necessary changes to proposed schedule within 5 days.

.2 Submit letter ensuring the schedule has been prepared in coordination with major subcontractors and suppliers.

.3 Promptly provide additional information to validate practicability of schedule as required by Departmental Representative.

.4 Submittal of Schedule indicates that it meets Contract Requirements and will be executed generally in sequence.

1.5 COMPLIANCE WITH SCHEDULE

.1 Comply with reviewed schedule.

.2 Proceed with significant changes and deviations from schedule sequence of activities which cause delay only after review by Departmental Representative.

.3 Identify activities that are behind schedule and causing delay. Provide measures to regain slippage.

.1 Corrective measures may include:
- .1 An increase of personnel on the site for effective activities or work packages.
- .2 An increase in materials and equipment.
- .3 Additional work shifts, longer hours.

1.6 PROJECT SCHEDULE

.1 Develop detailed Project Schedule derived from Master Plan.

.2 Ensure detailed Project Schedule that shows milestone and activity types and expand from the following items:
- .1 Award.
- .2 Shop Drawings, Samples and Approvals.

.3 Permits.
.4 Mobilization.
.5 Mock-ups and Approvals.
.6 Procurement.
.7 Construction.
.8 Installation.
.9 Site Works.
.10 Training.

1.7 PROJECT SCHEDULE REPORTING

.1 On an ongoing basis, schedule on job site must show “progress to date”. Arrange participation on and off site of subcontractor and suppliers, as and when necessary, for purpose of network planning, scheduling, updating and progress monitoring. Inspect Work with Departmental Representative at least once monthly to establish progress on each current activity shown on applicable networks.

.2 Maintain a daily log of progress of the work:
.1 Submit daily force report to Departmental Representative daily prior to noon the following day indicating:
.1 Total number of personnel on site.
.2 Major subcontractors on site listed by trade.
.3 Major equipment on site, i.e. excavators, cranes, drills.
.4 Concrete volumes.
.5 Visitors to site.
.6 Weather
.7 Documents required from Departmental Representative to Contractor to maintain.

.3 Perform schedule update monthly dated on last working day of the month. Update to reflect activities completed to date, activities in progress, logic and duration changes.

.4 Do not automatically update actual start and finish dates by using default mechanisms found in project management software.

.5 Requirements for monthly progress monitoring and reporting are basis for progress payment request.

.6 Submit monthly schedule updates with the progress payment request.

.7 Submit monthly written reports based on schedule, showing Work to Date performed, comparing work progress planned and presenting current forecasts. Report must summarize progress, defining problem areas and anticipated delays with respect to Work Schedule, and critical paths. Explain alternatives for possible schedule recovery to mitigate any potential delay. Include in report:
.1 Description of progress made.
.2 Pending items and status of: Permits, shop drawings, samples, mockups, deliveries, change orders, possible time extension.
.3 Status of Contract Completion Date and Milestones.
.4 Current and Anticipated problem areas, potential delays and corrective measures.

.8 Submit weekly 2 week look ahead schedule to Departmental Representative at each biweekly site meeting indicating the planned tasks of the next two week period.

1.8 PROJECT MEETINGS

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

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

END OF SECTION 01 32 16.07

1.0 GENERAL

1.1 ADMINISTRATIVE

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

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

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

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

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

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

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

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

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

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

.11 Do not proceed with work until relevant submissions are reviewed by Departmental Representative.

1.2 SHOP DRAWINGS AND PRODUCT DATA

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

.2 When specified in the Contract document, submit drawings stamped and signed by professional engineer registered or licensed in Province of British Columbia of Canada.

.3 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.

.4 Allow 14 days for Departmental Representative's review of each submission, unless noted otherwise.

.5 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.

.6 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.

.7 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.

.8 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.

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

.10 Submit electronic copy of shop drawings for each requirement requested in specification sections and as Departmental Representative may reasonably request.

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

.12 Submit electronic copies of test reports for requirements requested in specification Sections and as requested by Departmental Representative.
- .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
- .2 Testing must have been within 3 years of date of contract award for project.

.13 Submit electronic copies of certificates for requirements requested in specification Sections and as requested by Departmental Representative.
- .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
- .2 Certificates must be dated after award of project contract complete with project name.

.14 Submit electronic copies of 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 Safety Data Sheets concerning impedances, hazards and safety precautions.

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

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

.17 Submit electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.

.18 Delete information not applicable to project.

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

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

.21 The review of shop drawings by Departmental Representative is for sole purpose of ascertaining conformance with general concept.
- .1 This review shall not mean that Departmental Representative 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.

.22 Shop drawings format larger than 11” x17” (275mm x 430mm) must be submitted with hardcopies together with electronic format. Submit sufficient copies such that Departmental Representative will be provided with 5 copies plus contractor’s distribution and maintenance manual.

.23 Electronic submissions will only be reviewed and returned electronically. No hardcopies will be returned to contractor.

1.3 SAMPLES

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

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

.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 be kept onsite and 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 electronic copy of colour digital photography in jpg format, standard resolution monthly with progress statement and as directed by Departmental Representative.

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

.3 Viewpoints and their locations as reasonably determined by Departmental Representative.

.4 Provide photographic documentation of adjacent existing conditions prior to commencement of construction for determining and accidental damage as a result of contractor’s work.

.5 Frequency of photographic documentation: monthly as directed by Departmental Representative.

.1 Upon completion of: demolition, framing and services before concealment of Work, and as directed by Departmental Representative.

.6 Prior approval of photographs is required.

1.6 CERTIFICATES AND TRANSCRIPTS

.1 Submit electronic copies of test results and inspection reports required as noted in each section of specifications.

END OF SECTION 01 33 00

1.0 GENERAL

1.1 REFERENCES

.1 Government of Canada.
- .1 Canada Labour Code - Part II
- .2 Canada Occupational Health and Safety Regulations.

.2 National Building Code of Canada (NBC 2010):
- .1 Part 8, Safety Measures at Construction and Demolition Sites.

.3 Canadian Standards Association (CSA as amended):
- .1 CSA Z797-2009 Code of Practice for Access Scaffold
- .2 CSA S269.1-1975 (R2003) Falsework for Construction Purposes
- .3 CSA S350-M1980 (R2003) Code of Practice for Safety in Demolition of Structures

.4 Fire Protection Engineering Services, HRSDC:
- .1 FCC No. 301, Standard for Construction Operations.
- .2 FCC No. 302, Standard for Welding and Cutting.

.5 American National Standards Institute (ANSI):
- .1 ANSI A10.3, Operations – Safety Requirements for Powder-Actuated Fastening Systems.

.6 Province of British Columbia:
- .1 Workers Compensation Act Part 3-Occupational Health and Safety.
- .2 Occupational Health and Safety Regulation

.7 Current B.C. Electrical Code

1.2 RELATED SECTIONS

.1	Construction Progress Schedule Bar (GANTT) Chart	Section 01 32 16.7
.2	Submittal Procedures	Section 01 33 00
.3	Temporary Utilities	Section 01 51 00
.4	Temporary Barriers Enclosures	Section 01 56 00

1.3 SUBMITTALS

.1 Submit to Departmental Representative submittals listed for review. In accordance with Section 01 33 00

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

.3 Submit the following:
- .1 Health and Safety Plan.
- .2 Copies of reports or directions issued by Federal and Provincial health and safety inspectors.
- .3 Copies of incident and accident reports.
- .4 Complete set of Safety Data Sheets (SDS), and all other documentation required by Workplace Hazardous Material Information System (WHMIS) requirements.
- .5 Emergency Procedures.

.4 The Departmental Representative will review the Contractor's site-specific project Health and emergency procedures, and provide comments to the Contractor within 2 days after Receipt of the plan. Revise the plan as appropriate and resubmit to Departmental Representative.

.5 Medical surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of work, and submit additional certifications for any new site personnel to Departmental Representative.

.6 Submission of the Health and Safety Plan, and any revised version, to the Departmental Representative is for information and reference purposes only. It shall not:
- .1 Be construed to imply approval by the Departmental Representative.
- .2 Be interpreted as a warranty of being complete, accurate and legislatively compliant.
- .3 Relieve the Contractor of his legal obligations for the provision of health and safety on the project.

1.4 RESPONSIBILITY

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

.2 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.

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

1.5 HEALTH AND SAFETY COORDINATOR

.1 The Health and Safety Coordinator must:
- .1 Be responsible for completing all health and safety training, and ensuring that personnel that do not successfully complete the required training are not permitted to enter the site to perform work.
- .2 Be responsible for implementing, daily enforcing, and monitoring the site-specific Health and Safety Plan.
- .3 Be on site during execution of work.

1.6 GENERAL CONDITIONS

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

.2 Ensure that non-authorized persons are not allowed to circulate in designated construction areas of the work site.
- .1 Provide appropriate means by use of barricades, fences, warning signs, traffic control personnel, and temporary lighting as required.
- .2 Secure site at night time as deemed necessary to protect site against entry.

1.7 REGULATORY REQUIREMENTS

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

.2 In event of conflict between any provision of the above authorities, the most stringent provision will

apply. Should a dispute arise in determining the most stringent requirement, the Departmental Representative will advise on the course of action to be followed.

1.8 WORK PERMITS

.1 Obtain specialty trade permits related to project before start of work.

1.9 FILING OF NOTICE

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

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

1.10 HEALTH AND SAFETY PLAN

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

.2 Prepare and comply with a site-specific project Health and Safety Plan based on hazard assessment, including, but not limited to, the following:

.1 Primary requirements:

.1 Contractor's safety policy.
.2 Identification of applicable compliance obligations.
.3 Definition of responsibilities for project safety/organization chart for project.
.4 General safety rules for project.
.5 Job-specific safe work, procedures.
.6 Inspection policy and procedures.
.7 Incident reporting and investigation policy and procedures.
.8 Occupational Health and Safety Committee/Representative procedures.
.9 Occupational Health and Safety meetings.
.10 Occupational Health and Safety communications and record keeping procedures.

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

.3 List hazardous materials to be brought on site as required by work.

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

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

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

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

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

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

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

1.11 EMERGENCY PROCEDURES

.1 List standard operating procedures and measures to be taken in emergency situations. Include an evacuation plan and emergency contacts (i.e. names/telephone numbers) of:
- .1 Designated personnel from own company.
- .2 Regulatory agencies applicable to work and as per legislated regulations.
- .3 Local emergency resources.
- .4 Departmental Representative and site staff.

.2 Include the following provisions in the emergency procedures:
- .1 Notify workers and the first-aid attendant, of the nature and location of the emergency.
- .2 Evacuate all workers safely.
- .3 Check and confirm the safe evacuation of all workers.
- .4 Notify the fire department or other emergency responders.
- .5 Notify adjacent workplaces or residences which may be affected if the risk extends beyond the workplace.
- .6 Notify Departmental Representative and site staff.

.3 Provide written rescue/evacuation procedures as required for, but not limited to:
- .1 Work at high angles.
- .2 Work in confined spaces or where there is a risk of entrapment.
- .3 Work with hazardous substances.
- .4 Underground work.
- .5 Work on, over, under and adjacent to water.
- .6 Workplaces where there are persons who require physical assistance to be moved.

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

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

1.12 HAZARDOUS PRODUCTS

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

.2 Where use of hazardous and toxic products cannot be avoided:
- .1 Advise Departmental Representative beforehand of the product(s) intended for use. Submit applicable SDS and WHMIS documents as per Section 01 33 00.
- .2 In conjunction with Departmental Representative, schedule to carry out work during "off hours" when CFIA Staff have left the building.
- .3 Provide adequate means of ventilation in accordance with Section 01 51 00.

1.13 ASBESTOS HAZARD

.1 In case of discovery of any suspected asbestos containing material during demolition, inform Departmental Representative and, carry out work or demolition activities involving asbestos in accordance with applicable Provincial regulations.

1.14 REMOVAL OF LEAD-CONTAINING PAINTs

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

.2 Carry out demolition activities involving lead-containing paints in accordance with applicable Provincial regulations.

1.15 ELECTRICAL SAFETY REQUIREMENTS

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

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

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

1.16 ELECTRICAL LOCKOUT

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

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

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

1.17 OVERLOADING

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

1.18 CONFINED SPACES

.1 Carry out work in confined spaces in compliance with Occupational Health and Safety Regulation, Part 9.

1.19 POWDER-ACTUATED DEVICES

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

1.20 FIRE SAFETY AND HOT WORK

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

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

1.21 FIRE SAFETY REQUIREMENTS

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

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

1.22 FIRE PROTECTION AND ALARM SYSTEM

.1 Fire protection and alarm systems shall not be:
- .1 Obstructed.
- .2 Shut off.
- .3 Left inactive at the end of a working day or shift.

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

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

1.23 UNFORESEEN HAZARDS

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

1.24 POSTED DOCUMENTS

.1 Post legible versions of the following documents on site:
- .1 Health and Safety Plan.
- .2 Sequence of work.
- .3 Emergency procedures.
- .4 Site drawing showing project layout, locations of the first-aid station, evacuation route and marshalling station, and the emergency transportation provisions.
- .5 Notice of Project.
- .6 Floor plans or site plans.
- .7 Workplace Hazardous Materials Information System(WHMIS) documents.
- .8 Safety Data Sheets (SDS).
- .9 List of names of Joint Health and Safety Committee members, or Health and Safety Representative, as applicable.

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

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

1.25 MEETINGS

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

.2 Tool box meeting minutes to be submitted to the Departmental Representative on a biweekly basis at project meeting. The purpose is to confirm that the contractor and subcontractors are conducting regular safety meetings and not to have the Departmental Representative approve the minutes.

1.26 CORRECTION OF NON-COMPLIANCE

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

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

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

1.27 CORRECTION OF NON-COMPLIANCE

A spill prevention and contingency plan should be in place prior to commencement of work.

.1 Spill kits should also be on site and equipment operators must be trained in spill clean-up and response procedures. All spills must be cleaned up immediately.

.2 Spills of fuel or other flammable liquids greater than 100L must be managed in accordance with legislation and guidelines (such as those of the BC Provincial Emergency Program)

.3 Designated staging area(s) should be on level grade and as far away from the creek as feasible (no designated staging areas on the drawings are shown)

END OF SECTION 01 35 33

1.0 INSPECTION AND TESTING OF WORK

1.1 Laboratories/Agencies

1.1.1 Independent Inspection/Testing Agencies will be engaged by the *Departmental Representative* for the purpose of inspecting and/or testing portions of the *Work*. All costs of such services will be borne by the *Departmental Representative.*

1.1.2 All equipment required for carrying out inspection and/or testing will be provided by the respective Agencies.

1.1.3 Employment of Inspection/Testing Agencies in no way relieves the *Contractor* of responsibility to perform the *Work* in accordance with the *Contract Documents*.

1.1.4 Allow the Inspection/Testing Agencies access to all portions of the *Work* on site and manufacturing or fabrication plants, as may be necessary. Provide facilities for such access.

1.2 Design Standards, Code Requirements

1.2.1 Inspection and/or testing will be performed in accordance with the standards described in the *Contract Documents*.

1.3 Tests and Mix Design

1.3.1 Prior to commencement of the *Work*, submit to the *Departmental Representative* the following:

(a) test results and mix designs of each class of concrete

(b) test results and mix design of mortar types

(c) mill test certificates

2.0 PROCEDURES

2.1 Notify the respective Inspection/Testing Agencies and *Departmental Representative* well in advance of the requirements for tests in order that necessary arrangement can be made.

2.2 Provide facilities to allow inspection and/or testing.

2.3 If defects are revealed during inspection and/or testing, the *Departmental Representative* may issue instructions for removal or correcting defective work and irregularities. The *Contractor* shall notify the *Departmental Representative* within two (2) *Business Days* if such instructions are in error or at variance with the *Contract Documents*.

2.4 The *Departmental Representative* will pay for successful tests only. Costs for re-inspection and/or testing of rejected work shall be borne by the *Contractor*.

3.0 REFERENCE STANDARDS

3.1 General

3.1.1 The *Contract Documents* contain references to standard specifications for testing, materials, manufacturing and installation procedures. These references have been abbreviated to identify only the referenced Association and specification designation. This section provides the full descriptive title of each referenced specification.

3.1.2 When references to capitalized abbreviations are made, they refer to specifications, standards, or methods of the respective Association. Abbreviations listed herein but not mentioned in the specifications shall be disregarded.

3.1.3 The numbers and letters following the abbreviations denote the Association's serial designation for the specification or standard to which reference is made.

3.1.4 All references to these specifications, standards or methods shall be understood to refer to the latest adopted revision, including all amendments.

3.1.5 The specifications and standards published by these organizations and other specified specifications and standards referred to in the *Contract Documents* are hereby made part of these specifications as far as they are applicable to and not inconsistent with these specifications.

3.2 Master Municipal Construction Documents (MMCD)

3.2.1 In instances where a relevant specification pertaining to civil site and infrastructure works is not provided in the *Contract Documents*, MMCD – Platinum Edition 2009, shall be applied.

3.3 Nomenclature

3.3.1 ACI American Concrete Institute

3.3.2 ANSI American National Standards Institute

3.3.3 ASTM American Society of Testing and Materials

3.3.4 AWWA American Water Works Association

3.3.5 CAN Prefix signifying endorsement of other current standard as a Canadian National Standard

3.3.6 CGSB Canadian General Standards Board

3.3.7 CSA Canadian Standards Association

3.3.8 CAN3 CAN/CSA

3.3.9 ATT Alberta Transportation and Utilities Test

3.4 Referenced Specifications

3.4.1 ACI

(a) ACI 315R, Manual of Engineering and Placing Drawings for Reinforced Concrete Structure.

3.4.2 ANSI

(a) ANSI B16.1, Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.

(b) ANSI B16.5, Pipe Flanges and Flanged Fittings.

3.4.3 ANSI/ACI

(a) ANSI/ACI 117, Tolerances for Concrete Construction and Materials.

(b) ANSI/ACI 315, Details and Detailing of Concrete Reinforcement.

3.4.4 ANSI/AWWA

(a) ANSI/AWWA C151, Ductile-Iron Pipe, Centrifugally Cast for Water

(b) ANSI/AWWA C219, Bolted, Sleeve-Type Couplings for Plain-end Pipe

(c) ANSI/AWWA C213, Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines

(d) ANSI/AWWA B300, Hypochlorites.

(e) ANSI/AWWA C300, Reinforced Concrete Pressure Pipe – Steel-cylinder Type

(f) ANSI/AWWA B301, Water Treatment - Liquid Chlorine.

(g) ANSI/AWWA C104/A21.4, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.

(h) ANSI/AWWA C105/A21.5, Polyethylene encasement for Ductile-Iron Piping for Water and Other Liquids.

(i) ANSI/AWWA C110/A21.10, Ductile-Iron and Gray Iron Fittings, 3 inches through 48 inches for Water and Other Liquids.

(j) ANSI/AWWA C111/A21.11, Rubber Gasket Joints for Ductile-Iron and Gray Iron Pressure Pipe and Fittings.

(k) ANSI/AWWA C150 Thickness Design of Ductile - Iron Pipe.

(l) ANSI/AWWA C151/A21.51, Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds for Water or other Liquids.

(m) ANSI/AWWA C153/A21.53, Ductile-Iron Compact Fittings, 3 inches through 16 inches, for Water and Other Liquids.

(n) ANSI/AWWA C200, Water Pipe 6 inches and Larger, Steel.

(o) ANSI/AWWA C203, Coal Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied.

(p) ANSI/AWWA C205, Cement Mortar Protective Lining and Coating for Steel Water Pipe - 4 inches and larger - Shop Applied.

(q) ANSI/AWWA C206, Field Welding of Steel Water Pipe.

(r) ANSI/AWWA C207, Steel Pipe Flanges for Waterworks Service, 4 inches through 144 inches.

(s) ANSI/AWWA C208, Fabricated Steel Water Pipe Fittings, Dimensions for.

(t) ANSI/AWWA C210, Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.

(u) ANSI/AWWA C301, Prestressed Concrete Pressure Pipe Steel Cylinder Type for Water and Other Liquids.

(v) ANSI/AWWA C303, Reinforced Concrete Pressure Pipe Steel Cylinder Type, Pretensioned for Water and Other Liquids.

(w) ANSI/AWWA C500, Gate Valves for Water and Sewage Systems.

(x) ANSI/AWWA C502, Dry-Barrel Fire Hydrants.

(y) ANSI/AWWA C504, Butterfly Valves.

(z) ANSI/AWWA C508, Swing-Check Valves Waterworks Service, 2 inches (50 mm). Through 24 inches (600 mm) NPS

(aa) ANSI/AWWA C509, Resilient-Seated Gate Valves for Water and Sewerage Systems.

(bb) ANSI/AWWA C510, Double Check Valve Backflow-Prevention Assembly

(cc) ANSI/AWWA C511, Reduced-Pressure Principle Backflow-Prevention Assembly

(dd) ANSI/AWWA C512, Air Release, Air/Vacuum, and Combination Air Valves for Waterworks Service

(ee) ANSI/AWWA C550, Protective Epoxy Interior Coatings for Valves and Hydrants

(ff) ANSI/AWWA C600, Installation of Ductile-Iron Water Mains, and their Appurtenances.

(gg) ANSI/AWWA C602, Cement Mortar Lining of Water Pipelines - 100 mm and larger - In Place.

(hh) ANSI/AWWA C605, Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water

(ii) ANSI/AWWA C651, Disinfecting Watermains.

(jj) ANSI/AWWA C800, Underground Service Line Valves and Fittings.

(kk) ANSI/AWWA C900, Pressure Pipe, 4 inches through 12 inches for Water, Polyvinyl Chloride (PVC).

(ll) ANSI/AWWA C901, Polyethylene (PE) Pressure Pipe and Tubing, ½ inch through 3 inches for Water Service.

(mm) ANSI/AWWA C902, Polybutylene (PB) Pressure Pipe and Tubing, ½ inch through 3 inches for Water Service.

(nn) ANSI/AWWA C905, Pressure Pipe, 14 inches through 36 inches for Water, Polyvinyl Chloride (PVC).

(oo) ANSI/AWWA C906, Polyethylene (PE) Pressure Pipe and Fittings, 4 inches through 63 inches, for Water Distribution.

(pp) ANSI/AWWA C907, Standard for Polyvinyl Chloride (PVC) Pressure Fittings for Water – 4 inches through 8 inches (100 mm through 200 mm

(qq) ANSI/AWWA M17, Installation, Field Testing, and Maintenance for Fire Hydrants

(rr) ANSI/AWWA M23, PVC Pipe – Design and Installation

(ss) ANSI/AWWA M41, Ductile-Iron Pipe and Fittings

3.4.5 ASTM (A)

(a) ASTM A36, Standard Specification for Structural Steel.

(b) ASTM A48, Specification for Gray Iron Castings.

(c) ASTM A53, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

(d) ASTM A90, Test Method for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.

(e) ASTM A120, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses.

(f) ASTM A121, Specification for Zinc-Coated (Galvanized) Steel Barbed Wire.

(g) ASTM A283/A283M, Specification for Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars.

(h) ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.

(i) ASTM A325, Standard Specification for High-Strength Bolts for Structural Steel Joints.

(j) ASTM A354, Quenched and Tempered Alloy Steel Bolts, Studs and Other Externally Threaded Fasteners

(k) A536, Ductile Iron Castings

(l) ASTM A585, Specification for Aluminum-Coated Steel Barbed Wire.

(m) ASTM563, Carbon and Alloy Steel Nuts

(n) ASTM A615M, Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

(o) ASTM A716, Specification for Ductile – Iron Culvert Pipe.

(p) ASTM A746, Specification for Ductile – Iron Gravity Sewer Pipe.

(q) ASTM A760, Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains

(r) ASTM A775/A775M, Specification for Epoxy-Coated Reinforcing Steel Bars.

3.4.6 ASTM (B)

(a) ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.

(b) ASTM B88M, Specification for Seamless Copper Water Tube.

(c) ASTM B633, Electodeposited Coatings of Zinc on Iron and Steel

(d) ASTM B766, Electodeposited Coatings of Cadmium

3.4.7 ASTM (C)

(a) ASTM C14M, Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.

(b) ASTM C76M, Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

(c) ASTM C88, Test Method for Soundness of Aggregates by Use of Sodium Sulphate of Magnesium Sulphate.

(d) ASTM C109, Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inches of 50 mm Cube Specimens).

(e) ASTM C117, Test Method for Material Finer than 0.075 mm Sieve in Mineral Aggregates by Washing.

(f) ASTM C123, Test Method for Lightweight Pieces in Aggregate.

(g) ASTM C127, Test Method for Specific Gravity and Absorption of Coarse Aggregate.

(h) ASTM C128, Test Method for Specific Gravity and Absorption of Fine Aggregate.

(i) ASTM C131, Test Method for Resistance to Degradation of Small Size Course Aggregate by Abrasion and Impact in the Los Angeles Machine.

(j) ASTM C136, Method for Sieve Analysis of Fine and Coarse Aggregates.

(k) ASTM C139, Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.

(l) ASTM C171, Specification for Sheet Materials for Curing Concrete.

(m) ASTM C309, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

(n) ASTM C332, Specification for Lightweight Aggregates for Insulating Concrete.

(o) ASTM C443M, Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

(p) ASTM C478M, Specification for Precast Reinforced Concrete Manhole Sections.

(q) ASTM C497, Test Methods for Concrete Pipe, Manhole Sections, or Tile

(r) ASTM C506M, Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe.

(s) ASTM C507M, Specification for Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe.

(t) ASTM C827, Test Method for Early Volume Change of Cementitious Mixtures.

(u) ASTM C902, Specification for Pedestrian and Light Traffic Paving Brick.

(v) ASTM C939, Test Method for Flow of Grout for Preplaced-Aggregate Concrete.

(w) ASTM C1433, Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers

(x) ASTM C1103, Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.

3.4.8 ASTM (D)

(a) ASTM D36, Test Method for Softening Point of Bitumen (Ring and Ball Apparatus)

(b) ASTM D140, Method for Sampling Bituminous Materials

(c) ASTM D412, Test Method for Rubber Properties in Tension.

(d) ASTM D570, Test Method for Water Absorption of Plastics

(e) ASTM D624-86, Test Method for Rubber Property - Tear Resistance.

(f) ASTM D698, Test Methods for Moisture Density Relations of Soils and Soil Aggregate Mixtures Using 2.49 kg Rammer and 304.8mm Drop.

(g) ASTM D995, Specification for Requirements for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.

(h) ASTM D1190, Concrete Joint Sealer, Hot-Applied Elastic Type

(i) ASTM D1248, Specification for Polyethylene Plastics Molding and Extrusion Materials.

(j) ASTM D1557, Specification for Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures using 10lb (4.54kg) Rammer and 18 inch (457mm) Drop.

(k) ASTM D1559, Test Method Resistance to Plastic flow of Bituminous Mixtures Using Marshall Apparatus.

(l) ASTM D1751, Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

(m) ASTM D1752, Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

(n) ASTM D1784, Standard Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds.

(o) ASTM D2000, Classification System for Rubber Products in Automotive Applications

(p) ASTM D2152, Test Method for Quality of Extruded Polyvinyl Chloride (PVC) Pipe by Acetone Immersion.

(q) ASTM D2241, Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe (SDR-PR).

(r) ASTM D2310, Classification for Machine Made Reinforced Thermosetting Resin Pipe.

(s) ASTM D2321, Standard Practice for Underground Installation of Thermoplastic Pipe for Sewer and Other Gravity-Flow Applications.

(t) ASTM D2412, Standard Test Method for External Loading Properties of Plastic Pipe by Parallel-Plate Loading.

(u) ASTM D2419, Test Method for Sand Equivalent Value of Soils and Fine Aggregate.

(v) ASTM D2657, Heat Fusion Joining of Polyolefin Pipe and Fittings

(w) ASTM D2680, Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping

(x) ASTM D2774, Practices for Heat Joining Polyethylene Pipe and Fittings.

(y) ASTM D2774, Practices for Underground, Installation of Thermoplastic Pressure Piping.

(z) ASTM D2837, Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.

(aa) ASTM D2992, Method for Obtaining Hydrostatic Design Basis for Reinforced Thermosetting Resin Pipe and Fittings.

(bb) ASTM D2996, Specification for Filament Wound Reinforced Thermosetting Resin Pipe.

(cc) ASTM D3034, Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

(dd) ASTM D3139, Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals.

(ee) ASTM D3203, Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures.

(ff) ASTM D3212, Specification for Joints for Drain and Sewer Plastic Pipes using Flexible Elastomic Seal

(gg) ASTM D3261, Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.

(hh) ASTM D3405, Specification for Joint Sealants, Hot Poured for Concrete and Asphalt Pavements.

(ii) ASTM 4101, Propylene Plastic Injection and Extrusion Materials

(jj) ASTM D4318, Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

(kk) ASTM D4354, Practice for Sampling of Geosynthetics for Testing

3.4.9 ASTM (E)

(a) ASTM E11, Specification for Wire Cloth Sieves for Testing Purposes.

(b) ASTM E 1155M, Test Method for Determining Floor Flatness and Levelness Using the F-Number System.

3.4.10 ASTM (F)

(a) ASTM F436, Hardened Steel Washers

(b) ASTM F477, Specification for Elastomeric Seals (Gaskets) for joining Plastic Pipe.

(c) ASTM F593, Stainless Steel Bolt, Hex Cap Screws, and Studs

(d) ASTM F594, Stainless Steel Nuts

(e) ASTM F679, Specification for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings.

(f) ASTM F714, Polyethylene (PE) Plastic Pipe (SDR-DR) Based on Outside Diameter.

(g) ASTM F738, Stainless Steel Metric Bolts, Screws, and Studs

(h) ASTM F794, Specification for Polyvinyl Chloride (PVC) Ribbed Gravity Sewer Pipe and Fittings based on Controlled Inside Diameter.

(i) ASTM F836M, Style 1 Stainless Steel Metric Nuts

3.4.11 AWWA: (See ANSAI/AWWA)

3.4.12 CAN3 = CAN/CSA:

(a) CAN3-A165 Series, CSA Standards on Concrete Masonry Units.

(b) CAN3-B137.3, Rigid Poly (Vinyl Chloride) (PVC) Pipe for Pressure Applications.

(c) CAN4-S543, Internal Lug, Quick-Connect Couplings for Fire Hose.

(d) CAN3-B70, Cast Iron Soil Pipe and Fittings, and Means of Joining.

(e) CAN3-G401, Corrugated Steel Pipe Products.

(f) CAN3-A23.3, Design of Concrete Structures for Buildings.

3.4.13 CAN/CSA = CAN3:

(a) CAN/CSA-A5, Portland Cement.

(b) CAN/CSA-A8, Masonry Cement.

(c) CAN/CSA-A23.1, Concrete Materials and Methods for Concrete Construction.

(d) CAN/CSA-A23.2, Methods of Testing for Concrete.

(e) CAN/CSA-A23.5, Supplementary Cementing Materials.

(f) CAN/CSA-A231.2, Precast Concrete Pavers.

(g) CAN/CSA-A266.1, Air-Entraining Admixtures for Concrete.

(h) CAN/CSA-A266.2, Chemical Admixtures for Concrete.

(i) CAN/CSA-A266.4, Guidelines for the use of Admixtures in Concrete.

(j) CAN/CSA-A362, Blending Hydraulic Cement.

(k) CAN/CSA-A363, Cementitious Hydraulic Slag.

(l) CAN/CSA-B182.1, Plastic Drain and Sewer Pipe and Pipe Fittings.

(m) CAN/CSA B182.6-M, Profile Polyolefin Sewer Pipe & Fittings

(n) CAN/CSA-G40.21, Structural Quality Steels.

3.4.14 CAN/CGSB

(a) CAN/CGSB-8.1, Sieves Testing, Woven Wire.

(b) CAN/CGSB-8.2, Sieves Testing, Woven Wire, Metric.

(c) CAN/CGSB-138.1, Fence, Chain Link, Fabric.

(d) CAN/CGSB-138.2, Fence, Chain Link, Framework, Zinc-Coated, Steel.

(e) CAN/CGSB-138.3, Fence Chain Link - Installation.

(f) CAN/CGSB-138.4, Fence, Chain Link, Gates.

(g) CAN/CGSB-37.2, Emulsified Asphalt, Mineral Colloid-Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings.

(h) CAN/CGSB-16.1, Asphalts, Liquids Petroleum, for Road Purposes.

(i) CAN/CGSB-16.2, Asphalts, Emulsified, Anionic Type, for Road Purposes.

(j) CAN/CGSB-16.3, Asphalt Cements for Road Purposes.

(k) CAN/CGSB-16.5, Asphalt, Emulsified, High Float Type, for Road Purposes.

3.4.15 CGSB

(a) CGSB 1-GP-12c, Standard Paint Colours.

(b) CGSB 1-GP-59M, Enamel, Exterior Gloss Alkyd Type.

(c) CGSB 1-GP-5M, Thinner, Petroleum Spirits, Low Flash (R/84).

(d) CGSB 1-GP-71, Method of Testing Paints and Pigments.

(e) CGSB 1-GP-74M, Paint, Traffic, Alkyd.

(f) CGSB 1-GP-149M, Paint, Traffic, Reflectorized Alkyd, White and Yellow.

(g) CGSB 15.1 Calcium Chloride

(h) CGSB 1-GP-181M, Coating, Zinc-Rich, Organic, Ready Mixed.

(i) CGSB 51-GP-51M, Polyethylene Sheet for Using in Building Construction.

(j) CGSB 41-GP-25M, Pipe, Polyethylene, for the Transport of Liquids.

3.4.16 CSA

(a) CSA A82.5, Structural Clay Non-Load-Bearing Tile.

(b) CSA A82.56, Aggregate for Masonry Mortar.

(c) CSA A123.3, Asphalt or Tar Roofing Sheets.

(d) CSA A257, Standards for Concrete Pipe.

(e) CSA B137.0, Definitions, General Requirements, and Methods of Testing for Thermoplastic Pressure Piping.

(f) CSA B137.1, Polyethylene Pipe, Tubing and Fittings for Cold Water Pressure Services.

(g) CSA B137.2, PVC Injection Moulded Gasketed Fittings for Pressure Applications.

(h) CSA B137.3, Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications.

(i) CSA B137.6, CPVC Pipe, Tubing and Fittings for Hot and Cold Water Distribution Systems.

(j) CSA B137.7, Polybutylene (PB) Pipe for Cold Water Distribution Systems.

(k) CSA B137.8, Polybutylene (PB) Pipe for Pressure Applications.

(l) CSA B137.9, M91, Polyethylene / Aluminum / Polyethylene Composite Pressure Pipe.

(m) CSA B137.16, Recommended Practice for the Installation of CPVC Piping for Hot and Cold Water Distribution Systems.

(n) CSA B181.12, Recommended Practice for the Installation of PVC Drain, Waste, and Vent Pipe Fittings.

(o) CSA B182.1, Plastic Drain and Sewer Pipe and Pipe Fittings.

(p) CSA B182.11, Recommended Practice for the Installation of Plastic Drain and Sewer Pipe and Pipe Fittings.

(q) CSA B182.2, Large Diameter, Type PSM PVC Sewer Pipe and Fittings.

(r) CSA B182.4, Large Diameter Ribbed PVC Sewer Pipe and Fittings.

(s) CSA C22.1, Safety Standard for Electrical Installations.

(t) CSA C22.2, Canadian Electrical Code, General Requirements.

(u) CSA C22.3, Canadian Electrical Code Outside Wiring.

(v) CSA G30.3, Cold Drawn Steel Wire for Concrete Reinforcement.

(w) CSA G30.5, Welded Steel Wire Fabric for Concrete Reinforcement.

(x) CSA 30.12, Billet-Steel Bars for Concrete Reinforcement.

(y) CSA G30.14, Deformed Steel Wire for Concrete Reinforcement.

(z) CSA G30.15, Welded Deformed Steel Wire Fabric for Concrete Reinforcement.

(aa) CSA G30.16, Weldable Low Allow Steel Deformed Bars for Concrete Reinforcement.

(bb) CSA G164, Hot Dip Galvanizing of Irregularly Shaped Articles.

(cc) CSA S157, Strength Design in Aluminum.

(dd) CSA S269.3, Formwork.

(ee) CSA W59, Welded Steel Construction (Metal Arch Welding).

(ff) CSA W186, Welding of Reinforcing Bars in Reinforced Concrete Construction

(gg) CSA G40.20, General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steels

3.4.17 ATT

(a) ATT-50, Percent Fracture

3.5 If there is question as to whether any product or system is in conformance with applicable standards, the *Departmental Representative* reserves the right to have such products or systems tested to prove or disprove conformance. The cost for such testing will be borne by the *Departmental Representative* in the event of conformance with *Contract Documents* or by the *Contractor* in the event of non-conformance.

END OF SECTION

1.0 GENERAL

1.1 INSPECTION

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

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

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

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

1.2 INDEPENDENT INSPECTION AGENCIES

.1 Independent Inspection/Testing Agencies will be engaged by Departmental Representative purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by Departmental Representative.

.2 Provide equipment required for executing inspection and testing by appointed agencies.

.3 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.

.4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Departmental Representative at no cost to Departmental Representative. Pay costs for retesting and re-inspection.

1.3 ACCESS TO WORK

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

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

1.4 PROCEDURES

.1 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.

1.5 REJECTED WORK

.1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Departmental Representative

as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.

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

.3 If in opinion of Departmental Representative it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, 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.

1.6 REPORTS

.1 Submit electronic copy of inspection and test reports to Departmental Representative.

.2 Provide copies to subcontractor of work being, inspected or tested or manufacturer or fabricator of material being inspected or tested.

1.7 TESTS AND MIX DESIGNS

.1 Furnish test results and mix designs as requested.

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

1.8 MOCK-UPS

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

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

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

1.9 MILL TESTS

.1 Submit mill test certificates as requested.

1.10 EQUIPMENT AND SYSTEMS

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

.2 Refer to Divisions 21, 22, 23, 25, 26, 27, and 28 for definitive requirements.

END OF SECTION 01 45 00

1.0 GENERAL

1.1 ACCESS AND DELIVERY

.1 Only the designated entrance may be used for personnel access to the site.

.2 Contractor is required to use only the designated entrance to access the work site, for deliveries to site, and as the exit for offsite disposal.
- .1 Maintain for duration of contract.
- .2 Make good damage resulting from Contractor's use.

.3 Provide and maintain access roads, sidewalk crossing ramps and construction runways as may be required for access to the work. All roadways and walkways outside of the Contractor's work site must be kept clear of materials and equipment at all times.

.4 Provide and maintain competent flag operators, traffic signals, barricades and flares, lights or lanterns as may be required to perform work and protect other users of the facility.

1.2 CONSTRUCTION PARKING

.1 No Construction Staff parking is provided at the facility.

1.3 STORAGE FACILITIES

.1 Confine work and operations of employees to areas indicated on Contract Documents. Do not unreasonably encumber premises with products. Storage space to be limited to the area of construction.

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

.3 Provide and pay for all off-site storage as required. Note that storage space is limited on site. Refer to site plan for location of Contractor's site storage and lay-down area.

1.4 POWER

.1 Subject to Coordination with Departmental Representatives electrical power within the facility may be used at no extra cost. There is no guarantee of uninterrupted power supply. Contractor will use this power source at their own risk. Contractor will not be compensated for any incurred cost or time owing to any power failure. Contractor will be responsible for other power source as they consider to be required for completing the project. Contractor will be responsible for all the cost of connecting and disconnecting from this power source after completion of project to the satisfaction of the Departmental Representative.

1.5 AIR

.1 Contractor to supply his own compressed air for the duration of the contract.

1.6 WATER SUPPLY

.1 Water supply is available for use by Contractor.

1.7 SANITARY FACILITIES

.1 Contractor will provide their own portable sanitary facilities. Maintain in a safe and sanitary condition. Construction staff will not be allowed to use the facility washrooms.

1.8 HEATING AND VENTILIATION

.1 Do not begin work until arrangements have been made with the Departmental Representative for protection of on-floor heating, ventilating and air conditioning.

.2 If there is any dirt in the heating and ventilation system, at the completion of work, it will be the Contractor's responsibility to return system to its original state in accordance with the Departmental Representative's directions.

.3 Prevent dust and odour migration to occupied areas.
- .1 Do not deactivate HVAC system to occupied floors. Purge air from construction floors only when directed by Departmental Representative, where dust and fumes will be generated.
- .2 Change filters in existing HVAC system frequently.

1.9 SCAFFOLDING

.1 Construct and maintain scaffolding in rigid, secure and safe manner.

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

1.10 HOISTING

.1 Provide, operate and maintain hoists required for moving of workers, materials and equipment. Make financial arrangements with Sub-contractors for their use of hoists.

.2 Hoists shall be operated by qualified operator.

1.11 HOARDING

.1 Prior to all demolition and construction, install dust proof hoarding or protective barrier to separate construction zone and the rest of the operating facility Maintain in safe and clean condition throughout duration of project. Submit hoarding plan to Departmental Representative for approval.

.2 Erect and maintain safety barricades around all openings and other danger areas as required by Building Code and WorkBC.

.3 Make good all floor, ceiling and wall to their original condition after removal of hoarding at completion of project.

1.12 SITE OFFICE

.1 Contractor to provide their own trailer as temporary site office. Coordinate with Departmental representative for exact location.

.2 Contractor should clear and demolish site office at end of project according to contract requirement.

1.13 REMOVAL OF TEMPORARY FACILITIES

.1 Remove temporary facilities from site when directed by the Departmental Representative.

1.14 SIGNS AND NOTICES

.1 Signs and notices for safety and instruction shall be in both official languages or graphic symbols conforming to CAN/CSA-Z321.

.2 Maintain approved signs and notices in good condition for duration of Project, and dispose of offsite on completion of Project when directed by Departmental Representative.

1.15 CLEAN-UP

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

.2 Clean dirt of mud tracked onto paved or surfaced roadways.

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

.4 Stack stored new or salvaged material not in construction facilities.

.5 At completion of Project: Remove and dispose of all debris, thoroughly clean and restore site to condition found at commencement of Work. Repair and make good to all damage caused by construction activities.

1.16 USE OF EXISTING UTILITIES

.1 It is the intention of the Departmental Representative to supply temporary services where specified, however, in the event of any unforeseen occurrence, the Departmental Representative may discontinue such temporary service, without notice, and without acceptance of any liability, for damage or delay, caused by such withdrawal of temporary services.

.2 Supply of temporary services by Department Representative is subject to the requirements of the facility and level of availability of existing services.

.3 Contractor shall bear costs of all temporary services required for the project, subject to approval by Departmental Representative those available from existing services.

END OF SECTION 01 51 00

1.1 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.

.2 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.

.2 Canadian Standards Association (CSA International)

.1 CSA-O121-M1978 (R2003, Douglas Fir Plywood.

1.2 INSTALLATION AND REMOVAL

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

.2 Remove from site all such work after use.

1.3 HOARDING

.1 Refer to Section 01 51 00 Temporary Utilities Clause 1.11.

1.4 ACCESS TO SITE

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

1.5 FIRE ROUTES

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

.2 Maintain clearance for all egress routes.

1.6 PROTECTION OF OFF-SITE AND PUBLIC PROPERTY

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

.2 Be responsible for damage incurred.

1.7 PROTECTION OF BUILDING FINISHES

.1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.

.2 Provide necessary screens, covers, and hoardings.

.3 Protect existing operating equipment within the project area

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

1.8 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

END OF SECTION 01 56 00

ENVIRONMENTAL PROTECTION

1.0 GENERAL

1.1 Fires

1.1.1 Fires and burning of rubbish on site are not permitted, without approval of *Departmental Representative*. All fires to conform to provincial and local regulations.

1.2 Disposal of Wastes

1.2.1 Do not bury rubbish and waste materials on site unless approved by the *Departmental Representative*.

1.2.2 Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner into watercourses, storm or sanitary sewers.

1.3 Drainage

1.3.1 Prepare and submit an Erosion and Sediment Control Plan prepared by a qualified Environmental Professional or another qualified party acceptable to the *Departmental Representative*.

1.3.2 Provide temporary drainage and pumping as necessary to keep excavations and site free from water.

1.3.3 Do not discharge water containing suspended materials into watercourses, sewer or drainage systems.

1.3.4 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with Federal, Provincial and Municipal requirements.

1.3.5 Storm drains in vicinity of work to be fitted with environmental covers.

1.3.6 Do not dump excavated fill, waste material or debris adjacent to drainage systems.

1.4 Site Clearing and Plant Protection

1.4.1 Protect existing trees and plants/shrubs on site and on adjacent properties except as indicated otherwise by *Contract Documents.* Carefully wrap all trees with burlap and encase with substantial timbers to a height of minimum 2.5 m where adjacent to construction work, material storage areas, and vehicle lanes. Similarly protect plants.

1.4.2 Protect roots during excavation and grading to minimize possible disturbance and damage. Do not allow traffic, vehicles and equipment to compact soil over tree and plant root systems.

1.4.3 Minimize stripping of topsoil and vegetation.

1.4.4 No tree removal will be permitted, unless otherwise indicated or designated by the *Departmental Representative*.

1.5 Work Adjacent to Watercourses

1.5.1 Do not operate construction equipment in watercourses.

1.5.2 Do not use watercourse beds for borrow material without approval from Federal, Provincial and Municipal authorities.

1.5.3 Do not dump excavated fill, waste material or debris in or adjacent to watercourses.

1.5.4 Design and construct temporary crossings to minimize erosion to watercourses.

1.5.5 Do not skid logs or construction materials across watercourses.

1.5.6 Avoid spawning beds when constructing temporary crossings of watercourses.

1.5.7 Do not blast under water or within 100 m of spawning beds without approval from Federal, Provincial and Municipal authorities.

1.6 Pollution Control

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

1.6.2 Control emissions from equipment and plant to local authorities emission requirements.

1.6.3 Prevent sandblasting and other extraneous materials from contaminating air beyond application area, by providing temporary enclosures.

1.6.4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads. Cover stockpiles to prevent erosion to sewer and drainage systems, and watercourses.

1.7 Inspection and Testing

1.7.1 *Departmental Representative* will arrange for all testing for work described in this Section.

2.0 DEFINITIONS

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

2.2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction. Control of environmental pollution and damage requires

consideration of land, water, air, biological and cultural resources, and includes management of visual aesthetics, noise; solid, chemical, gaseous, and liquid waste, radiant energy and radioactive material, as well as other pollutants.

3.0 PRODUCTS

3.1 Silt Fence

3.1.1 Silt fence to be manufactured from a woven, slit film geotextile material with a shiny to smooth surface texture designed to reduce velocity of runoff to point that suspended particles settle out due to reduction of hydraulic energy.

3.1.2 Minimum Requirements: (All values are “minimum average roll values”.)

(a) Grab Tensile: 500 N

(b) Mullen Burst: 1,900 kPa

(c) Elongation at Break: 25% maximum

(d) Opening: 600 µm maximum

(e) UV Rating at 500 hours: 90% retained

(f) Efficiency: >75% minimum

(g) Construction: woven (tape)

(h) Texture: smooth, shiny

(i) Posts: 4x4 cm, treated

(j) Post Spacing (centres): 2 m maximum

(k) Permittivity: 10 L/s/m^2

4.0 EXECUTION

4.1 Placement

4.1.1 Place silt barrier in a manner that will intercept runoff at or close to right angles to flow. In areas where problem is severe, erect two or more silt barriers parallel to each other, until required degree of control is achieved.

4.1.2 Position posts in such a manner that fence structure remains naturally taut and placed or driven a minimum of 500 mm into ground. Posts to always be positioned downstream.

4.1.3 Where a 500 mm depth is impractical or impossible, adequately secure or brace posts to prevent overturning of fence due to sediment loading.

4.1.4 Bury excess geotextile at bottom of silt fence minimum of 150 mm in trench located upstream such that no flow can pass under fence.

4.1.5 Splice subsequent lengths of barrier only at support post locations. Splice by wrapping geotextile fabric completely around each of two abutting support posts such that gap between abutting posts is completely covered by both sections of fabric.

4.2 Quantities

4.2.1 Limit silt fence to handle area equivalent to maximum 100 m^2 per 3 m of fence.

4.2.2 Do not use where site slope is steeper than 3:1 and water flow rates exceed 0.03 m^2/s per 3 m of fence.

4.2.3 Silt barrier to have efficiency >75%. Employ successive, parallel fences to achieve required degree of control.

4.3 Maintenance

4.3.1 Maintain integrity of silt fences as long as necessary to contain sediment runoff. Inspect all temporary silt fences immediately after each rainfall and at least daily during prolonged rainfall. Immediately correct any deficiencies. In addition, make daily review of location of silt fences in areas where construction activities have changed natural contours and drainage runoff to ensure that silt fences are properly located for effectiveness. Where deficiencies exist, install additional silt fences. Should silt fence become damaged or otherwise ineffective while barrier is still necessary, repair or replace promptly.

4.3.2 Remove sediment deposits when deposit reaches approximately one-third of height of silt fence or install second silt fence upslope.

4.3.3 Do not remove silt fence until *Departmental Representative* directs that it be removed.

4.4 Clean Up

4.4.1 At completion of construction phase or as directed by *Departmental Representative*, remove and dispose of any silt accumulations, dress area to give a pleasing appearance, and vegetate all bare areas as specified.

END OF SECTION

1.0 GENERAL

1.1 PRODUCTS/MATERIAL AND EQUIPMENT

.1 Use NEW products/material and equipment unless otherwise specified. The term "products" is referred to throughout the specifications.

.2 Use products of 1 manufacturer for material and equipment of the same type or classification unless otherwise specified.

.3 Unless otherwise specified, comply with manufacturer's latest printed instructions for materials and installation methods.

.4 Notify Departmental Representative in writing of any conflict between these specifications and manufacturer's instructions. Departmental Representative will designate which document is to be followed.

.5 Provide metal fastenings and accessories in the same texture, colour and finish as base metal in which they occur.

- .1 Prevent electrolytic action between dissimilar metals.
- .2 Use non-corrosive fasteners, anchors and spacers for securing exterior work.
- .3 Fastenings which cause spalling or cracking are not acceptable.
- .4 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .5 Use heavy hexagon heads, semi-finished unless otherwise specified.
- .6 Bolts may not project more than 1 diameter beyond nuts.
- .7 Types of washers as follows:
  - .1 Plain type washers: use on equipment and sheet metal.
  - .2 Soft gasket lock type washers: use where vibrations occur.
  - .3 Resilient washers: use with stainless steel.
- .8 Deliver, store and maintain packaged material and equipment with manufacturer's seals and labels intact.
- .9 Prevent damage, adulteration and soiling of products during delivery, handling and storage. Immediately remove rejected products from site.
- .10 Store products in accordance with suppliers' instructions.
- .11 Touch up damaged factory finished surfaces to Departmental Representative's satisfaction.
  - .1 Use primer or enamel to match original.
  - .2 Do not paint over nameplates.

1.2 QUALITY OF PRODUCTS

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

.2 Defective products will be rejected regardless of previous inspections.

- .1 Inspection does not relieve responsibility, but is precaution against oversight or error.
- .2 Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- .3 Retain purchase orders, invoices and other documents to prove that all products utilized in this Contract meet the requirements of the specifications. Produce documents when

requested by the Departmental Representative.

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

.5 Unless otherwise indicated in the specifications, maintain uniformity of manufacture for any particular or like item throughout the 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 MANUFACTURER'S INSTRUCTIONS

.1 Unless otherwise indicated in the specifications, install or erect products in accordance with the manufacturer's instructions.

.1 Do not rely on labels or enclosures provided with products.

.2 Obtain written instructions directly from the manufacturer.

.2 Notify Departmental Representative in writing of conflicts between the specifications and the manufacturer's instructions so that the Departmental Representative may establish the course of action.

.3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes the Departmental Representative to require removal and reinstallation at no increase in either the Contract price or the Contract time.

END OF SECTION 01 61 00

1.0 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 11 00 General Instructions

1.2 COORDINATION

.1 Contractor shall coordinate the Owner's fumehood testing agency with the Construction Schedule for incorporation of fumehood testing activities. This time for testing is to be included in the time that the fumehood is not available for use.

2.0 PRODUCTS

2.1 OWNER'S WORK

.

END OF SECTION 01 64 00

1.0 GENERAL

1.1 REFERENCES

.1 A set of construction drawings of existing buildings in pdf format are available for viewing and reference only upon request. The set of drawings may not be full completed set and do not necessarily represent as-built conditions. All existing conditions measurements need to be verified on site.

1.2 QUALIFICATIONS OF SURVEYOR

.1 Qualified registered land surveyor, licensed to practice in the province of British Columbia, acceptable to Departmental Representative.

1.3 EXISTING SERVICES

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

1.4 LOCATION OF EQUIPMENT AND FIXTURES

.1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.

.2 Locate equipment, fixtures and distribution systems to provide minimum interference and

maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.

.3 Inform Departmental Representative of impending installation and obtain approval for actual location.

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

1.5 RECORDS

.1 Maintain a complete, accurate log of control and survey work as it progresses.

.2 On completion of foundations and major site improvements, prepare a certified survey showing dimensions, locations, angles and elevations of Work.

.3 Record locations of maintained, re-routed and abandoned service lines.

1.6 SUBMITTALS

.1 Submit name and address of Surveyor to Departmental Representative.

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

.3 Submit certificate signed by surveyor certifying and noting those elevations and locations of completed Work that conform and do not conform with Contract Documents.

END OF SECTION 01 71 00

1.0 GENERAL

1.1 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 Departmental Representative or separate contractor.

.3 Include in request:
- .1 Identification of project.
- .2 Location and description of affected Work.
- .3 Statement on necessity for cutting or alteration.
- .4 Description of proposed Work, and products to be used.
- .5 Alternatives to cutting and patching.
- .6 Effect on Work of Departmental Representative 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 including excavation and fill, to complete Work.

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

.3 Uncover Work to install ill-timed Work.

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

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

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

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

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

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

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

.11 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with firestopping material in accordance with Section 07 84 00 - Firestopping, full thickness of the construction element.

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

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

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

END OF SECTION 01 73 00

1.0 GENERAL

1.1 REFERENCES

.1 Not used

1.2 PROJECT CLEANLINESS

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

.2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site, unless approved by Departmental Representative.

.3 Clear snow and ice from access to building, bank/pile snow in designated areas only.

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

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

.6 Provide and use marked separate bins for recycling. Refer to Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

.7 Dispose of waste materials and debris off site.

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

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

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

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

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

.13 Contractor will be responsible to clean the laboratory suite throughout should there be a blow through of dust during system commissioning or hook-up.

1.3 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 including that caused by other Contractors.

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

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

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

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

.13 Remove dirt and other disfiguration from exterior surfaces.

.14 Clean and sweep gutters.

.15 Sweep and wash clean paved areas.

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

.17 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.

.18 Remove snow and ice from access to buildings.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

END OF SECTION 01 74 11

1.0 GENERAL

1.1 WASTE MANAGEMENT GOALS

.1 Prior to start of Work conduct meeting with Departmental Representative to review and discuss CFIA's Waste Management Plan and Goals.

.2 Accomplish maximum control of solid construction waste.

.3 Preserve environment and prevent pollution and environment damage.

1.2 DEFINITIONS

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

.2 Cost/Revenue Analysis Workplan (CRAW): based on information from WRW, and intended as financial tracking tool for determining economic status of waste management practices.

.3 Demolition Waste Audit (DWA): relates to actual waste generated from project.

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

.5 Materials Source Separation Program (MSSP): consists of series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.

.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-modeling 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: acts of keeping different types of waste materials separate beginning from first time they became waste.

.13 Waste Audit (WA): detailed inventory of materials in building. Involves quantifying by volume/weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project. Indicates quantities of reuse, recycling and landfill. Refer to Schedule A.

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

.15 Waste Reduction Workplan (WRW): written report which addresses opportunities for reduction, reuse, or recycling of materials. Refer to Schedule B. WRW is based on information acquired from WA (Schedule A).

1.3 DOCUMENTS

.1 Maintain at job site, one copy of following documents:
- .1 Waste Audit.
- .2 Waste Reduction Workplan.
- .3 Material Source Separation Plan.
- .4 Schedules A, B, C, D, E completed for project.

1.4 SUBMITTALS

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

.2 Prepare and submit following prior to project start-up:
- .1 Submit 2 copies of completed Waste Reduction Workplan (WRW): Schedule B.
- .2 Submit 2 copies of completed Demolition Waste Audit (DWA): Schedule C.
- .3 Submit 2 copies of Materials Source Separation Program (MSSP) description.

.3 Submit before final payment summary of waste materials salvaged for reuse, recycling or disposal by project using deconstruction/disassembly material audit form.
- .1 Failure to submit could result in hold back of final payment.
- .2 Provide receipts, scale tickets, waybills, and show quantities and types of materials reused, recycled, co-mingled and separated off-site or disposed of.
- .3 For each material reused, sold or recycled from project, include amount quantities by number, type and size of items and the destination.
- .4 For each material land filled or incinerated from project, include amount in tonnes of material and identity of landfill, incinerator or transfer station.

1.5 WASTE AUDIT (WA)

.1 Conduct WA prior to project start-up.

.2 Prepare WA: Schedule A.

.3 Record, on WA - Schedule A, extent to which materials or products used consist of recycled or reused materials or products.

1.6 WASTE REDUCTION WORKPLAN (WRW)

.1 Prepare WRW prior to project start-up.

.2 WRW should include but not limited to:
- .1 Destination of materials listed.
- .2 Deconstruction/disassembly techniques and sequencing.
- .3 Schedule for deconstruction/disassembly.
- .4 Location.
- .5 Security.
- .6 Protection.
- .7 Clear labelling of storage areas.
- .8 Details on materials handling and removal procedures.

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

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

.4 Describe management of waste.

.5 Identify opportunities for reduction, reuse, and recycling of materials. Based on information acquired from WA.

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

.7 Set realistic goals for waste reduction, recognize existing barriers and develop strategies to overcome these barriers.

.8 Monitor and report on waste reduction by documenting total volume and cost of actual waste removed from project.

1.7 DEMOLITION WASTE AUDIT (DWA)

.1 Prepare DWA prior to project start-up.

.2 Complete DWA: Schedule C.

.3 Provide inventory of quantities of materials to be salvaged for reuse, recycling, or disposal.

1.8 MATERIALS SOURCE SEPARATION PROGRAM (MSSP)

.1 Prepare MSSP and have ready for use prior to project start-up.

.2 Implement MSSP for waste generated on project in compliance with approved methods and as reviewed by Departmental Representative.

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

.4 Provide containers to deposit reusable and recyclable materials.

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

.6 Locate separated materials in areas which minimize material damage.

.7 Collect, handle, store on-site, and transport off-site, salvaged materials in separate condition.
.1 Transport to approved and authorized recycling facility.

1.9 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 surface drainage, mechanical and electrical from damage and blockage.

.4 Separate and store materials produced during dismantling of structures in designated areas.

.5 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.
- .1 On-site source separation is recommended.
- .2 Remove co-mingled materials to off-site processing facility for separation.
- .3 Provide waybills for separated materials.

1.10 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 from deconstruction as deconstruction/disassembly Work progresses.

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

1.11 USE OF SITE AND FACILITIES

.1 Execute work with least possible interference or disturbance to normal use of premises.

.2 Provide temporary security measures approved by Departmental Representative.

1.12 SCHEDULING

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

2.0 PRODUCTS

2.1 NOT USED

.1 Not Used.

3.0 EXECUTION

3.1 APPLICATION

.1 Do Work in compliance with WRW.

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

3.2 CLEANING

.1 Remove tools and waste materials on completion of Work, and leave work area in clean and orderly condition.

.2 Clean-up work area as work progresses.

.3 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 salvaged recovered reusable and/or recyclable materials is not permitted.

.3 Demolition Waste:

Material Type	Recommended Diversion %	Actual Diversion %
Acoustical Insulation	100	
Doors and Frames	100	
Electrical Equipment	80	
Mechanical Equipment	100	
Metals	100	
Rubble	100	
Wood (uncontaminated)	100	
Other		

.4 Construction Waste:

Material Type	Recommended Diversion %	Actual Diversion %
Cardboard	100	
Plastic Packaging	100	
Rubble	100	
Steel	100	
Wood (uncontaminated)	100	
Other		

3.4 WASTE AUDIT (WA)

The following pertains to Schedule A - Waste Audit (WA). Column-1 refers to the category of waste, and a physical description of the material (e.g. off-cuts, clean drywall, etc.). Column-2 refers to the total quantity of materials received by the Contractor. Measurement units must be specified. Column-3 refers to the estimated percentage of material that is waste. Column-4 refers to the total quantity of waste (column-2 x column-3). Column-5 refers to the areas(s) in which the waste was generated. Column-6 refers to the total percentage of recycled material from the specified total quantity of waste (column-4). Column-7 refers to the total percentage of reused material from the specified total quantity of waste (column-4).

.1 Schedule A - Waste Audit (WA):

(1) Material Category	(2) Material Quantity Unit %	(3) Estimated Waste	(4) Total Quantity of Waste (unit)	(5) Generation Point	(6) % Recycled	(7) % Reused
Wood & Plastics						
Material Description						
Off-Cuts						
Warped						
Plastic						
Cardboard						
Other						
Doors & Windows						
Material Description						
Frames						
Glass						
Wood						
Metal						
Other						

3.5 WASTE REDUCTION WORKPLAN (WRW)

The following pertains to Schedule B - Waste Reduction Workplan (WRW). Column-1 refers to the category and type of waste materials. Column-2 refers to the persons responsible for completing the WRW. Column-3 refers to Column-4 of Schedule A. Column-4 refers to the amount of reused waste predicted and realized. Column-5 refers to the amount of recycled waste predicted and realized. Column-6 refers to the approved recycling facility.

.1 Schedule B:

(1) Material Quantity Category	(2) Person Amount Respon sible Waste	(3) Total of Project (unit)	(4) Reused Actual (units)	(5) Recycle Actual (s) Amount	(6) Material Destination (s)
Wood & Plastics					
Material Description					
Chutes					
Warped					
Plastic					
Cardboard Packaging					
Other					
Doors & Windows					
Material Description					
Painted					
Frames					
Glass					
Wood					
Metal					
Other					

3.6 DEMOLITION WASTE AUDIT (DWA)

The following pertains to Schedule C - Demolition Waste Audit (DWA). Column-1 refers to the type of material salvaged. Column-2 refers to the material quantity shown in column-1. Several columns may be required to identify specific demolition areas. Column-3 refers to the unit of measurement used to describe Column-2. Column-4 refers to the total quantity of salvaged material. Column-5 refers to the cumulative volume of salvaged material. Column-6 refers to the total weight in kilograms. Column-7 refers to remarks and assumptions made about the specified material.

.1 Schedule C - Demolition Waste Audit (DWA):

(1) Material Description Assumptions	(2) Quantity	(3) Unity	(4) Total	(5) Volume (cum)	(6) Weight (cum)	(7) Remarks & Assumptions
Wood						
Wood						
Stud						
Plywood						
Baseboard -wood						
Door						
Trim-Wood						
Cabinet						
Doors & Windows						
Panel						
Regular						
Slab Regular						
Wood						
Laminate						
Byfold-Closet						
Glazing						

3.7 CANADIAN GOVERMENTAL DEPARTMENTS CHIEF REPSONSIBLITY FOR THE ENVIROMENT

.1 Schedule E - Government Chief Responsibility for the Environment:

.1 Ministry of Environment Lands and Parks
810 Blanshard Street, 4th Floor
Victoria, BC V8V 1X4
604-387-1161 / 604-356-6464

.2 Waste Reduction Commission Soils and Hazardous Waste
770 South Pacific Blvd, Suite 303
Vancouver BC, V6B 5E7
604-660-9550 / 604-660-9596

END OF SECTION 01 74 19

1.0 GENERAL

1.1 SECTION INCLUDES

.1 Administrative procedures preceding preliminary and final inspections of Work.

1.2 RELATED SECTIONS

.1 Section 01 78 00 - Closeout Submittals.

1.3 INSPECTION AND DECLARATION

.1 Contractor's Inspection: Contractor and all Subcontractors shall conduct an 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 that corrections have been made.

.2 Request Departmental Representative's Inspection.

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

.4 Completion: submit written certificate that following have been performed:

.1 Work has been completed and inspected for compliance with Contract Documents.
.2 Defects have been corrected and deficiencies have been completed.
.3 Equipment and systems have been tested, adjusted, and balanced and are fully operational.
.4 Certificates required by authorities having jurisdiction.
.5 Commissioning of all systems: Final commissioning reports have been submitted to the Departmental Representative.
.6 Operation of systems have been demonstrated to Facility personnel.
.7 Work is complete and ready for Final Inspection.

END OF SECTION 01 77 00

Materail1.0 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 45 00 - Quality Control.

.2 Section 01 71 00 – Examination & Preparation.

.3 Section 01 77 00 - Closeout Procedures.

.4 Section 01 91 41 – Commissioning: Training

1.2 SUBMISSION

.1 Prepare instructions and data using personnel experienced in maintenance and operation of described products.

.2 Copy will be returned after final inspection, with Departmental Representative's comments.

.3 Revise content of documents as required prior to final submittal.

.4 Two weeks prior to Interim Completion of the Work, submit to the Departmental Representative, four final copies of operating and maintenance manuals in English.

.5 An electronic copy Interactive Operating and Maintenance Manual System is required as specified under clause 1.3. Provide 4 sets of the Electronic Interactive Operating and Maintenance Manual System to the Departmental Representative.

.6 Hard copies of the Operating and Maintenance Manual System is required as specified under clause 1.4. Provide 4 sets of the Hard Copy Interactive Operating and Maintenance Manual System to the Departmental Representative.

.7 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.

.8 If requested, furnish evidence as to type, source and quality of products provided.

.9 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.

.10 Pay costs of transportation.

1.3 INTERACTIVE OPERATING AND MAINTENANCE MANUAL SYSTEM

.1 In addition to the printed copies, submit provide an Interactive Operating and Maintenance Manual System as specified herein.

.2 System Description and Requirements

.1 All as constructed drawings and operation and maintenance (O&M) manuals listed under the Scope of Work shall be converted, where necessary, into Portable Data File (PDF) format for viewing using the Adobe Acrobat Reader.

.2 Documentation storage and retrieval system shall be structured based on a database framework with direct links to the appropriate PDF files. Documents retrieval and viewing shall be executed through a menu driven approach.

.3 Program shall be capable of storing separately and independently data of multiple buildings and shall be expandable for addition of new buildings and systems.

.4 Data of each building shall be accessible by the input of either the building name or building number as defined by the Departmental Representative.

.5 O&M data and as constructed drawings shall be classified by their corresponding disciplines, including:

.1 Architectural
.2 Mechanical
.3 Electrical
.4 Data & Communication
.5 BSCS
.6 Under each discipline, data shall be grouped into the following four major categories:

.1 Basic Documents

.1 'Basic Documents' shall, according to the type of services or disciplines, include the full contents of each hard copy of the O&M manuals with the addition of Miscellaneous Maintenance Reports and Records, or as defined by the user. In general the following shall be included unless specifically excluded by the Departmental Representative:

.1 Introduction
.2 Consultant/Contractor/Suppliers List
.3 System Description
.4 Maintenance and Lubrication Schedules
.5 Testing and Commissioning (T&C) Reports
.6 Misc. Reports
.7 Specifications
.8 Equipment and/or point schedules as identified in the hard copy documents
.9 Others as stipulated by the Departmental Representative

.2 All Basic Documents PDF files shall be enhanced with appropriate bookmarks to facilitate searching of information within the document or linking to other relevant documents for references.

.2 'As-Constructed' Drawings

.1 'As-Constructed' drawings shall be converted from the original electronic files, such as CAD, into PDF format. If only the hard copies of the 'as constructed' drawings are available, they shall be scanned and saved in PDF format. PDF files of the 'As-Constructed' drawings shall be enhanced with the following bookmarks to zoom into legible views on the computer screen as a minimum:

.1 Drawing Number and Title
.2 Drawing Notes
.3 Major Equipment Locations
.4 Cross-links to other related drawings
.5 Revisions

.3 System Data

.1 Building systems shall be identified by their services, disciplines, function, nature and specific scope. System data shall be classified into the following categories:

.1 System Description
.2 Schematic (where applicable)
.3 Equipment List

.2 Provide hot key buttons, where applicable, for direct access to drawings/data referenced on the schematics. The same shall be applied to listed equipment for direct links to the corresponding equipment data.

.4 Equipment Data

.1 Equipment data shall be classified into the following categories:

.1 Equipment submittals
.2 T&C Report
.3 Maintenance Data
.4 Maintenance Records
.5 Photo

.2 Provide a summary screen to list all equipment classified under a specific system. On the summary screen, provide direct links to the corresponding equipment data under each category with addition links to the relevant 'As Constructed' drawings.

.6 The system shall be executed by Professional Engineers with a minimum of 10 years post qualification experience in the field of Building Services Engineering.

.7 The Contractor shall provide a minimum of 3 past job references as proven record of similar undertakings.

1.4 FORMAT HARD COPY MANUALS

.1 Organize data in the form of an 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. 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 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. Bind in with text; fold larger drawings to size of text pages.

.9 Provide 1:1 scaled CAD files in .dwg format on CD.

1.5 CONTENTS - EACH VOLUME

.1 Table of Contents: provide title of project;

.1 date of submission;
.2 names, addresses, and telephone and fax numbers of Contractor, Subcontractors, Suppliers with name of responsible parties;
.3 schedule of products and systems, indexed to content of volume.

.4 copy of hardware schedule and paint schedules, complete with the actual manufacturer, supplier and identification names and numbers.
.5 all extended guarantees, warranties, maintenance bonds, certificates, letters of guarantees, registration cards, as called for in the various sections of the specification.
.6 complete set of all final reviewed shop drawings.
.7 certificates of inspection by authorities having jurisdiction.
.8 test reports and certificates as applicable.
.9 complete set of as constructed drawings.

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

.6 Training: Refer to Section 01 91 41 – Commissioning: Training.

1.6 'AS CONSTRUCTED' DRAWINGS AND SAMPLES

.1 In addition to requirements in General Conditions, maintain at the site one record copy of:
.1 Contract Drawings.
.2 Specifications.
.3 Addenda.
.4 Change Orders and other modifications to the 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. 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. Label each document "PROJECT RECORD" in neat, large, printed letters.

.4 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.

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

.6 Provide an electronic copy of as constructed drawings.

1.7 RECORDING ACTUAL SITE CONDITIONS

.1 Record information on set of black line opaque drawings, provided by Departmental Representative.

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

.3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.

.

.4 Contract Drawings and shop drawings: legibly 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: legibly mark each item to record actual construction, including:
- .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
- .2 Changes made by Addenda and change orders.

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

1.8 EQUIPMENT AND SYSTEMS

.1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. 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. Include regulation, control, stopping, shut-down, and emergency instructions. 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 coordination drawings, with installed colour coded piping diagrams.

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

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

.14 Include test and balancing reports as specified in Section 01 45 00 - Quality Control and 01 91 13 - Commissioning.

.15 Additional requirements: As specified in individual specification sections.

1.9 MATERIALS AND FINISHES

.1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.

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

.3 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.

.4 Additional Requirements: as specified in individual specifications sections.

1.10 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 all items. Submit inventory listing to Departmental Representative. Include approved listings in Maintenance Manual.

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

1.11 MAINTENANCE 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 all items. Submit inventory listing to Departmental Representative. Include approved listings in the Operating and Maintenance Manuals.

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

1.12 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 all items. Submit inventory listing to Departmental Representative. Include approved listings in Maintenance Manual.

1.13 STORAGE, HANDLING AND PROTECTION

.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 to satisfaction of Departmental Representative.

1.14 WARRANTIES AND BONDS

.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 the applicable item of work.

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

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

.6 Co-execute submittals when required.

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

END OF SECTION 01 78 00

1.0 GENERAL

1.1 ADMINISTRATIVE REQUIREMENTS

.1 Demonstrate scheduled operation and maintenance of equipment and systems to Owner's personnel two weeks prior to date of substantial performance.

.2 Owner: provide list of personnel to receive instructions, and co-ordinate their attendance at agreed-upon times.

.3 Preparation:
- .1 Verify conditions for demonstration and instructions comply with requirements.
- .2 Verify designated personnel are present.
- .3 Ensure equipment has been inspected and put into operation in accordance with each Division.
- .4 Ensure testing, adjusting, and balancing has been performed in accordance with Section 23 05 93 – Testing, Adjusting and Balancing Testing for HVAC.

.4 Demonstration and Instructions:
- .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at agreed upon times, at the equipment location.
- .2 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.
- .3 Review contents of manual in detail to explain aspects of operation and maintenance.
- .4 Prepare and insert additional data in operations and maintenance manuals when needed during instructions.

.5 Time Allocated for Instructions: ensure adequate amount of time required for instruction of each item of equipment or system: refer to Section 01 91 41

1.2 SUBMITTALS

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

.2 Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to designated dates, for Departmental Representative's approval.

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

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

.5 Provide electronic & hard copies (Refer to Section 01 78 00 Closeout Submittals) of completed operation and maintenance manuals for use in demonstrations and instructions.

1.3 QUALITY ASSURANCE

.1 When specified in individual Sections requiring manufacturer to provide authorized representative to demonstrate operation of equipment and systems:
- .1 Instruct Departmental Representative’s personnel.
- .2 Provide written report that demonstration and instructions have been completed.

END OF SECTION 01 79 00

Part 1 General

1.1 Section Includes

.1 Commissioning Requirements

.2 This section of the specifications does not prevent systems other than those described herein from being tested, verified, or commissioned as per other sections of the specifications.

.3 **Refer to the Commissioning Plan Section 01 91 00.01 attached to and forming part of the Division 1 – General Commissioning Requirements for the Project.** The Commissioning Plan has been written by the Commissioning Authority, **KD Engineering Co.**, and describes the commissioning process and documentation requirements for this Project.

1.2 Related Sections

.1 Division 01, Section 01 91 00.01 – Commissioning Plan

.2 Division 01, Section 01 79 00 – Demonstration and Training

.3 Division 01, Section 01 91 41 – Commissioning: Training

.4 Division 23, Section 23 05 00 – Common Work Results for HVAC

.5 Division 23, Section 23 08 00 – Commissioning of Mechanical Systems

.6 Division 23, Section 23 08 00.01 – Commissioning System Testing

.7 Division 23, Section 23 05 93 – Testing, Adjusting and Balancing

.8 Division 23, Section 23 31 10 – Cleaning of Mechanical Duct Systems

.9 Division 23, Section 23 34 00 – HVAC Fans

.10 Division 23, Section 23 36 00 – Air Terminal Units

.11 Division 23, Section 23 74 11 – Outdoor Air Handling Units

.12 Division 25, Section 25 05 01– EMCS: General Requirements

.13 Division 25, Section 25 30 11 – EMCS: Building Controllers

.14 Division 25, Section 25 30 12 – EMCS: Field Control Devices

.15 Division 26, Section 26 05 01- Electrical General Requirements

1.3 Definitions

.1 Commissioning is a methodical, team-based process. Each member of the commissioning team must fulfill his or her commissioning functions, as described in the Commissioning Plan in order for this process to be successful. The Commissioning Team is responsible for accomplishing the commissioning process activities and is to provide leadership in identifying and resolving all commissioning process issues.

.2 "The commissioning process is a quality assurance method adopted by an Owner to consistently achieve successful construction projects. It is not an additional layer of construction or project management – it is the Owner's means of verifying that the planning, design, construction and operational processes are achieving their goals, and ensures the delivery of a well-performing building with high quality and asset value.

.3 "The intent of the commissioning process is "To verify that the project's energy related systems are installed, calibrated and perform according to the owner's project requirements, basis of design, and construction documents.

.4 It is of primary concern that all "Commissioned Systems" in the project perform in accordance with the contract documents, the design intent and the Owner's Project Requirements. The process of assuring that such performance is achieved is referred to as "commissioning."

1.4 References

.1 PWGSC Commissioning Manual (CP.1)

Part 2 Products

2.1 Not Used

Part 3 Execution

3.1 The Commissioning Process

.1 Begins at project inception.

.2 Has ongoing verification of achievement of the owner's project requirements.

.3 Requires integration of contractor-completed commissioning process activities into the construction documents.

.4 Aids in the coordination of static and dynamic testing that acceptance is based on.

.5 Verifies staff training.

.6 Is completed with warranty verifications and lessons-learned documentation and implementation.

3.2 Commissioned Systems

.1 The following systems shall be commissioned for this Project:

.1 Mechanical Systems:

.1 AHU Replacement (AHU-101, 102 & 103)

.2 Replacement of Existing Exhaust System by Installation of New Exhaust Manifold System

.3 Energy Management & Control System (EMCS)

.2 Associated Electrical System for:

.1 AHU Replacement (AHU-101, 102 & 103)

.2 Replacement of Existing Exhaust System by Installation of New Exhaust Manifold System

3.3 Commissioning Team

.1 All commissioning team members are to refer to and perform tasks assigned to them listed in the Commissioning Plan.

.2 For this Project, the commissioning team will be comprised of, but not necessarily limited to, the following parties:

.1 Owner
.2 Owner's Representative
.3 Building Operation & Maintenance
.4 Commissioning Authority (overseeing, multiple discipline role)
.5 Design Consultant -Architectural
.6 Design Consultant – Electrical
.7 Design Consultant – Mechanical
.8 General Contractor
.9 Subcontractor – Electrical
.10 Subcontractor – Mechanical
.11 Subcontractor – Controls
.12 Subcontractor – Balancing
.13 Commissioning Agent – Electrical
.14 Commissioning Agent – Mechanical

.3 Commissioning requires cooperation and direct involvement by all Commissioning Team members throughout the construction and warranty processes. Commissioning Team member roles and responsibilities are listed within the Commissioning Plan.

3.4 Commissioning Plan

.1 **Refer to the Commissioning Plan Section 01 91 00.01 attached to and forming part of the Division 1 – General Commissioning Requirements for the Project.** The Commissioning Plan has been written by the Commissioning Authority, **KD Engineering Co.**, and describes the commissioning process and documentation requirements for this Project.

.2 The Commissioning Plan will be revised and re-issued over the course of the Project several times so that it is as accurate and as useful a document as is possible.

.3 The Commissioning Plan includes the following elements:

.1 Brief overview of the commissioning process.
.2 A list of all systems and assemblies included in the Commissioning Authority's scope of work.
.3 Identification of Commissioning Team and its responsibilities.
.4 Description of the management, communication and reporting of the commissioning process.

.5 Overview of the commissioning process activities for the pre-design, design, construction, and occupancy and operations phases, including the following:

.1 Development of the owner's project requirements (pre-design phase).

.2 Review of the basis of design (design phase).

.3 Review of the schematic design (design phase).

.4 Review of the construction documents (design phase).

.5 Review of submittals (construction phase).

.6 Construction phase verification (construction phase).

.7 Functional performance test development (construction phase).

.8 Functional performance test implementation (construction phase).

.9 Warranty review (occupancy and operations phase).

.6 A list of the expected work products.

.7 A list of key commissioning process milestones.

3.5 Commissioning Responsibilities

.1 The Commissioning Plan describes the expected contributions from the various commissioning team members as well as the expected commissioning work products.

.2 The Commissioning Authority provides the services in support of the commissioning requirements and for the overall commissioning of the project. The Commissioning Authority shall provide technical comments or advice to the Project team as the design documentation advances and shall assemble a Commissioning Plan to be followed by the commissioning team such that the project can be properly commissioned. By following the Commissioning Plan, the commissioning team can assure that the "commissioned systems" properly function in accordance with the owner's requirements and the consultant's design intent.

.3 It is important to note the clear distinction between the Commissioning Authority and the Commissioning Agents (mechanical & electrical). The Commissioning Authority is responsible for overseeing the overall multi-discipline commissioning process while the Commissioning Agents perform and document the testing of the various mechanical and electrical "commissioned systems".

.4 "The Commissioning Authority serves as an objective advocate for the Owner, plans and directs the commissioning process, and presents final recommendations to the Owner regarding the performance of commissioned systems and assemblies. The Commissioning Authority introduces standards and strategies early in the planning process and then verifies implementation of the commissioning process activities by clearly specifying the requirements in construction documents.

.5 Per the Commissioning Plan, the Contractor's commissioning process responsibilities shall include, but shall not necessarily be limited to, the following:

.1 Commissioning team involvement.

.2 Submittal review procedures.

.3 Operations and maintenance documentation requirements.

.4 Training plan development.

.5 Construction verification procedures.

.6 Start-up plan development and implementation.

.7 Functional performance testing.

.8 Milestones.

.9 Training.

.10 Warranty review site visit.

3.6 Commissioning Documentation

.1 All commissioning-related documentation shall to be copied to the Commissioning Authority in a timely manner. All commissioning issues shall be brought to the attention of the Commissioning Authority in a timely manner. All commissioning team members shall create or shall assist in the creation of all commissioning and commissioning-related documentation as indicated in the Commissioning Plan.

END OF SECTION

1.0 GENERAL

1.1 SUMMARY

.1 Section Includes:
This Section specifies roles and responsibilities of Commissioning Training.

.2 Related Sections:

.1	Mechanical	Section 25 00 00
.2	Electrical	Section 26 00 00

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 Engineer 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 certified installation, started up and carried out PV tests.

1.4 TRAINING OBJECTIVES

.1 Training to be detailed and duration to ensure:
- .1 Safe, reliable, cost-effective, energy-efficient operation of systems in normal and emergency modes under all conditions.
- .2 Effective 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 Departmental Representative, 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.
- .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 8 hours in length.
- .3 Training to be completed prior to acceptance of facility.

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

1.8 TRAINING CONTENT
- .1 Training to include demonstrations by Instructors using the installed equipment and systems.
- .2 Content includes:
  - .1 Review of facility and occupancy profile.
  - .2 Functional requirements.
  - .3 System philosophy, limitations of systems and emergency procedures.
  - .4 Review of system layout, equipment, components and controls.
  - .5 Equipment and system start-up, operation, monitoring, servicing, maintenance and shut-down procedures.
  - .6 System operating sequences, including step-by-step directions for starting up, shut-down, operation of valves, dampers, switches, adjustment of control settings and emergency procedures.
  - .7 Maintenance and servicing.
  - .8 Trouble-shooting diagnosis.
  - .9 Inter-Action among systems during integrated operation.
  - .10 Review of O&M documentation.

.3 Provide specialized training as specified in relevant Technical Sections of the construction specifications.

END OF SECTION 01 91 41

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1 Not used

1.2 REFERENCES

.1 CSA International

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

1.3 ACTION & INFORMATIONS SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures and 01 74 19 - Construction/Demolition Waste Management Disposal.

.2 Submit hoarding layout plan for approval by Departmental Representative at each stage of work.

1.4 SITE CONDITIONS

.1 Hazardous materials have been identified. Asbestos containing material was found to be present in the red mastic used to seal mechanical duct joints and in the grey mastic located on the window frames throughout the 2nd floor of the building. Include all remediation work required in the Work.

.2 Contractor to conduct a visual inspection prior to beginning demolition and advise the Departmental Representative of any material which is not identified above resembling spray or trowel applied, asbestos or other designated substance listed as hazardous.

.3 If material resembling spray or trowel-applied asbestos or other designated substance listed as hazardous is encountered not identified above, stop work, take preventative measures, and notify Departmental Representative immediately.

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

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

3.0 EXECUTION

3.1 EXAMINATION

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

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

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

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

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

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

3.2 PREPARATION

.1 Protection of In-Place Conditions:

.1 Prevent movement, settlement, or damage to adjacent structures, and utilities.

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

.3 Protect building systems, services and equipment.

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

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

.6 For lay-in t bar ceilings, the intent is to reuse the existing tiles. Any tiles damaged during construction must be replaced to match existing. For drywall ceilings, the intent is to leave the existing ceiling in place and access the ceiling space through existing ceiling access panels or provide new ceiling access panels if required.

.7 For seismic restraint, the intent is not to seismically upgrade the ceilings, light fixtures and new drywall.

3.3 CLEANING

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

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

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

END OF SECTION 02 41 99

1.0 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1 Section 03 20 00 - Concrete Reinforcement

.2 Section 03 31 00 - Cast-in-Place Concrete

1.2 REFERENCE STANDARDS

.1 Concrete formwork shall conform to the requirements of the following Standards unless otherwise required by this specification:

.1 CSA-A23.1-04 - Concrete Materials and Methods of Concrete Construction.

.2 CSA-A23.3-04 - Code for the Design of Concrete Structures for Buildings.

.3 CSA-S269.3 – Concrete Formwork

.4 Where the Standard is referenced in this specification it shall mean the documents specified in this clause and their referenced documents.

.2 A copy of A23.1 and A23.2 shall be kept by the Contractor on site for the duration of the work and be made available for reference.

2.0. PRODUCTS

2.1. GENERAL

.1 Products shall satisfy the requirements of the Standard unless otherwise specified herein or on the drawings.

2.2. MATERIALS

.1 Form Material

.1 Exposed surfaces - metal, plywood or plywood lined. Plywood to conform to the Standard.

.2 Unexposed surfaces - metal, plywood, or wood lumber to conform to the Standard.

.3 Plywood and wood formwork materials shall, conform to the Standard, be free from warp and sawn straight so that lines and shapes will be accurately retained.

.4 Un-lined forms for unexposed surfaces shall be made with a good grade of lumber or plywood and fitted so that there will be no leakage of mortar.

.5 Use metal forms, plywood lined forms or plywood forms of sufficient structural strength for exposed surfaces. Plywood for lining shall be GIS exterior grade fir plywood with waterproof glue.

.6 Proprietary and/or modular forming systems shall be designed such that they do not interfere with the specified placement of reinforcement or other embedded hardware and must be pre-approved by the Departmental Representative.

.2 Ties And Spreaders

.1 Use metal form ties that are adjustable in length to permit tightening of forms. Use only the snap-off type of form ties which will permit no metal within 25mm (1") of the concrete surface after removal. Twisted wire form ties will not be accepted.

.2 Wood spreaders inside wall forms will not be permitted.

.3 Form ties for concrete surfaces exposed to possible seawater attack shall be of a type that allows the removal of all components.

.3 Form Release Agent

.1 Use a non-staining form release agent that is compatible with any finishes specified elsewhere in the contract documents.

.4 Void Form

.1 Void form shall be of a deteriorating material.

3.0. EXECUTION

3.1. GENERAL

.1 All phases of concrete formwork construction shall be in accordance with the Standard unless otherwise specified herein or on the drawings. Only workers who are skilled and experienced in their trade shall do the work.

3.2. LINES AND LEVELS

.1 Verify lines, levels and column centres before proceeding with work and ensure that dimensions agree with drawings.

.2 Co-ordinate and co-operate with all other trades in forming and setting of recesses, chases, sleeves, inserts, bolts, and hangers.

3.3. DESIGN OF FORMWORK, FALSEWORK AND RESHORING

.1 Conform to the Standard.

.2 The Contractor shall assume full responsibility for the structural adequacy of the forms to withstand all concrete, environmental, and construction loads.

.3 As a minimum, the work shall conform to CSA-A23.1, Section 6.5 for regular work and Section 8.3.4 for architectural concrete.

.4 Where concrete is exposed to view, forms are to be laid out so that joints are kept to a minimum and located in an orderly and symmetrical arrangement wherever possible. Form ties shall be evenly spaced and located in straight horizontal and vertical lines. Spacing and location of form tie holes shall be detailed by the Contractor and approved

by the Departmental Representative. See also the architectural drawings and specifications for any special requirements for architectural concrete.

.5 The strength and rigidity of forms shall be such that they will not leak mortar or result in visible irregularities in the finished concrete. In addition the deflection of facing materials between studs, as well as the deflection of studs and whalers, shall not exceed 0.0025 times the span.

.6 Forms shall be so constructed that the finished concrete will conform to the shape, dimensions and tolerances as specified in the Standard or on the structural drawing, whichever is most rigorous. They shall also incorporate the cambers specified on the structural drawings. Movement resulting from form support deflection, closure of form joints, and elastic shortening of forms and shoring, must be calculated and added to the cambers indicated on the drawings.

.7 Construct forms so that they may be dismantled and removed without damaging the concrete.

.8 The Contractor shall submit details of the sequence and extent of formwork removal and re-shoring to the Departmental Representative for review. Such details shall include magnitude of loads and location of all reshores at each level. Forms shall not be removed or adjusted until the review is complete. Such review does not relieve the Contractor of responsibility for formwork and safety during construction.

.9 Set shores on wedges or use adjustable shores so they may be removed without causing undue strains in the concrete.

.10 Do not exceed the safe capacity of the structure with any construction or shoring loads. The safe capacity of the structure may be taken as the design live load, as indicated on the structural drawings, multiplied by the ratio of the concrete strength at the time of loading to the specified concrete strength, but not greater than 1.0.

3.4. ERECTION

.1 Sleeves and openings shown on the structural drawings must be confirmed with mechanical, electrical and architectural drawings. Any discrepancies are to be reported to the Departmental Representative.

.2 Sleeves and openings not shown on the structural drawings must be approved by the Departmental Representative.

.3 Keep all untreated forms moist to prevent shrinkage prior to placing of concrete and wet the surface at time of placing.

.4 Treated formwork surfaces shall have the approved form coating applied in accordance with the manufacturer's recommendations, prior to placing reinforcing steel. Remove any excess form coating.

3.5. TOLERANCES

.1 The tolerances for all concrete work shall conform to the requirements of the Standard and Drawings.

3.6. PRODUCT HANDLING

.1 Protect formwork materials before, during and after installation and protect installed work and materials of other trades.

.2 In the event of damage, immediately make required repairs or replacements necessary to the approval of the Departmental Representative at no extra cost to the Departmental Representatives.

3.7. REMOVAL OF FORMWORK

.1 Forms shall not be removed until concrete has attained sufficient strength that no damage to strength or continuity of concrete will occur when forms are removed. Time for formwork removal of suspended concrete shall be approved by the Departmental Representative. See also the requirements of Section 3.3.

.2 Prying against face of concrete to remove forms is not allowed, only wooden wedges shall be used.

.3 Removal of form ties shall be done carefully to avoid marking concrete and to allow for patching. Grout bottom of form tie hole to prevent rust staining.

.4 Form tie holes in concrete exposed to seawater shall be grouted in a manner that minimizes the penetration of chloride ions over time.

END OF SECTION 03 11 00

1.0 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1 Section 03 11 00 - Concrete Formwork

.2 Section 03 31 00 - Cast-in-Place Concrete

.3 Section 05 12 00 - Structural Steel

1.2 REFERENCE STANDARDS

.1 Concrete reinforcing shall conform to the requirements of the following Standards unless otherwise required by this specification:

.1 CSA-A23.1-04 - Concrete Materials and Methods of Concrete Construction.

.2 CSA-A23.2-04 - Methods of Test and Standard Practices for Concrete.

.3 CSA-A23.3-04 - Code for the Design of Concrete Structures for Buildings.

.4 CSA G30.5M - Welded Steel Wire Fabric for Concrete Reinforcement.

.5 CSA G30.15M - Welded Deformed Steel Wire for concrete reinforcement.

.6 CAN/CSA G30.18 - Billet Steel Bars for Concrete Reinforcement.

.7 CSA-W47.1 - Certification Of Companies For Fusion Welding Of Steel Structures.

.8 CSA-W186 - Welding of Reinforcing Bars in Reinforced Concrete Construction.

.9 CSA-S413 - Parking Structures.

.10 ASTM A775M - Standard Specification for Epoxy Coated Reinforcing Steel Bars - plus Annex Al.

.11 ASTM D3963 – Standard Specification for Fabrication and Jobsite Handling of Epoxy Coated Reinforcing Steel Bars.

.12 ASTM A767M Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.

.2 Where the Standard is referenced in this specification it shall mean the documents specified in this clause and their referenced documents.

.3 A copy of A23.1 and A23.2 shall be kept by the Contractor on site for the duration of the work and be made available for reference.

2.0. PRODUCTS

2.1. GENERAL

.1 Products shall satisfy the requirements of the Standard unless otherwise specified herein or on the drawings.

2.2. MATERIALS

.1 Reinforcing bars shall conform to the Standard unless otherwise specified herein or on the drawings.

.2 Reinforcing bars to be welded shall conform to the Standard, G30.18W.

.3 Reinforcing steel that is part of the seismic load-resisting system to conform to the Standard, G30.18W.

.4 Welded wire fabric shall conform to the Standard, size and gauges as shown on the drawings.

.5 Welded wire fabric for slabs shall be delivered in flat sheets.

.6 In suspended parking slabs, bar support chairs shall be plastic or plastic coated.

.7 Epoxy coating for reinforcing bars shall conform to the Standard. The bar shall be coated with a primer or a conversion coating to improve adhesion of the epoxy to the bar.

.8 Plastic ties or plastic coated wires shall be used for tying epoxy-coated reinforcement.

.9 For galvanized reinforcing, bar support chairs shall be plastic, plastic coated, or galvanized. Concrete blocks may be used for slabs on grade only if approved by the Departmental Representative.

.10 For galvanized reinforcing, bar support chairs shall be plastic, plastic coated, galvanized.

.11 Galvanized reinforcing shall conform to ASTM A767M Class I and shall be chromate treated. 10M and smaller reinforcing bars shall have a minimum zinc coating of 915 grams per square meter. 15M and larger reinforcing bars shall have a minimum zinc coating of 1070 grams per square meter.

.12 Hot dip galvanized wire with a minimum core diameter of 1.44 mm (16.5 ga.) shall be used for tying galvanized reinforcement.

.13 Galvanized Reinforcing Steel.

.1 Surface finish: Continuous, adherent, smooth and as evenly distributed as possible and free from any defect detrimental to the stated end use of the coated article.

.2 Adhesion: Withstand normal handling consistent with the nature and thickness of the coating and normal use of the article.

.3 Special quality provisions: Galvanized reinforcing bars that are “frozen” together shall be rejected. The presence of tears or sharp spikes, which make the bars hazardous to handle, shall be cause for rejection. Ash inclusions shall not be

cause for rejection.

.4 Storage: Galvanized bars that will be stored in the field in excess of 30 days shall be stored off the ground on dunnage to allow air circulation to prevent the formation of wet storage stain. Material galvanized in accordance with ASTM specifications shall be free from wet storage stain. These corrosion deposits, if present, shall be removed in a manner satisfactory to the Departmental Representative prior to incorporation of the material into the work. After removal of the wet storage stain, the coating shall have a uniform appearance free of uncoated spots, acid, flux or black spots.

3.0. EXECUTIVE

3.1. GENERAL

.1 All phases of concrete reinforcement work shall be in accordance with the Standards unless otherwise specified herein or on the drawings. The Contractor shall ensure that the work is executed only by workers skilled and experienced in their trade.

.2 The Contractor shall notify the Departmental Representative at least 24 hours before any concrete is placed in order that the Departmental Representative may review the work.

.3 For galvanized and epoxy coated reinforcing bars, all systems for handling shall have padded contact areas. All bundling bands shall be padded or suitable banding shall be used to prevent damage to the coating. All bundles of coated bars shall be lifted with a strong back, spreader bar, multiple supports, or a platform bridge to prevent bar-to bar abrasion from sags in the bundles of coated bars. The bars or bundles shall not be dropped or dragged.

3.2. FABRICATION

.1 Fabricate all reinforcing to the Standard and contract documents.

.2 Reinforcing bars shall be cold bent. Bars shall not be straightened or re-bent.

.3 Splices in reinforcing bars at locations not shown on the drawings must be submitted for review by the Departmental Representative. Such splices shall conform to the Standards.

.4 Colour code each bar to correspond with code mark appearing on bar list.

3.3. PRODUCT DELIVERY, STORAGE AND HANDLING

.1 Store reinforcement in a manner to prevent excessive rusting and fouling with dirt, grease, form-oil and other bond-breaking coatings

.2 Reinforcement at the time concrete is placed shall be free from excessive rusting, mud, oil or other coatings that adversely affect its bonding capacity

3.4. PLACING

.1 Reinforcing of size and shapes shown on the structural drawings shall be accurately placed in accordance with the drawings and the requirements of the Standard.

.2 Reinforcement shall be adequately supported by chairs, spacers, support bars, hangers or other accessories, and secured against displacement within the tolerances permitted in the Standard. Support devices contacting surfaces exposed to the exterior shall be non-corroding.

.3 Bars that are not part of the structural design or drawings, and whose only function is supporting other reinforcing in lieu of other support accessories, shall be considered as accessories.

.4 In suspended parking slabs, uncoated metal ties shall not extend more than 5.0 mm (3/16") into the concrete cover.

.5 All rebar shall be adequately tied and chaired to maintain it in the specified location during pouring. Lifting of reinforcing or welded wire mesh into specified position during the concrete pour will not be allowed.

.6 Tolerances for bar placement shall be as per the Standard. Tolerances shall not be used to justify the use of chair, bolsters, or chair/support combinations which result in improper cover.

.7 Galvanized reinforcement shall not come in contact with uncoated reinforcement.

3.5. WELDING

.1 Any welding of reinforcing steel shall be in accordance with the Standard.

.2 Welding of concrete reinforcement shall be performed by workmen who are approved by the Canadian Welding Bureau in accordance with the Standard. Copies of the Canadian Welding Bureau approved welding procedure and certificate of current operator qualification shall be submitted to the Departmental Representative prior to commencement of welding.

3.6. CONSTRUCTION REVIEW

.1 No concrete shall be placed until the Departmental Representative has completed a review of reinforcing in place. The Contractor shall provide a minimum of 24 hours notice of the time when the reinforcement will be substantially in place and ready for the Departmental Representatives review. A minimum of 6 hours is to be provided for review and any required remedial work prior to concrete placement.

3.7. DAMAGE AND REPAIR TO EPOXY-COATED REINFORCING

.1 Repair coating damage with patching material approved by the Departmental Representative.

.2 Bars with damaged areas of greater than 5% of the surface areas shall be replaced.

.3 Coated bars which do not meet the requirements of this specification shall be rejected. Coated bars having defects shall be replaced.

3.8. CERTIFICATION FOR EPOXY REINFORCING BARS

.1 Provide to the Departmental Representative and Testing Agency a written certification, as per the Standard, that properly identifies the number of each batch of coating material used in the order, material, quantity represented, date of manufacture, name and address of the manufacturer, and a statement that the supplied coating material meets the requirements of the Standard.

.2 Provide to the Departmental Representative and Testing Agency, at the time of shipment, written certification that the coated reinforcing bars meet the requirements of the Standard.

END OF SECTION 03 20 00

1.0 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1 Section 03 11 00 - Concrete Formwork

.2 Section 03 20 00 - Concrete Reinforcement

.3 Section 05 12 00 - Structural Steel

1.2 REFERENCE STANDARDS

.1 Concrete work shall conform to the requirements of the following Building Codes and Referenced Standards unless otherwise required by this specification:

.1 Building Code

.1 National Building Code of Canada - 2010.

.2 Referenced Standards

.1 CSA-A23.1 - Concrete Materials and Methods of Concrete Construction.

.2 CSA-A23.2 - Methods of Test for Concrete.

.3 CSA-A23.3 - Code for the Design of Concrete Structures for Buildings.

.4 CSA-S413 - Parking Structures.

.2 A copy of A23.1 and A23.2 shall be kept by the Contractor on site for the duration of the work and be made available for reference.

1.3 SUBMITTALS

.1 Keep a record at the job site showing time and place of each pour of concrete, together with a transit-mix delivery slip certifying contents of pour. Make the record available to the Departmental Representative for his inspection upon request. Upon completion of this portion of work, submit placing records and delivery slips to the Departmental Representative.

.2 Submit details of proposed methods of concrete curing and provisions for weather protection to the Departmental Representative for review.

.3 Submit plan locations and details of construction joints for the Departmental Representative’s review.

2.0 PRODUCTS

2.1 GENERAL

.1 Products shall satisfy the requirements of the Standard unless otherwise specified herein or on the drawings.

.2 Provide samples of materials on request

2.2 MATERIALS

.1 Cement for S-1, S-2, and S-3 concrete shall be as per Table 3 A23.1 and conform to the Standard.

.2 Aggregates shall be natural stone and conform to the Standard. If recycled aggregate is available, use shall be limited to a maximum of 25% of the mass proportion of total aggregates. Recycled aggregates may be used if a proven track record of acceptable use in concrete can be demonstrated. All aggregate shall meet the requirements of ASTM C33.

.3 Mixing water shall conform to the Standard.

.4 Air entraining admixtures to the Standard.

.5 Pozzolanic admixtures may be used and shall conform to the Standard.

.6 Calcium chloride, either as a raw material or as a constituent in other admixtures, shall not be used unless approved in writing by the Departmental Representative.

.7 Curing compounds shall conform to the specification and shall also be compatible with specified floor hardeners, covering adhesives and waterproofing compounds.

.8 Grout shall be preapproved, premixed, non-shrink conforming to the Standard. Exposed grout shall be non-staining cement grey in colour.

3.0 EXECUTION

3.1 GENERAL

.1 All phases of concrete work shall be in accordance with the Standard unless otherwise specified herein or on the drawings. The work shall be executed only by experienced and skilled workers.

.2 The Contractor shall notify the Departmental Representative at least 30 hours before any concrete is placed to allow the Departmental Representative to review the work.

3.2 MIX DESIGNS

.1 Concrete mixes shall be proportioned by the supplier to meet the compressive strength, exposure class, and other performance specifications noted in the contract documents. In addition, concrete mix design shall satisfy the transport, placing, and finishing requirements of the Contractor. All concrete shall be normal weight unless noted otherwise. Concrete types are specified in accordance with CSA-A23.1 Table 5, Alternate 1.

.2 Concrete mix design is the responsibility of the supplier, including the use of admixtures,

alone or in combination. The supplier is also responsible for ensuring the plastic and hardened properties of the concrete meet the construction and specified requirements. This includes the long term performance of the hardened mix.

.3 Pump mix slumps shall also conform to the above.

.4 Water/Cement ratios and air contents for exposure class shall be as per the Standard.

.5 The proposed mixes shall be submitted to the Departmental Representative and Testing Agency for review.

.6 The mix designs shall note the constituents by weight, the properties required by the structural drawings, and the structural elements for which the mix is to be used.

3.3 PRODUCTION

.1 Production shall conform to the Standard.

3.4 PLACING OF CONCRETE

.1 Conveying and placing of concrete is to conform to the Standard.

.2 All concrete shall be consolidated by means of vibrators of appropriate size operated by experienced workers.

.3 The use of vibrators to transport concrete shall not be permitted.

.4 Cement slurry used to prime concrete pumps shall be discarded and not placed in the project.

.5 Placement of pumped concrete on post-tensioned work shall not start at regions of post-tensioning anchorages.

3.5 OPENINGS AND INSERTS

.1 The Contractor shall notify all trades sufficiently in advance to ensure that provision is made for openings, inserts and fasteners. The Contractor shall cooperate with all trades in the forming and setting of all slots, sleeves, bolts, dowels, hangers, inserts, conduits, clips, etc. Any embedded hardware may be subject to review by the Departmental Representative.

.2 Openings and sleeves shown on the structural drawings must be confirmed with mechanical, electrical and architectural drawings.

.3 Openings and sleeves not shown on the structural drawings must be approved by the Departmental Representative.

.4 On post-tensioned work, inserts required to hang electrical/mechanical equipment shall be placed prior to placing concrete. Neither drilled nor powder activated fasteners longer than 20 mm (3/4") will be permitted unless the slab is X-rayed to miss strands.

.5 On post-tensioned work, any openings to be located in hardened concrete must receive the Departmental Representative’s approval before proceeding. X-rays shall be used to ensure no strands, reinforcement, or conduit will be cut.

.6 Sleeves shall be made from 100% post-consumer plastic where possible.

3.6 CONSTRUCTION AND CONTROL JOINTS

.1 Construction joints shall conform to the Standard except that for horizontal joints in walls it will be sufficient to place fresh concrete on a clean rough surface unless directed otherwise by the Departmental Representative or otherwise noted on the structural drawings.

.2 Joints in slabs on grade shall be located as indicated on the structural and/or architectural drawings. Unless noted otherwise on the drawings a joint in the slab on grade may be a pour joint, trowelled joint, saw cut, or other pre-approved method. The depth of joints shall be a minimum of ¼ of the thickness of the slab. Saw cut joints are to be completed within 24 hr. of placing. Alternative joint details are to be submitted in writing to the Departmental Representative.

.3 For vertical joints in walls below grade, see standard detail on structural drawings. For locations, see architectural and structural drawings.

.4 Construction joints in walls and columns shall occur at the top of slab and at the underside of slab/beam systems unless noted otherwise on the structural drawings.

.5 Construction joints not shown in the drawings or specifications shall be subject to the approval of the Departmental Representative. The Departmental Representative may require keys, or extra reinforcing to be provided at the Departmental Representative's discretion with associated costs borne by the Contractor.

.6 The existing concrete surface at construction joints shall be wetted thoroughly immediately prior to placement of concrete.

.7 Construction joints exposed to view may be subject to non-structural review by Departmental Representative.

.8 Unless noted otherwise on the drawings, control joints in walls are to be located at a maximum spacing of 9m (30') on centre and detailed as indicated on the structural drawings.

.9 Supply and install pre-molded water-stops in construction joints where indicated on the drawings. Weld joints to make watertight. Install waterstops in accordance with manufacturer's specifications and recommendations. Water stop procedures require approval of Departmental Representative.

3.7 CURING AND PROTECTION

.1 Curing procedures shall be in accordance with the Standard. Alternate methods with Departmental Representatives approval, may be used providing they produce concrete that meets the contract documents.

.2 Cold and hot weather protection shall comply with the Standard or the requirements on the structural drawings, whichever are more rigorous.

.3 Concrete place during extreme drying conditions shall satisfy clause 7.4.2.2 of A23.1.

.4 (Reference Standard CSA A23.1-04/A23.2-04) Contractor shall submit a plan for curing to the Departmental Representative, for review and approval, together with other tender documents. The curing plan shall be prepared in strict accordance with the Standard,

including:

- The method for protecting the concrete from evaporation of surface moisture from the fresh concrete.
- The type of curing material to be used.
- How the surface will be kept moist and the quality control requirements for keeping the surface moist.
- The time of initiation and duration of curing.
- Provisions to address potential problems such as high winds and hot and cold weather.
- The limitations of access, if any, to the surfaces being cured.

.5 (Reference Standard CSA A23.1-04/A23.2-04) All concrete mixes proportioned for C-XL class of exposure shall have Extended Curing. Concrete mixes that meet the definition of HVSCM-1 and where classes of exposure C-1, A-1, F-1, S-1, and S-2 apply shall have Extended Curing. For other exposure classifications, concrete mixes that meet the definition of HVSCM-1 or 2 shall have Additional Curing.

- HVSCM-1 = FA/40 + S/45 > 1.00
- HVSCM-2 = FA/30 + S/35 > 1.00
  where FA = fly ash (Type F, CI1, or CH content of the concrete (% mass of total cementing materials) and S = slag content of the concrete (% mass of total cementing materials)
- Additional Curing = 7 days at $\geq$ 10ºC for a time necessary to attain 70% of the specified strength. When using silica fume concrete, additional curing procedures shall be used. See Standard.
- Extended Curing = a wet-curing period of 7 days. The curing types allowed are ponding, continuous sprinkling, absorptive mat, or fabric kept continuously wet.

.6 Contractor shall obtain the approval of the Departmental Representative, for proposed means of monitoring concrete curing conditions. Contractor shall be responsible for confirming completion of curing.

.7 Suspended parking slabs shall be wet cured for seven (7) days minimum, as per S413. Curing compounds are not allowed.

3.8 PATCHING

.1 Honeycomb, exposed reinforcement and other defects shall be repaired and patched by the Contractor at the Contractor's cost using a procedure preapproved by the Departmental Representative. Exposed patching must also be approved by the Departmental Representative.

.2 Immediately after the removal of forms, all bolts, ties, nails or other metal not specifically required for construction purposes shall be removed or cut back to a depth of 25 mm (1") from the surface of the concrete.

3.9 TOLERANCES

.1 Tolerances shall conform to the Standard or the requirements on the structural or architectural contract documents, whichever are more rigorous.

3.10 FINISHING - FLOORS

.1 Finishing shall conform to CSA-A23.1 - Section 7.5 as a minimum. Care shall be taken during finishing to maintain the cambers specified on the structural drawings. See also the architectural drawings and specifications for additional finish requirements.

.2 Unless noted otherwise, floor finishes shall be Class A “institutional and commercial floors” and have gaps less than or equal to 8.0 mm (5/16") under a 3000 mm (10'-0") straight edge. Only a single curvature within this distance is allowed.

3.11 FINISHES - FORMED SURFACES

.1 All formed surfaces shall be treated in accordance with CSA A23.1, Section 7.7 as a minimum. See also architectural drawings and specifications for additional finish requirements.

3.12 ARCHITECTURAL CONCRETE

.1 See architectural drawings and specifications for any requirements. Conform to CSA-A23.1 - Section 8.3 as a minimum.

3.13 OPENINGS THROUGH STRUCTURAL WORK

.1 If, after any part of the structural work has been completed, it is required that additional openings be made through the structure, the Departmental Representative shall be so informed. No opening, including cored sleeves, shall be made through completed work without authorization in writing from the Departmental Representative.

3.14 REJECTION OF DEFECTIVE WORK

.1 In the event that concrete tests do not conform to the requirements of this specification, or when conditions are such to cause doubt about the safety of the structure, testing of the structure will be undertaken at the direction of the Departmental Representative. This may entail further concrete tests, coring or load testing as per the Standard, or any other test the Departmental Representative deems suitable. Such test shall be made at the expense of the Contractor and to the satisfaction of the Departmental Representative.

.2 Where, in the opinion of the Departmental Representative, material or workmanship fails to meet the requirements of the specification, such work may be rejected. Work rejected shall be replaced or repaired to the approval of the Departmental Representative and at no additional cost to the Departmental Representative.

END OF SECTION 03 31 00

1.0 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1 Section 03 31 00 - Cast-in-Place Concrete

1.2 REFERENCE STANDARDS

.1 Structural steel shall conform to the requirements of the following Standards unless otherwise required by the specification:

.1 Building Code

.1 National Building Code of Canada – 2010

.2 Reference Standards

.1 CSA S16 - Limits States Design of Steel Structures.

.2 CSA S136 - North American Specification for the Design of Cold-Formed Steel Structural Members

.3 CSA W47.1 - Certification of Companies for Fusion Welding of Steel Structures.

.4 CSA W59 - Welded Steel Construction (Metal Arc Welding) (Metric version).

.5 CSA G40.20 - General Requirements for Rolled or Welded Structural Quality Steel.

.6 CSA G40.21 - Structural Quality Steel.

.7 CSA G30.18 - Billet Steel Bars for Concrete Reinforcement.

.8 CSA W186 - Welding of Reinforcing Bars in Reinforced Concrete Construction.

.9 ASTM F1554 Standard Specification for 36, 55 and 105 ksi yield strength Steel Anchor Bolts.

.10 ASTM A193 – Standard Specification for Alloy-Steel Bolting Materials for Special Purpose Applications.

.11 ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated 120 / 105 ksi Minimum Tensile Strength.

.12 ASTM A490 - Standard Specification for Structural Bolts, Alloy Steel, Heat Treated 150 ksi Minimum Tensile Strength.

.13 ASTM A496 - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.

.14 CISC / CPMA Standard 1-73a - A Quick-Drying One-Coat Paint for Use on Structural Steel.

.15 SSPC SP-6 - Commercial Blast Cleaning

.16 ASTM A123 - Zinc (Hot-Dip Galvanizing) Coatings on Iron and Steel Products.

.17 ASTM A143 - Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.

.18 ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

.19 ASTM A384 - Safeguarding Against Warpage and Distortion During Hot Dip Galvanizing of Steel Assemblies.

.20 ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings.

.2 Where the Standard is referenced in this specification it shall mean the documents specified in clause 1.4.1.2, as specified in the Building Code noted in clause 1.4.1.1, and their referenced documents.

1.3 QUALIFICATIONS

.1 Steel fabricators and erectors must be certified under requirements of CSA W47.1 as required by CSA S16.

.2 Welding procedures, welders and welding operations shall be qualified in accordance with Canadian Welding Bureau Standards.

1.4 EXAMINATIONS

.1 All dimensions shall be taken from the drawings and verified by field measurement. Be responsible for the correctness of such measurements and report to the Departmental Representative in writing all discrepancies between measurements in the field and those shown on drawings prior to commencing work. Verify location of anchor bolts and embedded steel and ensure that work prepared by other trades is at a proper elevation, on line, level and true.

1.5 SUBMITTALS

.1 The Contractor shall submit, before starting work, written evidence of qualification of the steel fabricators and erectors for welding under Canadian Welding Bureau requirements.

.2 The Contractor shall submit, before starting work, written evidence of ability to weld reinforcing steel to structural steel in accordance with CSA W186.

.3 When requested, submit copies of mill test reports properly correlated to the materials used on the project.

.4 Provide a schedule of fabrication to the Departmental Representative, prior to the commencement of the fabrication.

1.6 SHOP DRAWINGS

.1 The Contractor shall notify the Departmental Representative, in writing and before the submission of shop drawings, of the name of the Specialty Structural Engineer who will be designing and providing field review for the connections and components designed by the Contractor.

.2 Submit “design” drawings for review summarizing the proposed connection details to be used on the project. These drawings to be prepared by, or under supervision of, the Specialty Structural Engineer and submitted for review before start of shop drawing production. These design drawings shall show the complete connection and:

.1 How the connection assembly fits with the connected members.

.2 Sizes of plates, bolts, welds, etc.

.3 Capacities of the connection.

.4 Assumed eccentricities, lines of action of forces, etc.

.3 Submit shop drawings prepared under direction of the Specialty Structural Engineer. Drawings of components and connections designed by the Contractor shall be sealed and signed by this Specialty Structural Engineer or a letter shall be submitted at the end of the project signed and sealed by this Specialty Structural Engineer. The letter shall identify what was designed by the Specialty Structural Engineer and list the final shop drawings by number with dates and revision numbers.

.4 Shop drawings shall show complete shop and erection details necessary for fabrication and erection of the component parts of the structure, including cuts, copes, connections, holes, threaded fasteners, splices and location, type, size and extent of all welds. Splices not shown on the shop drawings will be rejected. All welds, both shop and field, shall be indicated by AWS Welding Symbols as specified in the CSA W59 Appendix D and E.

.5 Provide a shop drawing clearly locating all anchor bolts, embedded plates, baseplates, etc.

.6 Provide setting drawings, templates and directions for the installation of anchor bolts, plates and other devices.

.7 Prior to starting erection work, submit a description of the methods, sequence of erection and type of equipment proposed for use in erecting structural steel for review of the effects of construction loads on the remainder of the structure.

.8 Review of the shop drawings by the Departmental Representative is intended as an assistance to the Contractor and does not relieve the Contractor of his responsibility for the completeness or accuracy of his work and its conformance with the contract documents.

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

.10 Clearly identify on the shop drawing all revisions, changes, or modifications.

.11 Resubmit reviewed shop drawings where noted, or when the Contractor makes revisions for his own purposes.

.12 Allow at least two (2) weeks for shop drawing review by the Departmental Representative.

.13 Structural drawings are not prepared to be used as erection or shop drawings.

1.7 TESTING AND FIELD REVIEW

.1 The Specialty Structural Engineer responsible for shop drawings, or the Specialty Structural engineer representative, shall visit the site to review in place the connections and components designed by that Specialty Structural Engineer. The Specialty Structural Engineer shall be satisfied or take steps to ensure that these connections and components substantially comply with the Specialty Structural Engineer's design. The Specialty Structural Engineer shall then provide a sealed and signed letter to the Departmental Representative to this effect.

.2 Prior to the commencement of work provide a schedule of shop fabrication to the Testing Agency.

.3 If requested, submit certified mill tests in accordance with the Standards.

.4 The Contractor shall advise the Testing Agency of the scheduling of all shop and field work pertaining to this Project. The Contractor shall permit the testing agency full access to the fabrication shop and the site, for the purpose of carrying out his work and he shall provide assistance required to aid in the performance of the inspection and testing.

1.8 STORAGE AND HANDLING

.1 The Contractor shall be responsible for the protection of all steelwork during fabrication, shipping, storage and construction. All small bends and damage shall be reported to the Departmental Representative for instructions. Steel work which is bent, broken or otherwise damaged, shall be repaired or replaced by the Contractor prior to erection to the satisfaction of the Departmental Representative at no cost to the Departmental Representative.

.2 The Contractor shall be responsible for proper scheduling of delivery and erection for the structural steel in accordance with the construction schedule.

.3 Store structural steel members at the site above ground on platforms, skids or other devices so that ground dampness will not affect the bottom members of the stacks.

.4 Steel, which is stored outdoors after fabrication, shall be protected from accumulations of standing water.

.5 Other materials shall be stored in a weather tight and dry place until ready for use in the Work.

.6 Packaged materials shall be stored in their original unbroken packages or containers.

1.9 COORDINATION WITH OTHER TRADES

.1 Supply all necessary instructions and drawings to other trades for setting bearing plates, anchor bolts, and other members that are built in with the work of other trades. Provide punched holes for the convenience of other trades in attaching wood blocking or other materials. Coordinate with drawings of other disciplines for locations and details. Supply the necessary material in accordance to the construction schedule.

2.0 PRODUCTS

2.1 MATERIALS

.1 All steel shall be new unless otherwise indicated and be of sizes and shapes listed in the current CISC Handbook or AISC Handbook and as indicated on the drawings.

.2 Rolled shapes, except wide flanges, and rolled plate shall be to CSA G40.21 - grade 300W or equal.

.3 Wide flange rolled shapes and welded wide flange sections shall be to CSA G40.21 - grade 350W or equal.

.4 Hollow structural sections shall be to CSA G40.21 - grade 350W, Class H or C.

.5 High strength bolts shall be to ASTM A325 or A490, as required by the drawings.

.6 Standard anchor rods shall be to ASTM F1554, 36ksi. High strength anchor rods shall be to ASTM A193, grade B7, see drawings for locations, if required.

.7 Bolts and nuts shall be to ASTM A307.

.8 Primer for interior exposure not to receive a shop or field paint finish shall be to CISC / CPMA Standard 1-73a or other pre-approved, unless noted otherwise.

.9 Primer used in a multi-coat system where a final shop or field paint finish is to be applied shall conform to Section 09 91 00 - Painting and shall be selected and preapproved by the Departmental Representative based on surface preparation, exposure conditions and compatibility with subsequent coatings, unless noted otherwise.

.10 Brick support angles and related framing materials exposed to weather, shall be galvanized to CSA G164.

.11 Headed shear stud connectors shall be Nelson anchors with fluxed ends or other pre-approved equal conforming to ASTM A108. Studs to be automatically end welded with suitable stud welding equipment or shop fillet welded to develop full strength of the stud. Field fillet welded studs will be rejected.

.12 Bar anchors shall be Nelson deformed bar anchors or pre-approved equal conforming to ASTM A496.

.13 Welding consumables for all processes shall be fully approved by the Canadian Welding Bureau and certified by the manufacturers as complying with the requirements of this specification. Such certificates shall be not more than two (2) years old.

.14 Electrode strengths to be equal to E49XX (E70XX) or better.

.15 Grout for column bases shall be non-metallic, non-expanding and non-shrink type with a minimum strength of 35 MPa at 28 days, unless noted otherwise. Grout may be place in a dry pack or flow-able consistency.

2.2 DESIGN

.1 Unless otherwise noted connections and trusses shall be designed by the Contractor to

the reference Standards by the Specialty Structural Engineer.

.2 Where connections are detailed, use connection of the type and detail shown on the drawings. Modifications to the specified connection types and details will not be permitted without prior approval from the Departmental Representative.

.3 The following connections, and any connections so noted on the structural drawings, shall be designed as slip critical and shall be pre-tensioned:

.1 Trusses.

.2 Elements resisting crane loads.

.3 Connections for supports of running machines or other live loads that produce impact or cyclic loads.

.4 Connections where bolts are subject to repeated tensile loads.

.5 Connections using slotted holes in the direction of the load or oversize holes unless specifically designed to accommodate movement.

.4 Connections for wind or seismic lateral load-resisting elements, such as bracing and drag struts, and others so noted on the structural drawings may be designed as bearing connections but shall be pre-tensioned.

.5 Other bolted connections may be snug tight.

.6 Use standard connection types where connections are not detailed on the structural drawings.

.7 Design shall be for the forces and loads shown on the drawings and shall allow for the effects of beam deflections. Provide a minimum of two (2) 19 mm (3/4") A325 bolts or an equivalent weld for all beam to girder and beam to column connections. If forces or loads are not given, the connection shall be designed for the maximum uniform distributed load that the member can carry for the span shown.

.8 Structural steel members spliced for ease of fabrication or transportation shall have splices designed to develop the full strength and stiffness of the member. Splices shall be subject to non-destructive testing as directed by the Departmental Representative. The cost for such testing shall be borne by the Contractor.

.9 Provide stiffeners in beam webs at all locations where beams pass over supports. Unless noted otherwise in the structural drawings, web stiffeners shall be 10 mm minimum.

.10 Provide separators for all double members in accordance with CSA S16.

3.0 EXECUTION

3.1 FABRICATION

.1 Fabrication shall be to CSA S16 and reviewed shop drawings.

.2 Welding shall be to CSA W59.

.3 Structural steel work shall be executed by skilled and experienced workmen.

.4 Fabricated units shall be straight and true and without sharp kinks or bends, accurate to sizes shown.

.5 Fabricate rolled steel sections so that any camber and/or sweep resulting from manufacturing is positioned to create a hump up between the ends, not a sag down.

.6 Flame cut steel columns shall have their ends milled. Steel base plates supporting columns shall be flat.

.7 Unless noted otherwise, all hollow structural sections shall be dry inside and closed airtight with end plates sealed with welds.

.8 Visually inspect all plates and shapes for laminations. Replace plates or shapes that contain laminations. Repair plates or shapes that contain laminations in a manner approved by the Departmental Representative.

.9 Headed shear stud connectors and deformed bar anchors shall be applied in strict accordance with the manufacturer's instructions and the Standards or shop fillet welded as per the Standards. Procedural control to be in accordance with W59 as a minimum. Field fillet welds will be rejected.

.10 Obtain Departmental Representative's approval for holes required through structural steel that are not shown on the drawings.

.11 Refer to Architectural drawings for extent and location of architecturally exposed steel elements.

.12 Remove and replace any work which is not acceptable to the Departmental Representative, when and as directed. Such operation shall not become an extra charge to the Departmental Representative.

.13 Steel members spliced for ease of fabrication shall develop the full strength and stiffness of the member.

.14 Where roof slopes exceed 5% and do not permit flush bearing of the steel deck on the beams, provide continuous 3mm bent plates to the pitch and necessary to ensure full bearing of the steel deck. Co-ordinate with the deck supplier the locations that will require these bent plates.

3.2 CLEANING AND PRIMING

.1 All steel shall be thoroughly cleaned of all loose mill scale, loose rust, oil or dirt.

.2 Architecturally exposed steel members, related framing and exterior steel shall be primed.

.3 Steel, which will be encased in concrete, fireproofed, zinc coated or galvanized, welded, receive shear studs, faying surfaces of slip resistant connections and the underside of base plates and bearing plates steel shall not be primed.

.4 Steel girder, beams, trusses, columns, bracing and connections plates on the perimeter of the building shall be primed.

.5 Other steel for interior exposure shall not be primed.

.6 Structural steel which will not receive a finish paint coat and is required to be primed for interior exposure shall be cleaned in accordance with CISC / CPMA Standard 1-73 (minimum)

.7 Structural steel to be primed for exterior exposure shall be cleaned in accordance with SSPC SP6 “Commercial Blast Cleaning” as a minimum.

.8 Structural steel to receive a shop or field paint finish shall be cleaned in accordance with Section 09 91 13 - Painting or SSPC SP6 “Commercial Blast Cleaning”, whichever produces a surface which has less rust and mill scale.

.9 Apply primers in accordance with the manufacturer’s instructions.

.10 Use paint prepared by manufacturer without thinning or adding admixtures. Execute painting on dry surfaces, free from rust, scale, or grease. Do not paint in temperatures lower than 8°C.

.11 Where finish painting to parts inaccessible for finish painting after final assembly is required, apply two coats of paint during fabrication. Apply paint of 2 different colours so that missed areas can be detected.

.12 Provide the following touchup for steel in an exterior exposure or which has a finish paint coat. After erection and after connections are completed, provide a field touchup coat of primer to all surfaces that had no paint shop coat and have been chipped or scraped. Touch up with primer and paint all shop coat painted areas that have been chipped or scraped.

.13 Provide the following touchup for galvanized steel. After erection and after connections are completed, provide a field touchup coat of zinc rich paint to all surfaces that have been chipped or scraped. After erection and after connections are completed, provide a field touchup coat of zinc metallizing to all surfaces that have been chipped or scraped.

3.3 ERECTION

.1 The erector is fully responsible for erection methods, equipment, workmanship and safety precautions.

.2 Confirm the setting of anchor bolts and bearing plates and make an instrument survey to verify the setting prior to erection of steel members.

.3 Cutting or burning of baseplates to accommodate anchor bolts shall be cause for rejection of baseplates.

.4 Install all temporary bracing that is required to stabilize the work against wind, earthquake and construction loads. Keep structure true and plumb until completion of the building. Assume complete responsibility for the extent and timing of the removal of such bracing. The bracing members indicated on the drawings are required for the finished structure and shall not be considered as adequate for temporary bracing. Any failure to make proper and adequate provision for stresses occurring during the erection from any causes whatsoever shall be entirely the responsibility of the Contractor.

.5 As erection progresses, the work shall be securely bolted up to take care of all loads including wind and seismic during erection. Any failure to make proper and adequate

provisions for loads during erection shall be solely the responsibility of the Contractor.

.6 The Contractor shall be responsible for the design of all hooks, erection connections and handling gear.

.7 Whenever piles of materials, erection equipment, or other loads are carried during erection, proper provision shall be made to take care of stresses resulting from same. All construction loads shall be adequately distributed so as not to exceed the capacity of any member.

.8 Structural steel shall be assembled and erected in accordance with the approved erection drawings and specified reference Standards.

.9 Structural steel work on concrete shall be carefully located at the proper grade and rigidly secured in place, using steel shims. Spaces under the steel shall then be filled with non-shrink premix grout as soon as possible, and before placing any concrete toppings or precast concrete units.

.10 Plumb, level and align individual members of steel work as specified in CSA S16.

.11 The various members forming parts of complete frame or structure after being assembled shall be aligned and adjusted accurately before being fastened.

.12 Bearing surfaces and surfaces which will be in permanent contact shall be cleaned before the members are assembled.

.13 Temporary bolts, clips and angles etc. used to facilitate erection shall be removed unless noted otherwise on the drawings.

3.4 TEMPORARY FLOORING

.1 Provide all temporary flooring, planking and scaffolding necessary in connection with erection of structural steel, or support of erection machinery in accordance with governing regulations and by-laws.

3.5 WELDING

.1 Welding shall be done by the shielded metal-arc method in accordance with the requirements CSA W59. The welding operators shall be currently certified under CSA W47.1 for the work they are performing.

.2 Submit, when requested, welding procedures prepared and sealed by a Specialty Structural Engineer for review.

.3 Surfaces to be welded shall be free from loose scale, rust, paint, or other foreign matter. Where weld material is deposited in two (2) or more layers, each layer shall be cleaned before the next layer is deposited. Care shall be taken to minimize stresses due to heat expansion, contraction and distortion by using proper sequence in welding and by approved methods.

.4 Appearance, quality of welds made, methods of correcting defective work shall be in accordance with CSA W59.

.5 Welding of reinforcing bars to structural steel as per CSA W186.

3.6 COMPLETION

.1 The Specialty Structural Engineer responsible for the sealed shop drawings, or his representative shall visit the site to review in place connections and components designed by that Specialty Structural Engineer to ensure substantial compliance with his sealed shop drawings. He shall then submit a sealed and signed letter of substantial compliance to the Departmental Representative.

.2 On completion of the work of this section, all protection erected in conjunction with the structural steel work shall be removed, all damage to this work and adjoining work shall be made good and all surplus materials and debris and all tools, plant and equipment shall be removed from the site.

END OF SECTION 05 12 00

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1 Cast-in-Place Concrete Section 03 30 00

.2 Exterior Painting Section 09 91 13

1.2 REFERENCES

1 ASTM International

.1 ASTM A 53/A 53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

.2 ASTM A 269 08, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

.3 ASTM A 307-07v, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.4 ASTM B 209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.5 ASTM B 221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.

.2 CSA International

.1 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.

.3 CSA S16-09, Design of Steel Structures.

.4 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).

.5 CSA W59-M03(R2008), Welded Steel Construction (Metal Arc Welding) [Metric].

.1 GS-11-2008, 2nd Edition], Paints and Coatings.

.3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Safety Data Sheets (SDS).

.4 The Master Painters Institute (MPI)

.1 Architectural Painting Specification Manual - current edition.

.5 Green Seal Environmental Standard GS 03 (anti-corrosive primer).

1.3 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 sections, plates, pipe, tubing, bolts and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit two copies of WHMIS SDS in accordance with Section 01 35 33 - Health and Safety Requirements

.1 For finishes, coatings, primers, and paints applied on site: indicate VOC concentration in g/L.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of British Columbia, Canada. Submit Model Schedule B and C.

.2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.

1.4 QUALITY ASSURANCE

.1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.

.2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.5 DELIVERY, STORAGE & HANDLING

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

.2 Storage and Handling Requirements:

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

.2 Replace defective or damaged materials with new.

2.0 PRODUCTS

2.1 MATERIALS

.1 Steel sections and plates: to CSA G40.20/G40.21, Grade 350W.

.2 Welding materials: to CSA W59.

.3 Welding electrodes: to CSA W48 Series.

.4 Bolts and anchor bolts: to ASTM A 307.

.5 Grout: non-shrink, non-metallic, flowable, 15 MPa at 24 hours.

.6 Unistrut: unistrut P1100 or similar profile embedded in concrete, 1.9mm (14ga) hot-dipped galvanized finish conforming to ASTM A123.

.7 Grout: non-shrink, non-metallic flowable, 15MPC at 24 hours.

.8 Stainless Steel Sheet: Conforming to ASTM A167, Type 316, #4 Satin Finish.12 Gauge for use in penthouse manifold plate.

.9 Security fasteners: screws and bolts with spanner type heads to prevent removal except with special tools; non-corrosive type.

.10 Shop coat primer: to CAN/CGSB-1.40M.

.11 Galvanize touch-up primer: zinc rich, read mix to CGSB-1-GP-181M.

.12 Metal Bar Grating:

.1 Grating Type: Carbon steel welded bar grating to support:
a. Uniform load U=100psf
b. Concentrated live load C= 300 lbs per foot of grating
c. Allowable deflection = 0.25 in

.2 Cross rod spacing: 4" on center
.3 Top traffic surface: plain
.4 Finish: Hot dip galvanized after fabricating in accordance with ASTM A123

2.2 FABRICATION

.1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.

.2 Use self-tapping shake-proof flat headed screws on items requiring assembly by screws or as indicated.

.3 Where possible, fit and shop assemble work, ready for erection.

.4 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

2.3 FINISHES

.1 Galvanizing: hot dipped galvanizing with zinc coating 610 g/m² to CAN/CSA-G164, for all exposed exterior structural steel and metal fabrication.

.2 Shop coat primer: CGSB 1GP 40M in accordance with chemical component limits and restrictions requirements and VOC limits of GC-03. Prepare surface to an abrasive blast specification SSPC-SP10.

.3 Zinc primer: To CGSB 1GP 48, CISC/CPMA 1-73A, CISC/CPMA 2-75 in accordance with chemical component limits and restrictions requirements and VOC limits of GC-03. Prepare surface to an abrasive blast SSPC-SP10.

2.4 ISOLATION COATING

.1 Isolate 2 different metals from following components, by means of bituminous paint:
.1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.
.2 Concrete, mortar and masonry.
.3 Wood.

2.5 SHOP PAINTING

.1 Primer: VOC limit 250 g/L maximum to GC-03.
.2 Apply one shop coat of primer to metal items, with exception of aluminum, galvanized or concrete encased items.

.3 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7 degrees C.

.4 Clean surfaces to be field welded; do not paint.

2.6 PIPE RAILINGS

.1 Steel pipe: 41 mm (1 5/8”) nominal outside diameter, formed to shapes and sizes as indicated with 19mm diameter vertical rails spaced at 100mm on centre.

.2 Fabricate free of distortion of section, with welded flush joints, ground smooth and filled as required.

.3 Cap and weld exposed ends of balusters.

.4 Weld balusters to stringers.

.5 All bends tight radius as detailed, complete with plate connections, brackets or for drilled in installation, shop prime painted.

.6 Open ends fitted with bullet nose end clips.

.7 Handrails and guardrails must meet the requirements of the National Building Code (NBC) (latest edition):

.1 Submit confirmation signed and sealed by an Engineer registered in the Province of British Columbia that handrails and guardrails meet the loading requirements of the NBC.

.2 To assist persons with visual impairment, steel pipe handrails are to have tactile identification extending out for a length of 750mm up and down from the exit level and a roughened surface, integral with the handrail, which is discernible by touch from the remainder of the handrail.

.8 Galvanize exterior pipe railings after fabrication. Shop coat prime interior railings after fabrication.

.9 Provide sample as noted.

3.0 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for metal fabrications 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.

.4 Contractor shall verify field measurements are as shown on shop drawings prior to fabrication.

3.2 ERECTION

.1 Do welding work in accordance with CSA W59 unless specified otherwise.

.2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.

.3 Provide suitable means of anchorage acceptable to Departmental Representative such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.

.4 Exposed fastening devices to match finish and be compatible with material through which they

pass.

.5 Supply components for work by other trades in accordance with shop drawings and schedule.

.6 Weld field connection.

.7 Deliver items over for casting into concrete and building into masonry together with setting templates to appropriate location and construction personnel.

.8 Touch-up rivets, field welds, bolts and burnt or scratched surfaces with primer after completion of:
.1 Primer: maximum VOC limit 250 g/L to GC-03.

.9 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.
.1 Primer: maximum VOC limit 250 g/L to GC-03.

.10 Interior welding or any exterior welding where there may be a risk of re-entrainment must occur on off hours.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
.1 Leave Work area clean at end of each day.

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

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by metal fabrications installation.

END OF SECTION 05 50 00

1.0 GENERAL

1.1 RELATED REQUIREMENTS

Not Used.

1.2 RFERENCES

.1 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-37.2- M88, Emulsified Asphalt, Mineral-Colloid Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings.
- .2 CAN/CGSB 37.3- M89, Application of Emulsified Asphalts for Dampproofing or Waterproofing.
- .3 CAN/CGSB 37.5- M89, Cutback Asphalt Plastic Cement.
- .4 CGSB 37-GP-6Ma- 83, Asphalt, Cutback, Unfilled, for Dampproofing.
- .5 CGSB 37-GP-9Ma- 83, Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing.
- .6 CGSB 37-GP-11M- 76 (R1984), Application of Cutback Asphalt Plastic Cement.
- .7 CGSB 37-GP-12Ma- 84, Application of Unfilled Cutback Asphalt for Dampproofing.
- .8 CGSB 37-GP-15M- 76(R1984), Application of Asphalt Primer for Asphalt Roofing, Dampproofing and Waterproofing.
- .9 CAN/CGSB 37.16- M89, Filled, Cutback, Asphalt for Dampproofing and Waterproofing.
- .10 CAN/CGSB 37.28- M89, Reinforced Mineral Colloid Type, Emulsified Asphalt for Roof Coatings and for Waterproofing.
- .11 CGSB 37-GP-36M- 76, Application of Filled Cutback Asphalts for Dampproofing and Waterproofing.
- .12 CGSB 37-GP-37M- 77, Application of Hot Asphalt for Dampproofing or Waterproofing.

.2 Canadian Standards Association (CSA International)
- .1 CSA A123.4- 98, Bitumen for Use in Construction of Built-Up Roof Coverings and Dampproofing and Waterproofing Systems.

.3 Health Canada
- .1 Workplace Hazardous Materials Information System (WHMIS)
  - .1 Safety Data Sheets (SDS).

.4 National Research Council Canada (NRC)/Institute for Research in Construction (IRC)
- .1 Canadian Construction Materials Centre (CCMC)

1.3 PRODUCT DATA

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

.2 Submit product data sheets for bituminous dampproofing products. Including:
- .1 Product characteristics.
- .2 Performance criteria.
- .3 Application methods.
- .4 Limitations.

.3 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence, cleaning procedures.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, handle, store and protect materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Provide and maintain dry, off-ground weatherproof storage.

.3 Store materials on supports to prevent deformation.

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

.5 Store materials in accordance with manufacturer's written instructions.

1.5 WASTE MANAGEMENT & DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - 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 corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Ensure emptied containers are sealed and stored safely.

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

.6 Divert unused bituminous dampproofing sealing compounds and asphalt primer materials from landfill to recycling facility approved by Departmental Representative

1.6 ENVIRONMENT

.1 Temperature, relative humidity, moisture content.

.1 Apply dampproofing materials only when surfaces and ambient temperatures are within manufacturers' prescribed limits.

.2 Do not proceed with Work when wind chill effect would tend to set bitumen before proper curing takes place.

.3 Maintain air temperature and substrate temperature at dampproofing installation area above 5 degrees C for 24 hours before, during and 24 hours after installation.

.4 Do not apply dampproofing in wet weather.

.2 Safety: Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of asphalt, sealing compounds, primers and caulking materials.

.3 Ventilation:

.1 Departmental Representative will arrange for ventilation system to be operated during installation of dampproofing. Ventilate area of Work as directed by Departmental Representative by use of approved portable supply and exhaust fans.

.2 Ventilate enclosed spaces in accordance with Section 01 51 00 - Temporary Utilities.

.3 Provide continuous ventilation during and after dampproofing application. Run ventilation system 24 hours per day during installation; provide continuous ventilation for 7 days after completion of dampproofing installation.

2.0 PRODUCTS

2.1 MATERIALS

.1 Asphalt:

.1 For application and curing at temperatures above 5 degrees C: to CGSB 37-GP-6Ma

.1 Package label or bill of lading for bulk hot liquid asphalt must indicate type, flash point, equiviscous temperature range and final blowing temperature.

.2 For application and curing at temperatures above 0 degrees C but below 5 degrees C: to CGSB 37-GP-6Ma CAN/CGSB-37.16 CSA A123.4 Type 1, 2, 3.

.1 Package label or bill of lading for bulk hot liquid asphalt must indicate type, flash point, equiviscous temperature range and final blowing temperature.

.2 Sealing compound: plastic cutback asphalt

.3 Asphalt primer: to CGSB 37-GP-9Ma.

3.0 EXECUTION

3.1 WORKMANSHIP

.1 Keep hot asphalt:

.1 Below its flash point.

.2 At or below its final blowing temperature.

.3 Within its equiviscous temperature range at place of application.

3.2 PREPARATION

.1 Before applying dampproofing:

.1 Seal exterior joints between foundation walls and footings, joints between concrete floor slab and foundation and around penetrations through dampproofing with sealing compound.

3.3 APPLICATION

.1 Do dampproofing in accordance with CAN/CGSB-37.3 except where specified otherwise.

.2 Do sealing work in accordance with CGSB 37-GP-11M except where specified otherwise.

.3 Do priming of surface in accordance with CGSB 37-GP-15M except where specified otherwise.

.4 Apply primer.

.5 Apply dampproofing in accordance with applicable CGSB application standard.

Material		Application
CAN/CGSB-37.2	use	CAN/CGSB-37.3
CGSB 37-GP-6Ma	use	CGSB 37-GP-12M
CAN/CGSB-37.16	use	CGSB 37-GP-36M
CAN/CGSB-37.2 8	use	CAN/CGSB-37.3
CSA A123.4	use	CGSB 37-GP-37M

3.4 SCHEDULE

.1 Apply continuous, uniform coating to entire exterior faces of foundation walls from 50 mm below finished grade level to and including tops of foundation wall footings.

.2 Apply continuous, uniform coating to exterior side of foundation walls enclosing rooms below finished grade. Include exterior portion of interior walls where floors in adjacent rooms are at different elevations.

.3 Apply two additional coats of dampproofing to vertical corners and construction joints for a minimum width of 230 mm on each side, and all around and for 230 mm along pipes passing through walls.

END OF SECTION 07 11 13

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1 Thermal Insulation — Section 07 21 00

.2 Air Barriers — Section 07 27 00.01

1.2 REFERENCES

.1 ASTM International Inc.

.1 ASTM D 6164- 05, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements.

.2 Canadian General Standards Board (CGSB)

.1 CGSB 37-GP-56M- 80b (A1985), Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing.

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Convene pre-installation meeting one week prior to beginning waterproofing Work, with waterproofing contractor's representative and Departmental Representative in accordance with Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart to:

.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.

1.4 SUBMITTALS

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

.2 Product Data:

.1 Provide for review by Departmental Representative prior to commencing work, two copies of most recent technical waterproofing components data sheets describing materials' physical properties and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Provide shop drawings and indicate:

.1 Flashing, control joints, details, transitions and lapping details according to construction sequencing.

.4 Manufacturer's Certificate: certify that products meet or exceed specified requirements.

.5 Manufacturer's Installation Instructions: indicate special precautions required for seaming the membrane.

.6 Manufacturer's field report: in accordance with Section 01 45 00 - Quality Control.

1.5 QUALITY ASSURANCE

.1 For each type of work, obtain primary materials from single manufacturer, which has produced that type of product successfully for not less than 10-Years. Provide ancillary materials only as recommended by manufacturer of membrane materials for use with roofing system specified.

.2 Installer shall be approved by the manufacturer of the materials prior to tender; shall be experienced in the application of the materials and shall supply job references to show similar

installations in satisfactory waterproof condition at least 5 years of age.

.3 Successful Contractors shall not sub contract any work unless special approval is received from the Consultant. Sub-contracting of work without approval shall be considered a violation of the contract.

.4 Mock-ups
- .1 Construct mock-up in accordance with Section 01 45 00 Quality Control.
- .2 Mock-up may be part of finished work if acceptable to Departmental Representative.
- .3 Provide a minimum of 3 days' notice to Departmental Representative to review installation of slab membrane prior to raft slab pour.

1.6 DELIVERY, STORAGE & HANDLING

.1 Provide and maintain dry, off-ground weatherproof storage.

.2 Store rolls of membrane in upright position.

.3 Remove only in quantities required for same day use.

.4 Handle waterproofing materials in accordance with manufacturer's written directives, to prevent damage or loss of performance.

.5 Store and manage hazardous materials in accordance with Section 01 35 33 - Health and Safety Requirements

1.7 SITE CONDITIONS

.1 Ambient Conditions in accordance with manufacturer's requirements.

1.8 WARRANTY

.1 The product manufacturer shall issue a written and signed document in the name of the owner, certifying the product will meet all the physical characteristic published by the manufacturer, for a period of 5 years, starting from the date of completion of installation of membranes. No letter amending the manufacturer's standard warranty will be accepted and the warranty certificate must reflect these requirements.

1.9 INSPECTION AUTHORITY

.1 Arrange manufacturer's representative to inspect the work on site.

.2 The presence of an Inspector shall in no way excuse the Contractor from performing the Work in accordance with the contract Documents and keeping with the best practices of the trades.

.3 The Contractor shall inform the Inspection Agency seven (7) days prior to commencement of work.

2.0 PRODUCTS

2.1 MEMBRANE

.1 Non-woven polyester reinforced SBS modified bitumen membrane, specifically designed for blind side waterproofing, with a sanded under face with a four inch self-adhered selvage edge covered by a silicone release film. The top face, against which the concrete is poured, has a polyester fleece with a four inch self-adhered selvage edge covered by a silicone release film.

.2 Properties Standards:

Thickness	ASTM D 3767	108 mils (2.70 mm)
Tensile strength	ASTM D 412	23.7/18.5 MPa
Ultimate elongation	ASTM D 412	67/74 %
Flexibility at cold temperature	ASTM D1970	Unaffected at -23 °C
Puncture resistance	ASTM E154	1210 N
Tear resistance	ASTM D 5601	125 N
Lap peel adhesion	ASTM D1876	1360 N/m
Water absorption	ASTM D 570	0.5 %
Adhesion of poured concrete	ASTM D 903	(Mod.) 2880 N/m
Water Vapor Permeance	ASTM E96	(Procedure B) 0.21 ng/Pa.s.m²

2.2 SURFACE PRIMER

.1 Primer used specifically for self-adhered membranes to substrates such as wood, metal or concrete. Primer is composed of a blend of natural resins and synthetic rubber; may be spray or roller applied (if required by construction conditions or detailing).

2.3 REINFORCEMENT MEMBRANE

.1 Self-adhered waterproofing membrane composed of SBS modified bitumen and a Tri-Laminate Woven Polyethylene Facer. The self-adhesive underside is covered by a silicone release sheet.

2.4 PREFABRICATED DRAINAGE BOARD

.1 Composite drainage board consisting of a post-industrial recycled polypropylene drainage core of fused entangled filaments and a geocomposite fabric bonded to one side.

Properties	**Standards**	**Values**
Thickness	ASTM D-1777	0.45 in.
Compressive Strength	ASTM D-1621	30,000 psf
Flow@ 3000 psf & 1.0 Gradient	ASTM D-4716	16 gpm/ft
Puncture Strength	ASTM D-4833	70 lbs.
Flow Rate	ASTM D-4491	120 gpm/ft²
Grab Tensile Strength	ASTM D-4632	120 lbs
Apparent Opening Size (AOS)	ASTM D-4751	70 sieve
Roll Dimensions		39” x 100’ (324 sf)

2.5 PROTECTION BOARD

.1 Asphaltic Hardboard: pre-molded, semi-rigid asphaltic protection board composed of bitumen, mineral core and reinforcement. Provide 3 mm (0.125 in.) thick hardboard on horizontal surfaces not receiving steel reinforced slab. Where steel reinforcing bars are to be used, apply two layers of 3 mm (0.125 in.) thick hardboard or one layer of 6 mm (0.25 in.) thick hardboard.

2.6 ACCESSORIES

.1 Waterproofing Mastic: one part urethane mastic containing SBS modified bitumen, fibers and mineral fillers.

.2 Waterproofing Liquid Membrane for conduits and piping penetrations: high performance, two component, rapid curing PMMA (poly methyl methacrylate) acrylic resin formulation for use at end laps only.

.3 Protection Board:

.1 A semi-rigid protection board composed of a mineral fortified asphaltic core formed between two saturated fibreglass felts.
.2 Characteristics:
.1 Thickness: 3mm
.2 Board Size: Width: 1.22m Length: 1.52m

.4 Termination Bar:
.1 Hexagonal Stainless Steel plate and Stainless Steel fasteners for outboard waterproofing. Standard of Acceptance to meet Factory Mutual.

.5 Drainage Layer:
.1 To be double dimpled sheeting with integral geo-textile made of high density polyethylene. Filter mat to be polyethylene. Compressive strength of approximately 90 kg/m^2. Drainage capacity of approximately 72 l/min-m. Resistance to root penetration and rotproof.

.6 Protection Layer:
.1 Provide protection sheet over horizontal underslab membrane as per manufacturer's recommendation.

3.0 EXECUTION

3.1 EXAMINATION AND PREPARATION OF SURFACES

.1 Surface examination and preparation must be completed in conformance with manufacturer's recommendations.
.2 Before waterproofing work begins, the Departmental Representative and the contractor will inspect and approve substrate condition and ensure that related work has been properly executed. If necessary, a non-conformity notice will be issued to the contractor so that required corrections can be made. The start of the membrane application will mean that substrate conditions are acceptable for work completion.

.3 Before commencing work, all surfaces must be smooth, dry with no standing water affecting raftslab membrane, clean and free of ice and debris as per manufacturer's recommendations.

.4 No materials will be installed during rain or snowfall.

.5 Concrete must be cured a minimum of fourteen (14) days and an adhesion test is recommended before membrane application.

.6 Verify the compatibility of all membrane components with curing compounds, coatings or other materials which are already installed on the surfaces to be treated.

.7 Any cracks over 3 mm wide should be reported to the Departmental Representative. After review, the crack should be filled in with waterproofing mastic. A 150 mm (6 inches) wide strip of membrane should be installed, centered over the crack.

3.2 METHOD OF EXECUTION

.1 Work shall be performed on a continuous basis as surface and weather conditions allow.

.2 Adjoining surfaces shall be protected against any damage that could result from the waterproofing installation.

3.3 EQUIPMENT

.1 Maintain all equipment and tools in good working order.

3.4 PRIMER APPLICATION

.1 Surface where heat-welded membrane is applied shall receive an asphalt primer coating at the rate of 0.15 to 0.20 l/m2. Application rate may vary depending on surface condition.

3.5 WATERPROOFING MEMBRANE INSTALLATION

.1 To begin application, align the first roll of membrane to a previously drawn chalk line.

.2 All inside and outside corners must be pre-stripped with a 300 mm (12 in.) wide strip of membrane centered over the corner. This membrane must be installed in direct contact with the substrate not leaving any voids under the membrane strip. Outside corners should be double lapped.

.3 Weld the membrane using a propane gas torch.

.4 Subsequent rolls must be installed in the same manner and should be aligned with the preceding roll with a side lap of at least 75 mm. End laps must be overlapped at least 100 mm.

.5 Holes and tears in the membrane must be repaired with the appropriate membrane material. The repair must exceed the affected surface area by at least 100 mm.

.6 Prior to backfilling, it is recommended to protect waterproofing system with protection boards. Backfilling should commence immediately after installation of protection boards.

.7 The uppermost edge of the membrane is to be mechanically fastened to the concrete substrate using termination bars. The termination bar should surpass the top edge of the membrane.

.8 Apply mastic on the top edge of termination bar to prevent water accumulation and infiltration.

.9 Any waterproofing membrane left exposed after backfilling shall be protected from ultra violet and mechanical damages.

.10 All membrane lap joints to be torched and reinforced.

.11 For horizontal underslab membrane, install loose lay membrane, torch and weld seams, install protection sheet on top of membrane.

.12 Mechanically fasten stainless steel termination bar with gumlip edge to receive termination caulking.

3.6 DRAINAGE BOARD INSTALLATION

.1 Adhere the drainage panels directly on the exposed insulation surface by applying a uniform pressure on the entire surface.

.2 Backfill as soon as possible after drainage board installation within 72 hours maximum.

3.7 DRAINAGE LAYER INSTALLATION

.1 Install drainage layer according to manufacturer’s recommendation by mechanical fastening.

.2 Install dimpled sheet and geo-textile so they overlap at the edges.

.3 Geo-textile to face outward – towards backfill side.

.4 Wrap the top edge of the drainage mat with the filter fabric facer to prevent soil from getting into dimples. Provide stainless steel mechanical fasteners to clamp drainage mat in place. Do not use mechanical fastener through waterproofing membrane. Use only intermittent fasteners that do not penetrate through the insulation layer into the membrane.

3.8 FIELD QUALITY CONTROL

.1 Inspection and testing of roofing systems and application will be carried out by testing laboratory designated by Owner and paid for by the Contractor.

.2 Field Review will be carried out on a daily basis during the entire roof installation procedure.

.3 Written "Daily" inspection reports to be distributed to Departmental Representative.

3.9 CLEANING

.1 Remove bituminous markings from finished surfaces.

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

END OF SECTION 07 13 52

1.0 GENERAL

1.1 SECTION INCLUDES

.1 Insulation and moisture protection as indicated on the drawings and specified herein.

1.2 RELATED SECTIONS

.1	Metal Wall Panels	Section 07 42 13
.2	Modified Bituminous Sheet Waterproofing	Section 07 13 52

1.3 PRODUCT DELIVERY, STORAGE & HANDLING

.1 Materials shall be stored in a dry and protected area, off the ground, in original undamaged, sealed container with manufacturer's labels and seals in tact. Avoid freezing.

1.4 PROJECT CONDITIONS

.1 Review manufacturer's recommendations for ambient temperatures during and after application.

.2 Report to general contractor in writing, defects of work prepared by other trades and unsatisfactory site or environmental conditions.

.3 Examine surfaces to ensure they are dry, clean, free of oil, grease, dirt, paint, mull scale or other deleterious material that would impair bonding.

.4 Commencement of work shall imply acceptance of surfaces and conditions.

2.0 PRODUCTS

.1 Roof Insulation Polyisocyanurate: Thermal Resistance of R28 minimum of any point of the roof. Shall conform to CAN/CGSB-51.26-M86 factory finished both sides with a nominal 2 lb./ft^3 density, compressive strength of 140 Kpa (20 psi) minimum and meet ULC S704. Facers must not have organic matter.

.2 Wall Cladding Exterior Insulation: Mineral Wool Insulation, non-combustible to ULC CAN 4-S114, zero falme spread and smoke development to ULC S102, 50 mm thick thermal resistance of R8x minimum.

3.0 EXECUTION

3.1 INSPECTION

.1 Ensure that surfaces to receive insulation are clean and free of obstructions.

.2 Do not install insulation in framing until roofing is complete and the building is enclosed.

3.2 WORKMANSHIP

.1 Install insulation to maintain continuity of thermal protection to building elements and spaces.

.2 Install batt and rigid insulation to all other areas indicated on drawings to thickness shown.

.3 Fit closely around electrical boxes, pipes, ducts, frames, joists, and other objects in or passing through insulation.

3.3 INSTALLATION

.1 Roof insulation installation

.1 Apply adhesive to rigid insulation board at applied thickness as recommended by manufacturer at all areas indicated on drawings.

.2 Butt joints tightly, offset vertical joints. Use insulation boards free from chipped or broken edges.

.3 Install material in accordance with manufacturer's instructions.

3.5 CLEANING

.1 Remove waste and excess material off site at completion of application. Repair and make good any defects to this application or any defects caused by this application.

END OF SECTION 07 21 00

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1 Air Barriers — Section 07 27 00

.2 Gypsum Board Assemblies — Section 09 21 16

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM)
- .1 ASTM C 553-02, Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.
- .2 ASTM C 665-01e1, Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- .3 ASTM C 1320-05, Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction.

.2 Canadian Standards Association (CSA International)
- .1 CSA B111-1974 (R2003), Wire Nails, Spikes and Staples.

.3 Underwriters Laboratories of Canada (ULC)
- .1 CAN/ULC-S604-M1991, Type A Chimneys.
- .2 CAN/ULC-S702-1997, Standard for Mineral Fibre Insulation

1.3 SUBMITTALS

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

.2 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 - Submittal Procedures.

.2 Manufacturer's Instructions:
- .1 Submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

.1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

.2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.3 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations in accordance with Section 01 32 16.07 - Construction Progress Schedules – Bar GANTT Chart.
- .1 Verify project requirements.
- .2 Review installation and substrate conditions.
- .3 Co-ordinate with other building sub-trades.
- .4 Review manufacturer's installation instructions and warranty requirements.

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

1.5 WASTE MANAGEMENT & DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

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

2. PRODUCTS

2.1 INSULATION

.1 Thermal Batt and blanket mineral wool: non-combustible to ULC CAN 4-S114, zero flame spread and smoke development to ULC S102, comply CAN/ULC-S702-97 Type 1.

.1 Thickness: as indicated.

.2 Density: more than 32 kg/m^3 , 184 mm thk = 5.9 kg/m^3, 150 mm thk = 4.8 kg/m^3, 89 mm thk = 2.8 kg/m^3

.3 Minimum Insulation Value:
R10 (RSI 1.76) = 64 mm thk
R14 (RSI 2.47) = 89 mm thk
R22.5 (RSI 3.96) = 152 mm thk

2.3 ACCESSORIES

.1 Insulation clips:

.1 Impale type, perforated 50 x 50 mm cold rolled carbon steel 0.8 mm thick, adhesive back, spindle of 2.5 mm diameter annealed steel, length to suit insulation, 25 mm diameter washers of self-locking type.

.2 Nails: galvanized steel, length to suit insulation plus 25 mm, to CSA B111.

.3 Staples: 12 mm minimum leg.

.4 Tape: as recommended by manufacturer.

3.0 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.2 INSULATION INSTALLATION

.1 Install insulation to maintain continuity of thermal protection to building elements and spaces.

.2 Fit insulation closely around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.

.3 Do not compress insulation to fit into spaces.

.4 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures, and minimum 50 mm from CAN/CGA-B149.1 and CAN/CGA-B149.2 Type B and L vents.

.5 Do not enclose insulation until it has been reviewed and approved by Departmental Representative.

3.4 CLEANING

.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers. security devices.

END OF SECTION 07 21 16

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1	Modified Bituminous Sheet Waterproofing	Section 07 13 52
.2	Thermal Insulation	Section 07 21 00
.3	Metal Wall Panels	Section 07 42 13
.4	Sheet Metal Flashing & Trim	Section 07 62 00

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-19.13M-M87, Sealing Compound, One Component, Elastomeric Chemical Curing.
- .2 CAN/CGSB-19.24M-M90, Multi-Component, Chemical Curing Sealing Compound.
- .3 CGSB 19-GP-14M-84, Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing.

.2 Sealant and Waterproofer's Institute - Sealant and Caulking Guide Specification.

1.3 SUBMITTALS

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

.2 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Quality Assurance Submittals: submit following in accordance with Section 01 45 00 - Quality Control.
- .1 Existing Substrate Condition: report deviations, as described in PART 3 -EXAMINATION in writing to Departmental Representative.
- .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.

1.4 QUALITY ASSURANCE

.1 Qualifications:
- .1 Applicator: company specializing in performing work of this section with minimum 5 years documented experience with installation of air/vapour barrier systems.

.2 Mock-Up:
- .1 Construct mock-up in accordance with Section 01 45 00 - Quality Control.
- .2 Construct typical exterior wall panel, incorporating louvre and door frame, insulation, illustrating materials interface and seals.
- .3 Locate in location as agreed to with Departmental Representative.
- .4 Mock-up may remain as part of finished work.
- .5 Allow 72 hours for inspection of mock-up by Departmental Representative before proceeding with air/vapour barrier Work.

.3 Schedule site visits with Departmental Representative, to review Work, at stages listed:

.1 After delivery and storage of products, and when preparatory Work is complete, but before installation begins.
.2 Minimum twice during progress of Work at 25% and 60% complete.
.3 Upon completion of Work, after cleaning is carried out, prior to cover up by other building component.

1.5 DELIVERY STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

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

.3 Avoid spillage: immediately notify Departmental Representative if spillage occurs and start clean up procedures.

.4 Clean spills and leave area as it was prior to spill.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

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

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

1.7 AMBIENT CONDITIONS

.1 Install solvent curing sealants and vapour release adhesive materials in open spaces with ventilation.

.2 Ventilate enclosed spaces.

.3 Maintain temperature and humidity recommended by materials manufactures before, during and after installation.

1.8 SEQUENCING

.1 Sequence work in accordance with Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Charts.

.2 Sequence work to permit installation of materials in conjunction with related materials and seals.

1.9 WARRANTY

.1 For sealant and sheet materials the 12 months warranty period is extended to 24 months.

2.0 PRODUCTS

2.1 SELF ADHESIVE MEMBRANE

.1 Membrane composed of high temperature grade SBS modified bitumen and a Tri-laminate woven polyethylene face on the top surface. The self-adhesive bottom surface is protected by a silicone release sheet.

- .1 Water Vapour transmission 202 g/m² /24 hours/ASTM E96/B (Dessicant).
- .2 Dry Tensile Strength 41 lbf/182N MD, 29 lbf/129N CD, ASTM D 828.
- .3 Average Dry Breaking Force 127 lbf/565N MD, 91 lbf/405N CD, ASTM D 5034.
- .4 Accelerated Aging, Pass, ICC-ES AC 48, 25 cycles.
- .5 Cycling and Elongation, Pass, ICC-ES AC48, 100 cycles at -29°C (20°F).
- .6 Application Temperature Minimum 5°C (41°F).
- .7 Flame Spread Index 0, Class A, ASTM E-84.
- .8 Smoke Developed 105, Class A, ASTM E-84.
- .9 Membrane thickness, Minimum 40 mil.
- .10 Air Permeance, Pass, ASTM E 2178 (Maximum 0.02 L/m²s @ 75Pa or 0.004 cfm/ft² @ 1.57pcf) ASTM E 2357 – assembly, Pass.
- .11 Criteria for Water Resistive Barriers, Pass, ICC-ES AV 38.
- .12 Low Temp Flexibility, Pass, ICC-AC38/3.3.4.
- .13 Peel-adhesion to Unprimed Plywood, PASS, ICC-ES AC48, Control 62 lbf/ft-905N/m, After 7 day water immersion 54 lbf/ft-788N/m, After accelerated aging 72 lbf/ft-1051N/m, After UV exposure 77 lbf/ft-1124N/m
- .14 Water Penetration Resistance around Nails, PASS, AAMA 711-05 and ASTM D 1970 modified.

2.2 SEALANTS

.1 Sealants in accordance with Section 07 92 10 - Joint Sealants.

.2 Sealant compatible with membrane as recommended by the manufacturer:

- .1 Silicone Sealant specifically for use with self-adhered membrane.

.3 Primer: recommended by sealant manufacturer as appropriate to application.

.4 Substrate Cleaner: non-corrosive type recommended by sealant manufacturer and compatible with adjacent materials.

2.3 PRIMER

.1 Apply primer to gypsum wall board and concrete masonry unit according to manufacturer’s specification. Ensure proper adhesion and compatibility to the membrane.

2.4 ACCESSORIES

.1 Provide mechanically fastened stainless steel termination bar with gumlip edge.

3.0 EXECUTION

3.1 MANUFACTURER’S INSTRUCTIONS

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

3.2 GENERAL

.1 Perform Work in accordance with Sealant and Waterproofer's Institute - Sealant and Caulking Guide Specification requirements for materials.

3.3 EXAMINATION

.1 Verify that surfaces and conditions are ready to accept work of this section.

.2 Ensure surfaces are clean, dry, sound, smooth, continuous and comply with air barrier manufacturer's requirements.

.3 Report unsatisfactory conditions to Departmental Representative in writing.

.4 Do not start work until deficiencies have been corrected.

.1 Beginning of Work implies acceptance of conditions.

3.4 PREPARATION

.1 All surfaces to receive the membrane must be thoroughly cleaned so as to have removed all concrete spatter, job dirt, laitance, from release agents, curing compounds, or any other substance which could inhibit the adhesion, and long term performance of the membrane.

.2 All honeycombing in concrete shall be grouted flush prior to application of primer.

.3 Apply primer as per manufacturer’s recommendation to all surfaces to receive the membrane on gypsum board or concrete masonry block substrate.

.4 Prepare in accordance with manufacturer’s instructions.

.5 Apply a horizontal membrane strip over vertical leg and fasteners of all horizontal cladding supports. Seal top with mastic regular.

.6 Fill all joints or gaps wider than ¼” with galvanized steel sheet steel or wood backing and apply 12” strip of membrane over joints prior to application of the field membrane. Seal all side laps without factory bitumen self-adhering edge and all top laps with mastic.

3.5 APPLICATIONS

.1 Apply in accordance with manufacturer’s instructions.

.2 Ensure continuity of air barrier. Co-ordinate construction of roof/wall junction to maintain continuity of air barrier from wall to roof. Co-ordinate with construction of exterior walls to maintain continuity of air barrier between various exterior wall construction types.

.3 Shingle laps to drain. Minimum side and end laps as per manufacturer’s recommendation with a minimum of 75mm.

.4 Lap and seal air barrier membrane over through-wall flashing at base of wall and at all horizontal wall flashings.

.5 Seal all through-wall equipment flanges with air barrier membrane flashing strips; apply mastic to edges.

.6 Seal all metal fabrication flanges with air/vapour barrier membrane flashing strips; apply mastic to edges.

.7 Seal all horizontal drip flashings to air/vapour barrier membrane with minimum 150 mm strips of membrane flashing applied horizontally; apply mastic to edges of flashing membrane.

3.6 CLEANING

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

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.7 PROTECTION OF WORK

.1 Protect finished work in accordance with Section 01 61 00 - Common Product Requirements.

.2 Do not permit adjacent work to damage work of this section.

.3 Ensure finished work is protected from climatic conditions.

END OF SECTION 07 27 00.01

1.0 GENERAL

1.1 RELATED SECTIONS

.1	Thermal Insulation	Section 07 21 00
.2	Air Barriers	Section 07 27 00
.3	Sheet Metal Flashing and Trim	Section 07 62 00
.4	Joint Sealants	Section 07 92 00

1.2 SUBMITTALS

.1 Submit 300 x 300 mm size sample of wall cladding material, of color and profile specified, in accordance with Section 01 33 00 Submittal Procedures.

.2 Submit product data or shop drawings in accordance with Section 01 33 00 showing the profiles of preformed metal cladding units, and the detail of forming, jointing (gaskets if any), internal supports, anchorages, trim, flashing and accessories. Show details of weatherproofing at edges, terminations and penetrations of the metal cladding work. Show small scale layout and elevations of entire work.

.3 Shop drawings to be designed and prepared under the supervision of a registered Professional Engineer registered in British Columbia. All submitted shop drawings shall be sealed and signed by the said Professional Engineer. The same Professional Engineer shall provide Model Schedule B and Schedule C confirming the work is designed and installed in conformance with the structural design criteria.

1.3 EXISTING CONDITIONS

.1 Before commencing erection, examine the structure carefully. Notify the Consultant of any defects and have the base surfaces corrected as required. Do not work until corrective measures are taken.

.2 Commencement of work signifies acceptance of all base surfaces.

1.4 WARRANTY

.1 The metal cladding installation and material shall be warranted against the penetration of rain, snow, ice or environmental elements, to be rigid and safely able to withstand all wind and snow loads, not to deflect, buckle, twist or pull away from fastenings. For the work of this Section 07 42 13 , the 12 month warranty period is extended to 24 months.

2.0 PRODUCTS

2.1 MATERIALS

.1 Exterior Cladding and Trim Materials
- .1 Minimum 0.759mm (22ga) sheet steel.
- .2 Minimum 0.912mm (20ga) for flat stock sheet metal installed behind fixtures or wall penetration.
- .3 All exposed sheet metal or cladding material to finish to match adjoining profile metal cladding.

.2 Profile:
- .1 To match adjoining profile metal cladding.

.3 Assembly and Installation Accessories: Provide manufacturer's standard fasteners, brackets, clips, anchoring devices, furring strips, spacers, flashings, closures, adhesives, joint sealers, expansion joints and other components needed for a complete permanently weather proof installation. Use materials which are non-corrosive, non-deteriorating, and compatible with the panel faces. All exposed fasteners shall be painted to match siding panels.

.4 Trims and Custom Break Shapes: Provide trim components as part of the preformed metal cladding work, including all flashing and collars, capping, seam covers, end stops and filler pieces, etc. Match the material and finish of the exterior panels, thickness minimum 0.61 mm (22 ga).

.5 Flashings: shall be of the same material and finish as metal cladding, thickness minimum 0.759 mm.

.6 Closure Strips: shall be of same material and finish as metal cladding, thickness minimum 0.759 mm.

.7 Sealant: for metal cladding system with the colour to match adjoining surfaces, field applied around all openings, and to side of all cladding. Sealant shall comply with Section 07 92 00.

.8 Z-Girt: Stainless steel, Thermally broken, adjustable with PVC spacers, composed of inner short sections of angle and a continuous angle to the outside, tie together with a screw fastener.

.9 Fasteners to have a minimum 2000hr salt spray rating.

.10 Finish: To be chosen from the Classic RAL colour system. Allow for two colours.

2.2 PANEL FABRICATION

.1 Determine the section properties of the metal cladding panel systems in strict accordance with the requirements of the National Building Code, Canadian Structural Design Manual including CSA S136, Design of Light Gauge Steel Structured Members.

.2 Metal cladding panel systems shall withstand all live loads resulting from wind or a combination of wind and temperature as defined in the National Building Code without exceeding the maximum working stress of 20,000 psi for steel members or the maximum deflection of 1/180th of the span.

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

.4 Provide resilient gaskets or spacers between metal components of panel assemblies, and between panels, as required to eliminate metal-to-metal contact and movement noises in the completed work, which might result from thermal or structural movements.

3.0 EXECUTION

3.1 PREPARATION

.1 Wherever possible, take field measurements prior to completion of shop fabrication and finishing of preformed metal cladding. Do not delay job progress; allow for trimming where final dimensions cannot be established before fabrication.

3.2 INSTALLATION

.1 Comply with panel manufacturer's instructions and approved Engineered shop drawing for assembly, installation and erection of preformed metal cladding.

.2 Apply a coat of bituminous paint, concealed, on one or both surfaces wherever dissimilar metals would otherwise be in contact. Use gasket fasteners where needed to eliminate the possibility of corrosive or electrolytic action between metals.

.3 Anchor component parts of the preformed metal cladding securely in place, providing for necessary thermal and structural movement as recommended by manufacturer and as indicated on Engineered Shop Drawings. Make corners square, surfaces true and straight in all planes and lines accurate to profiles.

.4 Tolerances: Erect the Work plumb, level and true to line with tolerances not exceeding 6 mm in runs of 6 m.

.5 Install exterior corners, fillers and closure strips with individually formed and profiled work using concealed fasteners.

.6 Install sealants for the preformed metal cladding work as indicated and as required for performance. Comply with sealant manufacturer's instructions for installation and curing.

.7 Install starter strips, backer plates, drip caps, outside custom corners and other trims and flashings, as indicated on the drawings and as required to provide a complete and finished product.

.8 All flashing in contact with steel preformed metal cladding as herein described shall be steel and by this trade, except as noted otherwise.

.9 Isolate all dissimilar materials.

.10 Apply waterproof membrane between all members/supports for metal cladding connecting to back-up structure and weather barrier. Ensure membrane projects 25 mm beyond all sides of every member to provide a complete seal around fastenings.

.11 Do not install cladding in direct contact with lead or copper or in areas where run off from these metals on to the cladding surface may occur.

3.3 CLEANING

.1 Clean exposed surfaces of preformed metal cladding work promptly after completion of installation. Comply with recommendations of both the panel and coating manufacturers.

.2 Clean up and remove from the site all surplus materials and rubbish resulting from the Work of this Section.

END OF SECTION 07 42 13

1.0 GENERAL

1.1 SECTION INCLUDES

.1 Section includes:

.1 The supply and installation of prefinished, standing seam metal roofing with all fasteners, sealants, closures and accessories complete with a continuous self-adhering membrane underlayment.

.2 Final roof is to be completely weathertight, with all penetrations flashed and sealed.

1.2 RELATED WORK

.1	Metal Wall Panels	Section 07 42 13
.2	Modified Bituminous Sheet Waterproofing	Section 07 13 52
.3	Joint Sealants	Section 07 92 00

1.3 CONDITIONS

.1 Report to the General Contractor for submission to the Departmental Reprsentative in writing any defects in work prepared by other trades and unsatisfactory site conditions. Starting of work shall imply acceptance of surfaces.

1.4 QUALITY ASSURANCE

.1 Carry out roofing work in accordance with applicable standards in Roofing Contractors Association of British Columbia (R.C.A.B.C.) Manual “Roofing Practices in British Columbia” (latest edition) complete with all amendements, and to U.L.C. requirements.

.2 Complete work using experienced trades persons familiar with common roofing sheet metal applications.

.3 Design Loads: loads shall be based on National Building Code (NBC) requirements. Where local building codes exceed the requirements they will take precedence over NBC.

1.5 REFERENCES

.1 ASTM A525M-91B: steel sheet, zinc-coated (galvanized) by the hot-dip process.

.2 ASTM B117-90: Test Method of Salt Spray (Fog) Testing.

.3 CAN/CSA-S136-M89: Cold Formed Steel Structural Members.

1.6 SUBMITTALS

.1 Samples:

.1 Submit duplicate 150 mm x 150 mm (6" x 6") samples of each type of sheet metal material. Include typical seaming and show lap condition at roof flashing.

.2 Submit metal samples of colours from manufacturer’s standard range for selection by Departmental Representative.

.3 Submit samples of the membrane underlayment.

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01300.

.2 Indicate flashings, control joints details and other standard manufacturer’s details from roof components and accessories as applicable.

.3 The application Contractor shall also submit typical erection drawings for approval before proceeding with installation.

1.7 DESIGN AND PERFORMANCE REQUIREMENTS

.1 Design complete roof system to withstand dead loads, snow loads and build-up, and wind loads including uplift calculated in accordance with NBC and applicable local regulations.

.2 Standing seam roofing system must include a continuous waterproof membrane which drains to the exterior below the metal panels. All fastenings through this membrane must be sealed to ensure a watertight system to the true intent of the Contract.

.3 Metal materials and flashings shall not be in contact with the protected membrane roofing.

.4 Design roof to allow adequate expansion and contraction of component parts without causing buckling, failure of joints and undue stress on fasteners in accordance with manufacturers recommendations.

.5 Design anchorage, method of fastening, frequency of clips, and spacing and number of fasteners for fixing roofing materials to meet all loading requirements, including but not limited to suction loads. Panel width dimensions and thickness details shall be in accordance with roofing manufacturers recommendations to avoid fluttering and cracking.

.6 Appearance: exposed fastening devices not permitted.

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

.1 Storage and Handling:

.1 Protection shall be provided during fabrication, storage and erection.

.2 During shipment, finished surfaces shall be protected from abrasion by a removable film between areas of contact.

.3 Job site storage shall be in a clean, dry area out of direct contact with the ground, under cover or sloped for drainage, protected from abuse by traffic and from contamination by corrosive or staining materials.

.4 Stored materials and unfinished work shall be secured against wind damage.

.5 Installed membrane and panels shall be protected from abuse by other trades. It shall be the responsibility of this Contractor to provide walk boards in areas of heavy traffic and any other measures required to prevent damage by his own crew and notify the General Contractor of other protection required.

1.9 INSPECTION AND WARRANTY

.1 Upon completion of work, this Contractor shall furnish the Departmental Representative with a 5-Year R.C.A.B.C. Guarantee for the work under this section.

.2 Provide for inspection by an independent RCABC-approved company in accordance with specifications and RCABC requirements. Include inspection fees in this Contract.

1.10 COMPATIBILITY

.1 Compatibility between metal flashing components is essential. Materials to be incorporated into the system must be compatible.

.2 Provide written declaration that metal flashings will be installed to comply R.C.A.B.C. Standards.

.3 Where the trade believes incompatible components may be in contact, advise Departmental Representative in writing and obtain written directive before proceeding.

2.0 PRODUCTS

2.1 SHEET METAL MATERIALS

.1 Prefinished steel sheet: 508 mm wide, 38 mm high seam 0.70 mm (24 ga.) minimum thickness, commercial quality to ASTM A526-80, prefinished in standard series colour to ASTM A525M. Colour to be selected by Departmental Representative from complete colour range. Standing seam profile to mimic a batten style roofing panel. Snap in/interlocking progressive system.

2.2 MEMBRANE

.1 Self-adhered membrane installed continuous below standing seam metal panels with drainage to the exterior.

2.3 ACCESSORIES

.1 Isolation coating: alkali resistant bituminous paint.

.2 Mastic: SBS modified mastic.

.3 Underlayment for metal flashings shall be Type CF Coated Base sheet (40# type).

.4 Sealants: in accordance with Section 07 900, colour selected by Departmental Representative. Only sealants listed on CGSB Qualified Products List are acceptable for use on this project.

.5 Clip or Cleats: of same material, and temper as sheet metal, minimum 50 mm wide shall be used where additional securement required at standing seams. Thickness same as sheet metal being secured. Exposed face to be painted as sheet metal.

.6 Fasteners: galvanized threaded screws with soft neoprene washer.

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

.8 Solder: to ASTM B32-76, as recommended by sheet metal manufacturer.

.9 Flux: suitable for materials to be soldered.

.10 Insulated spun aluminium sleeve flashing system.

.11 Touch-up paint: as recommended by metal flashing and trim manufacture.

.12 Sheet Metal Screws: Cadmium plated, self tapping.

.13 Plumbing vent flashing and vandal proof vent caps shall be aluminum-shop made by Menzies Metal Products. Aluminum vents to CSA-879.

.14 Scuppers: Shop manufactured from 0.61mm galvanized sheet with 150mm side and bottom flanges, throat outlet as indicated on drawing.

2.4 METAL FLASHINGS

.1 Form for flashings, copings and trims to profiles indicated of 0.61mm thick galvanized pre-finished steel sheet. Galvanization to be same as sheet steel.

.2 Caulk perimeter flashings with specified sealant where necessary to make a proper seal.

.3 'S' Lock and caulk end joints in flashing. Provide standing seams with concealed clips at corners. Hem exposed edges of flashing a minimum of 12.5 mm for rigidity.

.4 Provide flashings with edges turned to form a drip. Make proper allowance for expansion and contraction. Face clip flashings with concealed clips (600 mm) on centres.

.5 Provide new baked enamel coated galvanized iron base flashings at vents, chimneys, control joints and skylights.

.6 Carry face metal down exterior face a minimum of 100 mm or as indicated on drawings.

.7 Provide metal base and cap flashings to extend to within 25 mm of roof surface.

2.5 REGLETS AND CAP FLASHING

.1 Supply and install reglets and metal cap flashing of 0.61mm thick Galvanized pre-finished steel sheet metal. Galvanization quality to be same as sheet steel as indicated on Drawings.

.2 Provide and install connecting units between sections of reglets to provide weathertight joint.

.3 Use 'S' lock seams for all joints. Insert sealant in seam prior to fixing adjacent section of flashing.

2.6 FABRICATION

.1 Fabricate metal flashings and other sheet metal work in accordance with R.C.A.B.C. and C.R.C.A. standards.

.2 Panels shall be roll-formed in continuous lengths; standing seam spacing shall be 420 mm on centre, with a seam height of 38 mm.

.3 Hem exposed edges on underside 12.7mm (1/2"). Mitre and seal corners with sealant and make allowance for expansion at all joints.

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

.5 Valleys as required shall be one continuous strip with standing seam in middle and/or fabricated from flat sheet stock with “hook strip” jointing. Edges shall interlock with roof panels.

3.0 EXECUTION

3.1 INSTALLATION

.1 Storage and Handling:
  .1 Protection shall be provided during fabrication, shipment, storage and erection.
  .2 During shipment, finished surfaces shall be protected from abrasion by a removable film between areas of contact.
  .3 Job site storage shall be in a clean, dry area out of direct contact with the ground, under cover or sloped for drainage, protected from abuse by traffic and from contamination by corrosive or staining materials.
  .4 Stored materials and unfinished work shall be secured against wind damage.

.2 Installation Protection:
  .1 Before installation, this Contractor shall verify that the structure is ready to receive his work. He shall check field dimensions and alignment of structural members to assure that the roof panels and flashings will be straight and true.

.2 The Departmental Representative shall be notified on unresolved conditions which may adversely affect the performance or appearance of the installed roof, and work on that location will not proceed until approved.

.3 All metal roof work shall be in accord with the approved shop details under direct supervision of an experienced sheet metal craftsman.

.4 Attachments and joints shall allow for expansion and contraction from temperature changes without distortion or elongation of fastener holes.

.5 Flashing shall be installed in strict accordance with the recommended practice in the RCABC manuals, without fasteners in the end laps.

.6 Completed work shall be plumb and true, free of scrapes and dents. Panel ribs shall be on the module indicated in the Contract documents.

.7 Excess sealant shall be removed and touch-up paint applied to any areas where paint scrapes occur. Any panels which are badly damaged and in the judgement of the Departmental Representative cannot be repaired shall be removed and replaced.

END OF SECTION 07 62 00

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1 Air Barriers Section 07 27 00

1.2 REFERENCES

.1 The Aluminum Association Inc. (AAI)
- .1 AAI-Aluminum Sheet Metal Work in Building Construction-2002.
- .2 AAI DAF45-03, Designation System for Aluminum Finishes.

.2 American Society for Testing and Materials International (ASTM)
- .1 ASTM A 167-99 (2004), Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- .2 ASTM A 240/A 240M-07e1, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- .3 ASTM A 606-04, Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance.
- .4 ASTM A 653/A 653M-07, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .5 ASTM A 792/A 792M-06a, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- .6 ASTM B 32-04, Standard Specification for Solder Metal.
- .7 ASTM B 370-03, Standard Specification for Copper Sheet and Strip for BuildingConstruction.
- .8 ASTM D 523-89(1999), Standard Test Method for Specular Gloss.
- .9 ASTM D 822-01(2006), Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.

.3 Canada Green Building Council (CaGBC)
- .1 LEED Canada-CI Version 1.0-20079, LEED (Leadership in Energy and Environmental Design): Green Building Rating System and Reference Package For Commercial Interiors.

.4 Roofing Contractors Association of B.C. (RCABC)
- .1 RGC Roofing Practice Manual- Millennium edition.

.5 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-51.32-M77, Sheathing, Membrane, Breather Type.
- .2 CAN/CGSB-93.1-M85, Sheet Aluminum Alloy, Prefinished, Residential.

.6 Canadian Standards Association (CSA International)
- .1 CSA A123.3-05, Asphalt Saturated Organic Roofing Felt.
- .2 AAMA/WDMA/CSA 101/I.S.2/A440-2008, Standard/Specification for Windows, Doors, and Unit Skylights.
- .3 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.

.7 Green Seal Environmental Standards
- .1 Standard GS-03-93, Anti-Corrosive Paints.
- .2 Standard GS-11-97, Architectural Paints.
- .3 Standard GS-36-00, Commercial Adhesives.

.8 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
.1 Safety Data Sheets (SDS).

.9 South Coast Air Quality Management District (SCAQMD), California State
.1 SCAQMD Rule #1113-04, Architectural Coatings.
.2 SCAQMD Rule #1168-05, Adhesives and Sealants.

.10 British Columbia Sheet Metal Association (SMACNA-BC)
.1 Architectural Sheet Metal Manual- 6th Edition 2003.

1.3 SUBMITTALS

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

.2 Product Data:
.1 Submit manufacturer's printed product literature for sheet metal flashing systems materials, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
.2 Submit two copies WHMIS SDS - Safety Data Sheets in accordance with Section 01 35 33 - Health and Safety Requirements.

.3 Samples:
.1 Submit duplicate 50 x 50 mm samples of each type of sheet metal material, finishes and colours.

.4 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.
.1 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

2.0 PRODUCTS

2.1 PRE-FINISHED SHEET METAL

.1 Zinc coated steel sheet: 1 mm (20ga) thickness, commercial quality to ASTM A 653/A 653M, with Z275 designation zinc coating, finish enamel coated factory applied coating to CGSB 93-GP-3m Class F29, Custom color to match existing as approved by Departmental Representative.

2.2 PREFINISHED ALUMINUM SHEET

.1 Prefinished aluminum sheet: 0.81mm (20 gauge).

.2 Prefinished Aluminum with factory applied polyvinylidene fluoride.
.1 Class F2S.
.2 Custom Colour selected by Departmental Representative existing silver colour.
.3 Specular gloss: 5 units +/-5 in accordance with ASTM D 523.
.4 Coating thickness: not less than 25 micrometres.
.5 Resistance to accelerated weathering for chalk rating of 8, colour fade 5units or less and erosion rate less than 20 % to ASTM D 822 as follows:
.1 Outdoor exposure period 2500 hours.
.2 Humidity resistance exposure period 5000 hours.
.6 Applications of PVF2 Coating system by means of spray coating after forming and shaping of flashing elements is not acceptable.

2.3 ACCESSORIES

.1 Isolation coating: alkali resistant bituminous paint.

.2 Plastic cement: to CAN/CGSB 37.5.
.1 Maximum VOC limit 50 g/L to SCAQMD Rule 1168.

.3 Underlay for metal flashing: asphalt laminated 3.6 to 4.5 kg kraft paper.

.4 Sealants.
.1 Maximum VOC limit 50 g/L to SCAQMD Rule 1168.

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

.6 Fasteners: stainless steel, flat head roofing nails of length and thickness suitable for metal flashing application.

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

.8 Touch-up paint: as recommended by prefinished material manufacturer.
.1 Maximum VOC limit 50 g/L to SCAQMD Rule 1113.

2.4 FABRICATION

.1 Fabricate metal flashings and other sheet metal work in accordance with applicable RCABC Standards.

.2 Fabricate aluminum flashings and other sheet aluminum work in accordance with AAI-Aluminum Sheet Metal Work in Building Construction.

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

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

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

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

2.5 METAL FLASHINGS

.1 Form flashings, copings and fascias to profiles indicated of 1mm, 20ga thick galvanized steel, or aluminum 0.81 (20ga) thick as indicated on drawings.

.2 Caulk perimeter flashings with specified sealant where necessary to make a proper seal.

.3 'S' Lock and caulk end joints in flashing. Provide standing seams with concealed clips at corners. Hem exposed edges of flashing a minimum of 12.5 mm for rigidity.

.4 Provide flashings with edges turned to form a drip. Make proper allowance for expansion and contraction. Face clip flashings with concealed clips (600 mm) on centres.

.5 Carry face metal down exterior face a minimum of 100 mm or as indicated on drawings.

.6 Provide metal base and cap flashings to extend to within 25 mm of roof surface.

3.0 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install sheet metal work in accordance with R.C.A.B.C standards.

.2 Use concealed fastenings except where approved before installation.

.3 Provide underlay under sheet metal.
- .1 Secure in place and lap joints 100 mm.

.4 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs.
- .1 Flash joints using S-lock forming tight fit over hook strips.

.5 Lock end joints and caulk with sealant.

.6 Install pans, where shown around items projecting through roof membrane.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:
- .1 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

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.

.3 Leave work areas clean, free from grease, fingermarks and stains.

END OF SECTION 07 62 00

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1 Mechanical Divisions 20-25

.2 Electrical Communications/Electronics/Security Divisions 26-28

1.2 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Safety Data Sheets (SDS).

.2 Underwriter's Laboratories of Canada (ULC)
- .1 ULC-S115-1995, Fire Tests of Fire stop Systems.

1.3 DEFINITIONS

.1 Fire Stop Material: device intended to close off opening or penetration during fire or materials that fill openings in wall or floor assembly where penetration is by cables, cable trays, conduits, ducts and pipes and poke-through termination devices, including electrical outlet boxes along with their means of support through wall or floor openings.

.2 Single Component Fire Stop System: fire stop material that has Listed Systems Design and is used individually without use of high temperature insulation or other materials to create fire stop system.

.3 Multiple Component Fire Stop System: exact group of fire stop materials that are identified within Listed Systems Design to create on site fire stop system.

.4 Tightly Fitted; (ref: NBC Part 3.1.9.1.1): penetrating items that are cast in place in buildings of noncombustible construction or have "0" annular space in buildings of combustible construction.
- .1 Words "tightly fitted" should ensure that integrity of fire separation is such that it prevents passage of smoke and hot gases to unexposed side of fire separation.

1.4 SUBMITTALS

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

.2 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit two copies of WHMIS SDS - Safety Data Sheets in accordance with Section 01 35 33 Health and Safety Requirements.

.3 Shop Drawings:
- .1 Submit shop drawings to show location, proposed material, reinforcement, anchorage, fastenings and method of installation.
- .2 Construction details should accurately reflect actual job conditions.

.4 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.
- .1 Test reports: in accordance with CAN-ULC-S101 for fire endurance and CAN-ULC-S102 for surface burning characteristics.
  - .1 Submit certified test reports from approved independent testing laboratories, indicating compliance of applied fire stopping 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 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.

.4 Manufacturer's Field Reports: submit to manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

1.5 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: company specializing in fire stopping installations with 5 years documented experience.

.2 Pre-Installation Meetings: convene pre-installation meeting two weeks prior to beginning work of this Section, with contractor's representative and Departmental Representative in accordance with Section 01 32 16.07 - Construction Progress Schedule - Bar (GANTT) Chart to:

.1 Verify project requirements.

.2 Review installation and substrate conditions.

.3 Co-ordination with other building sub trades.

.4 Review manufacturer's installation instructions and warranty requirements.

.3 Site Meetings: as part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.

.1 After delivery and storage of products, and when preparatory Work is complete, but before installation begins.

.2 Twice during progress of Work at 25% and 60% complete.

.3 Upon completion of Work, after cleaning is carried out.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Product Requirements.

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

.3 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, ULC markings.

.2 Storage and Protection:

.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.

.3 Waste Management and Disposal:

.1 Separate waste materials for recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

2.0 PRODUCTS

2.1 MATERIALS

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

.1 Asbestos-free materials and systems capable of maintaining effective barrier against flame, smoke and gases in compliance with requirements of CAN- ULC-S115 and not to exceed opening sizes for which they are intended and conforming to specified special requirements described in PART 3.

.2 Fire stop system rating: 2 hours FRR, F rating.

.2 Service penetration assemblies: systems tested to CAN-ULC-S115.

.3 Service penetration fire stop components: certified by test laboratory to CAN-ULC-S115.

.4 Fire-resistance rating of installed fire stopping assembly in accordance with NBC.

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

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

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

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

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

.10 Sealants for vertical joints: non-sagging.

3.0 EXECUTION

3.1 MANUFACTURER’S INSTRUCTIONS

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

3.2 PREPARATION

.1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.

.1 Ensure that substrates and surfaces are clean, dry and frost free.

.2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.

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

.4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.3 INSTALLATION

.1 Install fire stopping and smoke seal material and components in accordance with manufacturer's certified tested system listing.

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

.3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.

.4 Tool or trowel exposed surfaces to neat finish.

.5 Remove excess compound promptly as work progresses and upon completion.

3.4 SEQUENCES OF OPERATION

.1 Proceed with installation only when submittals have been reviewed by Departmental Representative.

.2 Install floor fire stopping before interior partition erections.

.3 Mechanical pipe insulation: fire stop system component.

.1 Ensure pipe insulation installation precedes fire stopping.

3.6 FIELD QUALITY CONTROL

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

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in 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.

3.7 CLEANING

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

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

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

3.8 SCHEDULE

.1 Fire stop and smoke seal at:

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

.2 Penetrations through fire-resistance rated floor slabs, ceilings and roofs.

.3 Openings and sleeves installed for future use through fire separations.

.4 Around mechanical and electrical assemblies penetrating fire separations.

.5 Rigid ducts: fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.

END OF SECTION 07 84 00

1 .0 GENERAL

1.1 RELATED REQUIREMENTS

.1 Mechanical Divisions

.2 Electrical Divisions

1.2 REFERENCES

.1 American Society for Testing and Materials International, (ASTM)
- .1 ASTM C 919- 02, Standard Practice for Use of Sealants iAcoustical Applications.

.2 Canadian General Standards Board (CGSB)
- .1 CGSB 19-GP-5M- 1984 , Sealing Compound, One Component, Acrylic Base, Solvent Curing (Issue of 1976 reaffirmed, incorporating Amendment No. 1).
- .2 CAN/CGSB-19.13- M87, Sealing Compound, One-component, Elastomeric, Chemical Curing.
- .3 CGSB 19-GP-14M- 1984, Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing (Reaffirmation of April 1976).
- .4 CAN/CGSB-19.17- M90, One-Component Acrylic Emulsion Base Sealing Compound.
- .5 CAN/CGSB-19.24- M90, Multi-component, Chemical Curing Sealing Compound.

.3 Department of Justice Canada (Jus)
- .1 Canadian Environmental Protection Act, 1999 (CEPA).

.4 General Services Administration (GSA) - Federal Specifications (FS)
- .1 FS-SS-S-200- E (2)1993 , Sealants, Joint, Two-Component, Jet-Blast-Resistant, Cold Applied, for Portland Cement Concrete Pavement.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Safety Data Sheets (SDS).

.6 Transport Canada (TC)
- .1 Transportation of Dangerous Goods Act, 1992 (TDGA).

1.3 SUBMITTALS

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

.2 Manufacturer's product to describe.
- .1 Caulking compound.
- .2 Primers.
- .3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.

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

.4 Submit duplicate samples of each type of material and colour.

.5 Cured samples of exposed sealants for each color where required to match adjacent material.

.6 Submit manufacturer's instructions in accordance with Section 01 33 00 - Submittal

Procedures.

.1 Instructions to include installation instructions for each product used.

1.4 QUALITY ASSURANCE / MOCK-UPS

.1 Construct mock-up in accordance with Section 01 45 00 - Quality Control.

.2 Construct mock-up to show location, size, shape and depth of joints complete with back-up material, primer, caulking and sealant.

.3 Mock-up will be used:

.1 To judge workmanship, substrate preparation, operation of equipment and material application.

.4 Location to be decided with Departmental Representative.

.5 Allow 24 hours for inspection of mock-up by Departmental Representative before proceeding with sealant work.

.6 When accepted, mock-up will demonstrate minimum standard of quality required for this Work. Approved mock-up may remain as part of finished Work.

1.5 DELIVERY, STORAGE & HANDLING

.1 Deliver, handle, store and protect materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver and store materials in original wrappings and containers with manufacturer's seals and labels, intact. Protect from freezing, moisture, water and contact with ground or floor.

.3 Upon completion of Work, after cleaning is carried out.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

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

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

.4 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.

.5 Unused sealant material must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.

1.7 SITE CONDITIONS

.1 Environmental Limitations:

.1 Do not proceed with installation of joint sealants under following conditions:

.1 When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 4.4 degrees C.

.2 When joint substrates are wet.

.2 Joint-Width Conditions:

.1 Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

.3 Joint-Substrate Conditions:

.1 Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.8 ENVIRONMENTAL REQUIREMENTS

.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) use, handling, storage, and disposal of hazardous materials; and regarding labelling and of Safety Data Sheets (SDS) acceptable to Labour Canada.

.2 Conform to manufacturer's recommended temperatures, relative humidity, and substrate content for application and curing of sealants including special conditions governing use.

.3 Ventilate area of work as directed by Departmental Representative by use of approved supply and exhaust fans.

2.0 PRODUCTS

2.1 SEALANT MATERIALS

.1 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.

.2 When low toxicity caulks are not possible, confine usage to areas which offgas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize offgas time.

.3 Where sealants are qualified with primers use only these primers.

.4 Standard: For interior and exterior work unless otherwise specified, ensure compatibility of sealants being used and other materials in contact with them, meet LEED® requirement VOC level of 250 g/L for architectural sealant, and conform to the latest editions of the specifications summarized below:

2.2 SEALANT TYPE

.1 Type 1: Multi-Component chemical cure sealants: unless otherwise specified conform to CAN/CGSB-219.24-M90(TT-00227E-Type 11, Class A) standard, sealing compounds and as otherwise specified to exceed that standard; deliver to site and bear in addition to the product identification name, the qualification number when tested under CAN/CGSB Standard, Type 1 (self-leveling-horizontal joints) Type 2 (non-sag-vertical joints), Class A for glazing standard, Class B for non-glazing standard.

.2 Type 2: Multi-component chemical sealants: unless otherwise specified conform to CAN/CGSB-1-19.24-M90 (TT-00227E-Type 11, Class A) standard, sealing compounds and as otherwise specified to exceed that standard; deliver to site and bear in addition to the product identification name, the qualification number when tested under CAN/CGSB standard, Type 1 (self-leveling-horizontal joints) Type 2 (non-sag-vertical joints), Class A for glazing standard, Class B for non-glazing standard.

.3 Type 3: One component polyurethane sealants: conform at least to CAN/CGSB-2-19.13-M87 TT-S- 00230C) specifications; non-sag type; not fall cohesively or adhesively in a properly designed joint where total expansion does not exceed 25% of

the minimum width.

.4 Type 4: One component elastomeric chemical cure silicone: for joints minimum 6 mm x 6 mm and maximum as directed by product manufacturer; conform to CAN/CGSB-2-19.13-M87 (TT 002230C Type 11, Class A) standard; one component silicone base. (Consultant's written approval shall be required prior to use of this sealant).

.5 Type 5: Acrylic sealant: conform to CGSB-19-GP-5M.

.6 Type 6: Silicone caulking: white, mildew resistant.

2.3 SEALANT SELECTION

.1 Perimeters of exterior openings where frames meet exterior facade of building (i.e. concrete: Sealant type: 1 or 4

.2 Metal flashing and metal soffit: Sealant type: 3.

.3 Submersion/sealing of areas of standing water: Sealant type 2.

2.4 JOINT CLEANER

.1 Non-corrosive and non-staining type, compatible with joint forming materials and sealant recommended by sealant manufacturer.

.2 Primer: as recommended by manufacturer.

3.0 EXECUTION

3.1 PROTECTION

.1 Protect installed Work of other trades from staining or contamination.

3.2 SURFACE PREPARATION

.1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.

.2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair Work.

.3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.

.4 Ensure joint surfaces are dry and frost free.

.5 Prepare surfaces in accordance with manufacturer's directions.

3.3 PRIMING

.1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.

.2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.

3.4 BACKUP MATERIAL

.1 Apply bond breaker tape where required to manufacturer's instructions.

.2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

3.5 MIXING

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

3.6 APPLICATION

.1 Sealant.

.1 Apply sealant in accordance with manufacturer's written instructions.
.2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.
.3 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 Cleanup.

.1 Clean adjacent surfaces immediately and leave Work neat and clean.
.2 Remove excess and droppings, using recommended cleaners as work progresses.
.3 Remove masking tape after initial set of sealant.

3.7 CLEANING

.1 Clean adjacent surfaces immediately and leave work clean and neat. Remove excess sealant and droppings using recommended cleaners as work progresses. Remove masking after tooling of joints.

END OF SECTION 07 92 00

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1 Exterior Painting Section 09 91 13

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .2 CGSB 41-GP-19Ma-84, Rigid Vinyl Extrusions for Windows and Doors.

.2 Canadian Standards Association (CSA International)
- .1 CSA-G40.20-04/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .2 CSA W59-03, Welded Steel Construction (Metal Arc Welding).

.3 Canadian Steel Door Manufacturers' Association (CSDMA)
- .1 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames, 2000.
- .2 CSDMA, Selection and Usage Guide for Commercial Steel Doors, 1990.

.4 National Fire Protection Association (NFPA)
- .1 NFPA 80-2007, Standard for Fire Doors and Fire Windows.
- .2 NFPA 252-2012, Standard Methods of Fire Tests of Door Assemblies.

.5 South Coast Air Quality Management District (SCAQMD), California State
- .1 SCAQMD Rule 1113-04, Architectural Coatings.
- .2 SCAQMD Rule 1168-05, Adhesives and Sealants Applications.

.6 Underwriters' Laboratories of Canada (ULC)
- .1 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .2 CAN/ULC-S702-09, Standard for Thermal Insulation, Mineral Fibre, for Buildings.
- .3 CAN/ULC-S704-03, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.
- .4 CAN4-S104-M80, Standard Method for Fire Tests of Door Assemblies.
- .5 CAN4-S105-M85, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN4-S104.

1.3 SYSTEM DESCRIPTION

.1 Design Requirements:
- .1 Provide fire labeled frames for openings requiring fire protection ratings. Test products in conformance with CAN4-S104, and listed by nationally recognized agency having factory inspection services and to ULC fire protection rating.

1.4 SUBMITTALS

.1 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
- .1 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, glazed, arrangement of hardware and fire rating and finishes.
- .2 Indicate each type frame material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings and finishes.
- .3 Include schedule identifying each unit, with door marks and numbers relating to numbering

on drawings and door schedule.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Waste Management and Disposal:

.1 Separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

2.0 PRODUCTS

2.1 FRAME MATERIALS

.1 Hot dipped galvanized steel sheet: to ASTM A 653M, ZF75, minimum base steel thickness in accordance with CSDMA Table 1 - Thickness for Component Parts.

.2 Reinforcement to CSA G40.20/G40.21, Type 44W, coating designation to ASTM A 653M, ZF75.

.3 Interior Door and Window Frames: 16ga typical, 12ga for oversized door frame

2.2 DOOR CORE MATERIALS

.1 Honeycomb construction:

.1 Structural small cell, 24.5 mm maximum kraft paper 'honeycomb', weight: 36.3 kg per ream minimum, density: 16.5 kg/m³ minimum sanded to required thickness.

.2 Stiffened: doors to be reinforced with 0.8mm (20 gauge) hat shaped steel stiffeners welded to inside of face sheets. Stiffeners to be located a maximum 152mm (6”) on center and welded to face sheet on 100mm(4”) centers. Areas between stiffeners to be filled with fiberglass insulation.

2.3 ADHESIVES

.1 Honeycomb cores and steel components: heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.

.1 Adhesive: maximum VOC content 50 g/L to SCAQMD Rule 1168.

.2 Lock-seam doors: fire resistant, resin reinforced polychloroprene, high viscosity, and sealant/adhesive.

2.4 PRIMER

.1 Touch-up prime CAN/CGSB-1.181.

.1 Maximum VOC limit 50 g/L to GC-03.

2.5 PAINT

.1 Field paint steel doors and frames in accordance with Section 09 91 23 - Painting. Protect weatherstrips from paint. Provide final finish free of scratches or other blemishes.

.1 Maximum VOC emission level 50 g/L to GS-11 to SCAQMD Rule 1113.

2.6 ACCESSORIES

.1 Door silencers: single stud rubber/neoprene type.

.2 Interior top and bottom caps: rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19Ma.

.3 Fabricate glazing stops as formed channel, minimum 16 mm height, accurately fitted, butted at corners and fastened to frame sections with counter-sunk oval head sheet metal screws.

.4 Metallic paste filler: to manufacturer's standard.

.5 Fire labels for both frames and doors: metal riveted.

.6 Sealant:
.1 Maximum VOC limit 250 g/L to SCAQMD Rule 1168.

.7 Make provisions for glazing as indicated and provide necessary glazing stops.
.1 Provide removable steel glazing beads for use with glazing tapes and compounds and secured with countersunk stainless steel screws.
.2 Design exterior glazing stops to be tamperproof.

2.7 FRAMES FABRICATION GENERAL

.1 Fabricate frames in accordance with CSDMA specifications.

.2 Fabricate frames to profiles and maximum face sizes as indicated.

.3 Interior frames: 1.2 mm welded type construction.

.4 Blank, reinforce, drill and tap frames for mortised, templated hardware, and electronic hardware using templates provided by finish hardware supplier. Reinforce frames for surface mounted hardware.

.5 Prepare frame for door silencers, 3 for single door, 2 at head for double door.

.6 Manufacturer's nameplates on frames and screens are not permitted.

.7 Conceal fastenings except where exposed fastenings are indicated.

.8 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.

.9 Provide fire labelled frames for those openings requiring fire protection ratings, as scheduled. Test such products in conformance with and list by nationally recognized agency having factory inspection service and construct as detailed in Follow-Up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.

2.8 FRAME ANCHORAGE

.1 Provide appropriate anchorage to floor and wall construction.

.2 Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.

.3 Provide 2 anchors for rebate opening heights up to 1520 mm and 1 additional anchor for each additional 760 mm of height or fraction thereof.

2.9 FRAMES: WELDED TYPE

.1 Welding in accordance with CSA W59.

.2 Accurately mitre or mechanically joint frame product and securely weld on inside of profile.

.3 Cope accurately and securely weld butt joints of mullions, transom bars, centre rails and sills.

.4 Grind welded joints and corners to a flat plane, fill with metallic paste and sand to uniform smooth finish.

.5 Securely attach floor anchors to inside of each jamb profile.

.6 Weld in 2 temporary jamb spreaders per frame to maintain proper alignment during shipment.

2.10 DOOR FABRICATION GENERAL

.1 Doors: swing type, flush, with provision for glass and/or louvre openings as indicated.

.2 Fabricate doors with longitudinal edges welded. Seams: grind welded joints to a flat plane, fill with metallic paste filler and sand to a uniform smooth finish.

.3 Blank, reinforce, drill doors and tap for mortised, templated hardware and electronic hardware.

.4 Factory prepare holes 12.7 mm diameter and larger except mounting and through-bolt holes, on site, at time of hardware installation.

.5 Reinforce doors where required, for surface mounted hardware. Provide flush steel top caps to exterior doors. Provide inverted, recessed, spot welded channels to top and bottom of interior doors.

.6 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.

.7 Provide fire labelled doors for those openings requiring fire protection ratings, as scheduled. Test such products in conformance with and list by nationally recognized agency having factory inspection service and construct as detailed in Follow-Up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.

.8 Manufacturer's nameplates on doors are not permitted.

.9 Provide insulating core materials to doors in manufacturer’s standard for fire-rate ULC approved fire doors.

.10 Provide raceway in the interior of all doors at centre hinge height to accommodate future electrified locksets.

.11 Finish Hardware: Prepare door assemblies for installation of hardware specified in Section 08 71 00.

.12 Refer to Mechanical Drawings for doors with grilles or undercuts.

2.11 DOORS: HONEYCOMB CORE CONSTRUCTION

.1 Form face sheets for exterior and interior doors from 1.2 mm (18 gauge) sheet steel with honeycomb or laminated under pressure to face sheets. Coating designation to ASTM A 653M, ZF75.

.2 44.5mm thick flush panel design.

3.0 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION GENERAL

.1 Install labelled steel fire rated doors and frames to NFPA 80 except where specified otherwise.

.2 Install doors and frames to CSDMA Installation Guide.

3.3 FRAME INSTALLATION

.1 Set frames plumb, square, level and at correct elevation.

.2 Secure anchorages and connections to adjacent construction.

.3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.

.4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.

.5 Caulk perimeter of frames between frame and adjacent material.

.6 Maintain continuity of air barrier and vapour retarder.

3.4 DOOR INSTALLATION

.1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions .

.2 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows.

.1 Hinge side: 1.0 mm.
.2 Latchside and head: 1.5 mm.
.3 Finished floor: 13 mm.

.3 Adjust operable parts for correct function.

3.5 FINISH REPAIRS

.1 Touch up with primer finishes damaged during installation.

.2 Fill exposed frame anchors and surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.

END OF SECTION 08 11 00

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1 Metal Doors & Frame Section 08 11 00

1.2 REFERENCES

.1 American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA)

.1 ANSI/BHMA A156.1- 2000 , American National Standard for Butts and Hinges.
.2 ANSI/BHMA A156.2- 2003 , Bored and Preassembled Locks and Latches.
.3 ANSI/BHMA A156.4- 2000 , Door Controls - Closers.
.4 ANSI/BHMA A156.5- 2001 , Auxiliary Locks and Associated Products.
.6 ANSI/BHMA A156.6- 2005 , Architectural Door Trim.
.7 ANSI/BHMA A156.8- 2005 , Door Controls - Overhead Stops and Holders.
.8 ANSI/BHMA A156.13- 2002 , Mortise Locks and Latches Series 1000.
.9 ANSI/BHMA A156.16- 2002 , Auxiliary Hardware.
.10 ANSI/BHMA A156.18- 2006 , Materials and Finishes.

.2 Canadian Steel Door and Frame Manufacturers' Association (CSDMA)

.1 CSDMA Recommended Dimensional Standards for Commercial Steel Doors and Frames - 2009.

1.3 HARDWARE/SECURITY COORDINATION

.1 Prior to preparation and submittal of hardware list, door hardware supplier’s hardware consultant shall arrange a coordination meeting with the following attendees:

.1 Hardware supplier’s hardware consultant.
.2 Facility’s Building Maintenance Manager.
.3 Departmental Representative.
.4 General Contractor.

.2 The final door hardware lists shall reflect all decisions made at said coordination meeting.

1.4 ACTION & INFORMAL 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 door hardware and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Samples:

.1 Submit for review and acceptance of each unit.
.2 Samples will be returned for inclusion into work.
.3 Identify each sample by label indicating applicable specification paragraph number, brand name and number, finish and hardware package number.
.4 After approval samples will be returned for incorporation in Work.

.4 Hardware List:

.1 Submit contract hardware list.
.2 Indicate specified hardware, including make, model, material, function, size, finish and

other pertinent information.

.5 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

.6 Manufacturer's Instructions: submit manufacturer's installation instructions.

1.5 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for door hardware for incorporation into manual.

1.6 MAINTENANCE MATERIALS SUBMITTALS

.1 Extra Stock Materials:

.1 Supply maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Tools:

.1 Supply 2 sets of wrenches for door closers, locksets, and fire exit hardware.

1.7 QUALITY ASSURANCE

.1 Regulatory Requirements:

.1 Hardware for doors in fire separations and exit doors certified by a Canadian Certification Organization accredited by Standards Council of Canada.

.2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.8 DELIVERY, STORAGE & 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 Package items of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.

.4 Storage and Handling Requirements:

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

.2 Store and protect door hardware from nicks, scratches, and blemishes.

.3 Protect prefinished surfaces with wrapping strippable coating.

.4 Replace defective or damaged materials with new.

1.9 REDUNDENT LOCKSETS

.1 Where existing and other lock-bearing devices are to be removed and disposed of: turn-over to Departmental Representative and obtain receipt. In order to maintain building keying security, no existing locksets are to be removed from building.

1.10 MAINTENANCE

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 78 00-Closeout Submittals.

.2 Supply two sets of wrenches for door closers.

2.0 PRODUCTS

2.1 HARDWARE ITEMS

.1 Use one manufacturer's products only for similar items.

2.2 DOOR HARDWARE

.1 Locks and latches:

.1 Mortise locks and latches: to ANSI/BHMA A156.13, series 1000 mortise lock, grade 1, designed for function and keyed as stated in Hardware Schedule.

.2 Lever handles: plain 64mm x 114mm x 51mm design.

.3 Roses: round

.4 Normal strikes: box type, lip projection not beyond jamb.

.5 Cylinders: key into keying system as noted as directed.

.6 Finished to 652, 626 & 630

.7 6 pin (or7) tumbler keying to Maintenance’s Master System.

.2 Butts and hinges:

.1 Butts and hinges: to ANSI/BHMA A156.1, designated by letter A and numeral identifiers, followed by size and finish, listed in Hardware Schedule.

.3 Door Closers and Accessories:

.1 Door controls (closers): to ANSI/BHMA A156.4, listed in Hardware Schedule, multi-sized sized 1 to though 6 in accordance with ANSI/BHMA A156.4, table A1, finished to 689.

.2 Closer/holder release devices: to ANSI/BHMA listed in hardware schedule, finished to 689.

.5 Architectural door trim: to ANSI/BHMA A156.6, designated by letter J and numeral identifiers listed in Hardware Schedule as listed below, finished to 626 or 630.

.1 Architectural door trim: to ANSI/BHMA A156.6, listed in Hardware Schedule as listed below, finished to 626 or 630

.6 Threshold: integral to door frame – refer to drawings for details

.7 Weatherstripping:

.1 Head and jamb seal:

.1 Adhesive backed neoprene vinyl covered foam material.

.2 Door bottom seal:

.1 Extruded aluminum frame and [closed cell neoprene vinyl sweep, clear anodized finish.

2.3 FASTENINGS

.1 Use only fasteners provided by manufacturer. Failure to comply may void warranties and applicable licensed labels.

.2 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.

.3 Exposed fastening devices to match finish of hardware.

.4 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices, and install so pull can be secured through door from reverse side. Install push plate to cover fasteners.

.5 Use fasteners compatible with material through which they pass.

2.4 KEYING

.1 Doors, padlocks and cabinet locks to be keyed to grand master keyed as directed and as noted in Hardware Schedule. Prepare detailed keying schedule in conjunction with Departmental Representative.

.2 Supply keys in duplicate for every lock in this Contract.

.3 Supply (five) 5 master keys for each master key or grand master key group.

.4 Supply 5 keys for each lock.

.5 Stamp keying code numbers on keys and cylinders.

.6 Supply construction cores.

.7 Hand over permanent cores and keys to Departmental Representative.

.8 All cores to be high security interchangeable core.

2.5 KEYS

.1 Use standard construction cylinders for locks for Contractor’s use during the construction period.

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

.3 Upon completion of each phase of the construction, the Departmental Representative will, in conjunction with the lock manager:

.1 Prepare an operational keying schedule.

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

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

2.6 ADDITIONAL DOOR HARDWARE SCHEDULED ELSEWHERE

.1 Refer to Division 28- Electronic Safety and Security, for additional door items including, but not limited to the following:

.1 Access and intrusion control panels.

.2 Door Contacts.

.3 Intrusion detection.

.2 Refer to Division 26-Electrical for all wiring and conduit for above items.

3.0 EXECUTION

3.1 INSTALLATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product

technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

.2 Supply metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.

.3 Supply manufacturers' instructions for proper installation of each hardware component.

.4 Install hardware to standard hardware location dimensions in accordance with CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction.

.6 Use only manufacturer's supplied fasteners.
.1 Use of "quick" type fasteners, unless specifically supplied by manufacturer, is unacceptable.

3.2 ADJUSTING
.1 Adjust door hardware, operators, closures and controls for optimum, smooth operating condition, safety and for weather tight closure.

.2 Lubricate hardware, operating equipment and other moving parts.

.3 Adjust door hardware to ensure tight fit at contact points with frames.

3.3 CLEANING
.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
.1 Leave Work area clean at end of each day.
.2 Clean hardware with damp rag and approved non-abrasive cleaner, and polish hardware in accordance with manufacturer's instructions.
.3 Remove protective material from hardware items where present.
.4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment 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 Requirements.

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

3.4 DEMONSTRATION
.1 Maintenance Staff Briefing:
.1 Brief maintenance staff regarding:
.1 Proper care, cleaning, and general maintenance of projects complete hardware.
.2 Description, use, handling, and storage of keys.
.3 Use, application and storage of wrenches for door closers locksets and fire exit hardware.

.2 Demonstrate operation, operating components, adjustment features, and lubrication requirements.

3.5 PROTECTION
.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by door hardware installation.

3.6 FINISH HARDWARE SCHEDULE

.13 HARDWARE SET NO. 01

FOR USE ON MARK/DOOR #(S): M3

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION		FINISH
3	EA	HINGE	Hinge 5 Knuckle-.134 gauge- 114mm x 101mm x Non Removable Pin x 652	652
1	EA	CLASSROOM LOCK	ANSI F84	626
1	EA	PERMANENT CORE	By others	
1	EA	SURFACE CLOSER	Closer non sized, Jamb mount compression spring buffer arm x delayed	689
1	EA	WEATHER SEALS	.1 Head and jamb seal: Adhesive backed neoprene vinyl covered foam material. .2 Door bottom seal: Extruded aluminum frame and closed cell neoprene vinyl sweep, clear anodized finish.	

END OF SECTION 08 71 00

1.0 GENERAL

1.1 REFERENCES

.1 American National Standards Institute (ANSI)
- .1 ANSI Z97.1- 1984 (R1994), Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test.

.2 International Window Film Association (IWFA)
- .1 IWFA Visual Quality Standard for Applied Window Film1999.

.3 Consumer Product Safety Commission Publications (CPSC)/Code of Federal Regulations (CFR)
- .1 CPSC, 16 CFR 1201 CAT I.
- .2 CPSC, 16 CFR 1201 CAT II.

.4 General Services Administration (GSA)
- .1 GSA-TS01- 2003, Test Method for Glazing and Window Systems Subject to Dynamic Overpressure Loadings.

.5 Government of Canada
- .1 Canada Labour Code, WHMIS datasheets.

.6 Underwriters laboratories of Canada (ULC)
- .1 ULC-S332- 93, Standard for Burglary Resisting Material.
- .2 UL-972- 02, Burglary resisting Glazing Material.

.7 The American Society for Testing and Materials (ASTM) Publications:
- .1 ASTM D882-95a Tensile Properties of Plastic Film and Sheeting - Tensile, Elongation, Break and Flexibility (Young's Modulus)
- .2 ASTM D1004-94a Initial Tear Resistance of Plastic Film and Sheeting - Initial Force to Tear (Graves Area).
- .3 ASTM D2582-93 Puncture-Propagation Tear Resistance of Plastic Film and Sheeting.
- .4 ASTM F1642-96 Standard Test Method for Glazing and Glazing Systems Subject to Airblast Loadings, as per US Governments GSA Test Standard Protocol.
- .5 ASTM D1044 Standard Method of Test for Resistance of Transparent Plastics to Surface Abrasion.
- .6 ASTM E84-94 Surface Burn Characteristics of Building.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit one 300 x 300 mm sample of film installed on 7 mm thick clear plate glass for each specified type.

.2 Submit test reports from approved independent testing laboratory, certifying film's compliance with specified requirements.

.3 Provide operation and maintenance data for window film.
Follow manufacturer's written instructions for care and maintenance of security and safety film. Use only cleaning solution recommended by manufacturer for regularly scheduled cleaning of security film.

1.3 QUALITY ASSURANCE

.1 Health and Safety:

.1 Comply with requirements of WHMIS regarding use, handling, storage, and disposal of hazardous materials; and regarding labeling and provision of material safety data sheets acceptable to Canada Labour Code.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Provide and maintain dry, off-ground weatherproof storage.

.2 Store rolls of film flat on cross supports. Do not stand rolls of film on end.

.3 Remove from storage, in quantities required for same day use.

.4 Store materials in accordance with manufacturers written instructions.

1.7 WARRANTY

.1 Ensure warranty includes items as follows:

.1 Maintaining adhesion properties without blistering, bubbling or delaminating from glass surface.

.2 Maintaining appearance without discolouration.

.3 Removing, replace and reapply defective materials.

.4 In event of product failure under warranty terms, remove and re-apply film without glass replacement at no cost to Departmental Representative.

2.0 PRODUCTS

2.1 MATERIALS

.1 Glazing Film:

.1 Materials: Privacy/glazing film for interior application

.2 Film Thickness: 2 mil.

.3 Shading Coefficient: 0.44%

.4 Visible Light Reflectance: 43%

.5 Visible Light Transmittance: 21%

.6 Heat Transmission Coefficient: 5.9W/m² K

.7 Roll Size: 1270mm wide x 30m long

.8 Flammability: ASTM E84 Class 1(A)

.9 Color/Design: Opaque / Frost

.

2.2 FABRICATION

.1 Shop installation of security film to glass panels:

.1 Ensure dust, grease, and chemical residue are removed from surface of glass before installation of film.

.2 Examine glass under natural daylight and identify cracks, blisters, bubbles, discoloration, edge defects or other anomalies that may cause film to delaminate, or cause vision transparency or distortion problems.

.3 View glass from 2.0 m minimum. Report findings to Departmental Representative.

.4 Proceed with Work only after receipt of written approval from Departmental Representative.

.1 Install security film to glass panels ensuring no blisters, bubbles, scratches, edge defects or distortions.

.2 Cut film edges straight and square to within 3 mm of edge of panel.

.3 Deliver glass panels complete with security film installed and labels intact and legible to site in accordance with section 01 61 00 - Common Product Requirements.

3.0 EXECUTION

3.1 PREPARATION

.1 Clean glass before beginning installation using neutral cleaning solution.

.2 Ensure no deleterious material adheres to glass by scraping surface of glass using industrial razors.

.3 Ensure dust, grease, and chemical residue are removed from surface of glass before installation of film.

.4 Examine glass under natural daylight and identify cracks, blisters, bubbles, discoloration, edge defects or other anomalies that may cause film to delaminate or cause vision transparency or distortion problems. Report findings to Departmental Representative.

.5 Proceed with Work only after receipt of written approval from Departmental Representative.

.6 Before beginning Work, place absorbent material at frame to absorb moisture accumulation generated by film application.

3.2 INSTALLATION

.1 Field Installation of Glazing Film to Glass Windows:
- .1 Install film in the same manner as tested.
- .2 Ensure no deleterious material adheres to glass by scraping surface of glass using industrial razors.
- .3 Ensure dust, grease, and chemical residue are removed from surface of glass before installation of film.
- .4 Examine glass under natural daylight and identify cracks, blisters, bubbles, discolouration, edge defects or other anomalies that may cause film to delaminate, or cause vision transparency or distortion problems. Report findings to Departmental Representative before starting Work.
- .5 Proceed with Work only after receipt of written approval from Departmental Representative.
- .6 Install security film to glass windows ensuring no blisters, bubbles, scratches or distortions.

.2 Cut film edges straight and square.

.3 Cut edges 3 mm maximum from edge of glass sealing device in accordance with manufacturers written instructions.

.4 Apply and attach film to glass in accordance with manufacturer's written instructions.

.5 Splicing:
- .1 Splice film only when glass is greater in width than film.
- .2 Splice film only after receipt of written approval from Departmental Representative.
- .3 Use overlapped factory edges only.
- .4 Ensure maximum overlap of 3 mm.

.6 Use only water and film slip solution on glass to facilitate positioning of film.

.7 Ensure removal of excess water from between film and glass.

.8 Remove left over material form work area and return work area to original condition.

3.3 INSTALLER'S INSPECTION

.1 Visual Inspection: in accordance with IWFA - Visual Quality Standard for Applied Window Film.

.2 Remove and replace film that continues to show blisters, bubbles, tears, scratches, edge defects or vision distortion in film when viewed under natural daylight from 2.0 m minimum after 30 day period.

.3 Remove and replace without glass replacement, film that continues to show blisters, bubbles, tears, scratches, edge defects or vision distortion in film when viewed under natural daylight from 2.0 m minimum after 30 day period.

3.4 FINAL CLEANING

.1 Wash interior and exterior of each glass panel and film using cleaning solution recommended by film manufacturer.

END OF SECTION 08 87 53

1.0 GENERAL

1.1 REFERENCES

.1 ASTM International

.1 ASTM C 475-02 (2007), Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.

.2 ASTM C 514-04 (2009e1), Standard Specification for Nails for the Application of Gypsum Board.

.3 ASTM C 557-03 (2009) e1,Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.

.4 ASTM C 840-08, Standard Specification for Application and Finishing of Gypsum Board.

.5 ASTM C 954-07, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.

.6 ASTM C 1002-07, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

.7 ASTM C 1047-09, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.

.8 ASTM C 1396/C 1396M-09a, Standard Specification for Gypsum Wallboard.

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

.1 AWCI Levels of Gypsum Board Finish-97.

.3 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S102-07, Standard Method of Test of Surface Burning Characteristics of Building Materials and Assemblies.

1.2 SUBMITTALS

.1 Product Data:

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

1.3 DELIVERY, STORAGE AND HANDLING

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

.2 Storage and Handling Requirements:

.1 Store gypsum board assemblies materials level off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect gypsum board assemblies from nicks, scratches, and blemishes.

.3 Protect from weather, elements and damage from construction operations.

.4 Handle gypsum boards to prevent damage to edges, ends or surfaces.

.5 Protect prefinished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.

.6 Replace defective or damaged materials with new.

1.4 AMBIENT CONDITIONS

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

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

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

2.0 PRODUCTS

2.1 MATERIALS

.1 a) Standard board: to ASTM C 1396/C 1396M regular, 12.7mm and 15.9 mm thick and Type X, 12.7 mm and 15.9 mm thick, 1200 mm wide x maximum practical length, ends square cut, edges tapered.

b) Exterior Gypsum Sheathing: Paperless, noncombustible treated gypsum core bonded to inorganic fiberglass mat surfacing both faces; conform to ASTM C-79 and tests to ASTM C-473 and E-72 standards; minimum thickness-15.9mm ($^{5}/_{8}$") and greater where so shown;. Type "X" having a UL label for Fire Endurance rating; min. thickness 15.9mm.

.2 Resilient clips and drywall furring: 0.5 mm base steel thickness galvanized steel for resilient attachment of gypsum board.

.3 Nails: to ASTM C 514.

.4 Steel drill screws: to ASTM C 1002.

.5 Stud adhesive: to CAN/CGSB-71.25.

.6 Laminating compound: as recommended by manufacturer, asbestos-free.

.7 Casing beads, corner beads, control joints and edge trim: to ASTM C 1047, metal, zinc-coated by hot-dip process, 0.5 mm base thickness, perforated flanges, one piece length per location.

.8 Sealants: in accordance with Section 07 92 00 - Joint Sealants.
- .1 VOC limit 250 g/L maximum to SCAQMD Rule 1168.
- .2 Acoustic sealant: in accordance with Section 07 92 00 - Joint Sealants.

.9 Polyethylene: to CAN/CGSB-51.34, Type 2.

.10 Insulating strip: rubberized, moisture resistant, 3 mm thick cork closed cell neoprene strip, 12 mm wide, with self-sticking permanent adhesive on one face, lengths as required.

.11 Joint compound: to ASTM C 475, asbestos-free.

3.0 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for gypsum board assemblies' installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of consultant.
- .2 Inform consultant 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 consultant.

3.2 ERECTION

.1 Do application and finishing of gypsum board to ASTM C 840 except where specified otherwise.

.2 Install work level to tolerance of 1:1200.

.3 Install wall furring for gypsum board wall finishes to ASTM C 840, except where specified.

3.3 APPLICATION

.1 Apply gypsum board after bucks, anchors, blocking, sound attenuation, electrical and mechanical work have been approved.

.2 Apply single or double layer gypsum board to wood furring or framing using screw fasteners for first layer, screw fasteners for second layer. Maximum spacing of screws 300 mm on centre.

.1 Single-Layer Application:

.1 Apply gypsum board on ceilings prior to application of walls to ASTM C 840.

.2 Apply gypsum board vertically or horizontally, providing sheet lengths that will minimize end joints.

.3 Apply 12 mm diameter bead of acoustic sealant continuously around periphery of each face of partitioning to seal gypsum board/structure junction where partitions abut fixed building components. Seal full perimeter of cut-outs around electrical boxes, and ducts, in partitions where perimeter sealed with acoustic sealant.

.4 Install gypsum board on walls vertically to avoid end-butt joints. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs, except where local codes or fire-rated assemblies require vertical application.

.5 Install gypsum board with face side out.

.6 Do not install damaged or damp boards.

.7 Locate edge or end joints over supports. Stagger vertical joints over different studs on opposite sides of wall.

3.4 INSTALLATION

.1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure at 150 mm on centre.

.2 Install casing beads around perimeter of suspended ceilings.

.3 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.

.4 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.

.5 Construct control joints of preformed units set in gypsum board facing and supported independently on both sides of joint.

.6 Locate control joints at changes in substrate construction at approximate 10 m spacing on long corridor runs at approximate 15 m spacing on ceilings.

.8 Install control joints straight and true.

.9 Construct expansion joints as detailed, at building expansion and construction joints. Provide continuous dust barrier.

.10 Install expansion joint straight and true.

.11 Splice corners and intersections together and secure to each member with 3 screws.

.12 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.

.13 Gypsum Board Finish: finish gypsum board walls and ceilings to following levels in accordance with AWCI Levels of Gypsum Board Finish:

.1 Levels of finish:

.1 At typical wall and ceiling locations. Level 4: embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; surfaces smooth and free of tool marks and edges.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by gypsum board assemblies installation.

END OF SECTION 09 21 16

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1 Gypsum Board Assemblies Section 09 21 16

1.2 REFERENCES

.1 ASTM International
- .1 ASTM C 645- 00, Specification for Nonstructural Steel Framing Members.
- .2 ASTM C 754- 00 , Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products

.2 Green Seal Environmental Standards (GS)
- .1 GS-11-2008, 2nd Edition, Paints and Coatings.

.3 Environmental Choice Program (ECP).
- .1 CCD-047a - 98, Paints - Surface Coatings.
- .2 CCD-048- 98, Surface Coatings - Recycled Water-borne.

.4 Association of Wall and Ceiling Contractors of BC (AWCC)
- .1 Specification Standards Manual

1.3 SUBMITTALS

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

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

.3 Shop Drawings:
- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of British Columbia, Canada. Submit BCBC 2012 Schedule B and C-B or Model Schedule B and C.
- .2 Indicate system dimensions, framed opening requirements and tolerances, adjacent construction, anchor details anticipated deflection under load, affected related Work, weep drainage network, expansion and contraction joint location and details, and field welding required.

.4 Sustainable Design Submittals.
- .1 Construction Waste Management:
  - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
- .2 Low-Emitting Materials:
  - .1 Submit listing of adhesives and sealants and used in building, showing compliance with VOC and chemical component limits or restriction requirements.

1.4 QUALITY ASSURANCE

.1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

.2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1. 4 WASTE MANAGEMENT AND DISPOSAL

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

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

2.0 PRODUCTS

2.1 MATERIALS

.1 Steel Studs & Steel Stud Furring:

.1 Conform to CAN/CGSB-7.1-M86, non-loadbearing; C-shape, hot dipped galvanized steel studs with Z180 (G60) zinc coating to ASTM A525-86, roll formed from ASTM A446/A446M-85, Grade A steel.
Studs to have knurled face and pre-punched pass-through holes for horizontal runs of wiring and piping. Length to suit, no splicing allowed.

.2 Flange: Depth not less than 32mm , edges bent back 90 deg. and edges hemmed 5mm minimum.

.3 Widths: As scheduled and indicated.

.4 Gauges: Interior steel stud to be a minimum of 0.88mm (20 gauge). Interior door jamb studs: 0.88 mm (20 gauge), two (2) studs each side of opening. Increase gauge of steel studs at over-height locations to suit stud manufacturer's design tables, in order to maintain overall partition dimension as detailed in wall schedule and in accordance with the BC Building Code. Exterior steel stud to be minimum1.23 mm (18 gauge).

.5 Colour code steel studs for gauge in accordance with AWCC colour code chart.

.2 Stud Tracks:

.1 Top and bottom runner tracks fabricated from same materials as studs; leg design min. 32mm high, slightly bent in to hold studs; widths to equal stud width.

.2 Use extended leg top track to partitions as required for deflection.

.3 Stud Fasteners: Manufacturer's standard, suitable for intended application.

.3 Furring Channels: Hat section; roll formed from 0.53mm hot dipped galvanized steel having a Z180 (G60) coating to ASTM A525-86, dimensions 68.2 mm or 66.7mm overall width, face width 35 mm by 22.2mm deep, face knurled.

.4 "Z-bar" Furring: Roll formed from 0.46mm (26 ga.) hot dipped galvanized steel having a Z180 (G60) coating to ASTM A525-86, 32mm face dimension x depth to suit rigid insulation thickness, see drawings and wall schedule.

.5 Metal Backing Plates: Flat sheet from 0.91mm (20ga.) thick galvanized steel of same type as are the studs as blocking to support work of other sections.

Gypsum Board Thickness	Maximum Furring Spacing
Single 12.7mm board	400 mm
Single 15.9mm board	600 mm
Double layer	400 mm

3.0 EXECUTION

3.1 ERECTION

.1 Fire Resistance Rated Walls: Comply with requirements of testing agency approved by the Consultant for wall systems detailed on Drawings.

.2 Align partition tracks at floor and ceiling and secure at 600 mm on centre maximum.

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

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

.5 Attach studs to bottom and ceiling track using screws crimp method pop rivets.

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

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

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

.9 Install heavy gauge single jamb studs at openings.

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

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

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

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

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

.15 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs. Use 50 mm leg ceiling tracks.

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

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

.18 Provide clearances and isolation felt to ensure no contact between steel stud system and adjacent metal components to eliminate electrolytic action.

3.2 CHASE WALLS

.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

3.2 CLEANING

.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION 09 22 16

1.0 GENERAL

1.1 RELATED REQUIRMENTS

.1 Metal Fabrications Section 05 50 00

1.2 REFERENCES

.1 Environmental Protection Agency (EPA)
- .1 Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24 (for Surface Coatings).

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Safety Data Sheets (SDS).

.3 The Master Painters Institute (MPI)
- .1 Architectural Painting Specification Manual – November 2007.
- .2 Standard GPS-1- 05, MPI Green Performance Standard for Painting and Coatings.

.4 National Fire Code of Canada 2010.

.5 Society for Protective Coatings (SSPC)
- .1 Systems and Specifications, SSPC Painting Manual 2005.

1.3 QUALITY ASSURANCE

.1 Conform to the standards contained in the Master Painters Institute Architectural Painting Specification Manual, latest edition (hereafter referred to as MPI Painting Specification Manual) for all painting products including preparation and application of materials. MPI Painting Specification Manual as issued by the local MPI Accredited Quality Assurance Association having jurisdiction.

.2 All paint manufacturers and products used shall be as listed under the “Approved Products” section of the MPI Painting Specification manual.

.3 Other paint materials shall be the highest quality product of an approved manufacturer listed in MPI Painting Specification Manual and shall be compatible with other coating materials as required.

.4 Single-Source Responsibility: provide primers and undercoat paint produced by the same manufacturer as the finish coat.

.5 All painting and decorating work shall be inspected by Paint Inspection Agency (inspector) acceptable to the specifying authority and the local MPI Accredited Quality Assurance Association. The painting contractor shall notify the Paint Inspection Agency a minimum of one week prior to commencement of work and provide a copy of the project painting specification, plans and elevation drawings (including pertinent details) as well as a Finish Schedule.

.6 All surfaces requiring painting or repainting shall be inspected by the inspection agency who shall advise on all aspects of painting work including preparation, notifying the Departmental Representative, the Contractor and the Trade Contractor of any defects or problems prior to commencing painting work or after the prime coat shows defects in the substrate, and as the work progresses.

.7 Standard of Acceptance:
.1 Wall: No defects visible from a distance of 1000mm at 90° to surface.
.2 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

.8 Mock-Ups:
1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.
.1 Prepare and paint designated surface, area, room or item (in each colour scheme) to specified requirements, with specified paint or coating showing selected colours, gloss/sheen, textures.
.2 Mock-up will be used:
.1 To judge workmanship, substrate preparation, operation of equipment and material application and workmanship to MPI Architectural Painting Specification Manual standards.
.3 Locate where directed.
.4 Allow 24 hours for inspection of mock-up before proceeding with work.
.5 When accepted, mock-up will demonstrate minimum standard of quality required for this work. Approved mock-up may remain as part of finished work.

.9 Pre-Installation Meeting:
.1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations in accordance with Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart
.1 Verify project requirements.
.2 Review installation and substrate conditions.
.3 Coordination with other building subtrades.
.4 Review manufacturer's installation instructions and warranty requirements.

.10 Health and Safety:
.1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

1.4 PERFORMANCE REQUIREMENTS

1.5 SCHEDULING
.1 Submit work schedule for various stages of painting to Departmental Representative for approval. Submit schedule minimum of 48 hours in advance of proposed operations.

.2 Obtain written authorization from Departmental Representative for changes in work schedule.

.3 Schedule painting operations to prevent disruption of occupants in and about building.

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

.2 Product Data:
.1 Submit product data and instructions for each paint and coating product to be used.
.2 Submit product data for the use and application of paint thinner.

.3 Samples:
.1 Submit manufacturer’s standard range of color choices on each specified color type as listed in Colour Schedule of this section for selection, review and acceptance of each color.

.2 Submit triplicates 200 x 300 mm sample panels of each paint with specified paint in colours, gloss/sheen and textures required, based on selected colors, to MPI Architectural Painting Specification Manual standards submitted on following substrate materials:
.1 1 mm plate steel for finishes over metal surfaces.

.3 Retain reviewed samples on-site to demonstrate acceptable standard of quality for appropriate on-site surface.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Manufacturer's Instructions:
.1 Submit manufacturer's installation instructions.

.6 Closeout Submittals: submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals include following:
.1 Product name, type and use.
.2 Manufacturer's product number.
.3 Colour numbers.
.4 MPI Environmentally Friendly classification system rating.

1.7 MAINTENANCE

.1 Extra Materials:
.1 Deliver to extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Section 01 78 00 - Closeout Submittals.
.2 Delivery, storage and protection: comply with Departmental Representative requirements for delivery and storage of extra materials.

1.8 DELIVERY, STORAGE & HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements, supplemented as follows:
.1 Deliver and store materials in original containers, sealed, with labels intact.
.2 Labels: to indicate:
.1 Manufacturer's name and address.
.2 Type of paint or coating.
.3 Compliance with applicable standard.
.4 Colour number in accordance with established colour schedule.
.3 Remove damaged, opened and rejected materials from site.
.4 Provide and maintain dry, temperature controlled, secure storage.
.5 Observe manufacturer's recommendations for storage and handling.
.6 Store materials and supplies away from heat generating devices.
.7 Store materials and equipment in well-ventilated area with temperature range 7 degrees C to 30 degrees C.
.8 Store temperature sensitive products above minimum temperature as recommended by manufacturer.
.9 Keep areas used for storage, cleaning and preparation, clean and orderly to approval of Departmental Representative. After completion of operations, return areas to clean condition to approval of Departmental Representative
.10 Remove paint materials from storage only in quantities required for same day use.
.11 Comply with requirements of Workplace Hazardous Materials Information System

(WHMIS) regarding use, handling storage, and disposal of hazardous materials.

.12 Fire Safety Requirements:

.1 Provide one 9 kg Type ABC dry chemical fire extinguisher adjacent to storage area.

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

.3 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada.

.2 Waste Management and Disposal:

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

.2 Paint, stain and wood preservative finishes and related materials (thinners, solvents, etc.) are regarded as hazardous products and are subject to regulations for disposal. Information on these controls can be obtained from Provincial Ministries of Environment and Regional levels of Government.

.3 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.

.4 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.

.5 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into the ground the following procedures shall be strictly adhered to:

.1 Retain cleaning water for water-based materials to allow sediments to be filtered out.

.2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.

.3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.

.4 Dispose of contaminants in an approved legal manner in accordance with hazardous waste regulations.

.5 Empty paint cans are to be dry prior to disposal or recycling (where available).

.6 Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility.

.7 Set aside and protect surplus and uncontaminated finish materials: Deliver to or arrange collection by employees, individuals, or organizations for verifiable re-use or re-manufacturing.

.8 Close and seal tightly partly used sealant and adhesive containers and store protected in well ventilated fire-safe area at moderate temperature.

1.9 AMBIENT CONDITIONS

.1 Heating, Ventilation and Lighting:

.1 Perform no painting work unless a minimum lighting level of 323 Lux is provided on surfaces to be painted. Adequate lighting facilities to be provided by General Contractor.

.2 Temperature, Humidity and Substrate Moisture Content Levels:

.1 Unless specifically pre-approved by specifying body, Paint Inspection Agency and, applied product manufacturer, perform no painting work when:

.1 Ambient air and substrate temperatures are below 10 degrees C.

.2 Substrate temperature is over 32 degrees C unless paint is specifically formulated for application at high temperatures.

.3 Substrate and ambient air temperatures are expected to fall outside MPI or paint

manufacturer's prescribed limits.

.4 Relative humidity is above 85 % or when dew point is less than 3 degrees C variance between air/surface temperature.

.5 Rain or snow are forecast to occur before paint has thoroughly cured or when it is foggy, misty, raining or snowing at site.

.3 Surface and Environmental Conditions:

.1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.

.2 Apply paint to adequately prepared surfaces and to surfaces within moisture limits noted herein.

.3 Apply paint when previous coat of paint is dry or adequately cured.

.4 Apply paint finishes when conditions forecast for entire period of application fall within manufacturer's recommendations.

.5 Do not apply paint when:

.1 Temperature is expected to drop below 10 degrees C before paint has thoroughly cured.

.2 Substrate and ambient air temperatures are expected to fall outside MPI or paint manufacturer's limits.

.3 Surface to be painted is wet, damp or frosted.

.6 Provide and maintain cover when paint must be applied in damp or cold weather. Heat substrates and surrounding air to comply with temperature and humidity conditions specified by manufacturer. Protect until paint is dry or until weather conditions are suitable.

.7 Schedule painting operations such that surfaces exposed to direct, intense sunlight are scheduled for completion during early morning.

.8 Remove paint from areas which have been exposed to freezing, excess humidity, rain, snow or condensation. Prepare surface again and repaint.

.9 Paint occupied facilities in accordance with approved schedule only. Schedule operations to approval of Departmental Representative such that painted surfaces will have dried and cured sufficiently before occupants are affected.

1.10 GUARANTEE

.1 Furnish the local MPI Accredited Quality Assurance Association’s two (2) year guarantee.

.2 All painting and decorating work shall be in accordance with MPI Painting Manual requirements and shall be inspected by the local MPI Accredited Quality Assurance Association’s Paint Inspection Agency (inspector). The cost for such inspections, and for the local MPI Accredited Quality Assurance Association’s Guarantee.

2.0 PRODUCTS

2.1 MATERIALS

.1 Paint materials listed in latest edition of MPI Approved Products List (APL) are acceptable for use on this project.

.2 Paint materials for paint systems: to be products of single manufacturer.

.3 Only qualified products with E2 “Environmentally Friendly" ratings are acceptable for use on this project.

.4 Use only MPI listed materials.

.5 Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids, to be as follows:
- .1 Be water-based.
- .2 Be non-flammable biodegradable.
- .3 Be manufactured without compounds which contribute to ozone depletion in upper atmosphere.
- .4 Be manufactured without compounds which contribute to smog in the lower atmosphere.
- .5 Do not contain methylene chloride, chlorinated hydrocarbons, toxic metal pigments.

.6 Water-borne surface coatings must be manufactured and transported in a manner that steps of processes, including disposal of waste products arising therefrom, will meet requirements of applicable governmental acts, by-laws and regulations including, for facilities located in Canada.

.7 Water-borne surface coatings must not be formulated or manufactured with aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavelant chromium or their compounds.

.8 Water-borne surface coatings and recycled water-borne surface coatings must have flash point of 61.0 degrees C or greater.

.9 Both water-borne surface coatings and recycled water-borne surface coatings must be made by a process that does not release:
- .1 Matter in undiluted production plant effluent generating a 'Biochemical Oxygen Demand' (BOD) in excess of 15 mg/L to a natural watercourse or a sewage treatment facility lacking secondary treatment.
- .2 Total Suspended Solids (TSS) in undiluted production plant effluent in excess of 15 mg/L to a natural watercourse or a sewage treatment facility lacking secondary treatment.

.10 Recycled water-borne surface coatings must contain 50 % post-consumer material by volume.

.11 Recycled water-borne surface coatings must not contain:
- .1 Lead in excess of 600.0 ppm weight/weight total solids.
- .2 Mercury in excess of 50.0 ppm weight/weight total product.
- .3 Cadmium in excess of 1.0 ppm weight/weight total product.
- .4 Hexavelant chromium in excess of 3.0 ppm weight/weight total product.
- .5 Organochlorines or polychlorinated biphenyls (PCBS) in excess of 1.0 ppm weight/weight total product.

.12 The following must be performed on each batch of consolidated post-consumer material before surface coating is reformulated and canned. These tests must be performed at a laboratory or facility which has been accredited by the Standards Council of Canada.
- .1 Lead, cadmium and chromium are to be determined using ICP-AES (Inductively Coupled Plasma - Atomic Emission Spectroscopy) technique no. 6010 as defined in EPA SW-846.
- .2 Mercury is to be determined by Cold Vapour Atomic Absorption Spectroscopy using Technique no. 7471 as defined in EPA SW-846.
- .3 Organochlorines and PCBs are to be determined by Gas Chromatography using Technique no. 8081 as defined in EPA SW-846.

2.2 COLOURS

.1 Departmental Representative will provide Colour Schedule after Contract award. Submit proposed Colour Schedule to Departmental Representative for approval.

.2 Colour schedule will be based upon selection of three base colours.

.3 Selection of colours will be from manufacturer's full range of colours.

.4 Where specific products are available in restricted range of colours, selection will be based on limited range.

2.3 MIXING AND TINTING

.1 Perform colour tinting operations prior to delivery of paint to site. On-site tinting of painting materials is allowed only with Departmental Representative's written permission.

.2 Mix paste, powder or catalyzed paint mixes in accordance with manufacturer's written instructions.

.3 Add thinner to paint manufacturer's recommendations. Do not use kerosene or organic solvents to thin water-based paints.

.4 Thin paint for spraying according in accordance with paint manufacturer's instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to Departmental Representative.

.5 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

2.4 GLOSS/SHEEN RATINGS

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

	Gloss @ 60 degrees	Sheen @ 85 degrees
Gloss Level 1 Matte	Max.5	Max.10
Finish (flat) Gloss Level 2 -Velvet-Like Finish	Max.10	10 to 35
Gloss Level 3 -Eggshell Finish	10 to 25	10 to 35
Gloss Level 4 -Satin-Like Finish	20 to 35	Min.35
Gloss Level 5 -Traditional Semi-Gloss Finish	35 to 70	
Gloss Level 6 -Gloss finish	70 to 85	
Gloss Level 7 -High Gloss Finish	More than 85	

.2 Gloss level ratings of painted surfaces as indicated.

2.5 EXTERIOR PAINTING SYSTEMS

.1 Structural Steel and Metal Fabrications:
  .1 EXT 5.1B - Waterborne light industrial, gloss level 6 coating (over inorganic zinc).

.2 Galvanized Metal: not chromate passivated
  .1 EXT 5.3G - Waterborne light industrial, gloss level 6 coating.

.3 All paint systems to be MPI Premium Grade 3 coat system.

3.0 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 EXISTING CONDITIONS

.1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Departmental Representative damages, defects, unsatisfactory or unfavorable conditions before proceeding with work.

3.3 EXAMINATION

.1 Exterior repainting work: inspected by MPI Accredited Paint Inspection Agency (inspector) acceptable to specifying authority and local Painting Contractor's Association. Painting contractor to notify Paint Inspection Agency minimum of one week prior to commencement of work and provide copy of project repainting specification and Finish Schedule.

.2 Exterior surfaces requiring repainting: inspected by both painting contractor and Paint Inspection Agency who will notify Departmental Representative in writing of defects or problems, prior to commencing repainting work, or after surface preparation if unseen substrate damage is discovered.

.3 Where assessed degree of surface degradation of DSD-1 to DSD-3 before preparation of surfaces for repainting is revealed to be DSD-4 after preparation, repair or replacement of such unforeseen defects discovered are to be corrected, as mutually agreed, before repainting is started.

3.4 PROTECTION

.1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore such surfaces as directed by Departmental Representative.

.2 Protect items that are permanently attached such as Fire Labels on doors and frames.

.3 Protect factory finished products and equipment.

.4 Protect passing pedestrians, building occupants and general public in and about building.

.5 Remove light fixtures, surface hardware on doors, and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Store items and re-install after painting is completed.

.6 Move and cover exterior furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.

.7 As painting operations progress, place "WET PAINT" signs in pedestrian and vehicle traffic areas to approval of Departmental Representative.

3.5 APPLICATION

.1 Method of application to be as approved by Departmental Representative. Apply paint by brush or roller. Conform to manufacturer's application instructions unless specified otherwise.

.2 Brush and Roller Application:

.1 Apply paint in a uniform layer using brush and/or roller of types suitable for application.
.2 Work paint into cracks, crevices and corners.
.3 Paint surfaces and corners not accessible to brush using spray daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.
.4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces shall be free of roller tracking and heavy stipple unless approved by Departmental Representative .
.5 Remove runs, sags and brush marks from finished work and repaint.

.3 Spray Application:
.1 Provide and maintain equipment that is suitable for intended purpose, capable of properly atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.
.2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.
.3 Apply paint in a uniform layer, with overlapping at edges of spray pattern.
.4 Brush out immediately runs and sags.
.5 Use brushes to work paint into cracks, crevices and places which are not adequately painted by spray.

.4 Use dipping, sheepskins or daubers when no other method is practical in places of difficult access and when specifically authorized by Departmental Representative.

.5 Apply coats of paint as continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.

.6 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.

.7 Sand and dust between coats to remove visible defects.

.8 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as projecting ledges.

.9 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

3.6 MECHANICAL/ELECTRICAL EQUIPMENT

.1 Unless otherwise specified, paint exterior exposed conduits, piping, hangers, duct work and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as noted otherwise.

.2 Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.

.3 Do not paint over nameplates.

3.7 RESTORATION & CLEANING

.1 Clean and re-install hardware items removed before undertaken painting operations.

.2 Remove protective coverings and warning signs as soon as practical after operations cease.

.3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter

immediately as operations progress, using compatible solvent.

.4 Protect freshly completed surfaces from paint droppings and dust to approval of Departmental Representative. Avoid scuffing newly applied paint.

.5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by Departmental Representative.

.6 Proceed in accordance with Section 01 74 11 - Cleaning.

.1 Remove paint where spilled, splashed, splattered or sprayed as work progresses using means and materials that are not detrimental to affected surfaces.

3.8 COLOUR SCHEDULE

.1 Steel support frames – medium grey.

.2 Mechanical equipment shop finished by supplier– to be selected from manufacturer's full range by Departmental Representative

END OF SECTION 09 91 13

1.0 GENERAL

1.1 RELATED REQUIREMENTS

.1 Metal Fabrications Section 05 50 00

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Pre-installation meetings: Conduct pre-installation meeting one week prior to commencing work of this Section and on-site installations to:
- .1 Verify project requirements, including mock-up requirements.
- .2 Verify substrate conditions.
- .3 Co-ordinate products, installation methods and techniques.
- .4 Sequence work of related sections.
- .5 Co-ordinate with other building subtrades.
- .6 Review manufacturer's installation instructions.
- .7 Review existing components of building with Departmental Representative and note that work is not to damage such components.

.2 Mock-ups:
- .1 Construct mock-ups in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Mock-up used:
  - .1 To judge workmanship, substrate preparation, operation of equipment and material application.
- .3 Construct mock-up where directed by Departmental Representative.
- .4 Allow 24 hours for inspection of mock-up by Departmental Representative before proceeding with work.
- .5 When accepted by Departmental Representative, mock-up will demonstrate minimum standard for this work. Mock-up may remain as part of finished work.
- .6 Start work only upon receipt of written acceptance of mock-up by Departmental Representative.

1.3 ACTION & INFORMAL SUBMITTALS

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

.2 Product Data:
- .1 Provide product literature, specifications and datasheet and include product characteristics, performance criteria, limitations and colours.
- .2 Provide two copies of Workplace Hazardous Materials Information System (WHMIS) – Material Safety Data Sheets (MSDS) in accordance with Section 01 35 33 – Health & Safety Requirements.

.3 Samples:
- .1 Wire material and each type of wiring hardware.
- .2 Furnish samples of system(s) so installation can be coordinated with existing conditions and within on-site conditions.

.4 Submit shop drawings showing location of pole and wire configuration and mounting details.

1.4 PRODUCT HANDLING

.1 Protect products from damage before, during and after the installation.

1.5 QUALITY ASSURANCE

.1 Submit electronic copy of inspection and test reports to Departmental Representative.

.2 Prepare mockup of two typical wires, poles and clips installation.

1.6 WARRANTY

.1 Provide warranty on material against ultra-violet breakdown and defective workmanship.

1.7 CLOSEOUT SUBMITTALS

.1 Provide manufacturer's instructions for care, cleaning and maintenance of prefaced components for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

2.0 PRODUCTS

2.1 MATERIALS

.1 Steel Wire

.1 Material: High-density 302/304-grade stainless steel 7/7 braided wire.

.2 Sizes: 0.96mm maximum

.2 Mounting System

.1 Install hardware of the system, connection hardware and cable anchoring hardware as specified and as required to suit site conditions as per approved shop drawings.

.1 For anchor point attachments in concrete, use expanding corner net bolts.

.2 Perimeter support system shall be sufficient to withstand the tension of the proposed grid system.

.3 Upon completion of installing anchor point attachments, the 0.96mm stainless steel wire is attached to the cable stop spacer by wrapping the wire around the spacer and crimping with two 1mm copper ferrules. On longer runs of wire, three 1mm copper ferrules are to be provided at each termination point, Maximum spacing between support poles to be 15' (4500mm) and maximum opening between wires to be 3'x3' (915x915mm). Hardware determines max cable run lengths.

.4 Special crimping tools to be applied to insure proper installation of the system.

.5 Turnbuckles: Stainless steel, hook & eye turnbuckles, contractor to determine cable size, cable run and maximum allowable loading to suit design requirement.

.6 Wire Rope Clamps: Stainless steel, use 2 clamps per connection. Use in conjunction with Cable Thimble.

.7 Cable Thimble: Stainless steel cable thimble to prevent cable fraying and creasing when tensioning cable system.

.8 Eyebolts: for steel, iron, and heavy gauge sheet metal. Extreme duty stainless steel eyebolt, 2" (5.1cm) long, 9/16" I.D. (14.2mm) with 1/4-20 stainless steel hex nut. Maximum spacing between eyebolts: 50' (15.2m).

.9 Screw Eyes: extreme duty stainless steel screw eyes 2" (5.1cm) long, 17/32" I.D. (13.5mm). Pilot holes for all surfaces. Maximum spacing between screw eyes: 50' (15.2m).

.10 Eyebolts and Machine Screw Anchors: for concrete surfaces. Eyebolt specs are same as above. Machine Screw Anchor: Stainless steel anchor – 1/2" (12.7mm) diameter x 1" (25.4mm) deep with 1/4-20 threads inside. Setting tool included with anchors.

.11 Protection layer, at location where the concrete paver to be located, placed under the concrete paver and above the existing gravel roof. Material to be neoprene pad or approved material.

3.0 EXECUTION

3.1 EXAMINATION

.1 Examine installation area. Notify Departmental Representative of detrimental work conditions

.2 Do not proceed until conditions are corrected

3.2 PREPARATION

.1 Field measurements: Verify dimensions of the areas to be protected. Ensure sufficient quantity of wiring, hardware and surface cleaning products to be applied for the installation of the bird wiring system as per requirements prior to starting installation works.

3.3 SURFACE PREPARATION

.1 All surfaces to be clean, dry and free of obstructions before bird deterrent system is installed.

.2 Treat, neutralize and safely remove all bird waste from installation surfaces. Comply with Municipal, Provincial, and Federal regulations governing the proper removal and disposal of bird droppings.

.3 Use surface cleaning products to neutralize any bird droppings, nests and related waste materials that may be present. Allow all surfaces to air dry completely, and then reapply to sanitize and deodorize the surface before proceeding. Strictly follow treatment instructions provided with surface cleaning products. Products used by the contractor for cleaning bird droppings shall not have corrosive effect on Heritage masonry or flashings and shall not react in any manner with existing roofing membranes so to cause damage.

.4 Follow Contractor's Site Specific Health and Safety Plan when working around surfaces contaminated with bird droppings.

.5 If active or abandoned nests are encountered, stop work and notify Departmental Representative immediately. Nests shall be disturbed or removed only by Departmental Representative, who is permitted to do so.

.6 Work areas shall be cleaned, and repair work shall be done in areas which will be excluded by the wiring system.

.7 Remove or repair articles that may damage the wires after installation, such as tree limbs, brush, and loose parts of the building.

3.4 INSTALLATION

.1 Install the bird wire system as recommended by the manufacturer, install perimeter and support hardware; attach bird wires to installed hardware; install access or additional support hardware as specified . The system shall fit the area to be protected perfectly so pest birds cannot enter the protected area and blends perfectly with the existing building.

.2 Wires can be joined only with the recommended seam fastening hardware and manufacturer recommendations.

.3 Install wires to avoid contact with existing flashing, equipment, accessories mounted on the parapet or roof. Make necessary adjustments to keep wires a sufficient distance from these objects or conditions.

.4 Finished wires installation to be taught and free of wrinkles.

.5 Correct grid spacing shall be used to insure exclusion of the correct pest bird.

3.5 ADJUSTMENTS/CLEANING

.1 Remove debris and waste materials from project site.

.2 Inspect finished installation. Make any adjustments needed to conform to manufacturer's net installation guidelines.

END OF SECTION 10 81 13

PART 1 GENERAL

1.1 Related Sections

.1 This Section specifies the common work results for the Mechanical Divisions, including:

.1 Division 23 Heating Ventilation & Air Conditioning

.2 Division 25 Integrated Automation (EMCS)

1.2 Submittals

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

.2 Shop drawings to show:

.1 Mounting arrangements.

.2 Operating and maintenance clearances.

.3 Shop drawings and product data accompanied by:

.1 Detailed drawings of bases, supports, and anchor bolts.

.2 Acoustical sound power data, where applicable.

.3 Points of operation on performance curves.

.4 Manufacturer to certify current model production.

.5 Certification of compliance to applicable codes.

.4 In addition to transmittal letter referred to in Section 01 01 50 – General Instructions: 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 01 50 – General Instructions.

.2 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection. Also see “Mandatory Requirements for O&M Manuals” in this Section.

.3 Operation data to include:

.1 Control schematics for systems including environmental controls.

.2 Description of systems and their controls.

.3 Description of operation of systems at various loads together with reset schedules and seasonal variances.

.4 Operation instruction for systems and component.

.5 Description of actions to be taken in event of equipment failure.

.6 Valves schedule and flow diagram.

.7 Colour coding chart.

.4 Maintenance data to include:

.1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.

.2 Data to include schedules of tasks, frequency, tools required and task time.

.5 Performance data to include:

.1 Equipment performance verification test results.

.2 Special performance data as specified.

.3 For each fan and pump installed, provide performance data in "Curve" or multi rating table.

.4 For each plumbing fixture, floor and roof drain installed, provide manufacturer's "cut" of that item and "cuts" of associated brass goods.

.6 Approvals:

.1 Submit 1 copy of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.

.2 Make changes as required and re-submit as directed by Departmental Representative.

.7 Additional data:

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

.2 Copies of extended guarantees and warranties for equipment items such as hot water tanks and heat exchangers shall be included in a separate section of the manual.

.8 Site records:

.1 Departmental Representative will provide 1 set of mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.

.2 Transfer information weekly to site mechanical drawings. Update drawings to show work as actually installed.

.3 Use different colour waterproof ink for each service.

.4 Make available for reference purposes and inspection.

.5 The drawings shall indicate the inverts and dimensioned locations of all services at the property line and where they penetrate the building perimeter.

1.3 Regulations

.1 Comply with most stringent requirements of NBC, Provincial and Municipal regulations and by-laws, specified standards, codes and this specification. Practices contained in these standards or standards suggested or recommended by reference organizations, are to be taken as minimum requirements.

.2 Furnish certificates confirming work installed conforms to requirements of authorities having jurisdiction.

.3 Drawings and specifications should not conflict with these Regulations but where there are apparent discrepancies, notify the Departmental Representative in writing and obtain clarifications before proceeding with the work.

1.4 Quality Assurance

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

1.5 Guarantee Warranty

.1 Correct promptly at own expense, defects or deficiencies in the work in accordance with the Warranty requirements of the Contract.

.2 The Departmental Representative shall be the judge as to whether the failure is due to defective workmanship, improper usage or ordinary wear and tear.

.3 Make good any damage resulting from defective materials or workmanship.

.4 Rectify any deficiencies or omissions in respect to plans or Specifications which may appear during the guarantee period even though work has been accepted as complete.

1.6 Drawings

.1 Drawings:

.1 Are not intended to show structural details or architectural features.

.2 Are not to be scaled.

.3 Except where dimensioned, indicate general mechanical layouts only.

.4 The drawings are mainly schematic and do not attempt to show all offsets. Make such offsets at no additional cost to contract. Offset angles shall be as small as possible.

.5 All figured dimensions shall have precedence over scale. Detail drawings shall have precedence over small scale drawings; any difference between same shall be decided upon by the Departmental Representative.

.2 Provide field (shop) drawings to indicate relative position of various services when required by Departmental Representative and obtain approval before commencing work.

.3 Shop drawing review by Departmental Representative is for the sole purpose of ascertaining conformance with the general design concept. This review shall not mean that Departmental Representative approves the detail design inherent in the shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve the Contractor of his responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents. The Contractor is responsible for quantities and dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes

or to techniques of construction and installation and for coordination of the work of all sub-trades.

1.7 Maintenance

.1 Furnish spare parts in accordance with Section 01 01 50 – General Instructions as indicated in the detailed product specification clauses.

.2 Provide access doors for concealed expansion joints, traps, strainers, cleanouts, balance dampers, fire dampers, other parts requiring accessibility for operating and maintenance.

.3 In suspended panel ceilings, use panel in place of access door; provide in such panel a button or other means of identification and easy removal when necessary.

1.8 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 Section 01 01 50 – General Instructions.

1.9 Discrepancies and Omissions

.1 Bidders finding discrepancies in, or omissions from, Drawings, Specifications, or other documents, or having any doubt as to the meaning or intent of any part thereof, shall at once notify the Departmental Representative, who will send explanatory written instructions to all bidders. No verbal information will be considered valid.

.2 Should there be conflict(s) within or between the Specifications and/or Drawings, the most stringent or higher quality requirement shall apply.

1.10 Mandatory Requirements for O&M Manuals

.1 Hard Copy Requirements:

.1 Hard copies shall be placed in D-ring binders with clear overlay on front and spine with labels inserted on front cover and spine. Labels shall include the following information: Front cover label shall include the project name, project location, Departmental Representative, general contractor, mechanical contractor, firm preparing the manuals, and the month and year that the manuals were prepared. It shall also bear the label “Operating & Maintenance Manual for Mechanical Systems”.

.2 Spine label shall include the project name, project location, and the year that the manuals were prepared. It shall also bear the label “Operating & Maintenance Manual for Mechanical Systems”.

.3 Indicate Volume X of Y if more than one volume is required.

.4 Insert a Title page and Table of Contents in clear plastic covers.

.5 Title page shall include the project name, project location, as well as the name, address, phone number of the Departmental Representative, general contractor, mechanical contractor, firm preparing the manuals, and the month and year that the manuals were prepared. It shall also bear the label “Operating & Maintenance Manual For Mechanical Systems”.

.6 Index the binder according to the following system:

Tab 1.1 Mechanical Drawing Schedule

Tab 1.2 Description of Systems

- Provide a schematic drawing and component description for each major mechanical system including air handling systems, boiler and hot water heating piping distribution systems and (where applicable) water chillers and chilled water distribution systems. The schematic drawing shall identify each component with a letter designation corresponding to a description briefly explaining the purpose of each component and how it relates to the other components, and be presented in a current version of AutoCAD or similar computer aided drafting program.

- The component description shall be clearly written in a language that may be easily understood by the building operators and maintainers who will be using them.

Tab 1.3 Operating Division

Provide the following:

- Specific operating instructions for each major item of equipment, including air handling systems, pumps, boilers, chillers, etc.

  - Ventilation requirements, Energy considerations, Automatic temperature control settings, Information regarding air filters and pressure drops for clean and dirty conditions.

  - Trouble Shooting Procedure Guide in spreadsheet form with the most likely causes and recommended actions for all foreseeable problems. Trouble Shooting Procedure guides are required for all the major items of equipment including air handling systems, exhaust fans, circulating pumps, mechanical cooling equipment, etc.

  - Mechanical Equipment Starting Procedures.

Tab 1.4 Maintenance and Lubrication Division

Tab 1.5 Equipment Supplier and Contractor Schedule

- Provide a list of Equipment Suppliers and Contractors and include their address, telephone number.

- Provide the Equipment Make/Manufacturer

Tab 2.0 Guarantees, Certificates and Reports

- Including assurance letters, balancing and commissioning reports

Tab 2.1 Valve Tag Schedule

Tab 2.2 Labeling and Identification Schedule

- Piping colour code schedules
- Access panel identification schedules

Tab 2.3 Chemical Cleaning and Treatment

- Chemical cleaning shop drawings, water treatment data

Tab 3.0 Equipment Shop Drawings and Maintenance Data

- Organize this section into numbered tabs.
- Insert final shop drawings that have been reviewed and as-built control schematics.
- For each fan and pump installed, provide performance curves indicating the design point of intersection and the actual operating point.
- For each plumbing fixture, floor and roof drain installed, provide manufacturer's "cut" of that item and "cut" of associated brass goods.
- In addition to the shop drawings provided for the various items of mechanical equipment, this section shall also include the Manufacturers' Literature on:
    - Operating and maintenance instructions
    - Spare parts lists
    - Trouble Shooting information

Tab 4.0 Balance Report

The divider tabs shall be custom laminated mylar plastic and shall be in accordance with the following colour scheme:

- Tabs 1.1 to 1.5 – Orange
- Tabs 2.0 to 2.3 – Green
- Tab 3.0 – Yellow

.7 Furnish sufficient copies of equipment manufacturer's literature, a set of drawings, approved shop drawings, and Mechanical Specification to the company preparing the O&M manuals to meet the above requirements.

.2 Digital Manual Requirements

.1 The digital version of the manuals and the hard cover version shall be prepared by the same company.

.2 In addition to the operating and maintenance manuals provided in hard covered binders, two copies of all information shall be provided in digital format as follows:

.3 The information shall be organized into sections in a user-friendly format to make it easy to search for specific information. An indexing system shall be included that remains on an expandable portion of the screen that allows the end user to scroll through the manual information that appears on the main portion of the screen. The digital version content and organization for each manual shall be arranged in a manner identical to the hard copy version. The specific requirements are listed below:

.1 Utilize Adobe Acrobat PDF format.

.2 If there is more than one volume of manual, indicate “Volume X of Y” for each volume.

.3 Include a copy of the latest Adobe Acrobat Reader.

.4 The final Digital copies are to be copied to CDR with a custom CDR label. The custom CDR label shall include: Project Name, Location of Project, Date of Assembly, name of Departmental Representative, and shall be titled “Operating & Maintenance Manual for Mechanical Systems”.

.5 The Digital Manual shall be enhanced with the following features: Bookmarks, Thumbnails, Internet Links, Internal Document Links and Optical Character Recognition (OCR). Refer to Scanning Requirements and Organizational Requirements listed below.

.4 Scanning Requirements:

.1 All pages contained within the hard copy manual are to be scanned and/or digitized to Adobe Acrobat PDF format.

.2 Provide a minimum 300 DPI for all scanned pages.

.3 All scanned shop drawings may be searched for text with minimum 75% Optical Character Recognition (OCR).

.4 All shop drawings are to be scanned to a minimum 22 cm X 28 cm size. If the original page size is 43 cm X 28 cm, the digital copy shall also be 43 cm X 28 cm. Page sizes exceeding 43 cm X 28 cm may be shrunk down to 43 cm X 28 cm.

.5 Rotation of scanned page images/texts shall be displayed within +/- 20 degrees.

.5 Organizational Requirements:

.1 Digital Manual shall be organized in the same manner as the approved Hard Copy Manual. (e.g. Tabs 1.1, 1.2, 1.3, 1.4, 1.5, 2.0, 3.0, 4.0, etc).

.2 Bookmark all major tabs and subsections.

.3 Bookmark each set of shop drawings (Section 3.0).

.4 Link the Table of Contents page to the referenced sections.

.5 Insert an introduction/summary page for Sections 1.2, 1.3, 1.4, and 3.0 indicating major subsections. Link these pages to their referenced sections.

.6 Link the system descriptions to the referenced schematic drawings contained in section 1.2.

.7 Insert Internet Links and Internal Document Links from Section 1.5 to Mechanical Equipment Manufacturers/Suppliers/Contractors official websites.

.8 Mechanical Equipment Shop Drawings located in Section 3.0.

.6 Use the following colour code for links contained in Sections 1.2, 1.3, 1.4, and 1.5.:

.1 Internet Links (light blue with underline).

.2 Internal Document Link (dark blue) (excludes AutoCAD schematic links).

.7 Insert a title page for each major piece of equipment located in Section 3.0. The title page shall include the Shop Drawing name, and a link (dark blue in colour) to Section 1.5.

.8 It is the responsibility of the Mechanical Trade to provide high quality documentation for scanning.

.9 Digital Manual shall be reviewed by the Departmental Representative for content and layout prior to final submission.

1.11 Security Fasteners

.1 Use fasteners compatible with material through which they pass.

1.12 Firestopping

.1 Apply firestop sealant and systems around all penetrations through openings in fire rated wall, floor and ceiling assemblies.

.2 Seal around conduits penetrating fire separations.

.3 References:

.1 ULC-S115-05 – Standard Method of Fire Tests of Firestop Systems.

.4 Product Data

.1 Submit product data and layout plan in accordance with Section 01 01 50.

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

.3 Submit plan showing location of each penetration and product data to indicate type of firestopping being installed at each location.

PART 2 PRODUCTS

2.1 Access Doors

.1 Access door size shall be as indicated and where not indicated, make 305mm x 406mm minimum or 610mm x 457mm where persons have to enter. For acoustical ceilings, conform to architectural panel pattern.

.2 Unless otherwise indicated, access doors shall be hinged, flush type, steel framed panel, 14 gauge minimum, satin finished galvanized steel or type 304 stainless steel, with anchor straps for wet areas, washrooms, and all walls finished in ceramic tile.

.3 Hinges shall be concealed, spring hinge to allow door to open 175°. Locking devices shall be flush cam type, screwdriver operated, doors and frames shall have prime coated rust inhibiting paint, unless made of stainless steel.

.4 Where doors are required in fire rated walls, access doors shall be uninsulated and for all fire rated ceilings and walls where maximum temperature rise limitation is applicable, shall be insulated. All fire rated access doors shall have Warnock Hersey or ULC listed 2 hour fire rating and shall be installed in accordance with NFPA 80 and manufacturer’s installation instructions.

2.2 Security Access Doors

.1 Security type access doors shall be fully welded construction. Panels and frames shall be manufactured of 10 gauge steel. In addition to concealed spot welding, individual knuckles on the full length piano hinge shall be welded to the frame and panel. Piano hinge shall have non-removable pin. The return flange on the door panel shall provide rigidity and tamper-resistance edge. Provide deadbolt locks with a Schlage “C” keyway. Electro-statically applied off white finish.

2.3 Firestopping

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

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

.2 Fire stop system rating: to match wall/floor/roof assembly of rating indicated.

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

.3 Prefabricated flange units, with outer metal flange die-stamped from 0.3 mm thick 316 stainless steel, with inset of premoulded silicone elastomeric ring, factory moulded, U.L.C. or W.H. listed as a through penetration fire stop. Flange hinged for fixing over pipe and then secured tight with self-tapping screw.

.4 Fire-resistance rating of installed fire stopping assembly not less than the fire- resistance rating of surrounding wall assembly.

.5 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal; do not use cementitious or rigid seal at such locations.

.6 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: prefabricated silicone elastomeric seal; do not use a cementitious or rigid seal at such locations.

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

PART 3 EXECUTION

3.1 Installation

.1 Coordinate work with work of other sections to avoid conflict.

.2 Locate distribution systems, equipment, and materials to provide minimum interferences and maximum usable space.

.3 Where interference occurs, Departmental Representative shall approve relocation of equipment and materials, regardless of installation sequence.

3.2 Cleaning

.1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

3.3 Cutting and Patching

.1 Make arrangements with General Contractor for all cutting and patching in this work.

.2 Minimize cutting and patching. Set sleeves and mark openings in concrete or masonry.

.3 Conduct ground penetrating radar (GPR) scans prior to coring or cutting existing concrete structure.

3.4 Waterproofing

.1 Where any work pierces waterproofing including waterproofing concrete, the method of installation shall be as approved by the Departmental Representative before the work is done. Supply and install all necessary sleeves, caulking, roof curbs, and flashing required and make the openings watertight.

3.5 Protection of Work

.1 Protect equipment and material during construction from the weather, moisture, dust, painting, plastering and physical damage. Clean and return to "as new" condition.

.2 Mask or grease and cover machined surfaces. Firmly secure covers over equipment openings and open ends of piping, conduit and ductwork as work progresses. Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

.3 Any equipment that has operating parts, bearings or machined surfaces that show signs of rusting, pitting or physical damage will be rejected.

.4 Refinish damaged or marred factory finishes to the satisfaction of the Departmental Representative, using equal quality materials.

3.6 Field Quality Control

.1 Site Tests: conduct following tests in accordance with Section 01 01 50 – General Instructions and submit report as described in PART 1 - SUBMITTALS.

.2 Manufacturer's Field Services:

.1 Where specified, 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.

3.7 Demonstration and Operating Instructions

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

.2 Provide training to Departmental Representative for the controls and operation of mechanical equipment and systems installed and/or modified as part of this project.

.3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

.4 Use operation and maintenance manual and as-built drawings as part of instruction materials.

.5 Instruction duration time requirements as specified in appropriate sections.

.6 During substantial performance review of the work the Mechanical Contractor, together with the Departmental Representative, Controls Contractor, and other Subcontractors designated by the Departmental Representative, shall instruct the Departmental Representative’s operating personnel in the proper operation and maintenance of all systems and equipment installed under the contract.

.7 It shall be the Mechanical Contractor's responsibility to have the specified equipment manuals prepared, previously approved by the Departmental Representative, and ready for presentation to the Departmental Representative at this meeting.

.8 Convene the meeting with the aforementioned parties at the time called for in the substantial performance review. The arrangements shall include written notices to all the parties concerned. Should the equipment manuals, or system installation not be complete and operable at the proper time, he shall then convene the operating instruction meeting at a later date and pay any additional costs including time and travelling expenses for the personnel involved which are attributable to the delay.

.9 Keeping a sign-in sheet is mandatory for the demonstration and training session. Submit a copy of the sign-in sheet to Departmental Representative for record.

3.8 Access Doors

.1 Furnish access doors for concealed expansion joints, traps, strainers, cleanouts, balance dampers, fire dampers, other parts requiring accessibility for operating and maintenance. Access doors shall be provided to General Contractor for installation and shall be coordinated.

.2 In suspended panel ceilings, use panel in place of access door; provide in such panel a button or other means of identification and easy removal when necessary.

3.9 Firestopping

.1 Preparation:

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

.2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.

.2 Installation:

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

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

.3 Tighten self-tapping screw on flange unit to ensure adequate tight and permanent seal.

.4 Coordinate location and proper selection of cast-in-place Firestop Devices with trade responsible for the work. Ensure device is installed before placement of concrete. Responsible trade to provide adequate spacing of field run pipes to allow for installation of cast-in-place firestop devices without interferences.

.5 Avoid cutting or penetrating of existing firestop systems already installed by other trades. If unavoidable, especially in renovations, remove existing material and provide new fire stopping system to complete the installation in accordance with this specification.

.3 Inspection:

.1 Notify Departmental Representative when ready for inspection and prior to concealing or enclosing fire stopping materials and service penetration assemblies.

.2 Final inspection of through-penetration firestopping shall be performed by the Manufacturer’s Authorized Representative in accordance with ASTM E 2174, “Standard Practice for On-Site Inspection of Installed Fire Stops” or other recognized standard. At project closeout, provide a letter to certification to the Departmental Representative indicating all fire stopping supplied and installed for the project meets Building Code requirements and has been installed in accordance with the Manufacturer’s installation instructions. Include a copy of the letter in the O&M manual.

.4 Schedule:

.1 Fire stop and smoke seal at:

.1 Penetrations through fire-resistance rated walls, floors and ceilings.

.2 Around mechanical and electrical assemblies penetrating fire separations.

.2 Existing floor, wall and ceiling assemblies where there is fire stopping at existing penetration(s) shall be deemed to have fire resistive rating. New penetrations through such assemblies shall be fire stopped. Review existing condition on site and keep records.

END OF SECTION

PART 1 GENERAL

1.1 Use of Systems

.1 Use of new permanent heating and ventilating systems for supplying temporary heat or ventilation is permitted only under the following conditions:

.1 Entire system is complete, pressure tested, cleaned, flushed out.

.2 Specified water treatment system has been commissioned, water treatment is being continuously monitored.

.3 Building has been closed in, areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.

.4 There is no possibility of damage from any cause.

.5 Supply ventilation systems are protected by filters, which shall be inspected daily, changed every week or more frequently as required.

.6 Return systems have approved filters over all openings, inlets, outlets.

.7 All systems will be:

.1 operated as per manufacturer's recommendations or instructions.

.2 operated by Contractor.

.3 monitored continuously by Contractor.

.8 Warranties and guarantees are not thereby relaxed.

.9 Regular preventive and all other manufacturers recommended maintenance routines are performed by Contractor at his own expense and under supervision of Departmental Representative.

.10 Before static completion, entire system to be refurbished, cleaned internally and externally, restored to "as- new" condition, filters in air systems replaced.

.2 Filters referred to herein are over and above those specified elsewhere in this specification.

PART 2 PRODUCTS

2.1 Not Used

.1 Not Used.

PART 3 EXECUTION

3.1 Not Used

.1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 01 01 50 General Instructions

.2 Section 23 05 00 Common Work Results – Mechanical

.3 Section 23 05 29 Hangers & Support for Piping & Equipment

.4 Section 23 08 02 Cleaning and Start-up of Mechanical Piping Systems

.5 This Section applies to all related work under Divisions 22 and 23.

1.2 References

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.181-1999, Ready-Mixed Organic Zinc-Rich Coating.

1.3 Waste Management and Disposal

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

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

.3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.

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

PART 2 PRODUCTS

2.1 Not Used

.1 Not Used

PART 3 EXECUTION

3.1 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.

3.2 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, or components.

3.3 Pipework Installation

.1 Protect openings against entry of foreign material.

.2 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.3 Assemble piping using fittings manufactured to ANSI standards.

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

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

.6 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 Install globe valves in bypass around control valves.

.6 Use chain operators on valves NPS 65 and larger where installed more than 2,400 mm above floor in Mechanical Rooms.

.7 Install dielectric coupling between dissimilar metals.

.8 Install in accordance with Section 23 05 29 – Hanger & Support for Piping & Equipment.

3.4 Sleeves

.1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies (where steel sleeves are part of the listed 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 un-insulated 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 25mm above finished floor.

.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.

3.5 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 304 stainless steel.

.3 Sizes: Outside diameter to cover opening or sleeve. Inside diameter to fit around pipe.

3.6 Cleaning of Piping Systems

.1 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.

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

3.7 Pressure Testing of Equipment and Pipework

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

.2 Pipework: Test as specified in relevant sections.

.3 Maintain specified test pressure without loss for 24 hours minimum unless specified for longer period of time.

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

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

.6 Conceal work only after approval and certification of tests by Departmental Representative.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 01 01 50 General Instructions

.2 Section 23 05 00 Common Work Results – Mechanical

.3 This Section applies to all related work under Divisions 22 and 23.

1.2 References

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

.1 ASHRAE 90.1-2013, Energy Code for Buildings Except Low-Rise Residential Buildings.

.2 Electrical Equipment Manufacturers' Advisory Council (EEMAC)

.3 Workplace Hazardous Material Information System (WHMIS)

.4 National Energy Code for Buildings (NECB) 2011.

1.3 Section Includes

.1 Electrical work to conform to Division 26 including the following:

.1 Supplier and installer responsibility is indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.

.2 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 23. Refer to Division 26 for quality of materials and workmanship.

1.4 Shop Drawings

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

1.5 Closeout Submittals

.1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 01 50 – General Instructions.

1.6 Waste Management and Disposal

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

.2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.

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

.4 Dispose of packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

PART 2 PRODUCTS

2.1 General

.1 Motors to be high efficiency, in accordance with local Hydro company standards and the requirements of ASHRAE 90.1.

2.2 Motors

.1 Provide motors for mechanical equipment as specified.

.2 Motors under 373 W: speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120V, unless otherwise specified or indicated.

.3 Motors 373 W and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40°C, 3 phase, 208V, unless otherwise specified or indicated.

2.3 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 specified.

.3 For motors under 7.5 kW: 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 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 to be 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.

2.4 Drive Guards

.1 Provide guards for unprotected drives.

.2 Guards for belt drives:

- .1 Expanded metal screen welded to steel frame.
- .2 Minimum 1.2mm thick sheet metal tops and bottoms.
- .3 38mm 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 fastened in place.

.4 Removable for servicing.

PART 3 EXECUTION

3.1 Installation

.1 Fasten securely in place.

.2 Make removable for servicing, easily returned into, and positively in position.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 01 50	General Instructions
.2	Section 01 91 00	Commissioning
.3	Section 23 05 00	Common Work Results – Mechanical
.4	Section 23 05 13	Common Motor Requirements for Mechanical Equipment
.5	Section 23 08 00	Commissioning of Mechanical Systems

1.2 References

.1 ANSI/UL 508 Industrial Control Equipment

.2 Electrical Equipment Manufacturers' Advisory Council (EEMAC)

.3 Workplace Hazardous Material Information System (WHMIS)

1.3 Section Includes

.1 Electrical work to conform to Division 26 including the following:

.1 Supplier and installer responsibility is indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.

.2 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 23. Refer to Division 26 for quality of materials and workmanship.

1.4 Shop Drawings

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

1.5 Closeout Submittals

.1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 01 50 – General Instructions.

1.6 Waste Management and Disposal

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

.2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.

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

.4 Dispose of packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

1.7 Warranty:

.1 The VFD shall be warranted by the manufacturer for a period of 36 months from date of shipment. The warranty shall include parts, labor, travel costs and living expenses incurred by the manufacturer to provide factory authorized on-site service. The warranty shall be provided by the VFD manufacturer.

PART 2 PRODUCTS

2.1 General

.1 Furnish complete Variable Frequency Drives (VFD's), as specified herein, for mechanical equipment where noted on drawings, equipment schedules, or specifications.

.2 All standard and optional features shall be included within the VFD enclosure, unless otherwise specified. VFD shall be housed in a metal NEMA 1 enclosure, or other NEMA type according to the installation and operating conditions at the job site. The VFD's UL listing shall allow mounting in plenum or other air handling compartments. If a NEMA 12 enclosure is required for the plenum rating, the manufacturer must supply a NEMA 12 rated VFD.

.3 The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC motors. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump and fan control and to eliminate the need for motor de-rating.

.4 With the motor's rated voltage applied to the VFD input, the VFD shall allow the motor to produce full rated power at rated amps, RMS fundamental volts, and speed without using the motor's service factor. VFDs utilizing sine weighted/coded modulation (with or without 3rd harmonic injection) must provide data verifying that the motors will not draw more than full load current during full load and full speed operation.

.5 The VFD shall include an input full-wave bridge rectifier and maintain a fundamental power factor near unity regardless of speed or load.

.6 The VFD and options shall be tested to ANSI/UL Standard 508. The complete VFD, including all specified options, shall be assembled by the manufacturer, which shall be UL-508 certified for the building and assembly of option panels. Assembly of the option panels by a third-party panel shop is not acceptable. The appropriate UL stickers shall be applied to both the VFD and option panel, in the case where these are not contained in one panel. When these VFDs are to be located in Canada, CSA or C-UL certifications shall apply. Both VFD and option panel shall be manufactured in ISO 9001 certified facilities.

.7 The VFD shall have DC link reactors on both the positive and negative rails of the DC bus to minimize power line harmonics. VFDs without DC link reactors shall provide a minimum 3% impedance line reactor.

.8 The VFD's full load amp rating shall meet or exceed NEC Table 430-150. The VFD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 160% of rated current for up to 0.5 second while starting.

.9 The VFD shall be able to provide full torque at any selected frequency from 28 Hz to base speed to allow driving direct drive fans without de-rating.

.10 An automatic energy optimization selection feature shall be provided standard in the VFD. This feature shall automatically and continually monitor the motor's speed and load and adjust the applied voltage to maximize energy savings and provide up to an additional 3% to 10% energy savings.

.11 Input and output power circuit switching shall be able to be accomplished without interlocks or damage to the VFD. Switching rate may be up to 1 time per minute on the input and unlimited on the output.

.12 An automatic motor adaptation test algorithm shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to run the motor or de-couple the motor from the load to run the test.

.13 Galvanic and/or optical isolation shall be provided between the VFD's power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by voltage spikes, current surges, and ground loop currents. VFDs, not including either galvanic or optical isolation on both analog I/O and discrete I/O, shall include additional isolation modules.

.14 VFD shall minimize the audible motor noise through the used of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VFD efficiencies while reducing motor noise.

.15 Interface Features:

.1 Hand/Start, Off/Stop and Auto/Start selector switches shall be provided to start and stop the VFD and determine the speed reference.

.2 The VFD shall be able to be programmed to provide a 24 V DC output signal to indicate that the VFD is in Auto/Remote mode.

.3 The VFD shall provide digital manual speed control. Potentiometers are not acceptable.

.16 Bypass:

.1 Provide a manual 3-contactor bypass consisting of a door interlocked main fused disconnect padlockable in the off position, a built-in motor starter and a four position DRIVE/OFF/BYPASS/TEST switch controlling three contactors. In the DRIVE position, the motor is operated at an adjustable speed from the VFD. In the OFF position, the motor and VFD are disconnected. In the BYPASS position, the motor is operated at full speed from the AC power line and power is disconnected from the VFD so that service can be performed. In the TEST position, the motor is operated at full speed from the AC line power while power is applied to the input of the VFD. This allows the VFD to be given an operational test while continuing to run the motor at full speed in bypass. In case of an external safety fault, a customer supplied normally closed dry contact shall be able to stop the motor whether in DRIVE or BYPASS mode.

.2 Service personnel shall be able to defeat the main power disconnect and open the bypass enclosure without disconnecting power. This shall be accomplished through the use of a specially designed tool and mechanism while meeting all local and national code requirements for safety.

PART 3 EXECUTION

3.1 Installation

.1 Install per manufacturer's instructions.

.2 Install required safety labels.

3.2 Start-up Service

.1 The manufacturer shall provide start-up commissioning of the VFD and its optional circuits by a factory certified service technician. Sales personnel and other agents who are not factory certified shall not be acceptable as commissioning agents. Start-up

services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system.

.2 Commissioning:

.1 In accordance with Section 01 91 00 – Commissioning, and Section 23 08 00 – Commissioning of Mechanical Systems.

END OF SECTION

PART 1 GENERAL

1.1 Section Includes

.1 Materials and installation for thermometers and pressure gauges in piping systems.

.2 This Section applies to all related work under Divisions 22 and 23.

1.2 Related Sections

.1	Section 01 01 50	General Instructions
.2	Section 01 35 33	Health and Safety Requirements
.3	Section 23 05 00	Common Work Results – Mechanical
.4	Section 23 05 53	Mechanical Identification

1.3 References

.1 American Society of Mechanical Engineers (ASME).

.1 ASME B40.100-2013, Pressure Gauges and Gauge Attachments.

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

.2 Canadian General Standards Board (CGSB).

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

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

1.4 Submittal

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

.2 Submit shop drawings and product data.

1.5 Health and Safety

.1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

1.6 Waste Management and Disposal

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

.2 Collect, separate and place in designated containers for packaging in accordance with Waste Management Plan.

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

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

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

PART 2 PRODUCTS

2.1 General

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

.2 Ranges: as indicated.

2.2 Thermometers

.1 Industrial, adjustable angle, liquid-in-glass:

.1 Case: aluminum.

.2 Stem: Aluminum, 89mm length, adjustable angle.

.3 Window: acrylic or glass.

.4 Accuracy: 1%

.5 Scale length: 180mm minimum.

.6 Reading: Celsius.

.7 Socket: comply with industrial standard dimension.

2.3 Thermometer Wells

.1 Copper pipe: copper or bronze, 20 NPT.

.2 Steel pipe: brass or stainless steel, 20 NPT.

2.4 Pressure Gauges

.1 100 mm dial type: to ASME B40.100, Grade 1A, phosphor bronze bourdon tube having 1.0% accuracy full scale unless otherwise specified.

.1 Casing: Stainless Steel.

.2 Reading: S.I.

.3 Range: indicate mid-scale under normal operating conditions.

.2 Provide:

.1 Siphon for steam service.

.2 Snubber for pulsating operation.

.3 Diaphragm assembly for corrosive service.

.4 Gasketted pressure relief back with solid front.

.5 Bronze stop cock.

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 in wells on all piping. Provide heat conductive material inside well.

.2 Install on inlet and outlet of:

.1 Hot water coils.

.2 Chilled water coils.

.3 Install wells as indicated for balancing purposes.

.4 Use extensions where thermometers are installed through insulation.

3.3 Pressure Gauges

.1 Install in the following locations:

.1 Suction and discharge of pumps, and across pump strainers. Provide a single pressure gauge with point needle valves to isolate each point.

.2 Upstream and downstream of PRV's.

.2 Use extensions where pressure gauges are installed through insulation.

END OF SECTION

PART 1 GENERAL

1.1 Related Section

.1 Section 01 01 50 General Instructions

.2 Section 01 35 33 Health and Safety Requirements

.3 Section 23 05 00 Common Work Results – Mechanical

.4 Section 23 05 48 Vibration & Seismic Control for Ductwork, Piping and Equipment

.5 All work installed under Divisions 22 and 23 shall conform to this Section.

1.2 References

.1 American National Standards Institute / Sheet Metal and Air Conditioning Contractors National Association (ANSI/SMACNA):

.1 ANSI/SMACNA 001-2008, Seismic Restraint Manual, Guidelines for Mechanical Systems, 3rd Edition.

.2 American Society of Mechanical Engineers (ASME):

.1 ASME B31.1-12, Power Piping.

.3 American Society for Testing and Materials (ASTM):

.1 ASTM A125-96(2013)e1, Standard Specification for Steel Springs, Helical, Heat-Treated.

.2 ASTM A307-12, Standard Specification for Carbon Steel Bolts and Studs, 415 kPa Tensile Strength.

.3 ASTM A563-07a, Standard Specification for Carbon and Alloy Steel Nuts.

.4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS):

.1 MSS SP58-2009, Pipe Hangers and Supports - Materials, Design and Manufacture.

.2 MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.

.3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.

.5 National Plumbing Code 2010.

1.3 System Description

.1 Design Requirements:

.1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.

.2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.

.3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.

.4 Design hangers and supports to support systems under all conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.

.5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment to be in accordance with MSS SP58.

.2 Performance Requirements:

.1 Design supports and hangers to withstand seismic events as specified Section 23 05 48 – Vibration & Seismic Control for Ductwork, Piping and Equipment.

1.4 Submittals

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

.2 Submit shop drawings and product data for following items:

.1 Bases, hangers and supports.

.2 Connections to equipment and structure.

.3 Structural assemblies.

.3 Quality assurance submittals: submit following in accordance with Section 01 01 50 – General Instructions.

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

.2 Instructions: submit manufacturer's installation instructions.

.4 Closeout Submittals:

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

1.5 Quality Assurance

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

1.6 Delivery, Storage and Handling

.1 Packing, shipping, handling and unloading:

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

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

.2 Waste Management and Disposal:

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

PART 2 PRODUCTS

2.1 Design Requirements:

.1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.

.2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.

.3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.

.4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.

.5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.

2.2 General

.1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP58.

.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.3 Upper Attachment

.1 Concrete:

.1 Inserts for cast-in-place concrete: galvanized steel wedge. ULC listed for pipe NPS 20 through NPS 203 - Grinnell/Anvil Fig. 281.

.2 Carbon steel plate with clevis for surface mount: malleable iron socket with expansion case and bolt. Minimum two expansion cases and bolts for each hanger – Grinnell/Anvil, plate fig. 49, socket fig. 290, expansion case fig. 117.

.2 Steel Beam (bottom flange):

.1 Cold piping NPS 50 and under: malleable iron C clamp - Grinnell/Anvil fig. 61.

.2 Cold piping NPS 65 and larger and all hot piping: malleable iron beam clamp - Grinnell/Anvil fig. 292.

.3 Steel Beam (top):

.1 Cold piping NPS 50 and under: malleable iron "top of beam" C clamp - Grinnell/Anvil Fig. 61.

.2 Cold piping NPS 65 and larger and all hot piping: steel jaw, hook rod with nut, spring washer and plain washer - Grinnell/Anvil fig. 227.

.4 Steel Joist:

.1 Cold piping NPS 50 and under: steel washer plate with double locking nuts.

.2 Cold piping NPS 65 and larger and all hot piping: steel washer plates with double locking nut, carbon steel clevis and malleable iron socket - Grinnell/Anvil: washer plate, fig. 60; clevis, fig. 66; socket, fig. 290.

.5 Steel Channel or Angle (bottom):

.1 Cold piping NPS 50 and under; malleable iron C clamp - Grinnell/Anvil fig. 86.

.2 Cold piping NPS 65 and larger and all hot piping; universal channel clamp - Grinnell/Anvil fig. 226.

.6 Steel Channel or Angle (top):

.1 Cold piping NPS 50 and under: malleable iron "top of beam" C clamp - Grinnell/Anvil fig. 61.

.2 Cold piping NPS 65 and larger and all hot piping: steel jaw, hook rod with nut, spring washer and plain washer - Grinnell/Anvil fig. 227.

.7 Wood beam or ceiling:

.1 Ceiling plate and flanges: malleable iron – Grinnell/Anvil Fig. 128R.

.2 Eye socket: galvanized steel – Grinnell/Anvil fig. 189 or 190.

2.4 Middle Attachments (Rod)

.1 Carbon steel black (electro-galvanized/cadmium plated for mechanical rooms) continuous threaded rod - Grinnell/Anvil fig. 146.

.2 Ensure that hanger rods are subject to tensile loading only.

2.5 Pipe Attachments

.1 Piping with less than 25 mm horizontal movement, NPS 50 and under: adjustable swivel ring hanger - Grinnell/Anvil fig. 69.

.2 Piping with less than 25 mm horizontal movement, NPS 65 and over: adjustable clevis hanger - Grinnell/Anvil fig. 260.

.3 Suspended hot piping with horizontal movement more than 25 mm, all steam piping: pipe roller - Grinnell/Anvil fig. 174 or Grinnell/Anvil fig. 181 up to NPS 152 and Grinnell/Anvil fig. 171 NPS 203 and larger.

.4 Bottom-supported hot piping and steam piping: pipe roller stand - Grinnell/Anvil fig. 271.

.5 Spring hangers; where required to offset expansion on horizontal runs which follow long vertical risers - Grinnell/Anvil fig. 171 single pipe roll hanger with Grinnell/Anvil fig. 178.

.6 Use oversize pipe hangers for:

.1 Cold piping, all sizes.

.2 Hot piping, NPS 65 and over.

.3 Steam piping (supply, condensate return), all sizes.

.7 Perforated band iron, wire or chain hangers will not be approved.

.8 All hangers for copper pipe shall be copper, copper clad, felt lined or use plastic tape wrapped pipe at hanger.

2.6 Riser Clamps

.1 Steel or cast iron pipe: galvanized carbon steel - Grinnell/Anvil fig. 261.

.2 Copper pipe: carbon steel copper finished - Grinnell/Anvil fig. CT-121.

2.7 Protection Shields

.1 Cold piping, all sizes: protection shield with calcium silicate pipe insulation under shield with uninterrupted vapour barrier.

.2 Hot piping with less than 25 mm horizontal movement, NPS 50 and under: insulation over pipe hanger.

.3 Hot piping with less than 25 mm horizontal movement, NPS 65 and over: protective shield with calcium silicate insulation under shield.

.4 Hot piping with horizontal movement more than 25 mm, all sizes: protective shield with calcium silicate insulation under shield.

.5 Steam piping (supply and condensate), all sizes: protective shield with calcium silicate insulation under shield.

2.8 Wall Supports

.1 Horizontal pipe adjacent to wall:

.1 Angle iron wall brackets with specified hangers.

.2 Vertical pipe adjacent to wall.

.1 Exposed pipe wall support for lateral movement restraint - Grinnell/Anvil fig. 262 or 263.

.2 Channel type support.

2.9 Floor Support

.1 Horizontal pipe.

.1 Do not support piping from the floor unless specifically indicated.

.2 Vertical pipe.

.1 Mid-point of risers between floor slabs - adjustable fabricated steel supports.

PART 3 EXECUTION

3.1 Installation

.1 Install in accordance with:

.1 Manufacturer's instructions and recommendations.

.2 Vibration Control Devices:

.1 Install on piping systems per Section 23 05 48 – Vibration and Seismic Controls for Ductwork, Piping and Equipment.

.3 Clevis plates:

.1 Attach to concrete with 4 minimum concrete inserts, one at each corner.

.4 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations. Supporting piping from underside of light weight roof deck (without concrete) is not permitted.

.5 Use expansion anchor on existing concrete structure.

3.2 Hanger Spacing

.1 HVAC piping: in accordance with table below.

.2 Plumbing piping: in accordance with the most stringent requirements of the table below as well as the following:

.1 National. Plumbing Code.

.2 Authority Having Jurisdiction.

.3 Pipe hanger rods shall be sized in accordance to SMACNA Seismic Restraint Manual based on Seismic Hazard Level (SHL). For SHL, see Section 23 05 48 – Vibration and Seismic Controls for Ductwork, Piping and Equipment.

MAXIMUM HANGER SPACING						
PIPE DIA. NPS	STEEL SCH.40	COPPER L,K Hard Drawn	CAST.I STD.	GLASS	ABS/PVC	PEX
12	1.8 m	1.8 m			1.2 m	0.8 m
20 & 25	2.4 m	2.4 m			1.2 m	0.8 m
32	2.4 m	3.0 m			1.2 m	0.8 m
40 & 50	2.4 m	3.0 m	3.0 m		1.2 m	0.8 m
65, 75, 100 & 125	2.4 m	3.0 m	3.0 m	2.4 m	1.2 m	0.8 m
152 & 203	3.0 m	3.0 m	3.0 m	2.4 m	1.2 m	0.8 m

3.3 Hanger Installation

.1 Install hanger so that rod is vertical under operating conditions.

.2 Adjust hangers to equalize load.

.3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.4 Horizontal Movement

.1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.

.2 Where horizontal pipe movement is less than 13mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.5 Final Adjustment

.1 Adjust hangers and supports:

.1 Ensure that rod is vertical under operating conditions.

.2 Equalize loads.

.2 Adjustable clevis:

.1 Tighten hanger load nut securely to ensure proper hanger performance.

.2 Tighten upper nut after adjustment.

3.6 Cleaning

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

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 Summary

.1 Section includes:

.1 Heat tracing cables for pipes and tanks including controls and installation.

1.2 Related Sections

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.3 References

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Safety Data Sheets (SDS)

1.4 Submittals

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 – Submittals Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Safety Data Sheets (SDS) 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.

.3 Instructions: submit manufacturer's installation instructions.

1.5 Quality Assurance

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 – Health and Safety Requirements.

1.6 Delivery, Storage, And Handling

.1 Packing, shipping, handling and unloading:

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

.2 Waste Management and Disposal:

.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.

PART 2 PRODUCTS

2.1 Pipe Tracing Heating Cables

.1 Type A: Parallel zone system, 2 conductor stranded copper bus wires covered with FEPTEFLON or fluoropolymer inner insulation. Resistance heating cable connected to bus wires. Resistance heating cable connection to alternate bus wires covered with teflon tape and overall FEP protective jacket. Heating capacity: as indicated in W/m. For use with 120 V power supply.

.2 Type B: Copper alloy conductor with X-link polyethylene insulation copper ground braid, PVC protective jacket, cold leads factory spliced and as indicated. Heating capacity: as indicated in W/m. For use with 120 V power supply.

.3 Type C: Mineral insulated copper conductor with stainless steel sheath and HDPE jacket factory spliced and hermetically sealed cold leads and as indicated. Heating capacity: as indicated in W/m. For use with 120 V power supply.

.4 Type D: Self-limiting heating cable with copper ground wire, thermoplastic rubber primary and overall jackets. Heating capacity: as indicated in W/m. For use with 120 V power supply.

2.2 Controls

.1 Thermostat: remote bulb type, to Section 23 09 33 - Electric and Electronic Control Systems for HVAC. Rating as indicated.

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 Type A heating cables in accordance with manufacturer's instructions. Coordinate installation with pipe insulation application.

.2 Install Type B, C, D heating cables in accordance with manufacturer's instructions. Distribute and fasten cable evenly on pipe or tank using pipe strap or tape at maximum spacing 0.5 m. Ensure that heating cables do not touch or cross each other at any point. Run only cold leads in conduit and ensure sensing bulb does not touch cable. Ground shield to building ground. Coordinate cable installation with insulation application. Loop additional cable at fittings, valves, and flanges.

.3 Make power and control connections.

3.3 Field Quality Control

.1 Tests:

.1 Perform tests in accordance with Section 26 05 00 – Common Work Results – Electrical.

.2 Use 500 V Megger to test cables for continuity and insulation value and record readings before, during and after installation.

.3 Where resistance of 50 megohms or less is measured, stop work and advise the departmental representative.

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.

3.5 Commissioning

.1 Perform tests in accordance with Section 26 05 00 – Common Work Results – Electrical and Section 01 91 13 – General Commissioning (Cx) Requirements.

.2 Use 500 V megger to test cables for continuity and insulation value and record readings before, during and after installation.

.3 Where resistance of 50 megohms or less is measured, stop work and advise Departmental Representative.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 01 01 50 General Instructions

.2 Section 23 05 00 Common Work Results – Mechanical

.3 This Section applies to all related work under Divisions 22 and 23.

1.2 References

.1 National Building Code of Canada (NBC)

.2 American National Standards Institute / Sheet Metal and Air Conditioning Contractors National Association (ANSI/SMACNA):

.1 ANSI/SMACNA 001-2008, Seismic Restraint Manual, Guidelines for Mechanical Systems, 3rd Edition.

1.3 Shop Drawings

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

.2 Provide vibration isolation systems shop drawings complete with performance and product data. Shop drawings shall demonstrate compliance with the National Building Code and shall bear the seal of a Professional Engineer.

.3 Provide detailed drawings of all seismic restraint systems for piping and equipment.

1.4 Waste Management and Disposal

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

.2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.

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

.4 Dispose of packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

PART 2 PRODUCTS

2.1 Vibration Isolation System – General

.1 Performance of vibration isolation systems shall be designed by manufacturer specializing in vibration isolation materials and devices.

.2 Size and shape of bases type shall be coordinated with submitted equipment.

.3 Products shall of the same manufacturer unless otherwise noted.

2.2 Elastomeric Pads

.1 Type EP1 - neoprene waffle or ribbed; 9 mm minimum thick; 50 durometer; maximum loading 350 kPa.

.2 Type EP2 - rubber waffle or ribbed; 9 mm minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.

.3 Type EP3 - neoprene-steel-neoprene; 9 mm minimum thick neoprene bonded to 1.71 mm [16 gauge] steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.

.4 Type EP4 - rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm [16 gauge] steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.

2.3 Hangers

.1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30° arc without metal to metal contact.

.2 Type H1 - neoprene - in-shear, molded with rod isolation bushing which passes through hanger box.

.3 Type H2 - stable spring, elastomeric washer, cup with molded isolation bushing which passes through hanger box.

.4 Type H3 - stable spring, elastomeric element, cup with molded isolation bushing which passes through hanger box.

.5 Type H4 - stable spring, elastomeric element with pre-compression washer and nut with deflection indicator.

2.4 Acoustic Barriers for Anchors and Guides

.1 Acoustic barriers: between pipe and support, consisting of 25 mm minimum thick heavy duty duck and neoprene isolation material.

2.5 Flexible Pipe Connectors

.1 Inner corrugated hose: stainless steel.

.2 Outer braid: Braided wire mesh stainless steel outer jacket.

.3 Type of end connection: threaded for 50mm or smaller; flange for 65mm or larger.

.4 Operating conditions:

.1 Working pressure: 1379 kPa.

.2 Working temperature: 4540 °C.

2.6 Seismic Control Measures

.1 General:

.1 Design anchorage and attachment methods for all systems and/or equipment as specified herein.

.2 Seismic control systems to work in all directions.

.3 Fasteners and attachment points to resist same maximum load as seismic restraint.

.4 Drilled or power driven anchors and fasteners not permitted.

.5 No equipment, equipment supports or mounts to fail before failure of structure.

.6 Supports of cast iron or threaded pipe not permitted.

.7 Seismic control measures not to interfere with integrity of firestopping.

.8 For equipment mounted on housekeeping pad, specify the minimum distance between anchor bolt and edge of housekeeping pad.

.2 Static equipment:

.1 Anchor equipment to equipment supports. Anchor equipment supports to structure.

.2 Seismic restraints:

.1 Cushioning action to be gentle and steady.

.2 Shall never reach metal-like stiffness.

.3 Vibration isolated equipment:

.1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9mm clearance during normal operation of equipment and systems between seismic restraint and equipment.

.2 Provide seismic restraints in addition to vibration isolation system to resist complete isolator unloading.

.4 Piping systems:

.1 Provide seismic restraints for all piping in accordance to the latest edition of SMACNA Seismic Restraint Manual.

.2 To be compatible with requirements for anchoring and guiding of piping systems.

.3 Wet weight of piping shall be to be used for designing seismic restraint systems.

.4 Small pipes may be rigidly secured to larger pipes for restraint purposes, but not reverse.

.5 Where cable is used for restraining vibration isolated piping systems, install cable with sufficient slack to avoid short-circuiting of vibration isolators.

.5 Ductwork systems:

.1 Provide seismic restraints for all ductwork in accordance to the latest edition of SMACNA Seismic Restraint Manual as described below:

.1 All rectangular ducts with cross sectional areas 0.56m^2 and larger.

.2 All round ducts with diameters 711 mm and larger.

.2 Seismic restraints may be omitted for the following conditions:

.1 All ductwork suspended by hangers 305mm or less in length, as measured from the top of the duct to the bottom of the structural support for the hanger.

.2 Seismic restraints may not be omitted for post-disaster occupancies.

.6 Bracing methods:

.1 Approved by Departmental Representative.

.2 Structural angles or channels.

.3 Cable restraint system incorporating grommets, shackles and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points. Incorporate neoprene into cable connections to reduce shock loads.

PART 3 EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Seismic control measures to meet requirements of NBC.

.2 Install vibration isolation equipment in accordance with manufacturer's instructions and adjust mountings to level equipment.

.3 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.

.4 Where isolation is bolted to floor use vibration isolation rubber washers.

.5 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.3 Field Quality Control

.1 Provide the services of the Professional Engineer(s) who designed the restraint systems for "Field Review" of the installed components, and submit the following to the Departmental Representative:

.1 Schedule B, signed and sealed; provided at the commencement of the project.

.2 Signed and sealed shop drawings of seismic restraints for equipment, piping and ductwork; provided prior to installation.

.3 Typewritten inspection reports; provided during the construction period.

.4 Schedule C-B, signed and sealed; provided after performing "Field Review".

3.4 Cleaning

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

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 Related Sections

.1 Section 01 01 50 General Instructions

.2 Section 01 35 33 Health and Safety Requirements

.3 Section 23 05 00 Common Work Results – Mechanical

.4 This Section applies to all related work under Divisions 21, 22 and 23.

1.2 References

.1 Canadian Standards Association (CSA International):

.1 CAN/CSA B149.1, Natural Gas and Propane Installation Code.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.

.2 CAN/CGSB-24.3, Identification of Piping Systems.

.3 National Fire Protection Association (NFPA)

.1 NFPA 13, Standard for the Installation of Sprinkler Systems.

.2 NFPA 14, Standard for the Installation of Standpipe and Hose Systems.

1.3 Quality Assurance

.1 Quality assurance submittals: submit following in accordance with Section 01 01 50 – General Instructions.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

1.4 Delivery, Storage, and Handling

.1 Packing, shipping, handling and unloading:

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

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

.2 Waste Management and Disposal:

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

.2 Dispose of unused paint and coating material at official hazardous material collections site approved by Departmental Representative.

.3 Do not dispose of unused paint and coating material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

PART 2 - PRODUCTS

2.1 Manufacturer's Equipment Nameplates

.1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.

.2 Lettering and numbers raised or recessed.

.3 Information to include, as appropriate:

.1 Equipment: manufacturer's name, model, size, serial number, capacity.

.2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 System Nameplates

.1 Colours:

.1 Hazardous: red letters, white background.

.2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).

.2 Construction:

.1 3 mm thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:

.1 Conform to following table:

	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	11 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 Identification for Departmental Representative's 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.

2.3 Piping Systems Governed by Codes

.1 Identification:

.1 Natural gas and propane: to CSA/CGA B149.1.

.2 Sprinklers: to NFPA 13.

2.4 Identification of Piping Systems

.1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.

.2 Pictograms:

.1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.

.3 Legend:

.1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.

.4 Arrows showing direction of flow:

.1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.

.2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.

.3 Use double-headed arrows where flow is reversible.

.5 Extent of background colour marking:

.1 To full circumference of pipe or insulation.

.2 Length to accommodate pictogram, full length of legend and arrows.

.6 Materials for background colour marking, legend, arrows:

.1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.

.2 Other pipes: pressure sensitive [plastic-coated cloth] [vinyl] with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.

.7 Colours and Legends:

.1 Where not listed, obtain direction from Departmental Representative.

.2 Colours for legends, arrows: to following table:

Background colour:	**Legend, arrows:**
Yellow	BLACK
Green	WHITE
Red	WHITE

.3 Background colour marking and legends for piping systems:

Contents	Background Colour Marking	Legend
Hot water heating supply	Yellow	HEATINGSUPPLY
Hot water heating return	Yellow	HEATINGRETURN
Chilled water supply	Green	CH. WTR. SUPPLY
Chilled water return	Green	CH. WTR. RETURN
Domestic cold water supply	Green	DOM.CWS
Storm water	Green	STORM
Sanitary	Green	SAN
Plumbing vent	Green	SAN.VENT
Natural gas and propane	to Codes	

2.5 Identification Ductwork Systems

.1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.

.2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

2.6 Valves, Controllers

.1 Plastic tags with 12 mm stamped identification data.

.2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.7 Controls Components Identification

.1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.

.2 Inscriptions to include function and (where appropriate) fail-safe position.

2.8 Language

.1 Identification in English.

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 has been completed.

3.3 Installation

.1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.

.2 Provide CSA registration plates as required by respective agency.

.3 Identify systems, equipment to conform to Departmental Representative's 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.

3.7 Cleaning

.1 Proceed in accordance with Section 01 74 11 – Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 General

.1 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 Qualifications of TAB Company

.1 Testing and balancing shall be performed by an agency that specializes in this type of work. Provide proof that the agency has successfully completed five projects of similar size and scope

.2 All work shall be performed by persons with proven ability and thoroughly versed in the type of testing and balancing. Submit names and references for review by the Departmental Representative prior to work being carried out.

.3 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:

.1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1-2002.

.2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-1998.

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-2002.

.4 Recommendations and suggested practices contained in the TAB Standard: mandatory.

.5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.

.6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.

.7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.

.8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.

.1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.

.2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.3 Purpose of TAB

.1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads

.2 Adjust and regulate installed equipment and systems so as to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

.3 Balance systems and installed equipment to regulate flow rates to match load requirements over full operating ranges.

1.4 Exceptions

.1 TAB of systems and equipment regulated by codes, standards to be to satisfaction of authority having jurisdiction.

.2 TAB of existing equipment already in operation but not affected by the renovation.

1.5 Coordination

.1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule so as to ensure completion before acceptance of project.

.2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.6 Pre-TAB Review

.1 Review contract documents before project construction is started. Confirm in writing to Departmental Representative adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.

.2 Review specified standards and report to Departmental Representative in writing all proposed procedures which vary from standard.

.3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

.4 CFIA shall provide the latest testing and balancing reports for the existing system (2007 and 2009). TAB contractor to review prior to commencing work.

1.7 Start-Up

.1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.

.2 Follow special start-up procedures specified elsewhere in Division 23.

1.8 Operation of Systems During TAB

.1 Operate systems for length of time required for TAB and as required by Departmental Representative for verification of TAB reports.

1.9 Start of TAB

.1 Notify Departmental Representative 7 days prior to start of TAB.

.2 Start TAB when building is essentially completed, including:

.1 Installation of ceilings, doors, windows, other construction affecting TAB.

.2 Application of weather-stripping, sealing, caulking.

.3 All pressure, leakage, other tests specified elsewhere Division 23.

.4 All provisions for TAB installed and operational.

.3 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:

.1 Proper thermal overload protection in place for electrical equipment.

.2 Air systems:

.1 Filters in place, clean.

.2 Duct systems clean.

.3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.

.4 Correct fan rotation.

.5 Fire, smoke, volume control dampers installed and open.

.6 Coil fins combed, clean.

.7 Access doors, installed, closed.

.8 Outlets installed, volume control dampers open.

.3 Liquid systems:
- .1 Flushed, filled, vented.
- .2 Correct pump rotation.
- .3 Strainers in place, baskets clean.
- .4 Isolating and balancing valves installed open.
- .5 Calibrated balancing valves installed, at factory settings.
- .6 Chemical treatment systems complete, operational.

1.10 Application Tolerances

.1 Do TAB to following tolerances of design values:
- .1 LAB HVAC systems: plus 10%, minus 0%.
- .2 Hydronic systems: plus or minus 10%.

1.11 Accuracy Tolerances

.1 Measured values to be accurate to within plus or minus 2% of actual values.

1.12 Instruments

.1 Prior to TAB, submit to Departmental Representative list of instruments to be used together with serial numbers.

.2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

.3 Calibrate within 3 months of TAB. Provide certificate of calibration to Departmental Representative.

1.13 Submittals

.1 Submit, prior to commencement of TAB:

.2 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.14 Preliminary TAB Report

.1 Prior to calling Substantial Completion, submit for checking and approval of Departmental Representative prior to submission of formal TAB report, sample of rough TAB sheets. Include:
- .1 Details of instruments used.
- .2 Details of TAB procedures employed.
- .3 Calculations procedures.
- .4 Summaries.

1.15 TAB Report

.1 Format to be in accordance with Associated Air Balance Council Manual.

.2 TAB report to show results in SI units and to include:
- .1 Project record drawings.
- .2 System schematics.

.3 Include final TAB report in O&M manual. Provide three (3) copies of final TAB Report to Departmental Representative.

.4 Submitted TAB report to be in English, in D-ring Binder, complete with index tabs.

1.16 Verification

.1 Reported results subject to verification by Departmental Representative.

.2 Provide manpower and instrumentation to verify up to 30% of reported results.

.3 Number and location of verified results to be at discretion of Departmental Representative.

.4 Pay costs to repeat TAB as required to satisfaction of Departmental Representative.

1.17 Settings

.1 After TAB is completed to satisfaction of Departmental Representative, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.

.2 Permanently mark settings to allow restoration at any time during life of facility. Markings not to be eradicated or covered in any way.

1.18 Completion of TAB

.1 TAB to be considered complete when final TAB Report received and approved by Departmental Representative.

1.19 Air Systems

.1 Standard: TAB to be to most stringent of this section or TAB standards of AABC, NEBB, SMACNA and ASHRAE.

.2 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop, temperatures (dry bulb, wet bulb, dew point), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.

.3 Locations of equipment measurements: To include, but not be limited to, following as appropriate:

.1 Inlet and outlet of dampers, filter, coil, humidifier, air valve, fan, other equipment causing changes in conditions.

.2 At controllers, controlled device.

.4 Locations of systems measurements to include, but not be limited to, following as appropriate: Main ducts, main branch, sub-branch, run-out (grille, register or diffuser).

.5 TAB to include:

.1 All new equipment.

.2 Manifold system after installation of each air valve.

1.20 Water Systems (HVAC):

.1 Water circulating systems shall be balanced by means of balancing fittings and tabulated results.

.2 Standard: TAB to be to most stringent of this section or TAB standards of AABC, NEBB, SMACNA and ASHRAE.

.3 Measurements to include, but not limited to, following as appropriate for systems equipment, components, controls: flow rate, static pressure, pressure drop (or loss), temperature, specific gravity, density, RPM, electrical power, voltage, noise, vibration.

.4 Locations for equipment measurement to include, but not be limited to, following as appropriate:

.1 Inlet and outlet of heat exchangers (source and sink), coils, humidifiers, pumps, PRVs, control valves, other equipment causing changes in conditions.

1.21 New Air Handlers [AHU-101, AHU-102, and AHU-302]

.1 Test and report individual fan performance.
.2 Measure, adjust and report static pressure set points for DDC.
.3 Measure and report heating and chilled water flow rates and temperatures (both water and glycol sides for AHU-101/102); airflow rates, supply air temperatures (hot AND cold decks), motor amperage.
.4 Adjust VFDs for AHU-101/102 and AHU-302 as needed to balance airflow.

1.22 New Plume Dilution Exhaust Fan and Air Valves [PDEF-1 and V-XXX]

.1 Test and report individual fan performance.
  a. Balance using VFDs.
.2 For initial TAB
  a. Balance each exhaust main manual volume damper for minimum duct velocity in each main duct line. **This testing is to be completed prior to connecting new exhaust ducts to existing exhaust streams**.
.3 For remaining TABs
  a. Rebalance volume dampers as required to achieve minimum duct velocity after connecting each exhaust stream.
  b. Dampers are to be adjusted after connecting each new exhaust stream.
  c. Balance air valves to match airflow given in provided TAB report.

1.23 Other TAB Requirements

.1 Testing of Fire Dampers & Fire Stop Flaps:
  .1 Conduct a "trip" test on all fire dampers and fire stop flaps to ensure that fire mechanisms function correctly and that dampers attain a fully closed position when tripped.
  .2 Send a copy of test results tabulating the fire damper location, size, and date of trip test, to the Departmental Representative for record purposes. Copies shall also be inserted in Equipment Maintenance Manuals.
  .3 Dampers and Flaps which fail to function correctly shall be re-tested after corrective action has been completed. Any fusible links damaged when conducting tests shall be replaced by the Contractor. A signed and dated test label shall be attached to each fire damper upon completion of test and resetting of fire damper.
.2 Zone pressure differences:
  .1 Adjust HVAC systems, equipments, controls to establish existing system air pressures with all systems in all possible combinations of normal operating modes.
.3 Duct Leakage Test:
  .1 To be tested by install contractor and certified by TAB agent. See section 23 05 94 – Pressure testing of duct air systems.
.4 Measurement of noise and vibration from equipment specified in Mechanical Division:
  .1 Standard 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.
  .2 Vibration measurements around each piece of rotating equipment.
  .3 Sound measurements in each octave band around each piece of rotating equipment.
  .4 Induct sound measurements in each octave band at each fan inlet and discharge.
  .5 Induct sound measurements in each octave band at each air handling unit intake, return and discharge.

.6 Sound measurements in each octave band for each normally occupied room with air handling equipment running.

1.24 CAD Drawings

.1 CAD Drawing files of the heating and ventilating tender drawings will be made available to the balancing contractor if requested. To cover administrative time and cost of retrieval and transmission of files, a charge of 25.00 will be made for each drawing requested, to an upset maximum of $150.00

.1 Conduct a "trip" test on all fire dampers and fire stop flaps to ensure that fire mechanisms function correctly and that dampers attain a fully closed position when tripped.

1.25 Post- Occupancy TAB

.1 Measure DBT, WBT (or %RH), air velocity, air flow patterns, NC levels, in occupied zone of areas designated by Departmental Representative.

.2 Participate in systems checks twice during Warranty Period - #1 approximately 3 months after acceptance and #2 within 3 months of termination of Warranty Period.

PART 2 - PRODUCTS

2.1 Not Used

.1 Not used.

PART 3 - EXECUTION

3.1 General

.1 Test and balance new equipment and systems serving the existing building.

END OF SECTION

PART 1 GENERAL

1.1 Summary

.1 Related Sections:

.1	Section 01 01 50	General Instructions
.2	Section 01 35 33	Health and Safety Requirements
.3	Section 01 91 00	Commissioning
.4	Section 23 05 00	Common Work Results – Mechanical
.5	Section 23 05 93	Testing, Adjusting and Balancing
.6	Section 23 31 14	Metal Ducts
.7	Section 23 33 14	Dampers

1.2 References

.1 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)

.1 SMACNA HVAC Air Duct Leakage Test Manual, 2nd Edition, 2012.

1.3 Submittals

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

.2 Test Reports: submit certified test reports from approved 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 Departmental Representative for approval at least three months before proposed date of first series of tests. Do not start tests until approval received in writing from Departmental Representative.

.2 Prepare report of results and submit to Departmental Representative within 48 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.

1.4 Quality Assurance

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

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 Departmental Representative at least three months before anticipated start date.

.4 Test instruments: calibrated and certificate of calibration deposited with Departmental Representative no more than 28 days before start of tests.

.5 Re-calibrated every six months thereafter.

2.2 Equipment Tolerance

.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 to be 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 Reference Standard.

.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. Prorate 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 and mixing boxes and duct on downstream side of VAV box: leakage 2%.

.3 Large low pressure duct systems up to 500 Pa: leakage 2%.

.4 HP 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.

3.5 Field Quality Control

.1 Performance Verification:

.1 Departmental Representative to verify reported results.

.2 To be certified by same TAB agency approved by Departmental Representative to undertake TAB on this project.

3.6 Cleaning

.1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 01 50	General Instructions
.2	Section 01 35 33	Health and Safety Requirements
.3	Section 23 05 00	Common Work Results - Mechanical
.4	Section 23 05 29	Hangers and Supports for HVAC Piping and Equipment
.5	Section 23 05 53	Mechanical Identification

1.2 References

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

- .1 ANSI/ASHRAE/IESNA 90.1-2013; Energy Standard for Buildings Except Low-Rise Residential Buildings.

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

- .1 ASTM B209M-10, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
- .2 ASTM C335/C335M-10e1, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
- .3 ASTM C411-11, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
- .4 ASTM C449-07(2013), Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
- .5 ASTM C547-12, Standard Specification for Mineral Fiber Pipe Insulation.
- .6 ASTM C553-13, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- .7 ASTM C612-14, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
- .8 ASTM C795-08(2013), Standard Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
- .9 ASTM C921-10, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)

- .1 CGSB 51-GP-52Ma-1989, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.4 South Coast Air Quality Management District (SCAQMD), California State

- .1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

.5 Thermal Insulation Association of Canada (TIAC):

.1 Mechanical Insulation Best Practice Guide, 2013.

.6 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102-07, Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701-11, Standard for Thermal Insulation Polyotrene, Boards and Pipe Covering.

.7 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Safety Data Sheets (SDS).

1.3 Submittals

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 – General Instructions. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Safety Data Sheets (SDS) in accordance with Section 01 01 50 – General Instructions.

.3 Shop Drawings:

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

.4 Quality assurance submittals: submit following in accordance with Section 01 01 50 – General Instructions.

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

.2 Instructions: submit manufacturer's installation instructions.

1.4 Quality Assurance

.1 Qualifications:

.1 Installer: qualified to standards of TIAC.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

1.5 Delivery, Storage and Handling

.1 Packing, shipping, handling and unloading:

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

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

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

.2 Storage and Protection:

.1 Protect from weather, construction traffic.

.2 Protect against damage.

.3 Store at temperatures and conditions required by manufacturer.

.3 Waste Management and Disposal:

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

.2 Place excess or unused insulation and insulation accessory materials in designated containers.

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

.4 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.

PART 2 PRODUCTS

2.1 Fire and Smoke Rating

.1 In accordance with CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 Insulation

.1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C 335.

.3 TIAC Code C-1: Rigid mineral fibre board to ASTM C612. Provide factory applied vapour retarder jacket to CGSB 51-GP-52Ma as scheduled in PART 3 of this Section.

.4 TIAC Code C-2: Mineral fibre blanket to ASTM C553. Provide factory applied vapour retarder jacket to CGSB 51-GP-52Ma as scheduled in PART 3 of this section.

.1 Mineral fibre: to ASTM C553.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to ASTM C553.

.5 Evidence shall be provided to the Departmental Representative on the site of ULC listings of all products being used. Duct insulation adhesives and coatings shall be non-toxic as defined by WCB Regulations.

2.3 Jackets

.1 Aluminum foil laminate:

.1 Multi-layer aluminum foil laminate [minimum 5 ply]; highly puncture and resistant, non-permeable vapour barrier for complete moisture protection. Inhibits mold growth. UL listed. UV-resistant.

.2 Total thickness: 0.2 mm.

.3 Substrate thickness: 0.15 mm sheet.

.4 Finish: Aluminum, stucco embossed.

.5 Adhesive: cold weather acrylic adhesive.**2.4 Accessories**

.1 Vapour retarder lap adhesive:

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

.2 Indoor Vapour Retarder Finish:

.1 Vinyl emulsion type acrylic, compatible with insulation.

.3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.

.4 Outdoor Vapour Retarder Mastic:

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: Fibrous glass, untreated 305 g/m².

.5 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.

.6 Contact adhesive: quick-setting

.1 Maximum VOC limit 80 g/L to SCAQMD Rule 1168.

.7 Canvas adhesive: washable.

.1 Maximum VOC limit 250 g/L to SCAQMD Rule 1168.

.8 Tie wire: 1.5 mm stainless steel.

.9 Banding: 19 mm wide, 0.5 mm thick stainless steel.

.10 Facing: 25 mm stainless steel hexagonal wire mesh stitched on one face of insulation.

.11 Fasteners: 2 mm diameter pins with 35 mm square clips, length to suit thickness of insulation.

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 ductwork systems 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 as indicated.

.3 Use two layers with staggered joints when required nominal thickness exceeds 75 mm.

.3 Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Hangers, supports to be outside vapour retarder jacket.

.5 Seal vapor barrier penetrations with vapor barrier adhesive.

.6 Supports, Hangers in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

.7 Fasteners: At 300 mm oc in horizontal and vertical directions, minimum two rows each side.

.8 All ductwork exposed to weather shall have waterproof seams for weathertight construction. Ductwork exposed to weather which are not insulated or finish painted, shall be coated with two applications of bitumastic waterproofing compound to prevent corrosion. Exposed ducts, which are insulated, shall have aluminum jacket.

3.4 Duct Insulation Schedules

.1 Insulation types and thicknesses: Conform to following table:

	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular, cold, dual temperature supply air ducts	C-1	Yes	50
Rectangular, warm air ducts	C-1	No	25
Outside air ducts to mixing plenum	C-1	Yes	25
Exhaust ducts between dampers and louvers	C-1	No	25
Rectangular ducts outside	C-1	Special	50
Round ducts outside	C-2	Special	50
Outdoor exhaust duct, exposed to weather	C-2	Special	50

.2 Finish: Conform to following table:

	TIAC Code	
	Rectangular	Round
Indoor, exposed elsewhere	CRF/2	CRD/2
Outdoor, exposed to weather	CRF/3	CRD/3

3.5 Cleaning

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

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 01 01 50 — General Instructions

.2 Section 01 35 33 — Health and Safety Requirements

.3 Section 23 05 00 — Common Work Results - Mechanical

.4 Section 23 05 29 — Hangers and Supports for HVAC Piping and Equipment

1.2 References

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE/IESNA 90.1-2013; Energy Standard for Buildings Except Low-Rise Residential Buildings.

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

.1 ASTM B209M-10, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).

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

.3 ASTM C411-11, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

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

.5 ASTM C547-12, Standard Specification for Mineral Fiber Pipe Insulation.

.6 ASTM C553-13, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

.7 ASTM C612-14, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

.8 ASTM C795-08(2013), Standard Specification for Thermal Insulation for Use with Austenitic Stainless Steel.

.9 ASTM C921-10, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma-1989, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.4 Thermal Insulation Association of Canada (TIAC):

.1 Mechanical Insulation Best Practice Guide, 2013.

.5 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102-07, Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701-11, Standard for Thermal Insulation Polyotrene, Boards and Pipe Covering.

.6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Safety Data Sheets (SDS).

1.3 Submittals

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 – General Instructions. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Safety Data Sheets (SDS) in accordance with Section 01 01 50 – General Instructions.

.3 Shop Drawings:

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

.4 Quality assurance submittals: submit following in accordance with Section 01 01 50 – General Instructions.

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

.2 Instructions: submit manufacturer's installation instructions.

1.5 Quality Assurance

.1 Qualifications:

.1 Installer: Qualified to standards of TIAC.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

1.6 Delivery, Storage and Handling

.1 Packing, shipping, handling and unloading:

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

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

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

.2 Storage and Protection:

.1 Protect from weather, construction traffic.

.2 Protect against damage.

.3 Store at temperatures and conditions required by manufacturer.

.3 Waste Management and Disposal:

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

.2 Place excess or unused insulation and insulation accessory materials in designated containers.

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

.4 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.

PART 2 PRODUCTS

2.1 Fire and Smoke Rating

.1 In accordance with CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 Insulation

.1 Mineral fibre: includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24° C mean temperature when tested in accordance with ASTM C 335.

.3 TIAC Code A-1: Rigid moulded mineral fibre without factory applied vapour retarder jacket.

.1 Mineral fibre: ASTM C547.

.2 Maximum "k" factor: ASTM C547.

.4 TIAC Code A-3: Rigid moulded mineral fibre with factory applied vapour retarder jacket.

.1 Mineral fibre: ASTM C547.

.2 Jacket: to CGSB 1-GP-52Ma.

.3 Maximum "k" factor: ASTM C547.

.5 TIAC Code C-1: Rigid mineral fibre board, unfaced.

.1 Mineral fibre: ASTM C612.

.2 Maximum "k" factor: ASTM C612.

.6 TIAC Code C-4: Rigid mineral fibre board faced with factory applied vapour retarder jacket.

.1 Mineral fibre: ASTM C612.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: ASTM C612.

.7 TIAC Code C-2: Mineral fibre blanket unfaced or faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).

.1 Mineral fibre: ASTM C553.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: ASTM C553.

.8 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.

.4 Certified by manufacturer free of potential stress corrosion cracking corrodants.

.9 TIAC Code A-2: Rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.

.1 Insulation: ASTM C533.

.2 Maximum "k" factor: ASTM C533.

.3 Design to permit periodic removal and re-installation.

2.3 Cement

.1 Thermal insulating and finish

.1 To: ASTM C 449/C449M.

.2 Air drying on mineral wool, to ASTM C449.

2.4 Jackets

.1 Polyvinyl Chloride (PVC):

.1 One-piece moulded type and sheet to CGSB 51-GP-53M with pre-formed shapes as required.

.2 Colours: white.

.3 Minimum service temperatures: -20° C.

.4 Maximum service temperature: 65° C.

.5 Moisture vapour transmission: 0.02 perm.

.6 Thickness:

.1 Indoor: 0.5 mm [0.020”].

.2 Outdoor: UV rated material at least 0.7 mm [0.030”].

.7 Fastenings:

.1 Use solvent weld adhesive compatible with insulation to seal laps and joints.

.8 Covering adhesive: Compatible with insulation.

.2 Canvas:

.1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.

.2 Lagging adhesive: Compatible with insulation.

.3 Aluminum:

.1 To ASTM B 209.

.2 Thickness: 0.50mm [0.02”].

.3 Finish: Stucco embossed or corrugated.

.4 Joining: Longitudinal and circumferential slip joints with 50mm [2”] laps.

.5 Fittings: 0.50mm [0.02”] thick die-shaped fitting covers with factory-attached protective liner.

.6 Metal jacket banding and mechanical seals: stainless steel, 19mm [1-1/2”] wide, 0.50mm [0.02”] thick at 300mm [12”] spacing.

2.5 Insulation Securements

.1 Tape: Self-adhesive, aluminum, reinforced, 50 mm [2”] 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 [3/4”] wide, 0.5 mm thick.

.6 Facing: 25 mm steel hexagonal wire mesh on both faces of insulation.

.7 Fasteners: 2 mm diameter pins with 35 mm [1 1/4”] square clips. Length of pin to suit thickness of insulation.

2.6 Vapour Retarder Lap Ahesive

.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

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 ductwork systems complete, witnessed and certified.

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

3.3 Installation

.1 Install in accordance with TIAC National Standards.

.1 Hot equipment: To TIAC code 1503-H.

.2 Cold equipment: to TIAC code 1503-C.

.2 Provide vapour retarder as recommended by manufacturer.

.3 Apply materials in accordance with manufacturer's instructions and as indicated.

.4 Use two layers with staggered joints when required nominal thickness exceeds 75 mm.

.5 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Hangers, supports to be outside vapour retarder jacket.

.6 Supports, Hangers in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

3.4 Removable, Pre-fabricated Insulation and Enclosures

.1 Application: At expansion joints, valves, primary flow measuring elements, flanges and unions at equipment.

.2 Installation to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

3.5 Equipment Insulation Schedules

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

.2 Hot Equipment:

.1 TIAC code [A-1] [or] [C-1] with mechanical fastenings, wire or bands and 13 mm cement reinforced with one layer of reinforcing mesh.

.2 TIAC code C-2 unfaced with [wire] [or] [bands] and 13 mm cement precede by one layer of reinforcing mesh.

.3 Thicknesses per table below:

	Thickness (mm)
Domestic hot water storage tanks	25 (1")
Heat exchangers	50 (2")
Steam condensate receiver	50 (2")
Deaerator-feedwater heaters	50 (2")
All heat dissipating equipment related to steam systems	50 (2")

.3 Cold equipment:

.1 TIAC C-2 faced with vapour retardant jacket and with bands and 13 mm cement preceded by one layer of reinforcing mesh.

.4 Finishes:

.1 Equipment in mechanical rooms: TIAC code CEF/1 with PVC jacket.

.2 Equipment elsewhere: TIAC code CEF/2 with [13 mm cement] jacket.

3.5 Cleaning

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

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 Related Sections

.1	Section 01 01 50	General Instructions
.2	Section 01 35 33	Health and Safety Requirements
.3	Section 07 92 00	Joint Sealing.
.4	Section 23 05 00	Common Work Results - Mechanical
.5	Section 23 05 05	Installation of Pipe Work.
.6	Section 23 05 29	Hangers and Supports for Piping and Equipment
.7	Section 23 05 53	Mechanical Identification.
.8	Section 23 07 16	Thermal Insulation for Equipment.

1.2 References

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

- .1 ANSI/ASHRAE/IESNA 90.1-2013; Energy Standard for Buildings Except Low-Rise Residential Buildings.

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

- .1 ASTM B209M-10, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
- .2 ASTM C335/C335M-10e1, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
- .3 ASTM C411-11, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
- .4 ASTM C449-07(2013), Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
- .5 ASTM C547-12, Standard Specification for Mineral Fiber Pipe Insulation.
- .6 ASTM C553-13, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- .7 ASTM C612-14, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
- .8 ASTM C795-08(2013), Standard Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
- .9 ASTM C921-10, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)

- .1 CGSB 51-GP-52Ma-1989, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.4 Thermal Insulation Association of Canada (TIAC):

.1 Mechanical Insulation Best Practice Guide, 2013.

.5 South Coast Air Quality Management District (SCAQMD), California State

.1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

.6 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102-07, Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701-11, Standard for Thermal Insulation Polyotrene, Boards and Pipe Covering.

.7 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Safety Data Sheets (SDS).

1.3 Submittals

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 – General Instructions. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Safety Data Sheets (SDS) in accordance with Section 01 01 50 – General Instructions.

.3 Shop Drawings:

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

.4 Quality assurance submittals: submit following in accordance with Section 01 01 50 – General Instructions.

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

.2 Instructions: submit manufacturer's installation instructions.

1.4 Quality Assurance

.1 Qualifications:

.1 Installer: Qualified to standards of TIAC.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

1.5 Delivery, Storage and Handling

.1 Packing, shipping, handling and unloading:

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

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

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

.2 Storage and Protection:

.1 Protect from weather, construction traffic.

.2 Protect against damage.

.3 Store at temperatures and conditions required by manufacturer.

.3 Waste Management and Disposal:

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

.2 Place excess or unused insulation and insulation accessory materials in designated containers.

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

.4 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.

PART 2 - PRODUCTS

2.1 Fire and Smoke Rating

.1 In accordance with CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 Insulation

.1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code A-1: Rigid molded mineral fibre without factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/CGSB-51.9 / ASTM C547.

.2 Maximum "k" factor: to CAN/CGSB-51.9.

.4 TIAC Code A-2: Rigid molded calcium silicate without factory applied vapour retarder jacket.

.1 Calcium silicate: to CAN/CGSB-51.2 / ASTM C533.

.2 Maximum "k" factor: to CAN/CGSB-51.2.

.5 TIAC Code A-3: Rigid molded mineral fibre with factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/CGSB-51.9 / ASTM C547.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to CAN/CGSB-51.9 / ASTM C547.

.6 TIAC Code C-2: Mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).

.1 Mineral fibre: to CAN/ULC-S702 / ASTM C553.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to CAN/ULC-S702 / ASTM C553.

.6 TIAC Code A-6: Flexible unicellular tubular elastomer.

.1 Insulation: flexible closed-cell elastomer to ASTM C534.

.2 Jacket: to CGSB 51-GP-52Ma. Required for outdoor application.

.3 Maximum "k" factor: 0.27.

.4 Vapour transmission: 1.34 perm-mm.

.5 To be certified by manufacturer to be free of potential stress corrosion cracking corrodants.

.7 To be formaldehyde free, low VOC; resists mold and mildew.

.8 Evidence shall be provided to the Departmental Representative on the site of ULC listings of all products being used. Duct insulation adhesives and coatings shall be non-toxic as defined by WCB Regulations.

2.3 Insulation Securement

.1 Tape: Self-adhesive, aluminum, reinforced, 50mm wide minimum.

.2 Contact adhesive: Quick setting.

.1 Maximum VOC limit 80 g/L to SCAQMD Rule 1168.

.3 Canvas adhesive: Washable.

.1 Maximum VOC limit 250 g/L to SCAQMD Rule 1168.

.4 Tie wire: 1.5mm diameter stainless steel.

.5 Bands: Stainless steel, 19mm wide, 0.5mm thick.

2.4 Cement

.1 Thermal insulating and finishing cement:

.1 To CAN/CGSB-51.12.

.2 Hydraulic setting or Air drying on mineral wool, to ASTM C 449.

2.5 Vapour Retarder Lap Adhesive

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

2.6 Indoor Vapour Retarder Finish

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.7 Outdoor Vapour Retarder Finish

.1 Vinyl emulsion type acrylic, compatible with insulation.

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

2.8 Jackets

.1 Polyvinyl Chloride (PVC):

.1 One-piece moulded type and sheet to CGSB 51-GP-53M with pre-formed shapes as required.

.2 Colours: White.

.3 Minimum service temperatures: 20°C.

.4 Maximum service temperature: 65°C.

.5 Moisture vapour transmission: 0.02 perm.

.6 Fastenings:

.1 Use solvent weld adhesive compatible with insulation to seal laps and joints.

.2 Tacks.

.3 Pressure sensitive vinyl tape of matching colour.

.2 Canvas:

.1 220 and 120 gm/m cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.

.2 Lagging adhesive: Compatible with insulation.

.1 Maximum VOC limit 250 g/L to SCAQMD Rule 1168.

.3 Aluminum:

.1 To ASTM B 209 with and without moisture barrier as scheduled in PART 3 of this section.

.2 Thickness: 0.50 mm sheet.

.3 Finish: Stucco embossed.

.4 Jacket banding and mechanical seals: 19 mm wide, 0.5 mm thick stainless steel.

2.9 Weatherproof Caulking for Jackets Installed Outdoors

.1 Caulking to: Section 07 92 00 - Joint Sealing.

PART 3 - EXECUTION

3.1 Pre-Installation Requirement

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

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

3.2 Installation

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturer’s instructions and this specification.

.3 Use two layers with staggered joints when required nominal wall thickness exceeds 75mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Hangers, supports to be outside vapour retarder jacket.

.5 Supports, hangers:

.1 Apply high compressive strength insulation, suitable for service, at oversized pipe supports, saddles and shoes. See Section 23 05 29 – Hangers and Supports for Piping and Equipment.

.6 Seal vapor barrier penetrations with vapor barrier adhesive.

3.3 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: high temperature fabric for indoor applications and aluminum for outdoor applications.

3.4 Installation of Elastomeric Insulation

.1 Insulation to remain dry at all times. Overlaps to manufacturer's instructions. Ensure tight joints.

.2 Provide vapour retarder as recommended by manufacturer.

3.5 Piping Insulation Schedules

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

.2 TIAC Code: A-1.

.1 Securements: SS Bands at 300mm on centre.

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code 1501-H.

.3 TIAC Code: A-2.

.1 Securements: SS Bands at 300mm on centre.

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code 1501-H.

.4 Direct contact with pipe and hanger is not acceptable. Install hanger outside of sheet metal protection shield covering an insert section of high density calcium silicate insulation.

.4 TIAC Code: A-3.

.1 Securements: SS Bands at 300mm on centre.

.2 Seals: VR lap seal adhesive, VR lagging adhesive.

.3 Installation: TIAC Code: 1501-C.

.5 TIAC Code: A-6.

.1 Seals: lap seal adhesive, lagging adhesive.

.2 Installation: TIAC Code: 1501-CA; per manufacturer's recommendation.

.6 TIAC Code: C-2 with vapour retarder jacket.

.1 Insulation securements: SS Bands at 300mm on centre.

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code: 1501-C.

.7 Thickness of insulation to be as listed in following table.

.1 Run-outs to individual units and equipment not exceeding 4000mm long.

.2 Do not insulate exposed run-outs to plumbing fixtures, chrome plated piping, valves, fittings.

Application	**Temp °C**	**TIAC Code**	**Run out**	**To NPS1**	**1 ¼-2**	**2 ½-4**	**5-6**	**8 & over**
Hot Water Heating	60-94	A-1	25	38	38	38	38	38
Chilled Water	5-15	A-1	25	38	38	38	38	38

.7 Finishes:

.1 Exposed indoors: PVC jacket.

.2 Exposed in mechanical rooms: 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 Aluminium, or SS jacket.

.6 Finish attachments: SS screws or bands, at 150 mm oc. Seals: wing or closed.

.7 Installation: To appropriate TIAC code CPF/1 through CPF/5.

3.6 Cleaning

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

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 Related Sections

.1 Section 01 91 00 — Commissioning

.2 Section 23 05 93 — Testing, Adjusting and Balancing

1.2 Quality Assurance

.1 The commissioning of mechanical systems shall be executed in accordance with the intent of:

.1 ASHRAE Guideline 1.1-2007, HVAC&R Technical Requirements for the Commissioning Process.

.2 ANSI/ASHRAE/IES Standard 202-2013, Commissioning Process for Buildings and Systems.

1.3 General

.1 Commissioning of the mechanical systems, including the HVAC, and Plumbing and Drainage Systems, shall be carried out by an independent Commissioning Agent acceptable to the Departmental Representative with technicians specifically trained in commissioning procedures.

.2 The Mechanical Subcontractor shall retain a Commissioning Agent, who shall be active in the commissioning process and actively encourage his own forces and sub-trades to work together to achieve optimum system performance for the mechanical systems in a timely manner. Refer to Section 01 91 00 – Commissioning for additional requirements.

.3 It is not intended that this work shall, in any way, replace normal factory startup service for equipment or relieve the Contractor or his sub-trades of their responsibility for providing first-class installation in satisfactory working order.

.4 As part of the final commissioning report, submit a Certificate stating that the commissioning procedures have been completed, that complete factual reports have been distributed and that directions have been given to the Contractor to correct faults and omissions and finally, that follow-up testing, after the correction of faults and omissions has been completed and recorded.

.5 Be responsible for the performance and commissioning of all equipment supplied under the Sections of Division 23. Commissioning is the process of advancing the installation from the stage of static completion to full working order in accordance with the contract documents and design intent. It is the activation of the completed installation.

.6 In consultation with the General Contractor, ensure that sufficient time is allowed and fully identified on the construction schedule for the proper commissioning of all mechanical systems.

1.4 Commissioning and Demonstration

.1 Submit a schedule for the commissioning phase of the work. This schedule shall show:

.1 Equipment start-up schedule.

.2 Submission dates for the various documents required prior to substantial completion.

.3 Timing of the commissioning, testing, balancing, and demonstration process.

.2 Commissioning is concluded when the air and water system is balanced and the installation is in full working order and acceptable for use. The work shall include the following:

.1 Balancing of the air systems as specified in this section.

.3 Plug all air pressure and flow measuring holes.

.4 Adjust vibration isolators and earthquake restraints for optimum performance.

.5 Verification and certification of the sealing of all HVAC penetrations through fire separations (rated & non-rated) and sound separations. Forms in Section 23 08 02 shall be used for this purpose.

.6 Verification of water tightness of all roof and exterior wall penetrations.

.7 Verification that coil drain pan operates.

.8 Set up all automatic control valves/dampers and automatic temperature control devices.

.9 Set up and test all alarm and protective devices.

.10 EMCS:

.1 Commissioning of EMCS is primarily responsible by Controls Contractor. Refer to Section 25 05 01 EMCS General Requirements.

.2 The Commissioning Agent shall assign one person qualified in commissioning control systems with a comprehensive knowledge of the interactive nature of HVAC systems and DDC controls **to verify** the performance of the control systems by conducting random tests of the control sequences until the Commissioning Agent is satisfied that the controls are performing according to the intended control sequences.

.3 The Controls Contractor shall loan a current copy of all control software/devices needed for full access to the control system, at no charge to the Commissioning Agent. The software/devices shall be returned to the Controls Contractor in good working order at the completion of the commissioning process, or the Commissioning Agent must reimburse the Controls Contractor for the purchase price of the material.

.3 At the conclusion of commissioning, demonstrate the operation of the systems to the Departmental Representative. For demonstration and instruction to Operating staff requirements, refer to this section of the specification and also to section 25 05 01 EMCS: General Requirements.

.4 The verification process shall include the demonstration of the following:

.1 The ease of access that has been provided throughout for servicing coils, motors, drives, control dampers and damper operators.

.2 Location of and opening and closing of all access panels.

.3 Operation of all automatic control dampers and automatic temperature control devices.

.4 Operation of all alarm and protective devices.

.5 Operation of all equipment and systems under each mode of operation, and failure.

.5 At the completion of commissioning, testing, balancing and demonstration submit the following to the Departmental Representative:

.1 A letter certifying that all work specified under this contract is complete, clean and operational in accordance with the specification and drawings.

.2 Completed copies of all commissioning check lists plus copies of start-up reports from specialty contractors and vendors.

.3 “As-Built” record drawings, as specified.

.4 A list of all alarm and protective devices tested, with the final operating settings.

.6 Training

.1 During "Substantial Performance" review, the Mechanical Contractor, Control Subcontractor, and other Subcontractors designated by the Departmental Representative shall provide training to the operating personnel in the proper operation and maintenance of all systems and equipment installed under the contract.

.2 It shall be the Mechanical Contractor's responsibility to have the specified equipment manuals prepared, previously approved by the Departmental Representative, and ready for presentation to the Departmental Representative at this meeting.

.3 Convene the meeting with the aforementioned parties at the time called for in the substantial performance review. The arrangements shall include written notices to all the parties concerned. Should the equipment manuals, or system installation not be complete and operable at the proper time, he shall then convene the operating instruction meeting at a later date and pay any additional costs including time and travelling expenses for the personnel involved which are attributable to the delay.

PART 2 - PRODUCTS

2.1 Not Used

PART 3 - EXECUTION

3.1 Not Used

END OF SECTION

PART 1 – GENERAL

1.1 Description

A. This section contains sample Prefunctional Checklists. Most checklists contain items for several contractors. Contractor is to assign responsibility for each line item using the responsibility column.

B. Those executing the checklists shall perform only items that apply to the specific application at hand. These checklists do not take the place of the manufacturer's recommended checkout and start-up procedures or report. Coordinate with Section 01810 Fundamental Commissioning Requirements to utilize these checklists.

C. Items that do not apply should be noted along with the reasons on the form. Contractor shall ensure that checklist items by their subcontractors are completed and checked off. "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item.

1.2 Prefunctional Checklists

A. Sample Prefunctional Checklists Included in this section are:

1. Packaged HVAC Units
2. Exhaust Fans
3. Pumps
4. Building Automation System (DDC)
5. Test & Air Balance
6. Piping (Hydronic)
7. Ductwork

B. Contractor shall develop prefunctional checklists with the start-up plans. Electronic copies of these checklists are available upon request.

C. Sample forms of similar rigor will be provided to the Contractor by the CA upon request for other equipment (e.g. VAV terminal units).

PART TWO - PRODUCTS

1.1 Not Used

Sample Prefunctional Checklist

Packaged HVAC Units, Unit ID #'s: _____

Components Include: ____Supply Fans, ____Return/exhaust Fans, ____coils, ____ valves, ____ VFDs, ____ dampers, ____compressors, ___ condensers

Associated Checklists: Piping (Hydronic)

1. Submittals / Approvals

Submittal. The above equipment and systems integral to them are complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This prefunctional checklist is submitted for approval, subject to an attached list of outstanding items yet to be completed. A Statement of Correction will be submitted upon completion of any outstanding areas. None of the outstanding items preclude safe and reliable functional tests being performed. ___ List attached.

_____	_____	_____	_____
Mechanical Contractor	Date	Controls Contractor	Date
_____	_____	_____	_____
Electrical Contractor	Date	Sheet Metal Contractor	Date
_____	_____	_____	_____
TAB Contractor	Date	General Contractor	Date

Prefunctional checklist items are to be completed as part of startup & initial checkout, preparatory to functional testing.

- This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.
- Items that do not apply shall be noted with the reasons on this form (N/A = not applicable, BO = by others).
- If this form is not used for documenting, one of similar rigor shall be used.
- The Contractors who are assigned responsibility for sections of the checklist shall also be responsible to see that checklist items by their subcontractors are completed and checked off.
- "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. DR = Departmental Representative, All = all contractors, CA = commissioning agent, CC = controls contractor, EC = electrical contractor, GC = general contractor, MC = mechanical contractor, SC = sheet metal contractor, TAB = test and balance contractor.

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

_____	_____	_____	_____
Commissioning Agent	Date	Departmental Representative	Date

2. Installation Checks

Check if Okay. Enter N/A if not applicable. Enter Note number if deficient.

Check Equip Tag →					Contr.
Cabinet and General Installation					
Permanent labels affixed, including for fans					
Casing condition good: no dents, leaks, door gaskets installed					
Access doors close tightly - no leaks					
Boot between duct and unit tight and in good condition					
Vibration isolation equipment installed & released from shipping locks					
Maintenance access acceptable for unit and components					
Sound attenuation installed					
Thermal insulation properly installed and according to specification					
Instrumentation installed according to specification (thermometers, pressure gages, flow meters, etc.)					
Clean up of equipment completed per contract documents					
Filters installed and replacement type and efficiency permanently affixed to housing					
Piping and Coils					
No leaking apparent around refrigerant fittings					
All coils are clean and fins are in good condition					
All condensate drain pans clean and slope to drain per spec					
OSAT, MAT, SAT, RAT sensors properly located and secure (related OSAT sensor shielded)					
Sensors calibrated (See calibration section below)					
If split system, refrigerant piping in good condition and suction insulated					
P/T plugs and isolation valves installed per drawings					
Fans and Dampers					
Supply fan and motor alignment appear correct					
Supply fan belt tension & condition good					

Check Equip Tag →					Contr.
Supply fan protective shrouds for belts in place and secure					
Supply fan area clean					
Supply fan and motor properly lubricated					
Return/exhaust fan and motor aligned					
Return/exhaust fan belt tension & condition good					
Return/exhaust fan protective shrouds for belts in place and secure					
Return/exhaust fan area clean					
Return/exhaust fan and motor lube lines installed and lubed					
Filters installed and replacement type and efficiency permanently affixed to housing--construction filters removed					
Filter pressure differential measuring device installed and functional (magnahelic, inclined manometer, etc.)					
All dampers close tightly					
All damper linkages have minimum play					
Motors: premium efficiency verified, if specified?					
Compressor and Condenser					
Refrigerant sight glass clear of bubbles (if OSAT > 70F)					
Moisture indicator shows no moisture					
Correct oil level (check site glass during operation)					
Compressors and piping were leak tested, as required					
Crankcase heater on when unit is off					
Condenser coils clean and in good condition (air cooled)					
Adequate clearance for airflow around condenser					
Ducts (preliminary check)					
Sound attenuators installed					
Duct joint sealant properly installed					
No apparent severe duct restrictions					
Turning vanes in square elbows as per drawings					

Check Equip Tag →					Contr.
OSA intakes located away from pollutant sources & exhaust outlets					
Pressure leakage tests completed					
Branch duct control dampers operable					
Balancing dampers installed as per drawings and TAB's site visit					
Electrical and Controls					
Power disconnects in place and labeled					
All electric connections tight					
Proper grounding installed for components and unit					
Safeties in place and operable					
Current overload heaters installed and correct size					
Auxiliary heaters installed					
Sensors calibrated (see section below)					
All building control system interlocks hooked up with packaged controls and functional					
Enthalpy control and sensor properly installed (if applicable)					
Related thermostats are installed					
Related building automation system points are installed					
All control devices and wiring complete					
TAB					
Installation of system and balancing devices will allow balancing to be done per specified NEBB or AABC procedures & contract docs					
Final					
Safeties installed and safe operating ranges are established					
Functional test procedures for this equipment reviewed and approved by installing contractor					
If unit is started and will be running during construction: have quality filters on RA grills, etc. to minimize dirt in the ductwork and coils and in any finished areas. Verify moisture migration is not a problem due to improper pressures between spaces.					

Checklist items of Part 2 are all successfully completed for given trade… ____Yes ____No

3. Operational Checks (These augment manufacturer's list. This is not a functional performance test)

Check if Okay. Enter N/A if not applicable. Enter Note number if deficient.

Check Equip Tag →					Contr.
Supply fan rotation correct					
Return / exhaust fan rotation correct					
No unusual noise or vibration in supply and exhaust fans					
Fans > 3.73 kW Phase Checks: (% imbalance = 100 x (avg. - lowest) / avg.) List fan & record all 3 voltages in cell. Imbalance less than 2%?					
Record full load running amps for each fan. _____rated FL amps x _____srvc factor = _____ (Max amps). Running less than max?					
Inlet vanes aligned in housing, actuator spanned, modulate smoothly and proportional to input signal and EMS readout.					
All dampers (OSA, RA, EA, etc.) stroke fully without binding and spans calibrated and BAS reading site verified (follow procedure in Calibration and Leak-by Test Procedures). List dampers checked: _____					
Valves stroke fully and easily and spanning is calibrated (follow procedure in Calibration and Leak-by Test Procedures). List each actuated valve here when spanned: _____					
Valves verified to not be leaking through coils when closed at normal operating pressure (follow procedure in Calibration and Leak-by Test Procedures).					
The HOA switch properly activates and deactivates the unit					
Safeties installed and safe operating ranges for this equipment provided to the commissioning agent					
Specified sequences of operation and operating schedules have been implemented with all variations documented					
Specified point-to-point checks have been completed and documentation record submitted for this system					

Checklist items of Part 3 are all successfully completed for given trade… ___Yes___No

4. Sensor and Actuator Calibration [Contr. = _____]

All field-installed temperature, relative humidity, CO, CO_2 and pressure sensors and gages, and all actuators (dampers and valves) on this piece of equipment shall be calibrated using the methods and tolerances given in the Calibration and Leak-by Test Procedures document. All test instruments shall have had a certified calibration within the last 12 months: Y/N_____. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated.

Sensor or Actuator & Location	Loc-atio n OK	1st Gage or BAS Value	Instr. Meas'd Value	Final Gage or BAS Value	Pass Y/N?

Sensor & Location	Loc-atio n OK	1st Gage or BAS Value	Instr. Meas'd Value	Final Gage or BAS Value	Pass Y/N?

Gage reading = reading of the permanent gage on the equipment. BAS = building automation system. Instr. = testing instrument. Visual = actual observation. The Contractor's own sensor check-out sheets may be used in lieu of the above, if the same recording fields are included and the referenced procedures are followed.

All sensors are calibrated within required tolerances … ____Yes ____No

-- END OF CHECKLIST --

Sample Prefunctional Checklist

Exhaust Fans, Unit ID #'s: _____

1. Submittals / Approvals

Submittal. The above equipment and systems integral to them are complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This prefunctional checklist is submitted for approval, subject to an attached list of outstanding items yet to be completed. A Statement of Correction will be submitted upon completion of any outstanding areas. None of the outstanding items preclude safe and reliable functional tests being performed.___ List attached.

_____	_____	_____	_____
Mechanical Contractor	Date	Controls Contractor	Date
_____	_____	_____	_____
Electrical Contractor	Date	Sheet Metal Contractor	Date
_____	_____	_____	_____
TAB Contractor	Date	General Contractor	Date

Prefunctional checklist items are to be completed as part of startup & initial checkout, preparatory to functional testing.

- This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.
- Items that do not apply shall be noted with the reasons on this form (N/A = not applicable, BO = by others).
- If this form is not used for documenting, one of similar rigor shall be used.
- The Contractors who are assigned responsibility for sections of the checklist shall also be responsible to see that checklist items by their subcontractors are completed and checked off.
- "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. DR = Departmental Representative, All = all contractors, CA = commissioning agent, CC = controls contractor, EC = electrical contractor, GC = general contractor, MC = mechanical contractor, SC = sheet metal contractor, TAB = test and balance contractor.

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

_____	_____	_____	_____
Commissioning Agent	Date	Departmental Representative	Date

2. Installation Checks

Check if Okay. Enter N/A if not applicable. Enter Note number if deficient.

Check Equip Tag →					Contr.
Cabinet and General Installation					
Permanent labels affixed					
Casing condition good: no dents or leaks					
Mountings checked and shipping bolts removed					
Vibration isolators installed					
Equipment guards installed					
Pulleys aligned					
Belt tension correct					
Plenums clear of debris					
Fans rotate freely					
Fire and balance dampers installed					
Back draft dampers installed per drawings and operate freely					
Duct system complete					
Electrical					
Electrical connections complete					
Disconnect switch installed					
Overload heaters in place					
Control connections complete					

Checklist items of Part 2 are all successfully completed for given trade… ____Yes ____No

3. Operational Checks (These augment mfr's list. This is not a functional performance test)

Check if Okay. Enter N/A if not applicable. Enter Note number if deficient.

Check Equip Tag →					Contr.
Fan rotation correct					
Electrical interlocks verified					
Any fan status indicators functioning					
No unusual vibration or and noise					

Check Equip Tag →					Contr.
Record full load running amps for each fan. _____rated FL amps x _____srvc factor = _____ (Max amps). Running less than max?					
Check voltage: Rate = _____ Actual = _____ Within 5%?					
The disconnect switch properly operates					
After 24 hours of operation, recheck belt tension and alignment					

Checklist items of Part 3 are all successfully completed for given trade… ___Yes____No

-- END OF CHECKLIST --

Sample Prefunctional Checklist

Pumps, Unit ID #'s: _____

1. Submittals / Approvals

Submittal. The above equipment and systems integral to them are complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This prefunctional checklist is submitted for approval, subject to an attached list of outstanding items yet to be completed. A Statement of Correction will be submitted upon completion of any outstanding areas. None of the outstanding items preclude safe and reliable functional tests being performed.___ List attached.

_____	_____	_____	_____
Mechanical Contractor	Date	Controls Contractor	Date
_____	_____	_____	_____
Electrical Contractor	Date	Plumbing Contractor	Date
_____	_____	_____	_____
TAB Contractor	Date	General Contractor	Date

Prefunctional checklist items are to be completed as part of startup & initial checkout, preparatory to functional testing.

- This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.
- Items that do not apply shall be noted with the reasons on this form (N/A = not applicable, BO = by others).
- If this form is not used for documenting, one of similar rigor shall be used.
- The Contractors who are assigned responsibility for sections of the checklist shall also be responsible to see that checklist items by their subcontractors are completed and checked off.
- "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. DR = Departmental Representative, All = all contractors, CA = commissioning agent, CC = controls contractor, EC = electrical contractor, GC = general contractor, MC = mechanical contractor, SC = sheet metal contractor, TAB = test and balance contractor.

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

_____	_____	_____	_____
Commissioning Agent	Date	Departmental Representative	Date

2. Installation Checks

Check if Okay. Enter N/A if not applicable. Enter Note number if deficient.

Check Equip Tag →					Contr.
General Installation					
Label permanently affixed					
Pumps installed in place and properly grouted, bases filled					
Vibration isolation devices installed and functional					
Factory alignment checked and appears correct					
Field alignment, if required, completed					
Seismic anchoring installed					
Temperature and pressure gauges and sensors installed					
Pump and motor lubricated					
Piping (immediately around pump, see full piping checklist)					
Pipe fittings completed and piping properly supported					
No leaks in pipe fittings and accessories at pump?					
Piping and pump properly insulated					
Strainers in place and cleaned out					
Piping system properly flushed					
Valves properly tagged					
Electrical and Controls					
Disconnect switches in place and labeled					
Electrical connections tight					
Proper grounding installed for components and unit					
Motor overloads calibrated					
Control system interlocks hooked up and functional					
Control devices, tubing and wiring complete					
VFD					
VFD powered up and wired to controlled equipment					
VFD interlocked to control system					

Check Equip Tag →					Contr.
Pressure or other controlling sensor properly located and per drawings and calibrated					
Controller location not subject to excessive temperatures					
Controller location not subject to excessive moisture or dirt					
Controller size matches motor size					
Internal settings designating the application are correct					
Input of motor FLA represents 105% to 115% of motor FLA rating					
Appropriate Volts vs Hz curve is being used; energy saver on?					
Accel and decel times are around 10-50 seconds, except for special applications. Actual decel = Actual accel =					
Upper frequency limit set at 100%, unless explained otherwise					
Unit is programmed with written programming record available					
VFD kW demand at panel matches BAS readout					
TAB					
Installation of system and balancing devices permits balancing to be completed following specified NEBB or AABC procedures and contract documents					
Final					
Startup report completed with this checklist attached					
Safety controls tested, calibrated and safe operating ranges for this equipment provided to the commissioning agent					
Internal settings designating the application are correct					

Checklist items of Part 2 are all successfully completed for given trade… ____Yes ____No

3. Operational Checks (These augment mfr's list. This is not a functional performance test)

Check if Okay. Enter N/A if not applicable. Enter Note number if deficient.

Check Equip Tag →					Contr.
The HOA switch properly activates and deactivates the unit under manual and automatic control.					
Pump rotation verified correct					
No unusual noise or vibration					
No leaking apparent around fittings					

Check Equip Tag →					Contr.
Measure line to line voltage phase imbalance for each pump:					
(%Imbalance = 100 x (avg. - lowest) / avg.) Record imbalance of each pump in cell. Imbalance less than 2%?					
Record full load running amps for each pump. FL amps x factor (Max amps). Running less than max?					
Specified sequences of operation and operating schedules have been implemented with variations documented					
Specified point-to-point checks have been completed and documentation record submitted for this system					

Checklist items of Part 3 are all successfully completed for given trade… ___Yes____No

1. Sensor and Actuator Calibration [Contr. = _____]

Field-installed temperature, CO, and pressure sensors and gages on this piece of equipment are calibrated. Test instruments NIST certified for calibration within the last 12 months: Y/N_____.

Sensors installed in the unit at the factory with NIST calibration certificates provided need not be field calibrated.

Sensor or Actuator & Location	Loc-atio n OK	1st Gage Value	Instr. Meas'd Value	Final Gage Value	Pass Y/N?

Sensor or Actuator & Location	Loc-atio n OK	1st Gage Value	Instr. Meas'd Value	Final Gage Value	Pass Y/N?

Gage reading = reading of the permanent gage on the equipment. Instr. = testing instrument. Visual = actual observation.

Sensors are calibrated within required tolerances … ____Yes ____No

-- END OF CHECKLIST --

Sample Prefunctional Checklist

Building (DDC) Automation System, Unit ID #'s: _____

1. Submittals / Approvals

Submittal. The above equipment and systems are installed and ready for functional testing. The checklist items are completed and have been checked off by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This prefunctional checklist is submitted subject to an attached list of outstanding items yet to be completed. A Statement of Correction will be submitted upon completion of outstanding areas. ___ List attached.

_____	_____	_____	_____
Controls Contractor	Date	General Contractor	Date
_____	_____	_____	_____
Electrical Contractor	Date	Mechanical Contractor	Date

Prefunctional checklist items must be completed as part of startup & initial checkout, preparatory to functional testing.

- This checklist does not take the place of the manufacturer's recommended startup procedures or reports.
- Note items that do not apply with the reasons on this form (N/A = not applicable, BO = by others).
- If this form is not used for documenting prefunctional testing, one of similar rigor shall be used.
- The Contractors who are assigned responsibility for sections of the checklist shall also be responsible to see that checklist items by their subcontractors are completed and checked off.
- "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. DR = Departmental Representative, All = all contractors, GC = general contractor, PC = plumbing contractor, MC = mechanical contractor, CC = controls contractor, SM = sheet metal contractor, TAB = test and balance contractor, EC = electrical contractor, CA = commissioning agent.
- A significant part of the BAS functional testing requirements is the successful completion of the functional tests of equipment the BAS controls or interlocks with. Uncompleted equipment functional tests or outstanding deficiencies in those tests lend the required BAS functional testing incomplete.
- Integral or stand-alone controls are functionally tested with the equipment they are attached to, including any interlocks with other equipment or systems and thus are not covered under the BAS testing requirements, except for any integrated functions or interlocks listed below. In addition to the controlled equipment testing, the following tests are required for the BAS, where features have been specified. The following testing requirements are in addition to and do not replace any testing requirements elsewhere in the specifications.

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

_____	_____	_____	_____
Commissioning Agent	Date	Departmental Representative	Date

2. Installation Checks

Check if Okay. Enter N/A if not applicable. Enter Note number if deficient.

Check Equip Tag->			Contr.
Cabinet and General Installation			
General appearance good, no apparent damage			
Equipment labels affixed			
Layout and location of control panels matches drawings			
Areas or equipment panels serve clear in control drawings			
Wiring labeled inside panels (to controlled components)			
Controlled components labeled/tagged			
BAS connection made to labeled terminal(s) as shown on drawings			
Shielded wiring used on electronic sensors			
110 volt AC power available to panel			
Battery backup in place and operable			
Panels properly grounded			
Environmental conditions according to manufacturer's requirements			
Date and time correct			
Misc. Functions			
Provide a verbal discussion of specified functions and features that are set up, debugged and fully operable			
Demonstrate power failure and battery backup and power-up restart functions			
Specified trending and graphing features demonstration			
Demonstrate global commands features			
Demonstrate security and access codes			
Demonstrate occupant over-rides (manual, telephone, key, keypad, etc.)			
Demonstrate O&M schedules and alarms			
Scheduling features fully functional and setup, including holidays			

Check Equip Tag->			Contr.
Demonstrate date and time setting in central computer and verify field panels are the same.			
Demonstrate included features not specified to be setup are installed (list)			
Demonstrate occupancy sensors and controls			
Demonstrate functionality of 100% of field panels using local operator keypads and 10% of local ports (plug-ins) using portable computer/keypad			
Demonstrate graphic screens and value readouts completed			
During equipment testing demonstrate set-point changing features and functions			
Demonstrate communications to remote sites			
Through sampling during equipment tests verify sensor calibrations			
Final as-builts or redlines (per spec) control drawings, final points list, program code, set-points, schedules, warranties, etc. per specs, submitted for O&Ms.			
Verify that points that are monitored only, having no control function, are checked for proper reporting to BAS.			

3. Installation: Checks - Device and Point Checkout Contr. = [ ]

The following procedures are required to be performed and documented for each and every point in the control system. The following procedures are minimum requirements. The control contractor is encouraged to identify better and more comprehensive checkout procedures in their submitted plan. These procedures are not a substitute for the manufacturer's recommended start-up and checkout procedures, but are to be combined with them, as applicable. The documentation may be provided on the vendor's stock form, as long as all the information in the sample table below can be clearly documented on the form.

Similar checkout and calibration requirements are found on the equipment prefunctional checklists. Redundant documentation is not required. Cross reference, by name and form number, to other forms that contain documentation left blank on the current form.

Procedures:

a. [Wire] Verify that the wiring is correct to each point.

b. [Actu] If the device is or has an actuator, verify full free movement through its full range.

c. [Addr] Verify that the software address is correct.

d. [Load] For devices with a controller, verify that current software program with proper setpoints has been downloaded.

e. [DevCal] Device stroke/range calibration. This applies to all controlled valves, dampers, fans, pumps, actuators, etc. Simulate maximum and minimum transmitter signal values and verify minimum and maximum controller output values and positively verify each and every control device minimum and maximum stroke and capacity range.

f. [SensLoc] Verify that all sensor locations are appropriate and away from causes of erratic operation.

g. [SensCal] Sensor calibration. Calibrate or verify calibration of all sensors and thermostats, including temperature, pressure, flow, current, kW, rpm, Hertz, etc. Verify that the sensor readings in the control system are within the sensor accuracies specified in this section, using hand-held or other external measuring instruments.

h. [OperCk] For controlled devices (dampers, valves, actuators, VAV boxes, etc.), after mechanical equipment control becomes operational, perform an operational test of each control loop. Follow procedure 6.2 below. Operational checks are preparatory to the later functional testing.

i. Other Abbreviations: [BAS] Building automation system or gage-read value; [Instru] Instrument (calibrated) read value; [Ofset] Offset programmed into the point to correct the calibration.

Items of Parts 2 and 3 are all successfully completed for given trade… ___Yes ____No

4. Sensor and Actuator Calibration [Contr. = _____]

Field-installed temperature, CO_2, CO, and pressure sensors and gages on this piece of equipment are calibrated. Test instruments NIST certified for calibration within the last 12 months: Y/N_____.

Sensors installed in the unit at the factory with NIST calibration certificates provided need not be field calibrated.

SAMPLE FORM: Controls Checkout Documentation Table

Point	Object	Field Device	Hardware Checks			Load	Dev	Sens	Senscal			Final Check	
			Wire	Actu	Addr				BAS	Instru	Offset	Oper	
			1	2	3	4	5	6	7	7	7	8	9

Sensors are calibrated within required tolerances … ____Yes ____No

-- END OF CHECKLIST --

Sample Prefunctional Checklist

Test & Air Balance (TAB), Review Checklist

Components Included: ____ Airside, ____ Waterside

The purpose of this checklist is to verify that necessary components for TAB have been included.

1. Submittals / Approvals

Submittal. The TAB Plan has been developed and reviewed against the checklist below.

This plan is submitted for approval, subject to the attached list of outstanding items yet to be completed.

_____	_____	_____	_____
TAB Contractor	Date	General Contractor	Date

- The TAB Plan checklist does not take the place of the recommended formats or procedures in standards referenced in the specifications, but it is intended to augment them.
- Items that do not apply shall be noted with the reasons on this form (N/A = not applicable, BO = by others).

Approvals. This filled-out checklist and the TAB Plan have been reviewed. Their completion is approved with the exceptions noted below.

_____	_____	_____	_____
Commissioning Agent	Date	Departmental Representative	Date

2. TAB Plan Checklist

Check if included in Plan. Write N/A if not applicable. Enter Note number if deficient.

Check	Air Side	Chilled Water	Heating Water
Specified qualifications and certifications of parties performing TAB work were submitted			
TAB contractor has reviewed drawings, walked through the site and verified that there are sufficient balancing dampers, valves, isolation dampers and valves and test ports installed to perform TAB per spec. Deficiencies in design or installation that will adversely affect or preclude proper TAB have been reported.			

Check	Air Side	Chilled Water	Heating Water
TAB contractor has reviewed the construction documents and the systems with the Departmental Representative and contractors to sufficiently understand the design intent for each system and outlet.			
Prior to plan, TAB contractor met with controls contractor to become familiar with using the terminal unit programmer for TAB			
Field checkout sheets and logs provided as part of plan			
Proposed final test report sheets provided as part of plan			
Field and final test report sheets list each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each			
Discussion of what notations and markings will be made on the duct and piping drawings.			
List of air flows, water flows, sound levels, system capacities and efficiency measurements to be performed, and a description of specific test procedures, parameters, formulas and test instrument type to be used for the measurements have been provided. Sample forms have been included.			
Detailed step-by-step procedures for TAB work: Terminal flow calibration (for each terminal type), diffuser proportioning, branch/sub-main proportioning, total flow calculations, rechecking, and others. Similar for water side.			
Details of how total flow will be determined (Air: Sum of terminal flows via BAS calibrated readings or via hood read of terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations. Water: pump curves, circuit setter, flow station, ultrasonic meter.)			
Specific procedures that will ensure (and which can be verified) that both air side and water side are operating at the lowest possible pressures and energy consumption.			
Outside air ventilation criteria under clearly understood by TAB contractor			
Details of if and how minimum outside air flow will be verified and set and for what level (total bldg, zone, other.)			
Details of how building static and exhaust fan/relief damper capacity will be checked.		N/A	N/A
The identification and types of measurement instruments to be used and their most recent calibration date			
Proposed selection points for sound measurements			
Details of any TAB work to be done in phases, by floor, or of areas to be built out later			
Details regarding specified deferred or seasonal TAB work			

Check	Air Side	Chilled Water	Heating Water
Details of specified false loading of systems to complete TAB work			
Details of exhaust fan balancing and capacity verifications, including required room pressure differentials.			
Plan for hand-written field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency)			
Plan for formal progress reports (scope and frequency)			
Plan for formal deficiency reports (scope, frequency and distribution)			

Checklist items of Part 2 are successfully completed … ____Yes ____No

-- END OF CHECKLIST --

Sample Prefunctional Checklist

Piping (Hydronic)

Associated Checklists: Air Handling Units and Pumps

1. Submittals / Approvals

Submittal. The above equipment and systems integral to them are complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This prefunctional checklist is submitted for approval, subject to an attached list of outstanding items yet to be completed. A Statement of Correction will be submitted upon completion of any outstanding areas. None of the outstanding items preclude safe and reliable functional tests being performed.___ List attached.

_____ _____ _____ _____

Plumbing Contractor Date General Contractor Date

Prefunctional checklist items are to be completed as part of startup & initial checkout, preparatory to functional testing.

- This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.
- Items that do not apply shall be noted with the reasons on this form (N/A = not applicable, BO = by others).
- If this form is not used for documenting, one of similar rigor shall be used.
- The Contractors who are assigned responsibility for sections of the checklist shall also be responsible to see that checklist items by their subcontractors are completed and checked off.
- "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. DR = Departmental Representative, All = all contractors, GC = general contractor, PC = plumbing contractor, MC = mechanical contractor, CC = controls contractor, TAB = test and balance contractor, EC = electrical contractor, CA = commissioning agent.

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

_____ _____ _____ _____

Commissioning Agent Date Departmental Representative Date

2. Installation Checks

Check if Okay. Enter N/A if not applicable. Enter Note number if deficient.

Check		Contr.
Piping		
Pipe fittings complete and pipes properly supported allowing for thermal expansion and contraction and building expansion joints.		
Pipe joints properly installed		
Required seismic anchoring installed		
Pipes properly labeled		
Pipes properly insulated		
Piping properly sloped		
Proper construction isolation		
Strainers in place and clean		
Isolation valves and balancing valves installed		
Test ports (P/T) installed near all control sensors and as per spec		
Piping system properly flushed and cleaned and temporary piping removed (report attached)		
10% of strainers and Departmental Representative -selected low-point drains opened and witnessed by Departmental Representative to be clean. (List points checked below).		
Piping hydrostatic pressure test completed according to contract documents (report attached)		
No leaking apparent around fittings		
ASME pressure vessel data sheet or certification tag posted and inspection complete for each expansion tank and storage tank		
Expansion tanks verified to not be air bound and system completely full of water. System purged of air.		
Air vents and bleeds at high points of systems functional		
Water hammer arrestors installed and tested		
Backflow preventer proper location		
Adequate depth of bury for service piping		
Cross connection protection		
Valves		

Check		Contr.
Valve tags permanently affixed		
Valves installed in proper direction		
Pressure reducing valves set at proper pressure		
No leaks		
Flexible connections at equipment installed		
Dielectric fittings for dissimilar metals installed		
Vibration Isolation installed		
Fire-rated pipe penetrations installed properly		
Valves that require a positive shut-off are verified to not be leaking when closed at normal operating pressure. List: _____		
Sensors and Gages		
Temperature, pressure and flow gages and sensors installed. List : _____ _____		
TAB		
Installation of system and balancing devices allowed balancing to be completed following specified NEBB or AABC procedures and contract documents		

Checklist items of Part 2 are all successfully completed for given trade… ____Yes ____No

-- END OF CHECKLIST --

Prefunctional Checklist

Ductwork

Associated Checklists: HVAC Units

1. Submittals / Approvals

Submittal. The above equipment is complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This prefunctional checklist is submitted for approval, subject to an attached list of outstanding items yet to be completed. None of the outstanding items preclude safe and reliable functional tests being performed.
___ List attached.

_____	_____	_____	_____
Mechanical Contractor	Date	Sheet Metal Contractor	Date
_____	_____	_____	_____
General Contractor	Date	Electrical Contractor	Date

Prefunctional checklist items are to be completed as part of startup & initial checkout, preparatory to functional testing.

- "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. DR = Departmental Representative, All = all contractors, CA = commissioning agent, CC = controls contractor, EC = electrical contractor, GC = general contractor, MC = mechanical contractor, SC = sheet metal contractor, TAB = test and balance contractor.

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

_____	_____	_____	_____
Commissioning Agent	Date	Departmental Representative	Date

2. Installation Checks

Check if Okay. Enter N/A if not applicable. Enter Note number if deficient.

Check Run to/from →					Contr.
Ducts					
Sound attenuators installed					
Duct joints properly installed and sealed					
No apparent severe duct restrictions					
Turning vanes in square elbows as per drawings					
OSA intakes located away from pollutant sources & exhaust outlets					
Pressure leakage tests completed					
Branch duct control dampers operable					
Ducts clean					
Balancing dampers installed as per drawings					
Proper roof penetration curbs and flashing					
Fire-rated penetrations, fire/smoke dampers properly located					
Ducts insulated or lined per drawings					
Ductwork and plenums are clean and free of construction debris					
TAB (Test, adjust, air balance)					
Terminal units/Diffusers, registers, grilles are adjusted for air flow quantity and direction					

Checklist items of Part 2 are all successfully completed for given trade… ____Yes ____No

-- END OF CHECKLIST --

END OF SECTION

PART 1 - GENERAL

1.1 Related Sections

.1 Section 01 91 00 — Commissioning

.2 Section 23 05 93 — Testing, Adjusting and Balancing

.3 Section 23 08 00 — Commissioning of Mechanical Systems

.4 Section 23 08 02 — Cleaning and Start-up of Mechanical Piping Systems

.5 This Section applies to all related work under Division 23.

1.2 References

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

.1 ASTM E202-12, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

1.3 Cleaning and Start-up of Mechanical Piping Systems

.1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

1.4 Hydronic Systems – Performance Verification (PV)

.1 Perform hydronic systems performance verification after cleaning is completed and system is in full operation.

.2 When systems are operational, perform following tests:

.1 Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of [48] hours to demonstrate compliance with design criteria.

.2 Verify performance of hydronic system circulating pumps as specified, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.

.1 Pump operation.

.2 Maximum heating demand.

.3 Maximum cooling demand.

1.5 Hydronic System Capacity Test

.1 Perform hydronic system capacity tests after:

.1 TAB has been completed

.2 Verification of operating, limit, safety controls.

.3 Verification of primary and secondary pump flow rates.

.4 Verification of accuracy of temperature and pressure sensors and gauges.

.2 Calculate system capacity at test conditions.

.3 Using manufacturer's published data and calculated capacity at test conditions, extrapolate system capacity at design conditions.

.4 When capacity test is completed, return controls and equipment status to normal operating conditions.

.5 Submit sample of system water to approved testing agency to determine if chemical treatment is correct. Include cost.

.6 Heating system capacity test [Air Handling Units AHU-101/2 and AHU-302]:

.1 Perform heating coils capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:

.1 Increasing OA flow rates through heating coils (in this case, monitor heating coil discharge temperatures to ensure that coils are not subjected to freezing conditions)

.2 Test procedures:

.1 Open fully heating coils control valves.

.2 With boilers on full firing and hot water heating supply temperature stabilized, record flow rates and supply and return temperatures simultaneously.

.7 Chilled water system capacity test [Air Handling units AHU-101/2 and AHU-302]

.1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:

.1 Adding heat from building heating system or;

.2 Raising space temperature by turning off cooling and air systems for sufficient period of time before starting testing and pre-heating building to summer design space temperature (occupied) or above. Set OAD and RAD for minimum outside air if OAT is near outside design temperature or to maximum recirculation if RAT is greater that OAT. RAT to be at least 23 degrees C minimum.

.2 Test procedures:

.1 Open fully cooling coil control valves.

.2 Set thermostats on associated AHU's for maximum cooling.

.3 Set AHU's for design maximum air flow rates.

.4 Set load or demand limiters on chillers to 100%.

.5 After system has stabilized, record chilled water, and condenser water flow rates and supply and return temperatures simultaneously.

1.6 Reports

.1 In accordance with Section 01 91 00 – Commissioning and Section 23 08 00 – Commissioning of Mechanical Systems

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

PRIOR TO CLEANING CONTRACTOR TO CONFIRM COMPATIBILITY OF PROPOSED CLEANING PRODUCTS WITH PRODUCTS USED IN EXISTING HYDRONIC SYSTEM.

1.1 Related Sections

.1	Section 01 01 50	General Instructions
.2	Section 01 35 33	Health and Safety Requirements
.3	Section 23 05 00	Common Work Results-Mechanical
.4	Section 23 05 93	Testing Adjusting and Balancing
.5	Section 23 25 00	HVAC Water Treatment Systems

1.2 References

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Safety Data Sheets (SDS).

1.3 Submittals

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 – General Instructions. Include product characteristics, performance criteria, and limitations.

.2 Quality assurance submittals: submit following in accordance with Section 01 01 50 – General Instructions.

.1 Instructions: submit manufacturer's installation instructions.

1.4 Quality Assurance

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

1.5 Delivery, Storage, and Handling

.1 Packing, shipping, handling and unloading:

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

.2 Waste Management and Disposal:

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

PART 2 PRODUCTS

2.1 Cleaning Solutions and Chemicals

.1 Tri-sodium phosphate: 0.40 kg per 100 L water in system.

.2 Sodium carbonate: 0.40 kg per 100 L water in system.

.3 Low-foaming detergent: 0.01 kg per 100 L water in system.

.4 Cleaning solutions shall be provided by the supplier of chemicals for water treatment under Section 23 25 00 – HVAC Water Treatment Systems.

PART 3 EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Cleaning of Hydronic Systems

.1 Timing:

.1 Systems to be operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.

.2 Cleaning Agency:

.1 Retain qualified water treatment specialist to perform system cleaning.

.3 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist. Install cross upstream per manufacturer's recommendation. Install plugs in unused connections.

.4 Cleaning procedures:

.1 Provide detailed report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:

.1 Cleaning procedures, flow rates, elapsed time.

.2 Chemicals and concentrations to be used. Include Material Safety Data Sheets (MSDS).

.3 Inhibitors and concentrations.

.4 Specific requirements for completion of work.

.5 Special precautions for protecting piping system materials and components.

.6 Complete analysis of water to be used to ensure water will not damage systems or equipment.

.5 Conditions at time of cleaning of systems:

.1 Systems to be free from construction debris, dirt and other foreign material.

.2 Control valves to be operational, fully open to ensure that terminal units can be cleaned properly.

.3 Strainers to be clean prior to initial fill.

.6 Report on Completion of Cleaning:

.1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.

.7 Hydronic System:

.1 Fill system with water, ensure air is vented from system.

.2 Provide drain connections to drain system in one hour. All drains for chemical treatment shall be piped to the nearest floor drain. After initial flushing ahs been completed, clean all strainer screens.

.3 System pumps may be used for circulating cleaning solution provided that pumps are dismantled and inspected, worn parts repaired with new gaskets and seals install. Submit used seals.

.4 Add cleaners and chemicals to closed systems at concentration levels recommended by the Chemical Specialist.

.5 For heating hot water systems, apply heat while circulating, raise temperature slowly to 70°C and maintain at 70°C for a minimum of 12 hours. Remove heat and continue to circulate until temperature is below 38°C.

.8 Glycol Systems:

.1 In addition to procedures specified above perform specified procedures.

.2 Test to prove concentration will prevent freezing to minus 40°C. Test inhibitor strength and include in procedural report. Refer to ASTM E202.

.9 Steam Systems: in addition to general requirements as specified above, perform following:

.1 Remove internal components of steam traps until flushing and warm-up have been completed.

.2 Open drip points to atmosphere. If needed for protection of personnel or environment, install flexible hose and direct discharge to safe location.

.3 Starting at drip point closest to source, verify removal of condensate, then re-install steam trap internal parts. Repeat sequence down the line.

.4 Water hammer: determine source and eliminate cause.

3.3 Start-up of Hydronic Systems

.1 After cleaning is completed and system is filled:

.1 Establish circulation and expansion tank level, set pressure controls.

.2 Ensure air is removed.

.3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.

.4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.

.5 Clean out strainers repeatedly until system is clean.

.6 Commission water treatment systems as specified in Section 23 25 00 - HVAC Water Treatment Systems.

.7 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.

.8 Repeat with water at design temperature.

.9 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.

.10 Bring system up to design temperature and pressure slowly over a 48 hour period.

.11 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing.

.12 Adjust pipe supports, hangers, springs as necessary.

.13 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.

.14 Re-tighten bolts, etc. using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.

.15 Check operation of drain valves.

.16 Adjust valve stem packings as systems settle down.

.17 Fully open all balancing valves (except those that are factory-set).

.18 Check operation of over-temperature protection devices on circulating pumps.

.19 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

3.4 Cleaning

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

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 01 50	General Instructions
.2	Section 01 35 33	Health and Safety Requirements
.3	Section 23 05 00	Common Work Results - Mechanical
.4	Section 23 05 05	Installation of Pipework
.5	Section 23 05 93	Testing, Adjusting and Balancing
.6	Section 23 08 01	Performance Verification of Mechanical Piping
.7	Section 23 08 02	Cleaning and Start-up of Mechanical Piping Systems

1.2 References

.1 American Society of Mechanical Engineers (ASME).

- .1 ASME Boiler and Pressure Vessel Code, 2013.

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

- .1 ASTM A47/A47M-09, Standard Specification for Ferritic Malleable Iron Castings.
- .2 ASTM A278/278M-01(2011), Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 350°C.
- .3 ASTM A516/A516M-10, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
- .4 ASTM A536-11, Standard Specification for Ductile Iron Castings.
- .5 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.

.3 Canadian Standards Association (CSA International).

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

1.3 Submittals

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

.2 Closeout Submittals:

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

1.4 Quality Assurance

.1 Health and Safety.

- .1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

1.5 Delivery Storage and Handling

.1 Waste Management and Disposal.

.1 Separate waste materials for reuse and recycling in accordance with 01 01 50 – General Instructions.

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

.3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.

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

PART 2 PRODUCTS

2.1 Manual Air Vent

.1 Disc vent: with built-in check valve, NPT 3.175 connection. Rated at 345 kPa working pressure.

2.2 Automatic Air Vent

.1 Float vent: brass body, stainless steel float, NPT 20 connection, with built-in check valve. Rated at 1,034 kPa working pressure and 121°C operating temperature.

.2 High capacity vent: cast iron body, stainless steel float and NPS 20 connection. Rated at 1,034 kPa working pressure and 121°C operating temperature.

2.3 Strainer

.1 NPS 12 to 50: Y-type, bronze body to ASTM B62, screwed connections, 304 stainless steel screen with 20 mesh perforations.

.2 NPS 65 to 305: Y-type, cast iron body to ASTM A126 Class B, flanged connections, 304 stainless steel screen with 20 mesh perforations.

.3 NPS 203 to 305: T-type, cast iron body to ASTM A126 Class B, flanged connections, 304 stainless steel screen with 0.063 perforations for NPS 50 to 100, and 0.125 perforations for NPS 152 and larger.

.4 Working pressure: 1,034 kPa.

.5 Provide blow-down valve with capped hose adapter fitting and chain.

PART 3 EXECUTION

3.1 General

.1 Install as indicated and to manufacturer's recommendations.

.2 Run drain lines and blow off connections to terminate above nearest drain.

.3 Maintain proper clearance to permit service and maintenance.

.4 Should deviations beyond allowable clearances arise, request and follow Depatmental Representative's directive.

.5 Check shop drawings for conformance of all tappings for ancillaries and for equipment operating weights.

3.2 Strainer

.1 Install in horizontal or down flow lines.

.2 Ensure clearance for removal of basket.

.3 Install ahead of each pump unless suction diffuser is provided.

.4 Install ahead of each automatic control valve and as indicated.

3.3 Air Vents

.1 Install at high points of systems.

.2 Install isolation valve on automatic air vent inlet. Run discharge to nearest drain.

.3 Applications:

.1 Disc vent: radiators and convectors.

.2 Float vent: pipe mains.

.3 High capacity vent: air separator.

3.4 Performance Verification

.1 In accordance with Section 23 08 01 - Performance Verification of Mechanical Piping.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 01 50	General Instructions
.2	Section 01 35 33	Health and Safety Requirements
.3	Section 23 05 00	Common Work Results - Mechanical
.4	Section 23 05 05	Installation of Pipework
.5	Section 23 05 93	Testing, Adjusting and Balancing for HVAC
.6	Section 23 08 01	Performance Verification of Mechanical Piping
.7	Section 23 08 02	Cleaning and Start-up of Mechanical Piping Systems

1.2 References

.1 American National Standards Institute (ANSI) / American Welding Society (AWS)

- .1 ANSI/AWS A5.8/A5.8M-2011, Specification for Filler Metals for Brazing and Braze Welding.

.2 American Society of Mechanical Engineers (ASME).

- .1 ASME B1.20.1-2013, Pipe Threads, General Purpose.
- .2 ASME B16.1-05(2009), Cast Iron Pipe Flanges and Flanged Fittings.
- .3 ASME B16.3-2011, Malleable Iron Threaded Fittings, Classes 150 and 300.
- .4 ASME B16.5-2013, Pipe Flanges and Flanged Fittings.
- .5 ASME B16.9-2012, Factory-Made Wrought Steel Buttwelding Fittings.
- .6 ASME B16.15-2013, Cast Copper Alloy Threaded Fittings.
- .7 ASME B16.18-2012, Cast Copper Alloy, Solder Joint Pressure Fittings.
- .8 ASME B16.22-2013, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
- .9 ASME B16.25-2012, Buttwelding Ends.
- .10 ASME B18.2.1-2003, Square and Hex Bolts and Screws.
- .11 ASME B18.2.2-2010, Square and Hex Nuts.

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

- .1 ASTM A47/A47M-09, Standard Specification for Ferritic Malleable Iron Castings.
- .2 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
- .3 ASTM A126-04(2009), Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
- .4 ASTM A536-11, Standard Specification for Ductile Iron Castings.
- .5 ASTM B32-08, Standard Specification for Solder Metal.
- .6 ASTM B61-08(2013), Standard Specification for Steam or Valve Bronze Castings.

.7 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.

.8 ASTM B371/B371M-08(2013), Standard Specification for Copper-Zinc Silicon Alloy Rod.

.4 American Water Works Association (AWWA).

.1 AWWA C111-12, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.5 Canadian Standards Association (CSA International).

.1 CSA B242-M1980(R1998), Groove and Shoulder Type Mechanical Pipe Couplings.

.2 CAN/CSA W48-06(R2011), Filler Metals and Allied Materials for Metal Arc Welding.

.6 Manufacturer's Standardization of the Valve and Fittings Industry (MSS).

.1 MSS-SP-67-2002a, Butterfly Valves.

.2 MSS-SP-70-2006, Cast Iron Gate Valves, Flanged and Threaded Ends.

.3 MSS-SP-71-2005, Cast Iron Swing Check Valves Flanged and Threaded Ends.

.4 MSS-SP-80-2008, Bronze Gate, Globe, Angle and Check Valves.

.5 MSS-SP-85-2002, Gray Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.3 Submittals

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

1.4 Quality Assurance

.1 Health and Safety.

.1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

1.5 Delivery Storage and Handling

.1 Waste Management and Disposal.

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

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

.3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.

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

1.6 Maintenance

.1 Extra Materials.

.1 Provide following spare parts:

.1 Valve seats: one for every ten valves, each size. Minimum one.

.2 Discs: one for every ten valves, each size. Minimum one.

.3 Stem packing: one for every ten valves, each size. Minimum one.

.4 Valve handles: two of each size.

.5 Gaskets for flanges: one for every ten flanges.

PART 2 PRODUCTS

2.1 Steel Pipe

.1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:

.1 To NPS 254: Schedule 40.

.2 NPS 305 and over: 10 mm wall thickness.

.2 Joints

.1 NPS 50 and under: screwed fittings to ANSI/ASME B1.20.1.

.2 NPS 65 and over: welding fittings and flanges to ANSI/ASME D1.1, ANSI/ASME Section 9 and CAN/CSA W48.

.3 Pipe thread: taper.

.4 Flanges: weld neck, raised face to AWWA C111.

.5 Orifice flanges: slip-on, raised face.

.6 Flange gaskets: to AWWA C111.

.7 Bolts and nuts: to ASME B18.2.1 and ASME B18.2.2.

.8 Nipples: extra heavy black steel.

.3 Fittings

.1 Screwed fittings: malleable iron, to ASME B16.3, Class 150.

.2 Pipe flanges and flanged fittings:

.1 Cast iron: to ASME B16.1, Class 125.

.2 Steel: to ASME B16.5.

.3 Butt-welding fittings: steel, to ASME B16.9.

.4 Unions: malleable iron, to ASTM A47/A47M and ASME B16.3.

.5 Fittings for roll grooved piping (only to be used at for equipment with grooved connection): malleable iron to ASTM A47/A47M; ductile iron to ASTM A536.

2.2 Copper Pipe

.1 Pipe NPS 75 and under: Type L hard drawn copper tubing to ASTM B88M;

.1 Copper piping can be used for existing system with copper piping.

.2 Fittings

.1 Cast bronze threaded fittings: to ANSI/ASME B16.15.

.2 Wrought copper and copper alloy solder joint pressure fittings: to ANSI/ASME B16.22.

.3 Cast iron threaded fittings: to ANSI/ASME B16.4.

.4 Cast copper alloy solder joint pressure fittings: to ANSI B16.18.

.3 Flanges

.1 Brass or bronze: threaded.

.2 Cast iron: threaded.

.3 Orifice flanges: slip-on, raised face, 2100 kPa.

.4 Joints

.1 Solder, tin-antimony, 95:5: to ASTM B 32.

.2 Silver solder BCUP: to ANSI/AWS A5.8.

.3 Brazing: as indicated.

2.3 Valves

.1 Gate valves: to MSS-SP-70 and MSS-SP-80:

.1 NPS 50 and under: Class 150 to MSS-SP80. Rising stem, threaded, union bonnet and solid wedge. Body, bonnet and wedge shall be of bronze ASTM B62. Stem shall be of dezincification-resistant silicon bronze ASTM B371 or low-zinc alloy B-99.

.2 NPS 65 and over: Class 150 to MSS-SP70. OS&Y, flanged, bolted bonnet, solid wedge, iron body, bronze trimmed, with body and bonnet conforming to ASTM A126 Class B cast iron.

.2 Drain valves:

.1 Ball type, Class 150 to MSS-SP-110, 2-piece cast bronze body, threaded, full port, anti-blowout stem, stainless steel ball and stem, 20mm hose connection with cap and chain.

.3 Swing check valves:

.1 NPS 50 and under: Class 150 to MSS-SP-80. Swing type, Y-pattern, threaded, bronze body to ASTM B-62, renewable TFE seat and disc, regrinding type, dezincification-resistant.

.2 NPS 65 and over: Class 125 to MSS-SP-71. Swing type, flanged, cast iron to ASTM A126 Class B, renewable bronze seat disc.

.4 Silent check valves:

.1 NPS 50 and under: Class 125 to MSS-SP-80. Inline lift type, threaded, bronze body to ASTM B-584, TFE disc, stainless steel stem, spring, disc holder and seat screw, dezincification-resistant.

.2 NPS 65 and over: Class 125 to MSS-SP-71. Globe style, flanged, cast iron to ASTM A126 Class B, renewable bronze seat (bonded with Buna-N) and disc, stainless steel spring.

.5 Ball valves:

.1 NPS 50 and under: Class 150 to MSS-SP-110. Cast bronze, 2-piece body, threaded, full port, anti-blowout stem, 316 stainless steel stem and ball (vented), TFE packing, RTFE thrust washers and seat rings, 50mm extended blowout stem for insulated piping, lever handle with position indicator.

2.4 Dielectric Coupling

.1 NPS 50 and under: Screwed, Schedule 40 electro zinc plated ASTM A120/A53 casing with inert self-cleaning thermoplastic liner, 2068 kPa WP at 107°C.

.2 NPS 65 and over: Flanged with isolation gaskets, washers and sleeves, 136 kg. WOG.

2.5 Balancing Fittings, for TAB:

.1 Sizes: Calibrated balancing valves, as specified this section.

.2 NPS 50 and under: Globe type, Y-pattern, bronze body, EPDM O-ring and NPT connections.

.3 Flow measuring valve shall be fitted with meter readout ports with check valves and caps, digital handwheel with memory stop indicator, NPS 20 hose connection, and a nameplate bearing manufacturer's name and calibrated nameplate.

.4 Furnished with preformed rigid polyurethane insulation.

2.6 Underground Piping [CHWS&R/HWS&R to AHU-101/2]

.1 The underground piping shall be pre-insulated piping system.

.2 The system shall consist of schedule 40 steel pipe insulated with polyurethane foam for straight sections and preformed polyurethane foam for all fittings. All pipe joints shall be socket or butt welded for 50mm and smaller, and butt welded for 65mm and larger. Pipe shall be supplied in 12.2m lengths, unless shorter lengths are needed, with piping exposed at each end for field joint fabrication. The insulation shall be formed-in-place closed-cell polyurethane foam providing intimate contact with both the core pipe and casing pipe. It shall be 90-95 percent closed cell with a 32 kg/m3. density. Provide a thermal conductivity coefficient of 0.023 W/(m K) at 23°C.

MINIMUM INSULATION THICKNESS (UNDERGROUND PIPING)

Pipe Size (mm)	Insulation Thickness (mm)	
	Chilled Water	Hot Water
25 – 200	25	25
250 – 305	25	38
350 – 910	38	50

.3 Insulation shall be 25mm thick for 150mm and small pipe, nominal 32 kg/m3 density.

.4 All straight sections, fittings, anchors and other accessories shall be factory fabricated to job dimensions and designed to minimize the number of field welds. Each system shall be computer analyzed by the piping system manufacturer to determine stress on the service pipe and anticipated thermal movement of the service pipe. The system design shall be in

strict conformance with ANSI B31.1, latest edition. Factory trained field technical assistance shall be provided for critical periods of installation such as unloading, field joint instruction and testing.

.5 End seals, gland seals and anchors shall be designed and factory fabricated to prevent the ingress of moisture into the system.

.6 All straight sections of the insulated piping system shall be filament wound polyester resin/fiberglass reinforcement composite directly applied on the insulating foam. Thermoplastic casing material such as PVC or PE shall not be allowed. All fittings of the insulated piping system shall be prefabricated to minimize field joints and jacketed in a chopped spray up, polyester resin/fiberglass-reinforced composite, directly applied onto the insulating foam to as thickness related to the filament-wound jacket thickness.

.7 The casing shall be seamless high-density polyethylene with a minimum thickness of 120 mils. Field joints shall be made only on straight pipe sections. Fitting insulation and casing shall be factory applied. The end of each pipe casing joint shall be sealed to the carrier pipe with a preformed flexible polyethylene end seal or by turning down the jacket to seal against the service pipe. End seals shall be factory applied and bonded to the jacket and carrier pipe. End seals/jacket combinations are to be certified by an independent testing laboratory at 60 kPa head pressure for 48-hour test period to maintain a watertight seal. End seal certification shall be submitted for approval. Mastic end seals are not acceptable. O-Ring seals are not acceptable. Provide a preformed heat shrink end seal at all field cuts.

.8 Underground piping shall be bedded in compacted granular material ASTM C33 gradation 67, with pea gravel 203 mm under, around and 152 mm over laid pipe. Cover with densely compacted backfill. Piping trench for a distance of 2440 mm out from building shall not have pea gravel or sand but shall be select backfill densely compacted as specified for building floor slab backfill.

.9 **Prepare shop drawings to scale indicating the entire site plan with all underground piping thereon. Elevations of all piping shall be indicated. Details of piping and bedding shall be drawn indicating size materials and arrangement. All shop drawings shall be submitted to the pipe manufacturer for their review and shall bear their stamp of approval prior to A/E review**. Excavation for and laying of pipe shall not be started until these shop drawings are approved.

.10 Prior to fabrication, the Contractor shall review drawings of all disciplines, visit the site and make on-site measurements to ascertain that no interferences will be encountered upon installation. If there are any significant deviations from the Contract Drawings, produce "Interference Drawings." Before fabricating the piping and installing related equipment, the Contractor shall send a letter to the Owner stating that no interferences exist in the proposed installation. By submitting this letter, the Contractor certifies that he has performed the above requirements and no interferences will result during installation. There will be no additional compensation for minor deviations.

PART 3 EXECUTION

3.1 Piping Installation

.1 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.

.2 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping where ever practical.

.3 Slope piping in direction of drainage and for positive venting.

.4 Use eccentric reducers at pipe size change installed to provide positive drainage and positive venting.

.5 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.

.6 Assemble piping using fittings manufactured to ANSI standards.

.7 Install dielectric couple between dissimilar metals on open systems.

.8 Use long radius elbows.

.9 Remake leaking joints using new materials. Do not caulk or cement leaking threaded joints.

.10 Do not use thread protection couplings, close nipples, running nipples or street elbows.

3.2 Valve Installation

.1 Install rising stem valves in upright position with stem above horizontal.

.2 Install isolation valves at branch take-offs and to isolate each piece of equipment, and as indicated.

.3 Install check valves on discharge of pumps and as indicated. Provide silent check valves in vertical pipes with downward flow and swing check valves horizontal pipes.

.4 Install chain operators on valves NPS 65 and over where installed more than 2400mm above finished floor in mechanical room(s).

.5 Install control valves with stems in upright position unless otherwise approved. Provide adequate clearance for removal of actuators.

.6 Swing and wafer check valves:

.1 Install only in horizontal lines unless absolutely impractical. If installed vertically, flow shall be upwards.

.2 Do not install in pump discharge piping.

.7 Silent check valves:

.1 Install in all pump discharge lines.

.2 Silent check valves may be installed in vertical pipes with flow down upon Departmental Representative’s review for each instance.

3.3 Drain Connections

.1 Pipe the discharge from all liquid relief valves, liquid safety valves, high capacity air vents, steam drip pan elbows, equipment blowdown, water columns, overflows and piping system drains to the nearest building drain. No drains or overflow shall discharge onto floor in the building.

.2 Provide 20 mm drain valves as shown on the drawings and at all low points of piping systems. Provide 40 mm valves for pipe cleaning. Provide hose end adaptors on all drain valves.

.3 Provide chained caps for all drain valves.

.4 Drains from drain pans shall be DWV copper ASTM B306 32mm minimum size.

.5 Drain and vent piping shall be of the same material as the piping system to which it is connected unless otherwise noted.

.6 For hydronic systems with anti-freeze (e.g. glycol), pipe all high point drains from liquid relief valves, liquid safety valves, high capacity air vents to the anti-freeze mixing tank. Provide capped drains at all system low points suitable for connecting hose system drainage. No drains or overflow shall discharge onto floor in building.

3.4 Cleaning, Flushing, & Start-Up

.1 In accordance with Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems.

3.5 Testing

.1 Test system in accordance with Section 23 08 01 - Performance Verification – Mechanical Piping Systems.

3.6 Balancing

.1 Balance water systems to within plus or minus 5% of design output.

.2 Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

3.7 Underground Piping

.1 Prior to ordering materials, contractor shall field verify exact lengths required. No extras will be allowed for discrepancies between site conditions and lengths indicated on drawings.

.2 The internal pipe shall be hydrostatically tested to 1035 kPa. Insulation shall then be poured in place into the field weld area. All field applied insulation shall be placed only in straight sections. Field insulation of fittings shall not be acceptable. The installer shall seal the field joint area with a heat shrinkable adhesive-backed wrap or with wrappings of glass reinforcement fully saturated with a catalyzed resin identical in properties to the factory applied resin. Backfilling shall not begin until the heat shrink wrap or the FRP lay-up has cured. All insulation and coating materials for making the field joints shall be furnished by manufacturer.

.3 Provide trenching, backfill, concrete anchor blocks, delivery of pipe to site, and stringing along trench. Provide 100mm of tamped sand bedding to 150mm above and around the pipe.

.4 Contractor installing pre-insulated pipe shall be trained by manufacturer representative. Installation procedures shall be in strict accordance with manufacturer's instructions.

.5 Provide heat tracing for full length on all piping serving new AHU-101/2 [underground piping, piping in crawl space and inside air handling unit]. Installation procedures shall be in strict accordance with manufacturer's instructions.

.6 On completion the installing contractor shall provide to the Departmental Representative a certificate stating that the underground installation has been made in accordance with the manufacturer's recommendations. Include a copy of the certificate in the O&M Manual.

.7 Clean piping prior to filling system by using a pressurized water jet system that is drawn thru the piping system. The Contractor shall provide all temporary connections, piping, valves, air vents, portable pumps, shot feeders, etc. as required for cleaning, filling and draining the piping system. Submit a complete cleaning plan to the Departmental Representative for review, include a drawing showing all temporary connections. Provide a written plan for filling the system, method of adding chemicals, description of chemicals to be used, and method of the disposal of cleaning water. Disposal of chemically treated water is to be in accordance with City of Houston requirements. After cleaning is complete introduce the approved chemicals into the system and provide a chemical analysis report of the treated water in the piping. After the report is approved by the Departmental Representative, receive approval from the Departmental Representative to open the piping system to the buildings.

3.8 Performance Verification

.1 In accordance with Section 23 08 01 - Performance Verification of Mechanical Piping.

END OF SECTION

PART 1 GENERAL

1.1 Section Includes

.1 Materials, equipment selection, installation and start up for hydronic system pumps.

1.2 Related Sections

.1	Section 01 01 50	General Instructions
.2	Section 01 35 33	Health and Safety Requirements
.3	Section 01 91 00	Commissioning
.4	Section 23 05 13	Common Motor Requirements for HVAC Equipment
.5	Section 23 05 48	Vibration & Seismic Controls for HVAC Piping & Equipment
.6	Section 23 08 00	Commissioning of Mechanical Systems

1.3 References

.1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE).

.1 Standard 90.1-2013 Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 Electrical Equipment Manufacturers Advisory Council (EEMAC).

.3 Canadian Standards Association (CSA International).

.1 CAN/CSA-B214-12, Installation Code for Hydronic Heating Systems.

.4 National Electrical Manufacturers Association (NEMA).

.1 NEMA MG 1-2011, Motors and Generators.

1.4 Submittals

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 – General Instructions. Include product characteristics, performance criteria, and limitations.

.2 Shop Drawings:

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

.3 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.

.4 Submit product data of pump curves for review showing point of operation.

.5 Indicate piping, valves and fittings shipped loose by packaged equipment supplier, showing their final location in field assembly.

.6 Closeout Submittals:

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

1.5 Health and Safety

.1 Do construction occupational health and safety in accordance with Section 01 35 33 – Health and Safety Requirements.

1.6 Waste Management and Disposal

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

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

.3 Collect and separate for disposal 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 containers in accordance with Waste Management Plan.

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

1.7 Extra Materials

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

.2 Furnish following spare parts:

.1 One pump seal and casing gasket for each size and type of pump.

PART 2 PRODUCTS

2.1 Equipment Selection

.1 Do component selection and sizing to CAN/CSA-B214.

2.2 In-Line Circulator

.1 Volute: cast iron, radially split, with flanged connection.

.2 Impeller: cast bronze.

.3 Shaft: alloy steel with copper or bronze sleeve bearing, integral thrust collar.

.4 Seal assembly: mechanical.

.5 Coupling: flexible self-aligning.

.6 Design pressure: 860 kPa.

2.3 Vertical In-Line Pump

.1 Volute: cast iron, radially split, with tapped openings for draining and gauge connections, complete with vent line or internally flushed. Provide base ring tapping for floor mounted support as specified herein. Flanged connections.

.2 Impeller: cast bronze, enclosed type, dynamically balanced, keyed to shaft and secured in place.

.3 Shaft: alloy steel or stainless steel with bronze sleeve bearing, integral thrust collar.

.4 Seal assembly: mechanical.

.5 Coupling: closed coupled. Split coupled where noted.

.6 Design pressure: 1,200 kPa.

.7 Provide floor mounted support for pumps with 7.5 kW motor and larger.

2.4 Shaft Grounding Rings

.1 All VFD driven pumps shall be equipped with shaft grounding rings.

.2 Complete with mounting bracket and accessories.

PART 3 EXECUTION

3.1 Installation

.1 Do Work in accordance with CAN/CSA-B214.

.2 In-line circulators: install as indicated by flow arrows. Support at inlet and outlet flanges or unions and per manufacturer’s recommendation. Install with bearing lubrication points accessible.

.3 Vertical in-line pump: provide support for pipe elbows, suction diffuser and pump discharge combination valve at pump suction and discharge. Install floor mounted support where specified in this Section.

.4 Ensure that pump body does not support piping or equipment. Provide stanchions or hangers for this purpose. Refer to manufacturer's installation instructions for details.

.5 Pipe drain tapping to floor drain.

.6 Install volute venting pet cock in accessible location.

.7 Check rotation prior to start-up.

.8 Install pressure gauge test cocks.

3.2 Start-Up

.1 General

.1 In accordance with Section 01 91 00 - Commissioning, Section 23 08 00 – Commissioning of Mechanical Systems, and supplemented as specified herein.

.2 In accordance with manufacturer's recommendations.

.2 Procedures:

.1 Before starting pump, check that cooling water system over-temperature and other protective devices are installed and operative.

.2 After starting pump, check for proper, safe operation.

.3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.

.4 Check base for free-floating, no obstructions under base.

.5 Run-in pumps for 12 continuous hours.

.6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.

.7 Eliminate air from scroll casing.

.8 Adjust water flow rate through water-cooled bearings.

.9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.

.10 Adjust alignment of piping and conduit to ensure true flexibility at all times.

.11 Eliminate cavitation, flashing and air entrainment.

.12 Adjust pump shaft seals, stuffing boxes, glands.

.13 Measure pressure drop across strainer when clean and with flow rates as finally set.

.14 Replace seals if pump used to degrease system or if pump used for temporary heat.

.15 Verify lubricating oil levels.

3.3 Performance Verification

.1 General

.1 In accordance with Section 01 91 00 - Commissioning, Section 23 08 00 – Commissioning of Mechanical Systems, and supplemented as specified herein.

.2 Exclusions:

.1 This paragraph does not apply to small in-line circulators.

.3 Assumptions: these PV procedures assume that:

.1 Manufacturer's performance curves are accurate.

.2 Valves on pump suction and discharge provide tight shut-off.

.4 Net Positive Suction Head (NPSH):

.1 Application: measure NPSH for pumps which operate on open systems and with water at elevated temperatures.

.2 Measure using procedures prescribed in the Standard.

.3 Where procedures do not exist, discontinue PV, report to Departmental Representative and await instructions.

.5 Multiple Pump Installations - Series and Parallel:

.1 Repeat PV procedures specified above for pump performance and pump power for combinations of pump operations.

.6 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.

.7 Commissioning Reports: In accordance with Section 01 91 00 - Commissioning, Section 23 08 00 – Commissioning of Mechanical Systems, reports supplemented as specified herein. Reports to include:

.1 Record of point(s) of actual performance at maximum and minimum conditions and for single and parallel operation as finally set at completion of commissioning on pump curves.

.2 Pump performance curves (family of curves).

END OF SECTION

PART 1 GENERAL

1.1 Summary

.1 Section Includes:

.1 Materials, components, equipment and chemicals for installation of complete HVAC water treatment system.

1.2 Related Sections

.1	Section 01 01 50	General Instructions
.2	Section 01 35 33	Health and Safety Requirements
.3	Section 23 05 00	Common Work Results-Mechanical
.4	Section 23 08 02	Cleaning & Startup of Mechanical Piping Systems

1.3 References

.1 American Society of Mechanical Engineers (ASME)

.1 ASME Boiler and Pressure Vessel Code, Section VII – 2013.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.3 Submittals

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 – General Instructions. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 01 50 – General Instructions.

.2 Shop Drawings:

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

.3 Quality assurance submittals: submit following in accordance with Section 01 01 50 – General Instructions.

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

.4 Closeout Submittals:

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

.2 Include following:

.1 Log sheets as recommended by manufacturer.

1.4 Quality Assurance

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

1.5 Delivery, Storage, and Handling

.1 Packing, shipping, handling and unloading:

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

.2 Waste Management and Disposal:

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

PART 2 PRODUCTS

2.1 Manufacturer

.1 Equipment, chemicals, service provided by one supplier.

.2 Equipment, chemicals, service to be provided to match existing services on site.

2.2 Chemical Feed Piping

.1 Schedule 40 black steel.

2.3 Shipping/Feeding Chemical Containers

.1 High density molded polyethylene, with liquid level graduations, cover.

2.4 Water Treatment for Closed Systems

.1 Bypass pot feeder: 7.6 L capacity, constructed of heavy duty cast iron or welded steel suitable for 1,380 kPa working pressure, with quick opening cap and complete with NPS 20 connections. Isolation valves shall be installed on the inlet, outlet and drain.

.2 Sidestream filter: Steel construction using a 250mm x 30 micron filter cartridge, with a minimum flow rate of 35 litres/minute. A flow indicator with stainless steel impeller shall be installed in conjunction with the sidestream filter. Connections shall be NPS 20 and all isolation valves shall be installed per manufacturer’s instructions. Include 10 filter cartridges.

.3 Totalizing make-up water meter: Cast bronze body, NPS 20 connections, thermoplastic rotor and gear train, rated at 1,206 kPa maximum operating pressure.

.4 Provide corrosion coupon, coupon holder and cross.

2.5 Chemicals

.1 Closed System Treatment (Hot Water, Chilled Water): Use a Borated Nitrite-Molybdate based corrosion inhibitor. Maintain levels at 200 to 400ppm. The use of Nitrite only, Molybdate only or Sulphite will not be accepted.

.2 Cleaning solutions: as indicated in Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

.3 Provide one year supply.

2.6 Anti-Freeze

.1 Where noted in Contract Documents, provide inhibited Propylene Glycol anti-freeze and arrange with the supplier of this material to have three samples from the system analyzed during the first year of operation. The first sample shall be taken during the first week of plant operation after the installation of the anti-freeze, the second sample taken and analyzed approximately thirty (30) days later and the third one year after installation. Reports of anti-freeze analysis shall be submitted to the Departmental Representative.

.2 Anti-freeze solution shall be installed into system in strict accordance with the manufacturer's recommendations after cleaning and flushing procedures have been completed. Anti-freeze concentration shall be 35% (by volume) to provide freeze protection to -17°C.

.3 Provide suitably calibrated hydrometer for testing solution strength. Turn hydrometer over to the Departmental Representative.

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 HVAC water treatment systems in accordance with ASME Boiler Code Section VII, and requirements and standards of authorities having jurisdiction, except where specified otherwise.

.2 Ensure adequate clearances to permit performance of servicing and maintenance of equipment.

3.3 Chemical Feed Piping

.1 Install crosses at changes in direction. Install plugs in unused connections.

3.4 Cleaning of Mechanical System

.1 Provide copy of recommended cleaning procedures and chemicals for approval by Departmental Representative, include in O&M manuals.

.2 Thoroughly flush mechanical systems and equipment with approved cleaning chemicals designed to remove deposition from construction such as pipe dope, oils, loose mill scale and other extraneous materials. Chemicals to inhibit corrosion of various system materials and be safe to handle and use.

.3 During circulation of cleaning solution, periodically examine and clean filters and screens and monitor changes in pressure drop across equipment.

.4 Drain and flush system[s] until alkalinity of rinse water is equal to make-up water. Refill with clean water treated to prevent scale and corrosion during system operation.

.5 Disposal of cleaning solutions to be approved by authority having jurisdiction.

3.5 Water Treatment Services

.1 Provide water treatment monitoring and consulting services for period of one year after system start-up. Service to include:

.1 Initial water analysis and treatment recommendations.

.2 System start-up assistance.

.3 Operating staff training.

.4 Visit plant every 30 days during period of operation and as required until system stabilizes, and advise on treatment system performance.

.5 Provide necessary recording charts and log sheets for one year operation.

.6 Provide necessary laboratory and technical assistance.

.7 Provide clear, concise, written instructions and advice to operating staff.

3.6 Field Quality Control

.1 Start-Up

.1 Start up water treatment systems in accordance with manufacturer's instructions.

.2 Commissioning

.1 Commissioning Agency: to be installing water treatment sub-contractor.

.2 Timing:

.1 After start-up deficiencies rectified.

.2 After start-up and before TAB of connected systems.

.3 Pre-commissioning Inspections: verify:

.1 Presence of test equipment, reagents, chemicals, details of specific tests performed, and operating instructions.

.2 Suitability of log book.

.3 Currency and accuracy of raw water analysis.

.4 Required quality of treated water.

.4 Commissioning procedures - applicable to Water Treatment Systems:

.1 Establish, adjust as necessary and record automatic controls and chemical feed rates.

.2 Monitor performance continuously during commissioning of connected systems and until acceptance of project.

.3 Establish test intervals, regeneration intervals.

.4 Record on approved report forms commissioning procedures, test procedures, dates, times, quantities of chemicals added, raw water analysis, treated water analysis, test results, instrument readings, adjustments made, results obtained.

.5 Establish, monitor and adjust automatic controls and chemical feed rates as necessary.

.6 Visit project at specified intervals after commissioning is satisfactorily completed to verify that performance remains as set during commissioning (more often as required until system stabilizes at required level of performance).

.7 Advise Departmental Representative in writing on matters regarding installed water treatment systems.

.5 Commissioning procedures - Closed Circuit Hydronic Systems:

.1 Analyze water in system.

.2 Based upon an assumed rate of loss approved by Departmental Representative, establish rate of chemical feed.

.3 Record types, quantities of chemicals applied.

.6 Training:

.1 Commission systems, perform tests in presence of, and using assistance of, assigned O&M personnel.

.2 Train O&M personnel in softener regeneration procedures.

.7 Certificates:

.1 Upon completion, furnish certificates confirming satisfactory installation and performance.

.8 Commissioning Reports:

.1 To include system schematics, test results, test certificates, raw and treated water analyses, design criteria, other data required by Departmental Representative.

.9 Commissioning activities during Warranty Period:

.1 Check out water treatment systems on regular basis and submit written report to Departmental Representative.

3.5 Cleaning

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

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 01 50	General Instructions
.2	Section 23 05 00	Common Work Results-Mechanical
.3	Section 23 05 93	Testing Adjusting and Balancing

1.2 Waste Management and Disposal

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

.2 Dispose of unused cleaning solutions at official hazardous material collections site approved by the Departmental Representative.

.3 Do not dispose of unused cleaning solutions into sewer system, into streams, lakes, onto ground or in other locations where it will pose health or environmental hazard.

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

.5 Dispose of packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

1.3 Scope

.1 All air systems installed by this contract shall be cleaned by a Cleaning Contractor.

.2 The Cleaning Contractor shall visit the site in the case of existing systems or shall review the drawings and specifications of new systems, in order to be fully acquainted with the scope of work and requirements before tendering. No consideration will be granted for any misunderstanding of work to be done resulting from failure to visit the site or inspect the contract documents.

.3 The following air systems shall be cleaned, as applicable:

- .1 Relief
- .2 Supply
- .3 Return
- .4 Exhaust
- .5 Air Conditioning

.4 All components within each system shall be thoroughly cleaned to the Departmental Representative's satisfaction and shall include but not be limited to the following:

- .1 Intake exhaust and relief louvres
- .2 Bird screens
- .3 Auto dampers
- .4 Filter frames
- .5 Coils
- .6 Fans & motors - complete assembly

.7 All plenum surfaces

.8 Terminal heating/cooling coils

.9 Supply air grilles, registers and diffusers

.10 Ductwork

.11 Mixing boxes, air terminal units

.12 Return, exhaust and relief air grilles and diffusers.

1.4 Qualifications

.1 Cleaning shall be performed by a cleaning service company with high capacity cleaning equipment designed specifically for the work involved, executed by personnel specifically trained for the application.

PART 2 PRODUCTS

2.1 Cleaning Equipment

.1 Cleaning shall generally by high capacity power vacuum.

.2 High pressure compressed air, wire brushing and/or non-toxic solvent cleaning shall be used where dirt or scale cannot be removed otherwise.

PART 3 EXECUTION

3.1 Cleaning HVAC Systems

.1 The Cleaning Contractor shall provide access as required for the work and shall reseal and make good any duct or insulation damaged in the process of this work.

.2 Remove cheesecloth from grilles, etc., let over from the temporary use of the air systems.

.3 Air systems must not be shut down without prior approval from the Departmental Representative.

.4 The Cleaning Contractor shall be responsible for removing and replacing filter media. In new buildings this Contractor will remove the temporary filters and replace with new after cleaning the systems. In existing buildings this Contractor may re-use existing filter media (cleaned if possible) or new media will be provided by the Departmental Representative.

.5 The Cleaning Contractor shall mark balancing damper positions before cleaning and return them to their original position when cleaning is completed unless the system is to be balanced.

.6 Re-install any grilles, registers and diffusers which may have been removed for cleaning purposes.

3.2 Report

.1 After completion of the work, the Contractor shall provide four copies of a certificate stating that all systems have been cleaned as specified and that all access panels for all cleaning openings are in place. This certificate shall be placed in the Operating and Maintenance Manuals.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 01 50	General Instructions
.2	Section 01 35 33	Health and Safety Requirements
.3	Section 23 05 00	Common Work Results - Mechanical
.4	Section 23 05 48	Vibration and Seismic Controls for Ductwork, Piping and Equipment
.5	Section 23 05 94	Pressure Testing of Ducted Air Systems
.6	Section 23 07 13	Thermal Insulation for Ducting
.7	Section 23 31 10	Cleaning of Mechanical Duct 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 A312/A312M-2014, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.

.2 ASTM A480/A480M-2013, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.

.3 ASTM A635/A635M-2013, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.

.4 ASTM A653/A653M-2013, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

.3 Department of Justice Canada (Jus).

.1 Canadian Environmental Protection Act (CEPA), 1999, c. 33 .

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Safety Data Sheets (SDS).

.5 National Fire Protection Agency (NFPA)

.1 NFPA 90A-2012, Standard for the Installation of Air-Conditioning and Ventilating Systems.

.2 NFPA 90B-2012, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

.3 NFPA 91-2010, Standard for Exhaust System for Air Conveying of Vapours, Gases, Mists, and Non-combustible Particle Solids.

.6 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.1 ANSI/SMACNA 006-2006, HVAC Duct Construction Standards, Metal and Flexible, 3rd Edition.

.2 SMACNA HVAC Air Duct Leakage Test Manual, 2nd Edition, 2012.

.3 IAQ Guideline for Occupied Buildings Under Construction 1995, 1st Edition.

.7 Transport Canada (TC).

.1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

.8 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102-07, Surface Burning Characteristics of Building Materials and Assemblies.

.9 South Coast Air Quality Management District (SCAQMD), California State

.1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

1.3 Submittals

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

.2 Product Data: submit WHMIS SDS - Safety Data Sheets for the following:

.1 Sealants.

.2 Adhesive

.3 Duct tape.

.4 Duct liners.

1.4 Quality Assurance

.1 Certification of Ratings:

.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

1.5 Delivery Storage and Handling

.1 Protect on site stored or installed absorptive material from moisture damage.

.2 Waste Management and Disposal:

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

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

.3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.

.4 Separate for reuse and recycling and place in designated containers in accordance with Waste Management Plan.

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

.6 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.

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

PART 2 PRODUCTS

2.1 Seal Classification

.1 Classification as follows:

Pressure Class	Maximum Pressure (Pa)	SMACNA Seal Class
High Pressure	2,500	[A]
Medium Pressure	1,500	[A]
Low Pressure	500	[B]

.2 Seal classification:

.1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant.

.2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant.

2.2 Ductwork - General

.1 Duct dimension noted on drawings are clear inside dimensions. Insulation thickness shall be as noted on the drawings.

.2 All seams, joints and raw edges shall be sealed and covered with glassfab.

.3 Insulation shall be applied with mechanical fasteners and suitable adhesives. Duct insulation adhesive and coatings shall be non-toxic as defined by WCB Regulations.

.4 Round duct: with spiral seams. Sections shall be joined with a RT1 slip joint, screw fastened and sealed with no visible duct sealant to interfere with finish painting.

.5 Exposed round duct shall be installed in a neat workmanlike manner parallel to building walls and roof with no sags or misalignment, and shall be true and round.

.6 All new Air Handling Units [AHU-101/102; AHU-302] Ductwork installed under this contract shall be constructed to 1,500 Pa medium pressure duct. All new Supply and Return air Ductwork for AHU-101/102 and AHU-302 installed under this contract shall be SMACNA Galvanized sheet metal gauge 16ga [0.0625in-1.6mm sheet thickness] with maximum 600mm reinforcement spacing.

.7 All new Exhaust Air Systems Ductwork installed under this contract shall be constructed to 1,500 Pa medium pressure duct. All new Exhaust Air Systems Ductwork installed under this contract shall be SMACNA Stainless Steel SS316 sheet metal gauge 18ga [0.0500in-1.2mm sheet thickness] with maximum 600mm reinforcement spacing.

.8 Contractor to provide written confirmation that all ductwork installed under this contract is 16ga and meets Seal and Leakage Classification as specified.

2.3 Fittings

.1 Fabrication: to SMACNA. Fittings shall be 2 gauges heavier than connecting ductwork.

.2 Radius elbows:

.1 Rectangular: Centre-line radius equal to 1.5 times width of duct, with single thickness turning vanes.

.2 Round: Centre-line radius equal to 1.5 times diameter. 5-gore for 300mm and larger; die-stamped for 254mm and smaller.

3 Mitered elbows, rectangular:

.1 To 400mm with single thickness turning vanes.

.2 Over 400mm with double thickness turning vanes.

.4 Branches:

.1 Rectangular main and branch: 45° entry on branch.

2 Round main and branch: enter main duct at 45° or with conical connection. The use of spin-in collars is not acceptable.

.5 Transitions:

.1 Diverging: 20° maximum angle.

.2 Converging: 30° maximum angle.

.6 Offsets: full radius elbows.

.7 Obstruction deflectors: maintain full cross-sectional area.

2.4 Galvanized Steel

.1 Lock forming quality: to ASTM A653, Z90 zinc coating.

.2 Thickness, fabrication and reinforcement: to SMACNA.

.3 Joints: to SMACNA.

.4 Applications:

.1 All supply and return air ductwork unless otherwise noted.

2.6 Stainless Steel

.1 Material: 316 stainless steel to ASTM A312.

.2 Thickness: minimum 1.2mm [18 gauge], built for structural strength.

.3 Joints: continuously welded.

.4 Duct system shall be fitted with copper-grounding straps, connected to the duct and to an effective grounding system.

.5 Applications:

.1 Fume exhaust duct.

.2 Canopy exhaust duct.

.3 As noted on drawings.

2.7 Hangers and Supports

.1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hanger: 500mm.

.2 Hangers, hanger configuration and attachment to structure: to SMACNA.

2.8 Duct Liner

.1 Not acceptable. All insulation to be exterior to ductwork.

2.9 Sealant

.1 For indoor and outdoor applications:

.1 Water based, fiber reinforced, non-toxic, elastomeric duct sealant. Suitable for indoor and outdoor use, non-sagging, non-cracking, UV resistant, freeze/thaw stable, paintable. Temperature range of -32°C to 99°C. ULC listed and comply with NFPA 90A and NFPA 90B.

.2 Flame and smoke ratings:

.1 In accordance with CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

.2 For outdoor applications only:

.1 Solvent based, fiber reinforced, elastomeric duct sealant. Suitable for outdoor unit, non-sagging, non-cracking, UV-proof, freeze/thaw stable, paintable. Temperature range of -45°C to 120°C.

.3 Maximum VOC limit 420 g/L to SCAQMD Rule 1168 and SMACNA Technical Resource Bulletin (TRB) #9-09.

2.10 Adhesive

.1 Water-based vinyl copolymer adhesive. Temperature range of -23°C to 71°C. ULC listed and comply with NFPA 90A and NFPA 90B. Adhesive shall be non-toxic as defined by WorksafeBC Regulations.

.2 Flame and smoke ratings:

.1 In accordance with CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

.3 Maximum VOC limit 80 g/L to SCAQMD Rule 1168.

2.11 Duct Tape System

.1 Not Acceptable

PART 3 EXECUTION

3.1 General

.1 Do work in accordance with NFPA 90A, NFPA 90B, ASHRAE, SMACNA, and as indicated.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.

.3 Support risers in accordance with SMACNA.

.4 Install breakaway joints in ductwork on sides of fire separation.

.5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

.6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

.7 All openings in ductwork shall be sealed with temporary duct cover during construction. Failure to maintain duct cleanliness will require the inside of all air ducts, plenums and equipment in the air stream to be cleaned with an industrial vacuum cleaner before system balancing is started.

.8 Apply protective galvanize coating to galvanized ductwork and accessories which have been welded.

.9 Apply duct sealer to all joints of metal ducts, connections to diffusers, plenums and flexible duct.

.10 Provide medium pressure duct for the following:

.1 Ductwork serving systems with air terminal units, extending from the air handling unit discharge to the inlet of air terminal units.

.2 As indicated.

.11 The use of plastic duct tape is not permitted.

.12 Thermal insulation to Section 23 07 13 – Thermal Insulation for Ducting.

3.2 Hangers

.1 Strap hangers: Install in accordance with SMACNA.

.2 Rectangular duct: Extend strap hanger down on both sides of duct, turn under bottom 25mm minimum. On each strap provide two sheet metal screws on the side and one in the bottom.

.3 Angle hangers: complete with locking nuts and washers.

.4 Hanger spacing: to SMACNA.

.5 Seismic restraint to Section 23 05 48 – Vibration and Seismic Controls for Ductwork, Piping and Equipment.

3.3 Ductwork Exposed to Weather

.1 All ductwork exposed to weather shall have watertight seams.

.2 Exposed ducts which are not insulated or finished with paint shall be coated with two applications of bitumastic waterproofing compound to prevent corrosion.

.3 Supports for ductwork exposed to weather and miscellaneous metals exposed to weather shall be electro-galvanized or hot dip galvanized steel, or coated with two applications of bitumastic waterproofing compound.

3.4 Duct Liner

.1 Duct liner is unacceptable. All insulation is to be exterior to ductwork.

3.5 Watertight Duct

.1 Provide watertight duct for:

.1 AHU-101/2 and AHU-302 new ductwork systems.

.2 Form bottom of horizontal duct without longitudinal seams.

.1 Solder or weld joints of bottom and side sheets.

.2 Seal other joints with duct sealer.

.3 Slope horizontal branch ductwork down towards fume hoods served.

.1 Slope header ducts down toward risers.

3.6 Sealing and Taping

.1 Apply sealant to outside of joint to manufacturer's recommendations.

.2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturers recommendations.

3.8 Leakage Tests

.1 Refer to Section 23 05 94 - Pressure Testing of Ducted Air Systems.

.2 In accordance with SMACNA HVAC Duct Leakage Test Manual.

.3 Perform leakage tests in sections.

.4 Perform trial leakage tests, as instructed to demonstrate workmanship.

.5 Install no additional ductwork until trial tests have been achieved.

.6 Test section minimum of 30m long with not less than three branch takeoffs and two 90ª elbows.

.7 Complete tests before insulation or concealment.

3.9 Cleaning

.1 Perform cleaning operations as specified in Section 01 01 50 – General Instructions, Section 23 31 10 – Cleaning of Mechanical Duct Systems and in accordance with manufacturer's recommendations.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 01 50	General Instructions
.2	Section 01 35 33	Health and Safety Requirements
.3	Section 01 74 11	Cleaning
.4	Section 23 05 00	Common Work Results - Mechanical
.5	Section 23 31 10	Cleaning of Mechanical Duct Systems

1.2 References

.1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.1 ANSI/SMACNA 006-2006, HVAC Duct Construction Standards, Metal and Flexible, 3rd Edition.

.2 National Fire Protection Association (NFPA)

.1 NFPA 90A-2012, Standard for the Installation of Air-Conditioning and Ventilating Systems.

.2 NFPA 90B-2012, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

.3 Underwriter's Laboratories of Canada (ULC)

.1 CAN/ULC-S110-07, Standard Method of Tests for Air Ducts.

.2 UL 181-2013, Standard for Factory-Made Air Ducts and Air Connectors.

1.3 Submittals

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:

.1 Flexible ducts.

.2 Flexible duct connectors.

.3 Duct access doors.

.4 Turning vanes.

.5 Instrument test ports.

.3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.1 Certification of ratings: catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

.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: manufacturer's field reports specified.

.7 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 01 50 – General Instructions.

1.4 Quality Assurance

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

1.5 Delivery, Storage and Handling

.1 Waste Management and Disposal:

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

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

.3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan (WMP).

.4 Separate for reuse and recycling and place in designated containers in accordance with Waste Management Plan (WMP).

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

PART 2 PRODUCTS

2.1 General

.1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 Flexible Duct

.1 General:

.1 UL-181 listed and labeled as Class I air duct, and complies with NFPA 90A and 90B.

.2 Non-metallic, Insulated:

.1 Constructed of CPE liner duct permanently bonded to a spring steel wire helix and with factory applied fibreglass insulation, lower permeability vapour barrier and laminate jacket for low and medium pressure systems.

.2 Maximum rated pressure: 1,000Pa positive, 250Pa negative.

.3 Operating temperature: -29 to 121 °C.

.4 Thermal resistance: RSI-0.74.

.5 Application: cold air supply duct.

.3 Non-metallic, un-insulated:

.1 Constructed of supporting helix of coated spring steel wire permanently bonded to a coated woven fiberglass.

.2 Maximum rated pressure: 2,500Pa positive, 250Pa negative.

.3 Operating temperature: -18 to 121 °C.

.4 Application: warm air supply duct.

2.3 Flexible Duct Connectors

.1 Frame: galvanized sheet metal frame 0.66mm [24 gauge] thick with fabric clenched by means of double locked seams.

.2 Fabric:

.1 Indoor: Fire resistant, self extinguishing, neoprene coated fibreglass fabric, temperature rated at -40°C to 90°C, thickness of 0.63mm.

.2 Outdoor: Fire resistant, self extinguishing, DuPont Hypalon coated fibreglass fabric, temperature rated at -40°C to 120°C, thickness of 0.61mm.

2.4 Access Doors in Ducts

.1 Non-insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6mm [24 gauge] thick complete with sheet metal angle frame.

.2 Insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6mm [24 gauge] thick complete with sheet metal angle frame and 25mm thick rigid fibreglass insulation.

.3 Gaskets: neoprene.

.4 Hardware:

.1 Up to 300 x 300 mm: two sash locks complete with safety chain.

.2 301 to 450 mm: four sash locks complete with safety chain.

.3 451 to 1000 mm: piano hinge and minimum two sash locks.

.4 Doors over 1000 mm: piano hinge and two handles operable from both sides.

2.5 Turning Vanes

.1 Factory-made, single or double thickness as specified elsewhere, with trailing edge. Vanes shall be constructed of same material as duct, 0.55mm [26 gauge].

.2 Rails shall be fabricated of same material as duct, 0.66m [24 gauge]. Vanes shall be attached to rails using fasteners.

2.6 Instrument Test Ports

.1 Alloy casting with screw-in cap, neoprene gasket, 18 mm inside diameter opening for pitot tube or velometer.

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 Flexible Duct

.1 Provide flexible duct connecting air outlets as indicated. Flexible duct with integral volume damper is not acceptable.

.2 Install flexible duct fully extended, without tight bends and kinks. The radius at the centre-line shall not be less than one duct diameter. Do not install in compressed state.

.3 Length of flexible duct shall within 1,500mm to 2,100mm .

.4 Provide support for flexible duct at 1,200mm on centre. Maximum permissible sag is 42 mm/m of spacing between support. A connection to a rigid duct or equipment shall be considered a support joint.

.5 Sheet metal strap for flexible duct support shall be minimum 38mm wide.

.6 Sheet metal collars to which the flexible ducts are attached shall be minimum 50mm in length.

.7 Repair torn or damaged vapour barrier jackets approved duct tape. If the internal core is penetrated, replace the flexible duct.

.8 Do not use flexible duct for connecting mixing box and air terminal unit inlets.

.9 Do not use flexible duct on return and exhaust ductwork.

.2 Flexible Duct Connectors

.1 Install in following locations:

.1 Inlets and outlets to supply air units and fans.

.2 Inlets and outlets of exhaust and return air fans.

.3 As indicated.

.2 Length of connection: 100mm.

.3 Minimum distance between metal parts when system in operation: 75mm.

.4 Install in accordance with recommendations of SMACNA.

.5 When fan is running:

.1 Ducting on sides of flexible connection to be in alignment.

.2 Ensure slack material in flexible connection.

.6 Flexible duct connector exposed to weather shall have a sheet metal shield for additional UV protection.

.3 Access Doors in Ducts

.1 Size:

.1 610mm x 1520 mm for person size entry.

.2 460mm x 460 mm for service.

.3 300mm x 200mm for cleaning.

.4 As indicated.

.2 Locations:

.1 Fire dampers and smoke dampers.

.2 Control dampers.

.3 Devices requiring maintenance.

.4 Required by code.

.5 Reheat coils.

.6 On both sides of turning vanes.

.7 At the base of all duct risers.

.8 At 12,000m intervals in all duct systems, and 6,000mm intervals in horizontal exhaust ducts for cleaning purposes.

.4 Instrument Test Ports

.1 Install in accordance with manufacturer's instructions.

.2 Locate to permit easy manipulation of instruments.

.3 Locations:

.1 For traverse readings:

.1 Ducted inlets to roof and wall exhausters.

.2 Inlets and outlets of other fan systems.

.3 Main and sub-main ducts.

.4 And as indicated.

.2 For temperature readings:

.1 At outside air intakes.

.2 In mixed air applications in locations.

.3 At inlet and outlet of coils.

.4 Downstream of junctions of two converging air streams of different temperatures.

.5 And as indicated.

.5 Turning Vanes

.1 Install in accordance with manufacturer's recommendations.

3.3 Cleaning

.1 Proceed in accordance with Section 01 01 50 – General Instructions01 74 11 – Cleaning, and Section 23 31 10 - Cleaning of Mechanical Duct Systems.

.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 Related Sections

.1	Section 01 01 50	General Instructions
.2	Section 01 35 33	Health and Safety Requirements
.3	Section 23 05 00	Common Work Results – Mechanical
.4	Section 23 31 10	Cleaning of Mechanical Duct Systems
.5	Section 23 33 00	Air Duct Accessories

1.2 References

.1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.1 ANSI/SMACNA 006-2006, HVAC Duct Construction Standards, Metal and Flexible, 3rd Edition.

.2 SMACNA – Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems, 2002.

.2 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S112-10, Standard Method of Fire Test of Fire Damper Assemblies.

.2 CAN/ULC-S112.2-07, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.

.3 ULC-S505-1974, Standard for Fusible Links for Fire Protection Service.

.3 National Fire Protection Agency (NFPA)

.1 NFPA 90A-2012, Standard for the Installation of Air-Conditioning and Ventilating Systems.

1.3 Submittals

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 – General Instructions. Include product characteristics, performance criteria, and limitations.

.1 Indicate the following:

.1 Volume dampers.

.2 Remote control damper regulators.

.3 Fire dampers.

.4 Backdraft dampers.

.5 Relief dampers.

.2 Quality assurance submittals: submit following in accordance with Section 01 01 50 – General Instructions.

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

.2 Instructions: submit manufacturer's installation instructions.

1.4 Quality Assurance

.1 Health and Safety Requirements:

.1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

1.5 Delivery, Storage and Handling

.1 Packing, shipping, handling and unloading:

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

.2 Waste Management and Disposal:

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

1.6 Extra Materials

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

.2 Provide following:

.1 Six (6) fusible links for each type of fire damper.

PART 2 PRODUCTS

2.1 General

.1 Manufacture to SMACNA standards.

2.2 Single Blade Volume Dampers

.1 Blade: Of same material as duct. Two gauges heavier than duct but not less than 0.6mm [24 gauge], stiffened.

.2 Maximum dimension: 305mm [12”] height for rectangular ducts.

.3 Axles: 9.5mm [3/8”] continuous square rod up to 457mm [18”] wide duct, and 13mm [1/2”] continuous square rod up to 1,219mm [48”] wide duct.

.4 Linkage: shaft extension with locking quadrant and position indicator.

.5 Bearings: bronze oilite.

.6 Frame: of the same material as duct. Complete with angle stop for rectangular duct.

2.3 Multi-Bladed Volume Dampers

.1 Opposed blades: 1.2mm [18 gauge] of same material as adjacent duct, stiffened.

.2 Maximum blade width: 150mm [6”].

.3 Axles: 9.5mm [3/8”] or 13mm [1/2”] continuous square rod.

.4 Bearings: bronze oilite.

.5 Linkage: shaft extension with locking quadrant and position indicator.

.6 Frame: 51mm [2”] or 40 x 13 x 3 mm [1-1/2”x1/2”x1/8”] structural or roll-formed channel, complete with angle stop.

2.4 Fire Dampers

.1 Dynamic type, Arrangement B, ULC listed and labelled, meeting requirements of provincial fire authority and NFPA 90A. Fire damper assemblies to be fire tested in accordance with CAN/ULC-S112. Factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.

.2 Frame and integral sleeve shall be of same material as duct with mounting angles furnished by the damper manufacturer. Sleeve thickness to SMACNA and NFPA-90A.

.3 Top hinged: offset, round or square, interlocking blade type and sized to maintain full duct cross section.

.4 Fusible link: 74°C, replaceable.

.5 40 x 40 x 3 mm [1-1/2” x 1-1/2” x 1/8”] retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.

2.5 Backdraft Dampers

.1 Multi-blade, gravity-operated, centre pivoted, constructed of same material as duct with nylon bearings.

2.6 Relief Dampers

.1 Multi-blade, insulated, counter-weight, centre pivoted, constructed of same material as duct with brass bearings, set to open at 12.4 Pa [0.05 in. w.g.] static pressure unless otherwise noted.

PART 3 EXECUTION

3.1 General

.1 Install where indicated.

.2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.

.3 Seal multiple damper modules with silicon sealant.

3.2 Volume Damper

.1 For supply, return and exhaust systems, locate balancing dampers in each branch duct.

.2 Run-outs to registers and diffusers: install single blade damper located as close as possible to main ducts.

.3 All dampers to be vibration free.

.4 Attach fluorescent tape to regulator handle for concealed volume dampers.

.5 Provide remote control damper regulator for volume dampers above inaccessible ceiling where ceiling access panel is not provided, and as indicated.

3.3 Fire Dampers

.1 Install in accordance to Part 3, Sub-section 3.1.8 of the National Building Code.

.2 Provide fire damper where duct penetrates through fire-rated floor, wall, or fire separation.

.3 Provide fire stop flap at fire-rated ceiling assembly.

.4 Provide access door per Section 23 33 00 – Air Duct Accessories.

3.4 Field Quality Control

.1 Tests:

.1 Tests to cover period of not less than 2 days and demonstrate that system is functioning as specified.

3.5 Cleaning

.1 Proceed in accordance with Section 01 01 50 – General Instructions, and Section 23 31 10 - Cleaning of Mechanical Duct Systems.

.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 Related Sections

.1	Section 01 01 50	General Instructions
.2	Section 01 35 33	Health and Safety Requirements
.3	Section 01 91 00	Commissioning
.4	Section 23 05 13	Common Motor Requirements for HVAC Equipment
.5	Section 23 05 48	Vibration & Seismic Controls for HVAC Piping & Equipment
.6	Section 23 08 00	Commissioning of Mechanical Systems
.7	Section 23 33 00	Air Duct Accessories
.8	Section 23 31 10	Cleaning of Mechanical Duct Systems

1.2 References

.1 Air Movement and Control Association (AMCA)

- .1 ANSI/AMCA 99-10, Standards Handbook.
- .2 ANSI/AMCA 204-12: Balance Quality and Vibration Levels for Fans.
- .3 ANSI/AMCA 210-07, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .4 ANSI/AMCA 300-08, Reverberant Room Method for Sound Testing of Fans.
- .5 AMCA 301-90, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.2 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB 1.181-1999, Ready-Mixed Organic Zinc-Rich Coating.

1.3 System Description

.1 Performance Requirements:

- .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.
- .2 Capacity: flow rate, static pressure, brake power, power, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.
- .3 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.
- .4 Sound ratings: comply with AMCA 301, tested to AMCA 300.
- .5 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210.

1.4 Submittals

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 – General Instructions. Include product characteristics, performance criteria, and limitations.

.2 Shop Drawings:

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

.3 Provide:

.1 Fan performance curves showing point of operation, brake power and efficiency.

.2 Sound rating data at point of operation.

.4 Indicate:

.1 Motors and sheaves details.

.5 Quality assurance submittals: submit following in accordance with Section 01 01 50 – General Instructions.

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

.2 Instructions: submit manufacturer's installation instructions.

.6 Closeout Submittals:

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

1.5 Quality Assurance

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

1.6 Delivery, Storage and Handling

.1 Packing, shipping, handling and unloading:

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

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

.3 Waste Management and Disposal:

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

PART 2 PRODUCTS

2.1 Fans General

.1 Motors:

.1 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment supplemented as specified herein.

.2 For use with variable speed controllers where specified.

.3 Sizes as specified.

.2 Accessories and hardware: as specified.

.3 Scroll casing drains: as indicated.

.4 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

.5 Vibration isolation: to Section 23 05 48 - Vibration and Seismic Controls for Ductwork Piping and Equipment.

.6 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

2.2 Centrifugal Fans

.1 Fan wheels:

.1 welded steel construction.

.2 Maximum operating speed of centrifugal fans not more than 50% of first critical speed.

.3 Air foil or backward inclined blades, as indicated.

.2 Bearings: heavy duty grease lubricated ball or roller self aligning type with oil retaining, dust excluding seals and a certified minimum rated life (L50) of 200,000 hours.

.3 Housings:

.1 Volute with inlet cones: fabricated steel for wheels 300 mm or greater, steel, for smaller wheels, braced, and with welded supports.

.2 For horizontally and vertically split housings provide flanges on each section for bolting together, with gaskets of non-oxidizing non-flammable material.

.3 Provide bolted or latched airtight access doors with handles.

.4 Provide belt driven sets with adjustable motor bed plate and variable pitch driver sheave.

2.3 Cabinet Fans – General Purpose

.1 Fan characteristics and construction: as centrifugal fans.

.2 Cabinet hung single wheel with centrifugal fan in factory fabricated, acoustically insulated casing complete with vibration isolators and seismic control measures, motor and other accessories as noted.

.3 Fabricate casing of zinc coated or phosphate treated steel of 18 gauge reinforced and braced for rigidity. Provide removable panels for access to interior. Paint uncoated, steel parts with corrosion resistant paint to CAN/CGSB 1.181.

2.4 In-Line Centrifugal Fans

.1 Characteristics and construction: as for centrifugal fan wheels.

.2 Provide AMCA arrangements 1 or 9 as indicated with stiffened flanges, smooth rounded inlets, and stationary guide vanes.

2.5 Roof-Mounted Centrifugal Exhaust Fans

.1 General: Spun aluminum, roof-mounted, centrifugal exhaust ventilator as scheduled:

.2 Construction: Bolted and welded construction with corrosion resistant fasteners. Spun aluminum structural components, minimum 16 gauge marine alloy aluminum, bolted to a rigid aluminum support structure. Aluminum base with one piece inlet spinning, continuously welded curb cap corners. Discharge baffle and/or windband with rolled bead. Two piece top cap with stainless steel quick release latches. Integral conduit chase into motor compartment. Lifting lugs.

.3 Wheel: centrifugal backward inclined, all aluminum construction, cast aluminum hub, aerodynamic aluminum inlet cone. Balanced in accordance with AMCA Standard 204.

.4 Motor: heavy duty type with permanently lubricated sealed bearings.

.5 Discharge: upblast or downblast as schedule.

.6 Drive: direct or belt drive as scheduled.

.7 Belt drive units shall have motor, bearings and drives mounted on a minimum 14 gauge steel power assembly, isolated from the unit structure with rubber vibration isolators. Enclosed in a weather-tight compartment, separated from the exhaust airstream.

.1 Bearings - Heavy duty regreasable ball type in a cast iron pillow block housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

.2 Drives - Precision machined, cast iron type, keyed and securely attached to the wheel and motor shafts. Sized for 150 percent of the installed motor horsepower.

.8 Roof curb: pre-fabricated 18 gauge galvanized steel, insulated, continuously welded corners, wood nailer, minimum height to meet RCABC standard, damper tray.

.9 Accessories: aluminum backdraft damper, disconnect switch.

2.9 Laboratory Fume Hood Tri-Stack Exhaust System Plume Dilution Exhaust Fans [PDEF]

.1 General

.1 References:

.1 Performance ratings: Conform to AMCA standard 210, 260 and 300. Fans must be tested in accordance with AMCA 210, 260 and 300 in an AMCA accredited laboratory and certified for air and sound performance. Fan shall be licensed to bear the AMCA ratings seal for air performance (AMCA 210), sound performance (AMCA 300), and induced flow fan for high plume dilution blowers (AMCA 260).

.2 Fans shall be UL and CUL listed per UL 705 safety standard.

.3 Fans shall meet the criteria of NFPA-45.

.4 Classification for Spark Resistant Construction shall conform to AMCA 99.

.2 Submittals

.1 Submit shop drawings and product data sheets including performance data, fan performance curves, vibration levels, maintenance requirements and sound power levels.

.2 Fan manufacturer shall furnish a certificate of guarantee stating that the fan, mixing plenum, outlet nozzle, acoustical silencer nozzle, stack extension if any, and all related accessories specified herein have been pre-tested at the factory and that the curves supplied in 1.3.1 have been de-rated for any and all system effects created by the accessories.

.4 Products

.1 Mixed-flow induced dilution fans:

.1 Impellers shall be mounted directly to the motor shaft to provide Arrangement 4 Direct Drive. Motors shall be isolated from the primary exhaust air stream and shall be visible and accessible from the fan exterior for inspection and service. Models that are not Arrangement #4 will be rejected.

.2 Mixed flow impellers shall consist of combination axial/backward curved blades and shall be of welded steel construction. The impellers shall have non-stall and non-overloading performance characteristics with aerodynamically stable operation at any point on the fan curves.

.3 Fan Performance shall be as stated on the schedule. The Static Pressure stated on the schedule shall be at the inlet to the “Fan System” and does not include any losses of equipment provided by the fan manufacturer (ie: HRU, Filters, Silencers, etc…). All losses for the equipment provided by the fan manufacturer shall be detailed in the fan manufacturers technical proposal and or submittal.

.4 Fan and all drive components shall have a combined bearing life of a minimum of L_{10} = 150,000 hours.

.5 Maintenance shall only be required on a minimum of 18 month intervals. This maintenance shall be limited to re-greasing of the motor bearings.

.6 Stationary discharge guide vane sections shall be provided to increase fan efficiencies.

.7 Fan dynamic balance not to exceed 0.5 mil, peak-to-peak for nominal 900RPM, 1200RPM, and 1800RPM fans, or 0.055 in/sec -peak for 1800 RPM, 0.035 in/sec — peak for 1200 RPM, and 0.030 in/sec-peak for 900 RPM fans measured at the blade pass area when operating at fan frequency. Vibration isolation shall be limited to rubber-in-shear pad type isolators unless otherwise specified.

.8 Factory test reports detailing vibration levels at the blade pass area shall be provided. Vibration levels shall be reported in both the axial and radial direction. If fan vibration is greater than 0.5 mils peak-to-peak at the

blade pass area, fan manufacturer shall be responsible for providing vibration isolators on each fan and flexible connection at each duct inlet. Manufacturer shall add 124 Pa additional static pressure to the fan system to compensate for losses through the flexible connection. Vibration isolators, 496 Pa deflection seismic rated spring, must be installed on each individual fan with a minimum of four per fan.

.9 Fan assemblies shall be designed for mounting on conventional roof curb without the need for guy wire supports.

.10 Discharges shall include twin FRP nozzles with passive third central stacks that are capable of generating aspiration. The FRP shall be chemically and UV resistant.

.11 Entrainment windbands shall provide secondary induction of outside air. Induction shall take place downstream of the fan impeller and shall not influence brake power or static pressure requirements. Windbands shall discharge up to 270% of the design flow rates. The manufacturer shall publish discharge volumes for all fans at specified primary exhaust flow.

.12 Fan shall be constructed to AMCA “C” standards per AMCA 99 with a non-ferrous inlet bell provided in order to reduce sparking in the event of a motor bearing failure.

.13 Fans shall be modular construction and capable of being assembled on the roof.

.14 Chemical resistant gaskets shall be provided at all companion flanged joints.

.15 Fasteners shall be 316 stainless steel.

.16 A bolted access door shall be provided for impeller inspection on each fan.

.17 Fans and accessories shall have internal drain systems to prevent rain water from entering building duct system.

.18 Electric motors shall be TEFC Mill & Chemical duty with a 1.15 service factor and an L_{10} bearing life of 150,000 hours. Premium Efficient motors shall have regreasable bearings with grease relief fittings in every NEMA frame. Fan motors shall be C-Face and foot mounted.

.19 Extended motor lube lines of Teflon tubing covered with braided stainless steel shall be provided. Extended lube lines shall be mounted to a bracket located on the fan housing with grease relief fittings on each line.

.20 A NEMA 3R non-fused disconnect switch shall be provided, mounted and wired to the motor.

.21 All steel and aluminum surfaces components within the airstream that are not stainless steel or fiberglass must be surface prepped by abrasive blast clean to SSPC-SP10. Chemically cleaning of these components as a form of surface preparation is not acceptable. These components must be coated with a high solids epoxy with low VOC chemical resistant barrier coating epoxy. The coating system, a total thickness of up to 12 mils, is not affected by the UV component of sunlight (does not chalk),

and has superior corrosion resistance to acid, alkali, and solvents. Coating system shall exceed 7000 hour ASTM B117 Salt Spray Resistance. Standard finish color to be gray. All coatings that include a zinc rich epoxy primer are strictly prohibited. Zinc coatings react with alkalis and acids, thus causing premature failure of the coating system and should never be used for laboratory applications.

.22 Fan and Mixing Box systems supplied by the manufacturer must have a foot print as shown on the drawings / schedule. Exhaust systems with larger footprints shall not be acceptable.

.24 The static pressure shown on the schedule is based on the static pressure requirements at the inlet to the mixing box. Any system deviating from the basis of design shall include and detail in their proposal additional losses for flexible connectors, fan losses, elbows, mixing box, etc. that are not included in their fan curves. In addition any deviation from the basis of design shall be subject to requirements stated in sections 1.3.2, 2.1.8 and 2.1.23.

.5 Accessories

.1 Inlet mixing plenums shall be provided by the fan manufacturer. Each plenum shall be sized to support the weight and performance requirement of the number of fans listed on the schedule. Multiple fan plenums shall be insulated double wall construction with structural stiffeners. Double wall plenums, except for fans over 2.24 kW shall have an overall minimum wall thickness of 40 mm, and the insulation shall have a minimum R value of 4.34. Outer skin of double wall plenums shall be coated 12Ga Galvaneal steel. Inner skin shall be uncoated 18Ga 316 stainless steel. Multiple fan plenums shall be able to withstand a minimum of 3.0 kPa of negative pressure. Single fan plenums shall be of continuously welded, heavy gauge steel construction. For single thickness plenums, coatings shall be the same as specified for the fans. All plenums shall be capable of supporting the fan(s) without guy wires or supports. The plenums shall include hinged access doors. The primary air inlets shall be located on the bottom or side as noted on construction drawings. Unless otherwise specified, plenums shall be suitable for mounting on roof curbs. Safety screens shall be supplied over inlet of fan.

.2 Bypass dampers shall be provided with all mixing plenums for outside air with primary exhaust. Bypass damper(s) shall be sized to bypass the airflow capacity of one fan at the required static pressure of the system. Dampers will be opposed blade low leakage air foil control dampers with extended shaft for connection to an operator. The dampers shall be all aluminum construction. Rain hoods shall be provided with each damper. The dampers shall be controlled by a 24v electric proportional control damper actuators shall be electronic direct-coupled type, which require no crankarm and linkage. Actuators must provide proportional damper control in response to a 2 to 10 VDC or, with the addition of a 500Ω resistor, a 4 to 20 mA control input from an electronic controller or positioner. Actuators shall have Brushless DC motor technology and be protected from overload at all angles of rotation. Actuators shall have reversing switch and manual override on the cover. Run time shall be constant and independent of torque. A 2 to 10 VDC feedback signal shall be provided for position indication.

.3 An acoustic louver shall be provided at the inlet to the bypass dampers on systems requiring sound attenuation.

.4 Low leakage isolation dampers shall be constructed of aluminum air foil extrusions and epoxy coated. Operators shall be 2 position, spring return and shall have On-off spring return damper actuators that are direct coupled type which require no crankarm and linkage and be capable of direct mounting to a jackshaft. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall have a manual positioning mechanism accessible on its cover. Actuators shall use a brushless DC motor and be protected from overload at all angles of rotation. Run time shall be constant and independent of torque. Auxiliary switches, 2 SPDT, shall be provided with one switch having the capability of being adjustable.

.5 Vortex breakers shall be provided on all side inlet and multiple fan plenums.

.6 Acoustical Silencer Nozzle shall be designed as an integral component of the exhaust fan discharge nozzle and shall not increase the height of the overall assembly. Integral Acoustical Silencer Nozzle with a minimum of 12dBA insertion loss. Lining the interior of the windband is not an acceptable method of attenuation due to line of site sound in the free area between the nozzle and windband.

.1 The Acoustical Silencer Nozzle shall provide the attenuation values as specified in the following schedule. The published insertion loss values shall be obtained from an AMCA 300 test with the silencer installed on the fan specified. Ratings based on separate silencer and fan testing is not acceptable.

OCTAVE BAND CENTER FREQUENCY (Hz)									
FAN SIZE / SILENCER MODEL	LENGTH	63	125	250	500	1000	2000	4000	8000
TS-2	64"	0	4	9	11	12	13	9	4
TS-3	88"	0	6	7	10	11	7	11	2
TS-4	89"	5	8	9	11	12	12	10	6
TS-5	93"	3	14	15	17	18	13	8	6

.2 The silencer shall be constructed with an outer shell of fiber reinforced plastic. The inner liner shall be perforated corrosion resistant steel. The silencer shall match the color of the fans. Acoustic media shall be isolated from the air stream by a non fibrous acoustical media.

2.10 Laboratory Exhaust Static Pressure Control Package:

.1 The control package shall be capable of maintaining the laboratory exhaust system static pressure at a predetermined level regardless of laboratory activity (i.e. opening/closing of laboratory hoods). This shall be accomplished without any user input.

.2 The outlet velocity of each fan in the exhaust system shall be maintained at a minimum of 15 m/s at all times.

.3 The static pressure at which the system is required to be maintained shall be capable of being set manually at the control package interface. The control package shall also be capable of receiving the static pressure set point from the building control system.

.4 Fans running simultaneously shall run at the same speed.

.5 The control package shall stage the fans in the system so that no one fan is idle for more than 30 days.

.6 The control package shall respond to a failure of one fan by energizing an unused fan (if present) to replace it.

.7 Include BACNET communication card, which will allow information to be sent from the control package to the building control system. This information shall include the measured system static pressure, the frequency at which the VFDs are running, fault status, and any other parameters required on the job.

.8 Wiring shall be done in the factory so as to minimize field wiring. Control wiring shall be brought to a single point in both the rooftop exhaust unit and VFD/mechanical room equipment.

.9 The controller shall be powered separately from any other component in the system.

.10 Factory installed VFD

.11 Factory installed control panel.

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 Fan Installation

.1 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48 – Vibration and Seismic Controls for Ductwork, Piping and Equipment, flexible electrical leads and flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.

.2 Provide sheaves and belts required for final air balance.

.3 Bearings and extension tubes to be easily accessible.

.4 Access doors and access panels to be easily accessible.

3.3 Anchor Bolts and Templates

.1 Size anchor bolts to withstand seismic acceleration and velocity forces as specified in Section 23 05 48 – Vibration and Seismic Controls for Ductwork, Piping and Equipment. Provide seismic bracing for suspended equipment as specified in Section 23 05 48.

3.4 Cleaning

.1 Proceed in accordance with Section 01 01 50 – General Instructions, and Section 23 31 10 - Cleaning of Mechanical Duct Systems.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.4 Field Quality Control

.1 Commissioning:

.1 In accordance with Section 01 91 00 – Commissioning, and Section 23 08 00 – Commissioning of Mechanical Systems.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 01 50	General Instructions
.2	Section 01 35 33	Health and Safety Requirements
.3	Section 01 91 00	Commissioning
.4	Section 23 05 00	Common Work Results – Mechanical
.5	Section 23 08 00	Commissioning of Mechanical Systems
.6	Section 23 31 10	Cleaning of Mechanical Duct Systems

1.2 References

.1 American National Standards Institute (ANSI)

.1 ANSI/ASHRAE 51/AMCA 210-07, Laboratory Methods of Testing Fans for Rating.

.2 ANSI/NFPA 90A-2012, Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 International Organization of Standardization (ISO)

.1 ISO 3741-2010, Acoustics-Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Methods for Reverberation Rooms.

.3 Underwriter's Laboratories (UL)

1.3 System Description

.1 Performance Requirements:

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from certified ADC (Air Diffusion Council) testing agency signifying adherence to codes and standards.

1.4 Submittals

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 – General Instructions. Include product characteristics, performance criteria, and limitations.

.2 Test data: to ANSI/AMCA 210.

.1 Submit published test data on DIN (Direct Internal Noise), in accordance with ISO 3741 made by independent testing agency for 0, 2.5 and 6 m/s branch velocity or inlet velocity.

.2 Sound power level with minimum inlet pressure of 250 Pa in accordance with ISO 3741 for 2nd through 7th octave band.

.3 Pressure loss through silencer shall not exceed 60% of inlet velocity pressure maximum.

.2 Shop Drawings:

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

.2 Indicate the following:

.1 Capacity.

.2 Pressure drop.

.3 Noise rating.

.4 Leakage.

.3 Quality assurance submittals: submit following in accordance with Section 01 01 50 – General Instructions.

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

.2 Instructions: submit manufacturer's installation instructions.

.4 Closeout Submittals:

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

1.5 Quality Assurance

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

1.6 Delivery, Storage and Handling

.1 Packing, shipping, handling and unloading:

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

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

.2 Waste Management and Disposal:

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

1.7 Related Work

.1 Supply and installation of Venturi Air Valves shall be part of the Division 23 Sheet Metal Sub Contractors scope of work and installed in accordance with installation standards as specified.

.2 Balancing Contractor shall be responsible for final onsite measurement and verification of the air valve flow and co-ordination of any corrective action required by the air valve supplier, as well as re verification after corrective action taken.

.3 **Note:** The Constant Volume Pressure Independent Venturi Air Valves specified require no power by the Electrical Contractor or external controls by the Controls Contractor.

1.8 General

.1 Warranty:
- .1 Warranty shall commence upon the date of Substantial Completion of the building and extend for a period of twelve (12) months whereupon any defects in materials or system performance shall be repaired by the manufacturer at no cost to the Departmental Representative.
- .2 The Air Valve supplier shall provide all on site labour to service and/or repair any problems identified by the Departmental Representative during the projects year warranty period.

.2 Preventive Maintenance:
- .1 The Air Valve supplier shall provide at no additional cost to the Departmental Representative during the warranty period, all required preventive maintenance for the airflow controls provided under this section.

PART 2 PRODUCTS

2.1 Laboratory Airflow Control General System Description

.1 The Laboratory Venturi Pressure Independent Air Valves shall precisely control the exhaust flow rate from the laboratory Fume Hoods, Bio Safety Cabinets, Extraction Exhaust and/or Ventilated Storage Cabinets to maintain desired airflows within +/- 5% of design flow provided sufficient duct static is provided to maintain accurate pressure independent control and metering of airflow.

2.2 Venturi Pressure Independent Constant Volume Exhaust Air Valves

.1 The airflow control device shall be a venture-type air valve. Each airflow device shall be factory tested and calibrated to be job specific as detailed in the specifications.

.2 **Mechanically Pressure Independent**: The airflow control valve shall be pressure independent over its specified differential static pressure operating range. An integral pressure independent assembly shall respond and maintain specific airflow within one second of a change in duct static pressure irrespective of the magnitude of pressure and/or flow change or quantity of airflow controllers on a manifold supply or exhaust system.

.3 **Valve Accuracy**: The airflow control valve shall maintain specified airflow within 5% of airflow set point provided the static pressure differential across the valve is within specification Note: low pressure air valves require a minimum duct static of 75 PA pressure across the valve. Maximum static pressure across the valve is 750 PA. No minimum entrance or exit duct diameters shall be required to ensure accuracy and/or pressure independence

.4 Corrosive Exhaust Air Valve Construction: Venturi air valves for corrosive airstreams shall be constructed of 14 gauge spun aluminum for the body with a baked on corrosion resistant phenolic (P403 Heresite) coating. The shaft shall be made of 316 stainless steel with Teflon coating. Shaft support brackets, pivot arm, internal linkage, bolts and nuts shall be 316 stainless steel. The pressure independent cone shall be 16 gauge aluminum with a baked on corrosion resistant phenolic (P403 Heresite) coating Cone pressure independent springs shall be spring grade stainless steel. All shaft bearing surfaces wear resistant with Teflon Additive.

.5 Draw Bands: shall be provided for all coated air valves c/w gasket and two bolts design for even tightening to be provided for single body Air Valve installation to allow for quick and easy installation or removal for single non flanged air valves. Provide Teflon tape for sealing the duct seam under the draw band.

.6 Air Valve Sizing: Refer to schedule on mechanical plans for selected sizing.

.7 Airflow Adjuster: Provide adjuster for manually setting the airflow set point.

.8 Base Channel for Future Actuator: Provide optional base channel to allow for future air valve upgradability to two state or variable volume operation.

.9 Airflow feedback Potentiometer: Air valves shall incorporate a factory installed potentiometer for monitoring of the air valve flow. The Factory shall provide airflow performance with listed potentiometer values to airflow values specific for each air valve as determined during the factory airflow station testing and valve characterization & calibration verification.

.10 Pressure Differential Pressure Tapping: Air valves shall be supplied with a factory installed pressure taps to allow for measuring the differential pressure across the valve venturi and future upgradability.

.11 Air Valve Airflow Certification: Each airflow control device shall be factory calibrated to the job specific airflow's as detailed on the plans and specifications using NIST traceable air stations and instrumentation having a combined accuracy of no more than ± 1% of signal over the entire range of measurement.

.12 Air Valve tagging and records: All airflow control devices shall be individually marked with device specific, factory calibration data. As a minimum, it should include tag number, serial number, model number, eight point characterization information (for electronic devices), and quality control inspection numbers. All information shall be stored by the manufacturer for use with as-built documentation.

PART 3 EXECUTION

3.1 System Start-up and Training

.1 A factory-authorized representative of the laboratory airflow controls manufacturer shall provide on-site assistance to balancing contractor as required. The Balancing Contractor shall be responsible for final verification and reporting of all airflows.

.2 The airflow control system supplier shall provide a minimum of four hours of Departmental Representative training, by factory trained and certified personnel.

3.2 Electrical Components, Wiring, and Conduit

.1 No electrical connection required.

3.3 Laboratory Airflow Controls Sequence of Operation

.1 Constant Volume Exhaust Airflow Control:

1. Provide for pressure independent phenolic coated Venturi Air Valves c/w manual adjuster set to provide constant airflow control from existing fume hoods and/or other connected Lab Exhaust devices.

.2 DDC Control System interface:

1. No external Controls or Monitoring required. Provide

3.4 Manufacturer's Instructions

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

3.5 Installation

.1 Install in accordance with manufacturers recommendations.

.2 Support independently of ductwork.

.3 Locate so that controls, dampers and access panels are easily accessible.

3.6 Field Quality Control

.1 Commissioning:

.1 In accordance with Section 01 91 00 – Commissioning, and Section 23 08 00 – Commissioning of Mechanical Systems.

3.7 Cleaning

.1 Proceed in accordance with Section 01 01 50 – General Instructions, and Section 23 31 10 - Cleaning of Mechanical Duct Systems.

.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 Related Sections

.1	Section 01 01 50	General Instructions
.2	Section 01 91 00	Commissioning
.3	Section 23 05 13	Common Motor Requirements for Mechanical Equipment
.4	Section 23 05 48	Vibration & Seismic Controls for Ductwork, Piping & Equipment
.5	Section 23 08 00	Commissioning of Mechanical Systems
.6	Section 25 30 12	EMCS Field Control Devices

1.2 References

.1 Air Conditioning and Mechanical Contractors (AMCA)

.1 ANSI/AMCA 99-10, Standards Handbook.

.2 ANSI/AMCA 210-07, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.3 ANSI/AMCA 300-08, Reverberant Room Method for Sound Testing of Fans.

.4 AMCA 301-90, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.2 American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)

.1 ANSI/ARI 430-2009, Central Station Air Handling Units.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB 1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.4 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE/IESNA 90.1-2013; Energy Standard for Buildings Except Low-Rise Residential Buildings.

1.3 Shop Drawings and Product Data

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

.2 Indicate the following:

.1 Unit configuration including plan and elevations drawn to scale.

.2 Fan curve showing point of operation

.3 Fan sound power information.

.4 Fan vibration isolation detail.

.5 Motor data.

.6 Shipping detail and operating weight.

.7 Detailed total static pressure calculations

.8 Coil selections.

.9 VFD

.10 Unit sound data.

1.4 Closeout Submittals

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

1.5 Waste Management and Disposal

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

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

.3 Collect and separate for disposal 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.

.5 Divert unused paint material from landfill to official hazardous material collections site.

.6 Do not dispose of unused paint materials into sewer systems, into lakes, streams, onto ground or in other locations where it will pose health or environmental hazard.

1.6 Extra Materials

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

.2 Furnish following spare parts:

.1 One set of spare filters.

PART 2 PRODUCTS

2.1 Outdoor Air Handling Units [AHU-101/2 and AHU-302]

.1 General:

.1 Custom, outdoor air handling units, fully assembled, consisting of casing, roof curb, fan section with motor and drive, filter section, mixing section, dampers, heating coil, discharge and return air plenums, VFD's (where specified).

.2 Manufacturer shall provide installing contractor all required details of fan installation within plenum chambers and with technical start up assistance including check lists of field tests for inclusion in equipment manuals.

.2 Roof Curb [AHU-302]:

.1 Factory fabricated 12 gauge, galvanized steel mounting curb designed for seismic conditions. Manufactured by air handling unit manufacturer with full support for unit base frame.

.2 Roof curb shall be field insulated with 50mm acoustic insulation.

.3 Provide gaskets for field mounting between unit base and roof curb.

.4 Method of installation and flashing shall be coordinated with project construction details.

.5 Minimum 305mm unless otherwise noted.

.6 Roof curb shall accommodate piping vestibule.

.3 Base:

1. Unit shall be constructed on a structural C-channel perimeter base with intermediate channel and angle support. Units that exceed 24 ft. shall have an 203 mm minimum base rail. Regardless of the frame size, the channel shall meet a deflection criteria of 25.4/6100 mm for an unsupported span.

2. Provide floor fully welded to the intermediate support members and all seams shall be continuously welded. Floors that are attached with screws or adhesive sealants are not acceptable. Floors that “oil can” are not acceptable. Floor to be 12 gauge steel flat floor, fully welded, with an integral water dam.

3. The base shall be insulated with 50 mm polyurethane foam or fibreglass sheeted with an unpainted, galvanized liner. Minimum density to be 48 kg/m^3.

4. The base pan shall have an integral 40 mm water dam including all floor penetrations. Base shall be provided with a minimum four (4) structural weld-on lifting lugs per section. Manufacturers who cannot provide a water dam constructible are not acceptable.

5. All drain connections shall be extended through the unit base rail and capped. Minimum drain size shall be 32 mm. Drains shall be steel or copper pipe.

6. The waterproof floor shall not be used as part of a coil drain pan / collection system.

.4 Casing:

.1 Walls and roof shall be constructed of double break design 16 gauge galvanized and painted steel panels with overlapped seams gasketed and caulked, not exceeding 610mm. Provide a double wall unit with wall seams that are turned inward to provide a clean, flush unit exterior. All wall panels shall be secured on 203 mm centers without the use of mechanical fasteners. All panel seams shall be caulked with clear silicone applied after the unit has been painted.

.2 All required holes in casing for controls, electrical, etc. shall have grommets. Seal all openings neatly and airtight. Site sealed openings shall be to a standard set by manufacturer.

.3 Floor duct openings shall be supplied with safety grates.

.4 Unit shall be manufactured for outdoor application including sloped roofs, door rain gutters and weather shields.

5. 22 gauge G90 washdown liner shall be of thermal break construction with gasket between inner and outer wall skin. All mechanical fasteners shall have rubber washers.

6. The insulation minimum density shall be 48.1 kg/m^3 and a minimum conductivity factor shall be 0.0332 W/m.K Insulation minimum sound absorption coefficient shall be 1.05. All insulation and accessories including sealants must have a composite fire and smoke hazard rating of 25/50 per ASTM E-84 and UL 723. Minimum insulation thickness of 50 mm.

7. The unit shall meet a deflection criteria of 1/300 of the panel span at 2500 Pa and the air handling unit manufacturer shall provide a casing deflection test (upon request) to indicate compliance. If the casing cannot meet the deflection criteria; the manufacturer shall provide additional internal reinforcement.

8. The unit casing shall meet a leakage rate of 0.75% or less of the total airflow, on both positive and negative pressure sections at 2500 Pa.

9. Casing panels shall be tested in accordance to ASTM Standard C-423 for sound absorption and ASTM E90-90 for transmission loss.

- NRC of .95 or greater and STC of 35 or greater.

10. Unit splits shall be constructed of structural steel angle and are to be supplied with a pre-drilled bolt flange pattern to accommodate securing of the sections. Manufacturer to supply butyl, caulking and bolting hardware. Sheet metal split joints are not acceptable.

.5 Access Doors:

1. Access doors shall be double walled with 16 gauge galvanized steel exterior and 22 gauge solid interior panel. Doors must be of the same thickness as the wall. Provide a reinforced door frame so that the opening remains square during manufacturing and installation. Door frames which are formed from the casing wall are not acceptable. Door insulation shall be 48.1 kg/m^3. For door options, please see equipment detail sheet.

2. Doors shall be sealed continuously with a double gasket arrangement with a neoprene "knife edge" seal and a 20 mm automotive bulb seal. Seals requiring pop rivet or screwed attachment are not acceptable. Doors with a single gasket sealing system are not acceptable. Minimum door opening to be 610 mm x 1830 mm, height permitting.

3. Doors shall have a minimum of two (2) glass-reinforced nylon handles. The handles shall be operable from either side of the door. AND Provide fan section doors with a locking device that is part of the handle. Fan section minimum door width must allow for removal of the fan motor.

4. Access doors shall open against system pressure, wherever feasible. In the event unit size does not allow for in-swing doors on positive pressure compartments, provide a safety pressure relief latch.

.5 **All access panels/doors to be key lockable in a manner acceptable to the Departmental Representative to prevent unauthorized access to unit components and controls**.

.6 Acoustic Liner:

.1 All walls, partitions and roof shall be insulated with 50mm, 48 kg/m3 neoprene coated fibre glass insulation secured with fire retardant adhesive.

.2 Underside of base shall have 50mm, 48 kg/m3 rigid foam.

.3 All edges of insulation shall be covered with metal Z-bar.

.4 Provide 24 gauge galvanized steel perforated in all sections to protect insulation.

.7 Finish:

.1 All metal surfaces shall be pre-painted with vinyl wash primer to ensure paint bond to metal.

.2 All uncoated steel shall be painted with red oxide primer.

.3 Unit casing shall be undercoated with two component zinc chromate primer and finish painted with electrostatically applied enamel paint.

4. The units shall be air dried finish with colour to suit Departmental Representative.

5. The finish shall be zero induction epoxy prime coat with a non-isocynate acrylic finish. The system shall be chemical curing to assure a hard, chemical resistant surface with strong color stability, UV resistance and gloss protection. Results for final paint thickness test results shall be submitted upon request.

.8 Mixing dampers:

.1 Return air: multi-opposed blade, low leakage type.

.2 Outdoor and relief air: insulated, multi-opposed blade, low leakage type.

.3 Dampers shall be sized to a minimum velocity of 7.62m/sec and a maximum velocity of 10.1m/sec and located to provide efficient air mixing and easy access to linkages and damper operators.

.4 Dampers blades shall be parallel where needed to eliminate stratification.

.5 Damper blades shall be extruded aluminum air foil shaped with synthetic rubber blade and frame seals mechanically fastened.

.6 Damper locations shall permit easy access to linkages and damper operators.

.9.1 Fans

.1 All fans shall be direct driven c/w fan base, motor, sheaves, inlet bell, inlet and discharge screens (where applicable) and extended grease nipples.

.2 Provide neoprene coated flexible connector on fan inlet/outlet.

.3 All fans shall be statically and dynamically balanced for quiet operation.

.4 Units shall have solid steel fan shafts mounted in heavy duty, self-aligning, L10-80K relubricative ball bearings. Fans with hollow shafts are not acceptable.

.5 Plenum fans shall be completely enclosed by expanded metal mesh including fan inlet and outlet, door latches or door screens shall not be considered a suitable substitute.

.9.2 **Multiple Plenum Fan Array**

1. The minimum fan sizes acceptable are as scheduled. Refer to schedule for fan types.
2. Supply fans shall be minimum Class II.
3. Fans shall be tested in accordance with AMCA publication 211 and Publication 311 and comply with the requirements of the AMCA Certified Ratings Program.
4. Fans shall be centrifugal plenum fan incorporating a wheel; heavy gauge reinforced steel inlet plate with removable spun inlet cone. Fan wheels up to and including 559 mm diameter shall be aluminum. The fans shall be direct drive AMCA Arrangement 4.
5. The blades shall be continuously welded, die-formed Airfoil type, designed for maximum efficiency and quiet operation. Partial welding is not acceptable on airfoil blades.
6. Fan impellers shall be statically and dynamically balanced and the complete fan assembly test balanced at operating speed prior to shipment. Manufacturer to provide balance report to Departmental Representative (upon request).
7. Each individual fan shall be encapsulated using 100 mm perforated acoustical panels constructed on a unistrut frame suitable for modular assembly and disassembly as required.
8. Each individual fan shall be connected to the fan wall using vinyl flex connectors.
9. Fan array shall be AMCA certified for sound power levels (system sound output levels are available upon request).
10. Fan array shall be seismically isolated using 4 OR 6 50 mm deflection seismic housed springs suitable for supporting the load of the entire assembly.
11. Fan inlets openings shall include extruded aluminum, counter-balanced backdraft/isolation dampers. Balance weights shall be set at the factory prior to shipment to open dampers against any negative fan inlet pressure. Static pressure drop through opened damper assembly shall not exceed 12.5 Pa or 15.2 m/s based on specified fan operating L/s.

.10 Vibration Isolation

1. Fan and motor shall be mounted on a welded structural steel epoxy coated isolation base. Formed metal isolation bases are not acceptable.
2. Provide a minimum of four seismically restrained OSHPOD approved isolators. Minimum isolation efficiency acceptable is 98%. Manufacturer is to provide isolation selection as part of the submittal.
3. The minimum static spring deflection shall be 50 mm spring defelection.

4. No penetrations shall be made in the floor to anchor isolators. Anchor bolts or any penetrations in the floor, regardless of sealing method, are prohibited.

5. Spring thrust restraints are required for all fans which will travel more than 6.35 mm when operating. Springs shall be sized and adjusted so that the assembly floats at design operating condition.

.11 Motors and Drives

.1 Type: heavy duty, high efficiency, 1800 RPM, T.E.F.C. motors with 1.15 service factor.

.2 Motors shall have heavy gauge structural steel base adjustable for motor alignment and belt tensioning by threaded bolt positioners. Extra set of sheaves shall be supplied, if required, when final air balance made. All motors shall be aligned and belts properly tensioned prior to turnover and acceptance by the Departmental Representative. V-belt drive shall be suitable for 150% of motor rating. Fan shall be guarded to WCB regulations, and be provided with openings suitable for instrument.

3. Internally mounted motor shall be provided with adjustable slide base to allow adjustment of belt tension.

4. Motors shall be high efficiency NEMA design B, insulated for 40 °C ambient continuous duty conditions. Motor service factor to be 1.15. Motors to be tested and rated to IEEE standard 112 test method B and NEMA MG1 12.53. All motors to be mounted on an adjustable motor mount base. Motors with a 256T frame size or larger, shall have a dual bolt slide adjustable base.

5. Fan motors shall be heavy duty premium efficiency, inverter ready, operable at the rated voltage scheduled and provided with an ODP motor enclosure.

6. Fan motors shall be suitable for operation with VFD and meet NEMA STD MG1 Part 31.4.4.2. Motor shall have Class F insulation, low-loss electrical grade lamination steel, ISR magnet wire and a one year warranty. Fan motors shall be inverter ready.

7. V-belt drive shall have a 1.5 service factor based on the motor nameplate rating. Adjustable sheaves shall be provided on motors 3.73 kW and less. Drives shall be selected with no less than 2 belt minimum for motors greater than 3.73 kW.

.12 Fan Base

.1 Fan base shall be formed with structural channel.

.2 Fan base shall have housed spring vibration isolators with seismic restraints selected to meet performance as specified in Section 23 05 48 – Vibration & Seismic Controls for HVAC Piping & Equipment, for the required load.

.13 Coils

.1 Heating coils shall be constructed of seamless copper tubing (minimum 0.635 mm thickness) and aluminum fins.

.2 Coils shall be fully enclosed within the casing and mounted on primed and painted angle iron racks manufactured to facilitate easy removal of coils.

.3 Removable coil access panel shall be provided to remove coil through casing wall. Coils shall be sealed to casing to allow no air by-pass.

.4 If not scheduled, coils selected by manufacturer shall not exceed 2.5m/sec.

.5 Coils shall be ARI rated, pressure tested to 2.4 MPa air under water.

.6 Heating coil piping from building to coil shall be enclosed in a piping vestibule. Piping vestibule shall accommodate piping appurtenance including control valve and isolation valves.

8. Coils shall be rated in accordance with ARI Standard 410. Minimum capacity and sizes are as scheduled.

9. Coils shall be tested to 2172 kPa and be suitable for operation at 1725 kPa.

10. Tube Material shall be 16 mm OD tube diameter with 0.508 mm copper tube wall.

11. Fin Material shall be 0.191 mm aluminum with a maximum 254 fins per mm.

12. Casing Material shall be galvanized.

13. Coil Connection shall be red brass MPT.

14. Coils shall be fully enclosed within the casing and cooling coil drain pans shall extend fully under the coil header and return bends. Coils shall be mounted on angle racks such that the coils may be individually removed. Cooling coil racks shall be 304 stainless steel and heating coil racks shall be galvanized steel.

15. Coil connections shall be extended through the unit casing. Provide grommet seals where the coils penetrate the casing and completely safe off the internal side of the coil penetration.

16. Coils shall be fully drainable. Provide a drain and vent connection on each coil and extend to the outside of the unit casing.

17. Provide a continuously welded 16 gauge 304 stainless steel drain pan double sloped for positive drainage under all cooling coils. Intermediate drain pans for stacked coil configurations are to be the same material as the primary drain pan interconnected with 25.4 mm copper drain line.

.14 Drain pans

.1 Drain pans shall be provided for coils.

.2 Constructed to SMACNA standards, continuously welded 304 stainless steel pans extending to outside of unit at header and return bends.

.3 Intermediate drain pans shall be interconnected with 304 stainless steel 32mm drain lines. Provide a 32mm drain pipe from lowest drain pan to exterior of unit through channel with stub suitable for connection.

.4 Drain pans must extend upstream and downstream as required to ensure no carry-over and provide access for cleaning.

.5 Drain pans shall have sloped bottom for positive drainage.

.15 Filters

.1 Filter sections shall have filter racks, and access doors for filter removal and block-offs as required to prevent air bypass around filters.

.2 Filter area shall be as scheduled. Where not scheduled, they shall be designed and selected for a face velocity of less than 2.5m/sec.

3. Pre-filters shall be 50 mm pleated disposable filters with minimum efficiency of MERV 8 and area as scheduled. Each filter shall consist of non-woven synthetic media, support grid and frame. Filters shall be listed UL Class II.

4. Pre-filters shall be installed on prefabricated galvanized rack. Filters shall lift out for upstream access where available, or slide out where access is not available.

5. Final filters shall be as 305 mm pleated with a minimum efficiency rating of MERV 13. The filters shall be high performance, deep pleated, totally rigid and disposable. Filter media shall be high density microfine glass fibers laminated to a non-woven synthetic backing with media support grid, contour stabilizers and a galvanized enclosing frame. Filters shall be listed UL Class II.

6. The filters shall be installed in a factory fabricated frame of 16 gauge galvanized steel. The frames shall be fitted with gaskets and heavy duty, positive sealing, mechanical fasteners.

7. Provide filter gauge with a signal gauge to indicate change out for each bank of filters. The gauges shall be magnehelic. Filter gauge shall be flush mounted within the casing; surface mounted gauges are not acceptable.

.8 Provide 0-250 Pa. magnehelic gauge for each filter bank, complete with static pressure tappings and tubing. Mount in accordance with manufacturer's instructions.

.9 All filter media shall be replaced with new filter media upon turn over and acceptance of job. Provide 2 spare set of filters to Departmental Representative upon turn over.

.16 Electrical

.1 Units equipped with adjustable speed drives shall be factory wired and tested. Separate power connections required:

· Single point power connection for all Fans (600V/3Ph/60Hz)

· Electric baseboard heater in vestibule space to be powered from air handler circuit.

· Single point power connection for all Lighting and GFIs(120V/1Ph/60Hz)

For units not equipped with adjustable speed drives, the starters and disconnect switches shall be supplied by Division 26.

.2 Units shall be furnished with dead-front disconnect, adjustable speed drives (where scheduled), transformers for 24 volt control circuit with fuse protection.

.3 Control enclosure will be NEMA 3R rated for outdoor applications.

.4 All wiring shall be run in EMT conduit.

.5 Provide maximum 0.9 m of flexible Liquid-tight between EMT and motor.

.6 The manufacturer shall label and number code all wiring and electrical devices in accordance with the unit electrical diagram. The unit shall be labeled and certified to CSA, UL, ETL, or NRTL. The manufacturer is to provide proof of this certification at time of submittal. Wiring shall comply with the latest NEC code

requirements. The units shall be CSA/NRTL or ETL listed as a complete unit. Individual listing of components is not acceptable.

.7 Units shall be provided with switched marine lights in each accessible/service section. Lights shall be in vapour proof enclosure with guard and a 25W compact fluorescent bulb. Wire lights to single switch mounted at 610 mm above the installed level of the equipment. Provide adjacent to the supply fan a GFI duplex service receptacle. Light and service receptacle to remain powered when the unit disconnect is open. Wiring from switches to lights and junction box to service outlets to be factory installed. All wiring shall be installed in EMT conduit complete with necessary couplings and connectors. The 120V power supply will be provided separately by electrical trade to allow power to lights and receptacles when the main unit disconnect is off.

.8 Provide mounting bracket and factory pre-wire disconnect switch to terminal blocks and motors to terminal blocks.

.9 Provide 120 volt service receptacle. Power will be provided separately by electrical trade.

.10 Factory installed VFD's to be controlled by a 0-10V signalled supplied in the field

.11 Factory installed pressure transducer and piezometer ring factory wired to pressure transducer.

.17 Pipe Chase

1. Air handler shall contain a piping vestibule with construction identical to the remainder of the air handler. Vestibule shall have an access door and the floor opening shall be covered with a sheet of 18 gauge galvanized steel.

2. The pipe chase shall be channel supported, coped and welded to the channel base of the air handler. OR The pipe chase shall be cantilevered and attached to the air handler using mechanical fasteners. Pipe chase shall be structurally disassembled and protected prior to shipment from the manufacturer's plant. Cantilevered pipe chases shall not have a channel base.

.18 Adjustable Speed Drives

.1 Variable volume units shall incorporate Adjustable Speed Drive controllers in place of magnetic starters.

.2 ASD's shall be factory installed and wired.

.3 The drive shall be accessed through a hinged access door complete with a 8 mm hex key latch. The door shall be hinged.

.4 Variable frequency drives are still to be wired to a single point power connection as noted above.

.19 Factory Testing - High Potential Testing

Upon completion of the air handler internal assembly, the fans shall be high potential tested for electrical connectivity. Power connection shall be connected to the motors by means of the VFD or junction box. Fans shall be verified for current draw, rotation direction, and RPM.

- 600V power connection.

PART 3 EXECUTION

3.1 Installation

.1 Provide appropriate protection apparatus.

.2 Install units in accordance with manufacturer's instructions and as indicated.

.3 Ensure adequate clearance for servicing and maintenance.

.4 Size anchor bolts to withstand seismic acceleration and velocity forces as specified in Section 23 05 48 – Vibration and Seismic Controls for Ductwork, Piping and Equipment.

.5 Make piping connections.

.6 Nothing to obstruct ready access to components or to prevent removal of components for servicing.

3.2 Fans

.1 Install fan sheaves required for final air balance.

.2 Install flexible connections at fan inlet and fan outlets.

3.3 Condensate drain.

.1 Install deep seal P-traps on drip lines.

3.4 Start-up and Commissioning

.1 Start-up and submit written report to Departmental Representative.

.2 Commissioning:

.1 In accordance with Section 01 91 00 – Commissioning, and Section 23 08 00 – Commissioning of Mechanical Systems.

3.5 Cleaning

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

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 01 50	General Instructions
.2	Section 01 35 33	Health and Safety Requirements
.3	Section 01 91 00	Commissioning
.4	Section 23 05 00	Common Work Results – Mechanical
.5	Section 23 08 00	Commissioning of Mechanical Systems

1.2 References

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Safety Data Sheets (SDS).

.2 Air Conditioning & Refrigeration Institute (ARI)

.1 ARI 410-2001, Forced-Circulation Air-Cooling and Air-Heating Coils.

1.3 Submittals

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 – General Instructions. Include product characteristics, performance criteria, and limitations.

.2 Shop Drawings:

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

.2 Indicate the following:

.1 Equipment, capacity, piping, and connections.

.3 Quality assurance submittals: submit following in accordance with Section 01 01 50 – General Instructions.

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

.2 Instructions: submit manufacturer's installation instructions.

.4 Closeout Submittals:

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

.2 Provide halocarbons documentations in accordance with Section 23 05 00 – Common Works Results – Mechanical.

1.4 Quality Assurance

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

1.5 Delivery, Storage and Handling

.1 Packing, shipping, handling and unloading:

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

.2 Waste Management and Disposal:

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

PART 2 PRODUCTS

2.1 General

.1 General: air coil certified by ARI 410.

.2 Applications: hydronic as scheduled.

.3 Capacity, pressure drop, dimensions as scheduled.

.4 Maximum air velocity:

.1 Heating: 3.0 m/s.

.5 Maximum operating pressure:

.1 Hydronic: 1,724 kPa.

.6 Factory tested at 2,172 kPa air pressure under water.

2.2 Construction

.1 Tube: NPS 16 O.D., 0.51mm thick seamless copper with 0.64 thick bends. Water velocity selected at less than 1.2 m/s.

.2 Fins: 0.2mm thick aluminum, mechanically bonded to tubes. Fin spacing shall not exceed 356 fins per mm.

.3 Header: seamless copper with die formed collars for brazing coil tubes, vent and drain connection.

.4 Casing: minimum 1.6mm (16 gauge) channel construction with flanges punched for mounted. Galvanized steel for heating coils and type 304 stainless steel for cooling coils. Provide intermediate tube support at 1,200mm interval.

.5 Connections: red brass, MPT connections.

.6 Hydronic and DX coils shall have connections on the same side of header.

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 manufacturer's instructions.

.2 Install in accordance with piping layout.

.3 Arrange coils for counter-flow of air and fluid.

.4 Provide space for cleaning, servicing or removal of all coils.

.5 For hydronic coils with vertical headers, arrange water entry at bottom to facilitate air removal.

.6 Clean finned tubes and comb straight.

.7 Provide unions at coil connections.

.8 Provide dielectric fittings at dissimilar metal.

.9 Clean finned tubes and comb straight.

3.3 Start-up and Commissioning

.1 Conduct start-up and submit written report to Departmental Representative.

.2 Commissioning:

.1 In accordance with Section 01 91 00 – Commissioning, and Section 23 08 00 – Commissioning of Mechanical Systems.

.3 Halocarbons Management:

.1 In accordance with Section 23 05 00 – Common Works Results – Mechanical.

3.4 Cleaning

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

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 01 50	General Instructions
.2	Section 01 35 33	Health and Safety Requirements
.3	Section 01 91 00	Commissioning
.4	Section 23 05 00	Common Work Results - Mechanical
.5	Section 23 05 48	Vibration and Seismic Controls for Ductwork, Piping and Equipment
.6	Section 23 08 00	Commissioning of Mechanical Systems

1.2 References

.1 Canadian Standards Association (CSA)

.2 Underwriter's Laboratories of Canada (ULC)

1.3 Submittals

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet for heating, ventilation and air conditioning distribution piping and ductwork.

.3 Shop Drawings:

.1 Submit shop drawings to indicate project layout, dimensions and extent of humidification system.

.2 Submit product data under provisions of Section 23. Include product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes. Include rated capacities, operating weights, furnished specialties, and accessories.

.3 Submit manufacturer’s installation instructions.

.4 Submit operation and maintenance data.

.5 Submit coordination drawings. Detail fabrication and installation of humidifiers. Include piping details, plans, elevations, sections, details of components, and dispersion tubes. Detail humidifiers and adjacent equipment. Show support locations, type of support, weight of each support, and required clearances.

.6 Submit wiring diagrams including power, signal, and control wiring. Differentiate between manufacturer-installed and field installed wiring.

.7 Submit minimum water quality requirements and water pressure requirements.

.4 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.6 Instructions: submit manufacturer's installation instructions.

.7 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 01 50 – General Instructions.

1.4 Quality Assurance

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 33 - Health and Safety Requirements.

.2 Certifications

.1 C-UL US listed.

.2 ISO 9001-2008

.3 ANSI/NFPA 70 – National Electrical Code

.4 ARI 640 – Standard for commercial and industrial humidifiers

.5 ASHRAE SSPC 135 BACNET

1.5 Delivery, Storage and Handling

.1 Waste Management and Disposal:

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

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

.3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan (WMP).

.4 Separate for reuse and recycling and place in designated containers in accordance with Waste Management Plan (WMP).

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

1.6 Maintenance

.1 Extra Materials:

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

PART 2 PRODUCTS

2.1 Resistive Element Steam Generating Industrial Humidifier for use with De-Ionized Water

.1 Provide CSA certified and ULC listed resisitive element humidifier generating mineral free, sterile steam for use with potable, de-ionized (DI) water. Packaged unit, wall or

unistrut system mounted, atmospheric steam generation using resistive heating element. Electrode technology and boiler steam (pressure steam) technology is not acceptable.

.2 Unit to come complete with:

.1 Touchscreen controller with standard building automation and online connectivity.

.2 Intuitive touchscreen control with colour graphic user interface.

.3 Standard building automation communication protocols BACnet IP/BACnet MSTP Modbus with embedded web and USB interface.

.4 Single or dual channel analog signal acceptance, supporting both demand and transducer control. Ability to control setpoint from humidifier control when using transducer controls.

.3 Packaged system with resistive element technology:

.1 Modulating output between 4% and 100% rated capacity.

.2 Control accuracy of up to +/- 1% RH using optional solid state relay control and high precision humidistat.

.3 Incoloy based resistive heating element for steam production.

.4 Dual magnetic electronic float system, located outside of the boiling water.

.5 Self-diagnostics during start-up of system.

.1 Float level check

.2 Drain pump check

.3 Fill valve check

.6 Integral fill cup with minimum 25 mm air gap to prevent back siphoning.

.7 Standard internal drain water tempering to ensure maximum 60 °C drain water. External drain water cooler not acceptable.

.8 Insulating air gap between plumbing and electrical compartments.

.9 Durable powder coated steel cabinet with zero side clearance requirement.

.3 Capacity: As scheduled.

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 manufacturers instructions. Provide service clearance per manufacturer’s recommendation.

.2 Install humidistat in accessible location.

.3 Water service overflow drain: to manufacturers' recommendation.

.4 Install access doors or panels in adjacent ducting and at airflow proving switch.

.5 When installing in ducting, provide waterproof duct up and downstream in accordance with Section 23 31 14.

.6 Install capped drain connection at low point in duct.

.7 Provide support and seismic restraints as specified in Section 23 05 48 – Vibration and Seismic Controls for Ductwork, Piping and Equipment.

3.3 Field Quality Control

.1 Commissioning:

.1 In accordance with Section 01 91 00 – Commissioning, and Section 23 08 00 – Commissioning of Mechanical Systems.

.2 Start-up of humidifiers to be by factory trained technician.

3.4 Demonstration

.1 Training: in accordance with Section 01 91 00 – Commissioning, and Section 23 08 00 – Commissioning of Mechanical Systems.

3.5 Cleaning

.1 Perform cleaning operations as specified in Section 01 01 50 – General Instructions and in accordance with manufacturer's recommendations.

.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 Related Sections

.1 Section 01 01 50 General Instructions

.2 Section 01 91 00 Commissioning

.3 Section 23 05 00 Common Work Results - Mechanical

.4 Section 23 08 00 Commissioning of Mechanical Systems

1.2 General

.1 Provide, install, program and commission a BACnet-based DDC controls system to achieve the performance specified in the following clauses. **The DDC controls system shall be integrated to the incumbent Reliable Controls DDC system**(installed in 2007) and pneumatic controls systems (installed in 1986, original).

Provide Reliable control DDC system installed by factory-trained Authorized Dealer.

1.3 Metric Reference

.1 Conform to CAN/CSA-Z234.1.

.2 Provide required adapters between Metric and Imperial components.

1.4 Standard Compliance

.1 All equipment and material to be from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.

.2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.

.3 Submit proof of compliance to specified standards with shop drawings and product data. Label or listing of specified organization is acceptable evidence.

.4 In lieu of such evidence, submit certificate from testing organization, approved by Departmental Representative, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.

.5 For materials whose compliance with organizational standards/codes/specifications is not regulated by an organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.

1.5 Existing Control Components

.1 Utilize any existing control wiring and/or piping as indicated.

.2 Field control devices that are usable in their original configuration may be re-used provided that they conform to applicable codes, standards, specifications. Do not modify original design of any existing devices without written permission from the Departmental Representative. Provide for new, properly designed device where components are not certain as to reusability. Provide list of equipment so included in bid. Include unit price of all for this equipment.

.3 Within 30 days of award of contract, and prior to installation of any new devices, inspect and test all existing devices intended for re-use. Furnish test report listing each component to be re-used and indicating whether it is in good order or requires repair by Departmental Representative.

.4 Non-functioning items:

.1 Provide with report specification sheets or written functional requirements to support findings.

.2 Departmental Representative will provide directions related to repair or replacement existing items judged defective yet deemed necessary for EMCS.

.5 Submit written request for permission to disconnect any controls and to obtain equipment downtime before proceeding with work.

.6 Assume responsibility for existing controls to be incorporated into EMCS, to commence upon approval for disconnection of controls or equipment downtime.

.1 Be responsible for repair costs due to negligence or abuse of Departmental Representative's equipment.

.2 Responsibility for existing devices to terminate upon acceptance of EMCS or applicable portions thereof.

.7 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed.

1.6 Submittals

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

.2 Provide six copies of schematic control diagrams for review. Each valve, actuator and instrument shall be given an identification label which will refer directly to control diagram.

.3 Provide damper shop drawings which include data such as arrangement, velocities, and static pressure drops for each system on shop drawings.

.4 Provide shop drawings including complete operating data, system drawings, wiring diagrams, and type written detailed operational description of sequences, and description and engineering data on each control system component.

.5 At completion of work, make detailed check of automatic control system and submit written report to the Departmental Representative.

.6 Provide sufficient copies of complete parts and repair manuals for binding in O&M Manuals.

.7 Provide "record" control drawings and schedules; incorporate into O&M Manuals.

.8 The submittals shall be prepared using the dynamic graphics software normally provided with system and be incorporated into the dynamic graphics system for on-line reference. Provide original, registered software disks of Windows, the Graphics Software package, the Operating System software, and the project graphic schematics, floor plan layouts, and control drawings.

1.7 Extra Materials

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Provide following:

.1 Three (3) Air Valves of each type.

1.8 Preliminary Design Review Meeting

.1 Convene a Preliminary Design Review meeting within 45 working days of award of contract to:

.1 Undertake functional review of preliminary design documents, resolve inconsistencies.

.2 Resolve conflicts between contract document requirements and actual items (e.g.: points list inconsistencies).

.3 Review interface requirements of materials supplied by others.

.4 Review "Sequence of Operations".

.2 Contractor's programmer to attend meeting.

.3 Departmental Representative retains right to revise sequence or subsequent Control Description Logic prior to software finalization without cost to Departmental Representative.

1.9 Monitoring and Control Features

.1 Operator defined digital and analogue alarms and automatic alarm condition reporting.

.2 Direct keyboard override of all inputs and outputs, with an indication on the display for any point that is operating under keyboard override.

.3 Addition, deletion, definition and modification of all points from operator keyboard.

.4 Trend log graphing and reporting of user selected points at user defined intervals.

.5 Run time logging of digital points.

.6 Ability to accept a variety of standard analogue and digital input signals.

.7 Ability to generate a variety of standard analogue and digital output signals.

1.10 Offline Storage

.1 The DDC system shall have the capability to be taken off-line in the event of failure or for maintenance and returned to operation without the need for entering any portion of the software program manually.

.2 An off-line disk storage device shall be utilized to provide software backup and reload. Backup and verification of the entire system, with full applications software, shall be less than TWO (2) seconds per real point.

1.11 Power Surge Protection

.1 The DDC system shall be protected from power line surges and voltage transients by installation of a power line filter.

1.12 Power Failure Protection

.1 The DDC system shall have automatic protection from any power failure of at least TWENTY-FOUR (24) hours duration.

.2 This protection shall at a minimum include continuous real-time clock operation and automatic system restart upon power return.

.3 Outputs shall have the option of being set to “staggered start” upon power reset.

1.13 Electrical Components, and Conduit

.1 Provide all control system components, except those supplied as part of packaged equipment controls, but including all auto sequencing devices, electric relays, safety devices and electrical interlocks required to accomplish specified sequences. Refer to the electrical motor schedule in the electrical drawings and/or specification, which delineate the limits of electrical work in Division 26 (Electrical) serving mechanical systems.

.2 Provide all control circuit transformers required for control systems and not supplied by Division 26 including line voltage power connection from indicated outlets shall be included by Division 23.

.3 All line voltage wiring shall be copper with RW90 X-Link P.E. insulation #12 minimum size. AWG wire shall be sized to meet code.

.4 Wiring is to be in conduit in all wall spaces and exposed locations as well as in pipe chases, service spaces, attics, and crawl spaces which are entered for service access. Wiring in suspended ceiling spaces does not require conduit but shall be neatly installed parallel to building lines using bridle rings. All wiring installed under this contract shall be plenum rated FT-6 or FT-4, if approved by all authorities having jurisdiction. Locate wiring away from top or bottom of ceiling joists or trusses to minimize possibility of accidental damage. Number 18 gauge wire may be used in Class 2 circuits unless voltage drops are excessive. THHN wire will not be acceptable. Twisted shielded wiring, minimum of 22 gauge wire shall be used for all DDC or co-axial communication wiring. Line voltage alternating current wiring shall not be run in the same conduit, or cabling as DDC wiring.

.5 Use 1m of flexible conduit for all connections to vibrating equipment. Use liquid tight flex cable and connections where required.

.6 The Control Contractor shall locate magnetic starters from the electrical drawings. All electrical work provided by this Contractor shall comply with all requirements of the Division 26 electrical specification, the Canadian Electrical Code and Local Codes and Ordinances.

.7 Wire all line voltage thermostats, pressure switches or aquastats for single phase equipment.

.8 Division 26 has been requested to provide specific devices, including magnetic starters supplied with 120 volt holding coils, HOA switching and space for the addition of auxiliary contacts. The Control Contractor shall provide all necessary normally open and normally closed contacts, wired to a terminal strip within the starter enclosure, required to achieve the specified control interlocking and sequencing. Manual starters for 120 volt equipment are to contain On-Off selector, external H.O.A., integral overload protection and pilot lights. The Controls Contractor shall provide control wiring interlocks from the control contacts provided on the automatic branch lines of the assembly, which will be contained within the associated Motor Control or Starter Assembly.

.9 Refer to Division 26 Specifications and Motor Schedule for the scope of work to be provided by the Electrical Contractor. Division 23 shall supply and install all components, in addition to those outlined within the Division 26 documents, as may be deemed necessary to provide all interlocks or sequences as called for elsewhere within the specifications. Include for the supply and installation of 2- 4 pair U.T.P. Level 5, plenum

rated cables from the hub location to the communications backboard. Coordinate with Division 26 and the Departmental Representative for interconnection of the hub into the Telephone System services.

.10 All power supplies for controls are this Contractor's responsibility unless otherwise specified in the Electrical Specifications. All control transformers to be located in fan rooms or mechanical rooms only and are to be mounted in serviceable locations.

.11 Line voltage will not be run with signal or trunk wiring or be present in the same junction box.

.12 All shielded wiring will be grounded at the BMS panels and prevented from grounding at the terminal end.

.13 Run all wiring parallel to building lines. All wiring to be installed in a neat, workmanlike manner.

.14 Support wiring independent of piping, ductwork, and equipment. Keep wiring clear of hot piping, ductwork/equipment.

.15 Identify all junction boxes with control company label.

.16 There are to be no splices in any of the control wiring except at devices or control panels.

1.14 Identification, Calibration and Programming

.1 Provide a written sequence of operation for each piece of equipment or system being controlled that does not require knowledge of DDC programming. Provide a print out of the complete data base, including program listings, inputs, outputs, controllers, virtual points, trend logs, alarm points, etc. Provide in an organized manner, separated for each panel.

.1 Procedures for daily operation of the system.

.2 Theory of operation of the equipment.

.3 Theory of operation of the control program.

.2 Mount an input/output layout sheet within each controller. This sheet shall include the name of the points connected to each controller channel.

.3 Identify all controllers and associated devices with symbols relating directly to the control diagram. Provide plastic labels for each input and output point with the following information:

.1 Point descriptor.

.2 Point type and channel number.

.3 Corresponding controller number.

.4 Program each controller immediately following installation. Setup and tune all control loops during the initial start-up of the systems. Submit a well documented print out of the controller program for review.

.5 At the time of the Departmental Representative's Demonstration and Instruction Period:

.1 Demonstrate and confirm that all systems are programmed and operating correctly. Submit trend logs, 1 week in duration, that confirm systems are operating as designed and follow the internal building loads in an energy efficient manner.

.2 Submit CD's (including back-up diskettes) containing up to date copies of the programs in each controller.

.3 Submit (4) CD's with printed PDF copies of the final programs that include all point definitions, weekly and annual schedule settings, controller setpoints and tuning parameters, and documented general control language programs. (As Built control shop drawings)

.4 Provide the original software diskettes and the users manuals for all software programs provided as part of this contract. Provide one set of original disks for each notebook, laptop, and desktop computer the software has been installed on. The controls contractor shall be responsible for registering all software with the manufacturer in the Departmental Representative's name. Provide copies of the registration of all software to the Departmental Representative as part of the final inspection.

.6 Check sensor calibration and control system operation twice during the first year of operation including the first heating season and prior to the first cooling season. Include all parts and labour in service. Following each visit submit:

.1 A report indicating all work performed.

.2 Printed graphs of trend logs one week in duration with hourly samples for all analog inputs connected to each controller.

.3 Update printed and diskette copies of any changes made to programs for any controller.

.7 Provide one day of on-site instruction to the Departmental Representative's operating personnel during the first year of operation, scheduled as requested by the Departmental Representative, during one or more of the 2 visits.

PART 2 PRODUCTS

2.1 Not Used

PART 3 EXECUTION

3.1 General

.1 Check and verify location of thermostats and other exposed control sensors with plans and room details before installation. Locate thermostats and temperature sensors 1.5m above floor.

.2 Install damper motors on outside of ducts. Do not locate in outside air stream.

.3 The installation shall conform to each manufacturer's recommended procedures and to all applicable codes, statutes and ordinances.

.4 All equipment installed shall be mechanically stable and, as necessary, fixed to wall or floor. Anti-vibration mounts to be provided, if required, for the proper isolation of the equipment.

.5 Equipment shall be installed so as to allow for easy maintenance access. Equipment shall be installed such that it does not interfere in any way with access to adjacent equipment and personnel traffic in the surrounding space.

.6 Equipment shall be installed in locations providing adequate ambient conditions for its specified functioning, allowing for adequate ventilation.

.7 Permanently identify each wire, cable, conduit and tube at each terminal.

.8 Wiring and tubing shall be identified at each DDC panel by termination number. Wiring and tubing shall be identified at terminal device by termination and DDC panel numbers.

.9 All transmitters, interfaces, terminations and control relays, etc. shall be mounted in field cabinets that may be locked.

.10 Freeze protection devices shall be hard wired and also wired to alarm through DDC system.

.11 All wall mounted devices in new finished space shall be mounted on a wall box. The wall box shall be connected to the ceiling space by a conduit stub. On renovations, when sensors are mounted in existing finished walls, wiring or tubing may be fished into the walls without conduit.

3.3 Enclosure and Conduit

.1 Relays, transformers, and I/O devices and peripherals shall be installed in separate enclosures and not in the enclosures containing the controllers.

.2 All wires penetrating the enclosure that are not required to be in conduit must be neatly bundled and strapped in place.

.3 All Building Controllers will be installed in CSA rated enclosures that are complete with hinged and key-locked doors. The door will be painted and labeled suitably bearing the manufacturer's system name/logos, the controller address, and the installing contractor's contact information. This enclosure will be mounted at a height that provides easy access without the need of a ladder.

.4 A hard points list shall be affixed on the inside of the door/cover of the enclosure.

.5 The inside bottom of the enclosure shall be clean of dirt, metal shavings, and debris.

.6 Provide EMT conduit with set screw metal fittings where wiring is exposed and in all mechanical rooms. All conduit will be piped smoothly and neatly following building lines. Wiring above accessible ceilings and in wall cavities may be run free-air.

.7 Liquid-tight flexible conduit to be used for rooftop unit wiring c/w liquid-tight fittings. Provide spun aluminum roof jack where control wiring penetrates roof unless penetration is within waterproof rooftop unit curb.

.8 All junction boxes will have covers properly and firmly affixed after installation completion.

3.4 I/O Wiring

.1 All input/output device wiring will use #18-2 solid core cable with individually jacked conductors and jacketed sheath over the pair.

.2 Use plenum cable where required.

.3 All I/O wiring passing near or within the enclosure of a VFD will be shielded, with the shield terminated at the device end.

.4 All I/O wiring will be identified using Panduit adhesive wire-marker at the controller and end device ends. Description of point to include point mnemonic, point type and network location.

.5 All I/O wiring within controller enclosure shall be neat and tidy and suitably bundled and strapped or contained in plastic wire duct or equivalent.

.6 All I/O wiring that requires a transition to a different conductor to meet electrical code requirement shall be executed using a terminal strip.

.7 Low voltage I/O wiring may be mixed together within a conduit. Low and line voltages may not be mixed together within a conduit.

3.5 Power Wiring

.1 Provide power wiring and transformers and grounding to each controller and transducer as per the manufacturer's specification.

.2 Each Building Controller will have its own dedicated power supply. No other controller or I/O device will be powered from this supply.

.3 Power wiring shall not be mixed with I/O wiring in a conduit.

3.6 LAN Wiring

.1 Provide LAN wiring as per manufacturer's specification.

.2 For EIA-485 LAN wiring, use low capacitance shielded #18-2 or #22-2 cable. Ensure that each contiguous section of shield is terminated at a single point.

3.7 Control System Commissioning

.1 Upon completion of the installation of the controls system and the calibration of all sensors, this Subcontractor shall carry out all required testing, debugging, and revision of operations to suit the intent of the Sequence of Operation and to the review of the Departmental Representative.

.2 The contractor is to supply digital point and non digital checkout data sheets for all controlled components installed in this contract, including components supplied by others. The data sheets shall indicate each components physical installation is complete, End to End, identification, tagged, the result of the functional test, calibration deviation recorded, setpoints and set-up of each device, digital and non digital.

.3 Each digital input or control device shall be checked by physical operation of the monitored device in the field with the result noted. Each digital output or controlled device shall be commanded or tested On/Off, Open/Close as required and the corresponding field device checked for correct operation with the result and comments noted.

.4 Each analog input or control device shall have its field values measured with a calibrated test instrument, with the deviation recorded and adjusted, if necessary, at the AI set up. The field measurement and analog point deviation must be reported. A hard copy of the set up for each digital and non digital controller with adjustments is required. Field set up and setpoints of other devices shall be reported.

.5 Each analog output, control or controlled device shall be field tested. The physical test data sheet is to indicate each controlled device function through its range 0, 25, 50, 75, 100% and 1 to 100% as required with no leakage or bypass of the controlled medium.

.6 Submit copies of all test data sheets intended to be used to the Departmental Representative and Commissioning Authority prior to the contractor's verification at least three months before the scheduled substantial completion of the project.

.7 The controls contractor shall provide sequence of operation check sheets, to the Departmental Representative, Commissioning Agent and Commissioning Authority, in standard letter size for each DDC and non DDC system sequence. Each sequence to be verified with each item/page signed off with comments noted.

.8 The commissioning contractor is not to commence controls checks until the above documentation is received. The Temperature Control Supplier and Installer shall loan a current copy of all control software/devices needed for full access to the control system, at no charge to the Commissioning Agent. The software/devices shall be returned to the Control Supplier in good working order at the completion of the commissioning process, or the Commissioning Agent must reimburse the Temperature Control Supplier for the purchase price of the material.

.9 All documentation, tagging, identification, as-builts, software, instruction manuals, special control connection to access all devices and panels must be in place before the granting of substantial performance.

.10 The Controls Contractor shall loan a current copy of all control software/devices needed for full access to the control system, at no charge to the Commissioning Agent. The software/devices shall be returned to the Controls Contractor in good working order at the completion of the commissioning process, or the Commissioning Agent must reimburse the Controls Contractor for the purchase price of the material. The Temperature Control Supplier shall cooperate fully with the Commissioning Agent to work together to obtain a fully operating system, providing additional technicians and trades people to assist the designated commissioning person as required. Refer to Section 01 91 31 – Commissioning Plan.

.11 The controls contractor is to provide the technicians for field checks, calibration, checkouts, and commissioning necessary for a complete and fully operational system. Provide two 2-way portable radios for the commissioning period.

.12 For existing air handlers AHU-101ex, AHU-102ex and AHU-103ex prior to switching to new Air Handling Units AHU-101/102 and AHU-302:

.1 Include End to End checks of all controlled devices (inputs and outputs).

.2 All existing analogue outputs shall be tested at 0, 50 and 100%.

.3 Points list of existing systems to be provided by CFIA.

.4 Report problems found to the Commissioning Authority and Departmental Representative.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 01 33 00 Submittal Procedures

.2 Section 25 05 01 EMCS: General Requirements

1.2 References

.1 American Society of Heating, Refrigeration, and Air-Conditioning Engineers, Inc. (ASHRAE).

ASHRAE, Applications Handbook, SI Edition.

ASHRAE Standard 135 – BAC net – A Data Communications Protocol for Building Automation and Control Networks.

ASHRAE Standard 135.1 Method of Test Conformance to BAC net.

.2 Canadian Standards Association (CSA)

C22.2 No.205, Signal Equipment.

.3 Institute of Electrical and Electronics Engineers (IEEE)

IEEE C37.90.1, Surge Withstand Capabilities Test for Protective Relays and Relays Systems.

1.3 Maintenance Procedures

.1 Provide manufacturers recommended maintenance procedures for insertion in Section 25 05 01 - EMCS: General Requirements.

1.4 Submittals

.1 In accordance with Section 25 05 01 - EMCS: General Requirements. Submit product data sheets for each product item proposed for this project.

PART 2 PRODUCTS

2.1 System Descriptions

.1 Provide a fully networked system of controllers which use LAN communications to support the distributed control features as specified herein. Each controller shall be connected directly to the LAN. Each controller shall have equal LAN access priority and shall NOT REQUIRE A SEPARATE GATEWAY or interface controller to accomplish normal, network communications.

.2 Provide a means to ensure communication integrity. At a minimum indicate for each controller in system: on-line/off-line status, residence of program or no program, the scan rate (frequency at which the controller updates all I/O and runs all programs), the number of network points imported and exported.

.3 The system will display an error message, in the event of a communication error.

.4 To prevent damage to the system, each connection to the LAN shall be provided with a means of isolation, either optically or fast-blow fuse or by some other means.

.5 Upon failure of the LAN to communicate information, each controller will retain the last legitimate value of its imported network points, and continue to control the systems based on those values. Failure of any controller, or any part of a controller on the LAN, shall not affect the ability of the LAN to communicate among the remaining controllers.

.6 Each hard point and soft point shall have a user-definable, unique, system-wide logical point mnemonic. The format of the point mnemonic shall conform to the naming convention of the incumbent system.

2.2 Memory

.1 Each controller shall have enough random access memory for all of the following:

.1 Variables - ONE (1) for each hard point connected to the controller.

.2 PID Controllers - TWO (2) for each analogue output point connected to the controller.

.3 Weekly Schedules - ONE (1) for every major system connected to the controller.

.4 Annual Schedule - ONE (1) for the entire LAN.

.5 Trend Logs - ONE (1) for each pair of hard points connected to the controller with 100 samples each.

.6 Runtime Logs - ONE (1) for each digital hard and soft point.

.7 Programs - ONE (1) for each output point connected to the controller. Each program must contain enough memory for TWENTY (20) syntactically correct lines of OCL with at least four operators.

2.3 Processing Speed

.1 Scan Rate - The maximum permissible scan rate is ONE (1) second. The scan rate is defined as the time it takes to controller CPU to sample all inputs, calculate all variables, update all timers and PID controllers, check all schedules, update all trend logs and runtime logs execute all OCL programs and assign values to all outputs.

2.4 Building Controllers

.1 Building Controllers shall reside on the main LAN or highest level of communication.

.2 The controller shall communicate on the main LAN using either Ethernet (IEEE.802.3) with TCP/IP and/or EIA-485.

.3 In addition to main LAN communications, the controller shall support EIA-485 subLANs, PC, modem and intelligent thermostat communications.

.4 The controller shall have at least one port (other than the PC port) which can be configured to BACnet conformance class 3 using EIA-232 point-to-point communications for interface to other BACnet products.

.5 The controller must be modular in design with removable I/O device terminations on separate I/O cards for ease of expansion and replacement.

.6 Controllers will accommodate a maximum of 160 universal I/O points on board using a single address.

.7 All I/O points must be universal (i.e. user definable as digital or analogue). Dedicated analogue/digital points will not be accepted.

.8 All outputs must have optional HOA on board for easy override by non DDC users.

2.5 VAV Controller

.1 VAV Controller (BACnet overview): A VAV Controller is VAV terminal unit controller with integral damper actuator and on-board differential pressure based flow measurement.

.1 Data Sharing - Ability to provide the values of any of its BACnet objects and Ability to allow modification of some or all of its BACnet objects by another device.

.2 Device and Network Management - Ability to respond to information about its status.

.2 VAV Controllers shall be used for dual duct mixing boxes and single duct air terminal units.

.3 VAV Controllers shall communicate on the main LAN or subLAN using EIA-485 (MSTP). In addition to main or subLAN communications, the controller shall support PC and/or modem communications and intelligent thermostat communications.

.4 Programming the controller shall be accomplished over the LAN or directly via PC and will not require the mandatory use of any other special interface hardware or a Building Controller. Firmware based programming will be accepted.

.5 Provide 120v-24vac transformers for controls.

2.6 Operator Interface - General

.1 Upgrade software on incumbent operator work station (OWS). The software shall communicate with the DDC system via Ethernet, PC direct connection or modem. Access to the system shall be available by all three methods simultaneously.

.2 Off Line Programming: The software shall have a “simulator” facility that allows controllers to be fully programmed off line without the need of any controller hardware.

.3 Database Programming: The software shall allow the operator to easily program and modify the complete database of any controller.

.4 Operator Control Language (OCL) Programming: The software shall allow the operator to easily program and modify the control strategy language for any controller.

.5 Graphic Programming: The software shall allow the operator to easily utilize colour graphics in generating user defined, dynamic data displays or system groups. The graphic images are created in any third party application (e.g. CorelDraw, Macromedia Fireworks, Adobe Illustrator, VisioTechnical, etc) and exported as a bit mapped image (.bmp, .tif, .png) for use within the DDC system. The operator shall be able to annotate the graphic with any combination of hard points, soft points, and keywords, and have the ability to link any group to any other group from any controller in the system. The operator will have the ability to display either the description, value or status of a point, using any colour. Any point shall have the ability to be hidden from view, yet retain functionality if accessed. The graphics must support mouse and keyboard cursor access. Each system group graphic will accommodate 160 annotations.

2.7 Operator Control Language

.1 The Operator Control Language (OCL) will support the concept of output oriented code allowing many small individual programs to be written and connected to graphic screens. Each output and/or calculation will have its own dedicated program and not be part of one larger program.

.2 The DDC system shall have the capacity for timed start/stop on daily schedules, as well as the capability for the Departmental Representative to develop and run user written application programs. For this, the DDC system shall have a proven OCL which shall be capable of reading the value and/or status of all system points and initiating both analogue and digital control actions from any user defined combination of calculations and logical expressions which shall at a minimum include:

.1 Addition, subtraction, multiplication and division.

.2 Square roots, summations, absolute differences.

.3 IF THEN ELSE statements.

Logical “not”, “and”, “or” , “less than”, “greater than”, and “equal to” or their equivalents.

.4 Time delays in seconds, minutes or hours.

.5 Ability to imbed comments in system generated documentation.

.6 Ability to use time-of-day and day-of year in algebraic calculations.

.7 Ability to filter continuous small changes in input signals to prevent equally small increment in output signals from occurring.

.3 All of the above functions must be accomplished via software. FIRMWARE BASED FUNCTIONS WILL NOT BE ACCEPTED.

PART 3 EXECUTION

3.1 General

.1 The installation shall conform to each manufacturer's recommended procedures and to all applicable codes, statutes and ordinances.

.2 All equipment installed shall be mechanically stable and, as necessary, fixed to wall or floor. Anti-vibration mounts to be provided, if required, for the proper isolation of the equipment.

.3 Equipment shall be installed so as to allow for easy maintenance access. Equipment shall be installed such that it does not interfere in any way with access to adjacent equipment and personnel traffic in the surrounding space.

.4 Equipment shall be installed in locations providing adequate ambient conditions for its specified functioning, allowing for adequate ventilation.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 01 33 00 Submittal Procedures

.2 Section 25 05 01 EMCS: General Requirements

1.2 References

.1 American National Standards Institute (ANSI)

.1 ANSI C12.7-[1993], Requirements for Watthour Meter Sockets.

.2 ANSI/IEEE C57.13-[1978(R1987)], Requirements for Instrument Transformers.

.2 National Electrical Manufacturer's Association (NEMA)

1.3 Submittals

.1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 01 33 00 – Submittal Procedures.

.2 Include:

.1 Information as specified for each device.

.2 Manufacturer's detailed installation instructions.

.3 Pre-Installation Tests

.1 Submit samples at random from equipment shipped, as requested by Departmental Representative, for testing before installation. Replace devices not meeting specified performance and accuracy.

.4 Manufacturer's Instructions

.1 Submit manufacturer's installation instructions for specified equipment and devices.

1.4 Closeout Submittals

.1 Submit operating and maintenance data for inclusion in operation and maintenance manual in accordance with Section 01 77 00 – Closeout Procedures and 01 78 00 – Closeout Submittals.

PART 2 PRODUCTS

2.1 General

.1 Control devices of each category to be of same type and manufacturer.

.2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof, vibration-proof, heat resistant assembly.

.3 Operating conditions: 0 - 32 °C with 10 - 90 % RH (non-condensing) unless otherwise specified.

.4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.

.5 Transmitters to be unaffected by external transmitters (eg. walkie talkies).

.6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

.7 Outdoor installations: use weatherproof construction in NEMA 3R enclosures.

.8 Devices to be installed in user occupied space must not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.

2.2 Averaging Duct Sensors

.1 Shall be installed in all mixed air ducts and/or plenums, discharge air ducts and/or plenums, or any duct and/or plenum where stratification occurs.

.2 Shall have a minimum length of 1.5 meters with a duct and/or plenum cross sectional area of .75 square meters or less, and a minimum length of 6 meters for duct and/or plenum cross sectional areas in excess of .75 square meters.

.3 The sensor shall have thermistor sensing elements with a scale range lookup table in the DDC producing a linear output over its sensing range.

.4 Accuracy: plus or minus 0.05°C at 21°C.

.5 Minimum sensing range: -40°C to 40°C.

2.3 Duct Sensors

.1 Shall be installed in all ducts and/or plenums where stratification of the air flow does not occur.

.2 Shall have thermistor sensing elements with a scale range lookup table in the DDC producing a linear output over its sensing range.

.3 Minimum length: 203mm.

.4 Accuracy: plus or minus 0.2% over its operating range.

.5 Minimum sensing range: 4.5° C to 60°C.

2.4 Immersion Sensors

.1 Shall be complete with a brass immersion well.

.2 Shall have thermistor sensing elements with a scale range lookup table in the DDC producing a linear output over its sensing range.

.3 Accuracy: plus or minus 0.05°C at 21°C.

.4 Minimum sensing range: -40°C to 40°C.

2.5 Room Temperature Sensors

.1 Shall have a blind cover for all applications. Provide a secured temperature sensor for public areas.

.2 Shall have a thermister sensing element producing a linear output over its sensing range.

.3 Accuracy: plus or minus 0.2% over its operating range.

.4 Minimum sensing range: 4.5°C to 35°C.

2.6 Differential Pressure Sensors (DPS)

.1 Shall vary the output voltage with changes in differential pressure.

.2 End to end accuracy: not less than +1% of span including non-linearity, repeatability and hysteresis.

.3 Application: building pressurization control shall have auto-zeroing feature.

2.7 Current Sensors (CT)

.1 Shall vary the output voltage with a change in current.

.2 Provide actual analog current indication for status of all motors 1 horsepower and larger.

.3 In software provide multiple switch points to determine both motor status and belt breakage. Size for inrush and F.L.A.

.4 Provide alarm indication for high and low current.

.5 Provide digital current indication for all motors 3/4 HP and smaller by using current switches (CS) which shall open or close a contact from motor induced current to indicate motor status.

2.8 Room Humidity Sensors

.1 Shall be ultra fast response polymer capacitance sensor, not affected by condensation, fog, high humidity, or contaminants.

.2 Suitable for 12-40 VDC/12-35 VAC unregulated supply voltage and 4-20 ma 2 wire output, or field selectable 0-5 VDC/0-10 VDC output.

.3 Accuracy: plus or minus 2%/3%

.4 Range of 0-100% RH.

.5 Shall have ABS plastic wall mount complete with blank cover with a clear Lexan guard.

.6 Warranty: 1 year.

2.9 Control Valves and Actuators

.1 Provide automatic temperature control valves as scheduled and indicated on drawings. Sufficient clearance above control valves shall be provided to allow removal of superstructure without removing body from line. All valve stems shall be vertical. All electric valves, including zone valves, scheduled for modulating service shall be fully proportional (no floating control) suitable for 0-10 volt, or 4-20 mA input signal.

.2 Control valves, both 2 and 3 way configuration, shall have the following minimum characteristics:

.1 Body shall be brass meeting ANSI Standard B16.15 Class 250 for all valves 50 mm and smaller. Larger valves shall be cast iron, Class 125, meeting ANSI Standard B16.15.

.2 Valve stem shall be 316 stainless steel.

.3 Valves shall have brass plug, composition seat with maximum seat leakage of 0.01% of flow rating per ANSI B16.104, and equal percentage flow characteristic.

.4 Valves for terminal zone coils, fan coils and radiation shall have EPT or TFE packing material and NPT, union or flare connections.

.5 Valves for primary equipment sized 50 mm and smaller shall have screwed connections. Valves sized 65 mm and larger shall have flanged connections.

.6 Ball Valves are not acceptable for control applications.

.3 When more than one control valve is used for temperature or pressure control on a system, or equipment item they shall be sequenced. e.g. two valves on a heating coil or pressure reducing station; heating and cooling coil valves on an air handling system.

.4 Valves on hazardous services shall fail to a safe position. e.g. Valves controlling heating to domestic hot water shall fail closed to heating when not powered.

.5 Actuators shall be of the rotary or piston type for either modulating or two position control. Actuators shall be powered by an overload-proof synchronous motor. Control voltage shall be either 120 VAC, 24 VAC, 10 VDC, or 4-20 mA with spring return on power failure, where required. (ie outdoor air dampers and HVAC primary heating valves). Actuators (motors) shall have repair kits available, and be re-buildable in the field. Provide proportional actuator position feedback on all primary equipment (air handling units) to prove actuator position.

.6 All control valves shall have replaceable bonnets, and packing.

The packing shall be replaceable in the field without having to remove the valve from the piping network.

.7 All control valves shall be sized to deliver the specified flow rate in the 100% open position. Control valves using a "limited stroke" to achieve the proper flow coefficient shall not be used.

2.10 Dampers and Actuators

.1 All control dampers not furnished with packaged equipment shall be supplied by the controls subcontractor and installed by the sheet metal subcontractor. Provide damper actuators for all dampers shown or specified.

.2 All dampers in a mixing application shall be parallel blade with direction of closing producing opposed air streams for optimal mixing. Return air dampers shall be a tight closing, low leakage type with replaceable blade and edge seals, T.A. Morrison Series 1000 or approved equal.

.3 Actuators shall be electronic, direct coupled, as manufactured by Belimo, Siemens, or Approved Equal. Control voltage shall be 0-10 VDC, or 4-20 mA with an internal spring return on power failure. Provide a 2-10 VDC proportional actuator position feedback signal on all primary equipment (air handling units, relief air and emergency generators) to prove actuator position. Actuators shall permit manual positioning of damper when actuator is not powered.

PART 3 EXECUTION

3.1 General

.1 Check and verify location of thermostats and other exposed control sensors with plans and room details before installation. Locate thermostats and temperature sensors 1.5m above floor.

.2 Install damper motors on outside of ducts. Do not locate in outside air stream.

.3 The installation shall conform to each manufacturer's recommended procedures and to all applicable codes, statutes and ordinances.

.4 Equipment shall be installed so as to allow for easy maintenance access. Equipment shall be installed such that it does not interfere in any way with access to adjacent equipment and personnel traffic in the surrounding space.

.5 All transmitters, interfaces, terminations and control relays, etc. shall be mounted in field cabinets that may be locked.

.6 Freeze protection devices shall be hard wired and also wired to alarm through DDC system.

.7 All wall mounted devices in new finished space shall be mounted on a wall box. The wall box shall be connected to the ceiling space by a conduit stub. On renovations, when sensors are mounted in existing finished walls, wiring or tubing may be fished into the walls without conduit.

3.2 Sensors

.1 Sensors provided shall be installed in accordance with the Manufacturer's prescribed procedures.

.2 Sensors shall be rigidly mounted and mountings shall be adequate for the environment within which the sensor operates.

.3 Averaging type temperature sensors shall be used wherever mixed air or stratified temperature is to be monitored. They shall be installed in a serpentine configuration with adequate provision for the mechanical protection of the sensor and such that it is supported as required along its entire length.

.4 Duct type Thermistors shall be used for the monitoring of all uniform air temperature. Length shall be such that the sensing element is installed to not less than one third of the duct width or duct diameter from the duct wall.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 25 05 01 EMCS: General Requirements

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 Sequence of Operation

.1 Air Handlers AHU-101/102 and AHU-302:

.1 Reuse existing duct static pressure transmitters on the 1/F and 2/F (field confirm existing location) hot and cold decks to modulate the fan speed in conjunction with the existing duct static pressure transmitter. Adjust set point. Provide new wiring and controls as required to accommodate new AHU-101/102 and AHU-302 location.

.2 Run Conditions - Requested: As per existing schedule [Adjustable]

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

Freeze Protection: The unit shall shut down and generate an alarm upon receiving a freezestat status.

High Static Shutdown: The unit shall shut down and generate an alarm upon receiving an >high static shutdown< signal.

Supply Air Smoke Detection: The unit shall shut down and generate an alarm upon receiving a >supply air smoke detector status<.

Supply Fan: The supply fan shall run anytime the unit is commanded to run, unless shutdown on safeties. To prevent short cycling, the supply fan shall have a user definable (adjustable) minimum runtime. Alarms shall be provided as follows:

Supply Fan Failure: Commanded on, but the status is off.

Supply Fan in Hand: Commanded off, but the status is on.

Supply Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adjustable).

.3 Supply Air Duct Static Pressure Control: The controller shall take the lowest of the two duct static pressure readings from the cold and hot ducts and shall modulate the supply fan VFD speed to maintain a duct static pressure setpoint of 250 Pa (adjustable). The supply fan VFD speed shall not drop below 30% (adustable).

Alarms shall be provided as follows:

High Supply Air Static Pressure: If the supply air static pressure is 25% (adjustable) greater than setpoint.

Low Supply Air Static Pressure: If the supply air static pressure is 25% (adustable) less than setpoint.

Supply Fan VFD Fault.

.4 Preheating Coil Valve:The controller shall measure the mixed air temperature and modulate the preheating coil valve to maintain a setpoint 2°C (adj.) less than the cooling supply air temperature setpoint The preheating shall be enabled whenever:

Outside air temperature is less than 13°C (adjustable) and the supply fan status is on.

The preheating coil valve shall open for freeze protection whenever:

Mixed air temperature drops from 4.5°C to 1.5°C (adjustable) or the freezestat is on.

.5 Cold Deck - Cooling Supply Air Temperature Setpoint - Optimized: The cooling supply air temperature setpoint shall be reset based on zone cooling requirements as follows:

The initial cooling supply air temperature setpoint shall be 13°C (adjustable).

As cooling demand increases, the setpoint shall incrementally reset down to a minimum of 11.5°C (adjustable).

As cooling demand decreases, the setpoint shall incrementally reset up to a maximum of 22°C (adjustable).

Cold Deck - Cooling Coil Valve:The controller shall measure the cooling supply air temperature and and modulate the cooling coil valve to maintain its cooling setpoint. The cooling shall be enabled whenever:

Outside air temperature is greater than 15.5°C (adjustable) and the supply fan status is on.

The cooling coil valve shall open to 50% (adjustable) whenever the freezestat is on.

Alarms shall be provided as follows:

High Cooling Supply Air Temp: If the cooling supply air temperature is 3°C (adjustable) greater than setpoint

6. Hot Deck - Heating Supply Air Temperature Setpoint - Optimized: The heating supply air temperature setpoint shall be reset based on zone heating requirements as follows:

The initial heating supply air temperature setpoint shall be 28°C (adjustable.).

As heating demand increases, the setpoint shall incrementally reset up to a maximum of 32°C (adjustable).

As heating demand decreases, the setpoint shall incrementally reset down to a minimum of 22°C (adustable.).

Hot Deck - Heating Coil Valve:The controller shall measure the heating supply air temperature and modulate the heating coil valve to maintain its setpoint. The heating shall be enabled whenever:

Outside air temperature is less than 18.5°C (adjustable) and the supply fan status is on.

The heating coil valve shall open whenever:

Heating supply air temperature drops from 4.5°C to 1.5°C (adjustable) or the freezestat is on.

Alarms shall be provided as follows:

High Heating Supply Air Temp: If the heating supply air temperature is greater than 49°C (adjustable).

Low Heating Supply Air Temp: If the heating supply air temperature is 3°C (adjustable) less than setpoint.

.7 Cooling Coil Pump: The recirculation pump shall run whenever:

The cooling coil is enabled or the freezestat is on.

Alarms shall be provided as follows:

Cooling Coil Pump Failure: Commanded on, but the status is off.

Cooling Coil Pump in Hand: Commanded off, but the status is on.

Cooling Coil Pump Runtime Exceeded: Status runtime exceeds a user definable limit.

.8 Heating Coil Pump: The recirculation pump shall run whenever:

The heating coil valve is enabled or the freezestat is on.

Alarms shall be provided as follows:

Heating Coil Pump Failure: Commanded on, but the status is off.

Heating Coil Pump in Hand: Commanded off, but the status is on.

Heating Coil Pump Runtime Exceeded: Status runtime exceeds a user definable limit.

.9 Preheating Coil Pump: The recirculation pump shall run whenever:

The preheating coil valve is enabled or the freezestat is on.

Alarms shall be provided as follows:

Preheating Coil Pump Failure: Commanded on, but the status is off.

Preheating Coil Pump in Hand: Commanded off, but the status is on.

Preheating Coil Pump Runtime Exceeded: Status runtime exceeds a user definable limit.

.10 Humidifier Control: The controller shall measure the space humidity and modulate the humidifier to maintain a setpoint of 45% rh (adjustable). The humidifier shall be enabled whenever the supply fan status is on.

The humidifier shall turn off whenever:

Supply air humidity rises from 90% rh to 95% rh (adustable) or on loss of supply fan status.

Alarms shall be provided as follows:

High Supply Air Humidity: If the supply air humidity is greater than 90% rh (adj.).

Low Supply Air Humidity: If the supply air humidity is less than 30% rh (adj.).

.11 Prefilter Differential Pressure Monitor: The controller shall monitor the differential pressure across the prefilter.

Alarms shall be provided as follows:

Prefilter Change Required: Prefilter differential pressure exceeds a user definable limit (adj.).

.12 Final Filter Differential Pressure Monitor:Alarms shall be provided as follows:

Final Filter Change Required: Final filter differential pressure exceeds a user definable limit (adj.).

.13 Mixed Air Temperature [AHU-302]: The controller shall monitor the mixed air temperature and use as required for economizer control.

Alarms shall be provided as follows:

High Mixed Air Temp: If the mixed air temperature is greater than 32°C (adj.).

Low Mixed Air Temp: If the mixed air temperature is less than 7°C (adj.).

Return Air Carbon Dioxide (CO_2) Concentration Monitoring: The controller shall measure the return air CO2 concentration.

Alarms shall be provided as follows:

High Return Air Carbon Dioxide Concentration: If the return air CO_2 concentration is greater than 1000ppm (adj.) when in the unit is running.

.2 Laboratory Exhaust Fan – Plume Dilution Exhaust Fan [PDEF-1]:

.1 PDEF shall be started, stopped and monitored at the DDC. Fans shall be interlocked with the operation of AHU-101/102 and AHU-302. Fans shall operate continuously during normal operation.

Normal Operation (Integration with Existing Control Sequence)

.1 On initial start-up, restart due to power failure or return to normal power [Refer to Existing Sequence for Automatic system startup provided by CFIA] .

.2 Provide a discharge velocity sensor for each of the PDEF fans. The velocity sensor will provide an input to the DDC system which in turn will modulate the outdoor air damper in the exhaust duct plenum to maintain a minimum velocity of 16 m/s. Refer to Exhaust Fan Specification for integration of Smart variable flow exhaust System.

Set fan plenum static pressure initially to 750Pa and optimize/calibrate as required for most efficient system operation..

3 Provide a hard wired pressure sensor in the new PDEF plenum. Rewire the existing pressure sensor in each of the laboratory exhaust ducts to shut down the new PDEF, whenever the pressure in the PDEF plenum exceeds 1250 Pa or the pressure in either of the exhaust ducts exceeds 950 Pa. Provide the pressure switche with its own manual reset button and indicating light located on the exterior of the DOC panel enclosure controlling the PDEF. The indicating light will illuminate indicating which pressure switch has tripped and its associated manual reset button must be pressed before the PDEFs will re-start.

.4 Only three of the new PDEF's fans are to run at a time with the remaining fan on standby. The fans shall be controlled by their associated variable speed drive (VFD) in order to maintain the static pressure and the fan discharge velocity at a minimum of 16 m/s. When the discharge velocity is less than 16 m/s, the outdoor air by- pass damper shall be modulated to open to provide make-up air to the fans. The associated VFDs shall regulate each fan to the same speed.

.5 While multiple fans are running and the load on the fans requires the fans to reach 35% (adjustable) speed, then one fan shall be commanded off and its isolation damper commanded closed. Similarly, as the load on one/two fan(s) requires the fan(s) to reach 90% (adjustable) speed, then a second/third fan shall be started as per regular startup sequence and the associated VFDs shall regulate each fan to the same speed. Optimum speed settings for starting/stopping a second/third fan shall be determined through the commissioning process.

.6 The duty fans shall be duty cycled with the standby fans on a two week (adjustable) cycle. The isolation dampers of the stand-by fan shall be normally closed. Upon scheduled changeover, or in the event of a failure of one of the PDEF's fans, the isolation damper of the stand-by fan shall open, and the stand-by fan shall be enabled. The by-pass damper modulates to open as needed to maintain internal exhaust duct static pressure.

.7 Upon any fan failure, the DOC system will generate an alarm at the terminal.

.8 The DOC system monitors the HAND/OFF/AUTO switches for the new PDEF. The DOC system is sent a signal when the HAND/OFF/AUTO switch is in the AUTO position.

.9 A PDEF fan VFD can be operated in by-pass mode by either operating (turning) the associated by-pass switch on the VFD to the ON position, or by manually turning the associated DOC control point ON.

.10 Provide current sensors installed on each of the new PDEF fan motors to provide operating feed back to the DOC system. This will allow monitoring of the PDEFs when in by- pass mode and normal operating mode.

.11 Refer to the existing low temperature freeze alarm shut down; coordinate operation of PDEF-1.

.3 General Exhaust Fan – EF-301:

.1 EF-301 shall be started, stopped and monitored at the DDC. Fan shall operate continuously during normal operation.

.4 Resistive Element Steam Humidifiers – HU-101, HU-102, HU-103, HU-104, HU-105, & HU-106:

.1 Provide field wiring (minimum 18 AWG) between the electric humidifier and the distribution unit (with integral fan and airflow proving switch). Duct humidity is controlled by the electric humidifier integral control.

.2 Interlock humidifier unit so that it cannot operate if:

a. Duct humidity exceeds set point of high limit duct humidistat.

b. Supply fan is stopped.

3.2 Point List

.1 The following point lists are typical of the Analog and Digital output and input points required to achieve the intended sequence of operation and provide the required level of monitoring and control. They are intended to set a minimum level of acceptability. All additional points required to achieve the specified features and sequence of operation shall be provided by the control contractor.

.2

AIR HANDLING UNITS - (AHU -101/102 and AHU-302)							
	POINTS				**ALARM/INDICATION**		
POINT DESCRIPTION	**AI**	**AO**	**DI**	**DO**	**HI**	**LO**	**FAIL**
SUPPLY AIR TEMPERATURE	DTS				X	X	
RETURN AIR TEMPERATURE	DTS				X	X	
MIXED AIR TEMPERATURE	ATS					X	
MIXING DAMPERS		DMA					
HEATING/COOLING COIL VALVES		VMA					
FILTER STATUS	DPS						
SPACE TEMPERATURE	RTS						
LOW LIMIT TEMPERATURE			LTS			X	
SUPPLY FAN START/STOP/STATUS & CONTROL	ASD	ASD					
RETURN FAN START/STOP/STATUS & CONTROL	ASD	ASD					
MOTION DETECTOR *[By Div. 16]*			MD				
CO_2 SENSOR	CDS	DMA					
FIRE ALARM INPUT			DCI				
SUPPLY AIR STATIC PRESSURE	DPS						
RETURN AIR STATIC PRESSURE	DPS						

.3

EXHAUST FAN CONTROL (PDEF-1 and EF-301)							
	POINTS				**ALARM/INDICATION**		
POINT DESCRIPTION	**AI**	**AO**	**DI**	**DO**	**HI**	**LO**	**FAIL**
EXH. FANS (START/STOP/STAT)	CT			CR			X
AIR PRESSURE PDEF-1	D						

ALL FUME HOOD EXHAUST DUCTS	DPS				X	X	

.4

COOLING , HEATING, & PUMP CONTROL							
	POINTS				**ALARM/INDICATION**		
POINT DESCRIPTION	**AI**	**AO**	**DI**	**DO**	**HI**	**LO**	**FAIL**
PUMPS START/STOP/STAT TYPICAL [P-]	CT			CR			X
HEATING PUMPS [P-]	ASD	ASD					X
HEATING WATER FLOW SENSOR	FSW						
CHILLED WATER PUMPS [P-]	ASD	ASD					X
CHILLED WATER FLOW SENSOR	FSW						
HEATING WATER TEMPERATURE ENTERING AND LEAVING AHU-101/102 AND AHU-302 COILS	WTS						
CHILLED WATER TEMPERATURE ENTERING AND LEAVING AHU-101/102 AND AHU-302 COILS	WTS						
CHILLED WATER TEMPERATURE SUPPLY AND RETURN TO BUILDING	WTS						
CHANGE OVER VALVE [AHU-101/102 COIL]				CR			

.5

CARBON DIOXIDE DETECTION SYSTEM [existing]							
	POINTS				**ALARM/INDICATION**		
POINT DESCRIPTION	**AI**	**AO**	**DI**	**DO**	**HI**	**LO**	**FAIL**
ALARM INPUT			RS-T				X
AUDIBLE ALARM				X			

.6

HUMIDIFICATION							
	POINTS				**ALARM/INDICATION**		
POINT DESCRIPTION	**AI**	**AO**	**DI**	**DO**	**HI**	**LO**	**FAIL**
ROOM RELATIVE HUMIDITY			RS-T				X

[EXISTING]							
AUDIBLE ALARM				X			

NOTE: POINT COUNT IS APPROXIMATE. CONTROLS CONTRACTOR SHALL VERIFY EXACT QUANTITY AND PROVIDE ADDITIONAL POINTS AS REQUIRED TO ACHIEVE THE SEQUENCE OF OPERATION DESCRIBED IN THE CONTRACT DOCUMENT.

ATS	Averaging Temperature Sensor	LTS	Low Temperature Switch
ASD	Adjustable Speed Drive	MOP	Proportional A.O. (4-20 ma)
CDS	Carbon Dioxide Sensor	MD	Motion Detector
CS	Current Switch	O-SW	Override Switch
CR	Digital Relay	OTS	Outdoor Air Temp. Sensor
CT	Analog Current Transformer	POT	Potentiometer
DCI	Dry Contact Input	R-ST	Relay Status
DHS	Duct Humidity Sensor	RHS	Room Humidity Sensor
DMA	Damper Motor (Analog)	RTS	Room Temperature Sensor
DMD	Damper Motor Digital	SPT	Static Pressure Transmitter
DPS	Diff. Press. Switch (Analog)	VMA	Valve Motor (Analog)
DTS	Duct Temperature Sensor	VMD	Valve Motor (Digital)
DHS	Duct Humidity Sensor	VPM	Variable pump motor
ES	End Switch	VPS	Velocity Pressure Sensor
FSA	Flow sensor - Air	WTS	Water Temperature Sensor
FSW	Flow sensor - Water		

END OF SECTION

AIR HANDLING UNITS						
Mark	AHU-101/2		AHU-302			
Location	Parking Lot		Roof			
Total Supply Fan Air Flow - L/s (cfm)	37,760	80,000	7,269	15,400		
Existing System Air Flow - L/s (cfm)	29,264	62,000	3,832	8,118		
Future Allowance Air Flow - L/s (cfm)	8,496	18,000	3,437	7,282		
Supply Fan Air Flow - L/s (cfm/fan)	4,720	10,000	3,634	7,700		
Supply Fan External S.P. - Pa (in w.g.)	875	3.5	1250	5		
Supply Fan Size/Type	Plenum Size 25		Plenum Size 18			
Supply Fan Drive	Direct		Direct			
Number of Supply Fans	8		2			
Supply Fan RPM	1,980		3,767			
Supply Fan Horsepower per fan	15		15			
Supply Fan Arrangement (AMCA)	4		4			
Total Return Fan Air Flow - L/s (cfm)			7,269	15400		
Return Fan Air Flow - L/s (cfm/fan)			3,634	7700		
Return Fan External S.P. - Pa (in w.g.)			1250	5		
Return Fan Size/Type			Plenum Size 18			
Return Fan Drive	N/A		Direct			
Number of Return Fans			2			
Return Fan RPM			3,767			
Return Fan Horsepower			15			
Return Fan Arrangement (AMCA)			4			
Notes						

Refer to Specification for accessories not scheduled/additional details. Refer to drawings for installation details. Static pressures noted are external to the unit. Fan total pressure to include all cabinet effects as well as an allowance of 75 Pa (0.3" w.g.) for dirty filters. Motors to be sized so normal operating load is not more than 90% of rated motor capacity.
Refer to coil schedules for integrated cooling and heating coil details.
Electrical power connection to be 600V 3 Phase 60Hz
All air handling units fans are to be provided with VFDs.
AHU 101/2 motor frame sizes 254T. AHU-302 motor frame sizes 215T.
AHU 101/2 fans to be class II. AHU-302 fans to be class III.

PLATE AND FRAME HEAT EXCHANGERS					
Mark	HX-101		HX-102		
Heating Capacity - kW (MBH)	3068	10470	1172.0	4000.0	
Heating Transfer Area - sq.m. (sq.ft.)	80	858	147.8	1590.0	
Side 1 Fluid Ent. Temp. - Deg.C (Deg.F)	77	170	13.9	57	
Side 1 Fluid Lvg. Temp. - Deg.C (Deg.F)	54	130	8.3	47	
Side 1 Flow - L/s (gpm)	34	540	51.74	820.0	
Side 1 P.D. - kPa (psi)	68	10	68.90328	9.96	
Side 2 Ent. Temp. - Deg.C (Deg.F)	49	120	6.7	44	
Side 2 Lvg. Temp. - Deg.C (Deg.F)	71	160	12.2	54	
Side 2 Flow - L/s (gpm)	34	540	51.74	820.0	
Side 2 P.D. - kPa (psi)	69	10	67.24296	9.72	
Number of Plates	157		166		
Connection Size - mm (in.)	102	4.00	152	6.00	
Notes					

Plate material to be 0.0157 inch AISI 304.
Gasket material to be Nitirl Sonder Lock.
Max design temperature 230 Deg. F.
Max working pressure 150 PSI. Max test pressure 195 PSI.
Heat exchangers to be ASME approved c/w stamp and CRN.

HUMIDIFIERS						
Mark	HU-101		HU-102		HU-103	
Location	MECHANICAL RM.		MECHANICAL RM.		MECHANICAL RM.	
Humidification capacity - kg/hr (lbs/hr)	82	180	82	180	82	180
Rated Amps	59		59		59	
Rated Power - kW	64		64		64	
Fille Rate - L/min (gpm)	29	8	29	8	29	8
Notes						

Refer to Specification for accessories not scheduled.
Electrical power connection to be 600V 3 Phase 60Hz
Contractor to provide compatible short absorption manifold distributors, approved by manufacturer, for distribution in AHU ducts.
Humidifier to be compatible for use with deionized water.

CONTROL VALVES								
Mark	V-DH-100		V-DC-100		V-PH-101		V-PC-101	
Service	AHU-101/2 Hot Water Diversion		AHU-101/2 Chilled Water Diversion		AHU-101 Pre-heat Coil		AHU-101 Pre-cool Coil	
Type	3-W Mod		3-W Mod		2-W Mod		2-W Mod	
Flow - L/s (gpm)	34.07	540.0	51.74	820.0	7.57	120.0	11.55	183.0
P.D. - kPa (psi)	13.8	2.0	13.8	2.0	6.9	1.0	6.9	1.0
Notes								
Mark	V-H-101		V-C-101		V-PH-102		V-PC-102	
Service	AHU-101 Heating Coil		AHU-101 Cooling Coil		AHU-102 Pre-heat Coil		AHU-102 Pre-cool Coil	
Type	2-W Mod		2-W Mod		2-W Mod		2-W Mod	
Flow - L/s (gpm)	9.47	150.0	14.39	228.0	7.57	120.0	11.55	183.0
P.D. - kPa (psi)	6.9	1.0	6.9	1.0	6.9	1.0	6.9	1.0
Notes								
Mark	V-H-102		V-C-102		V-DC-302		V-DH-302	
Service	AHU-102 Heating Coil		AHU-102 Cooling Coil		AHU-302 Chilled Water Diversion		AHU-302 Hot Water Diversion	
Type	2-W Mod		2-W Mod		3-W Mod		3-W Mod	
Flow - L/s (gpm)	9.47	150.0	14.39	228.0	9.78	155.0	5.68	90.0
P.D. - kPa (psi)	6.9	1.0	6.9	1.0	13.8	2.0	13.8	2.0
Notes								
Mark	V-C-302		V-H-302					
Service	AHU-302 Cooling Coil		AHU-302 Heating Coil					
Type	2-W Mod		2-W Mod					
Flow - L/s (gpm)	9.78	155.0	5.68	90.0				
P.D. - kPa (psi)	6.9	1.0	6.9	1.0				
Notes								

Notes

Refer to control contractor's shop drawings for piping configuration for multi-port valves.

Heating control valves are to be spring powered to fail to full open upon loss of power where specified.

Flow as scheduled. Provide isolation valves on all supply and return pipes to each coil.

Valve Types:

2-W Mod : 2-way modulating control valve
2-W 2-P : 2-way 2-position control valve
3-W Mod : 3-way modulating control valve

COOLING COILS (CHILLED WATER)						
Mark	CC-101		CC-102		CC-302	
Service	AHU-101/2 Pre-Cool		AHU-101/2 Cooling		AHU-302	
Quantity	6		6		2	
Rows | FPI	4	6	6	6	4	11
Height - mm (in.)	800	31.5	800	31.5	686	27
Length - mm (in.)	3048	120	3048	120	2134	84
Total Air Flow - L/s (cfm)	37,760	80,000	37,760	80,000	7,269	15,400
Air P.D. - Pa (in w.g.)	43	0.17	113	0.45	175	0.7
Entering Air DB - °C (°F)	32.2	90.0	26.7	80.0	26.7	80.0
Entering Air WB - °C (°F)	19.4	67.0	15.6	60.0	19.4	67.0
Leaving Air DB - °C (°F)	15.0	69.7	15.0	55.0	15.0	54.5
Leaving Air WB - °C (°F)	15.3	59.6	9.8	49.6	12.1	53.7
Total Cap. - kW (MBH)	539	1839	643	2194	181	618
Sens. Cap. - kW (MBH)	520	1775	643	2194	124	422
Water Flow - L/s (gpm)	23	365	29	457	10	155
Ent. Water Temp °C (°F)	8.3	47.0	8.3	47.0	7.2	45.0
Lvg. Water Temp °C (°F)	14.2	57.5	13.9	57.0	11.7	53.0
Water P.D. - kPa (ft.)	113	38	89	30	45	15
Notes						

Working fluid for CC-101 and CC-102 shall be 25 % Propylene Glycol
Casing material to be galvanized
Casing connection material to be red brass
Connection type to be MPT

HEATING COILS								
Mark	HC-101		HC-102		HC-302			
Unit	AHU-101/2 Pre-heat		AHU-101/2 Heating		AHU-302			
Quantity	6		6		2			
Rows	2		4		2			
Series or Fins per Inch	6		6		9			
Height - mm (in.)	800	31.5	572	22.5	686	27		
Length - mm (in.)	3048	120	3048	120	2134	84		
Air Flow - L/s (cfm)	37760	80000	37760	80000	7269	15400		
Air P.D. - Pa (in w.g.)	23	0.09	80	0.32	43	0.17		
Ent. Air Temp °C (°F)	-9.4	15.0	12.8	55.0	4.4	40.0		
Lvg. Air Temp °C (°F)	15.0	56.7	15.0	107.0	15.0	92.0		
Heating Cap. - kW (MBH)	1060	3617	1321	4509	268	915		
Water Flow - L/s (gpm)	15.14	240	18.93	300	5.69	90.1		
Water P.D. - kPa (ft.)	16	3.74	42.21	14.07	26.67	8.89		
Notes								

Refer to specification for accessories not scheduled, Refer to drawings for installation details
Heating coil sized to fit air handling unit
Casing material to be galvanized
Casing connection material to be red brass
Connection type to be MPT

ELECTRIC BASEBOARD HEATER		
Mark	EBH-1	
Location	AHU-101/2	
Type	Electric	
Heating Cap. - W (Btuh)	2000	6826
Length - mm (in.)	25400	1000
Power Supply	600/3/60	
Notes	1	

Notes:
1. Furnished with line-voltage thermostat.

PUMPS										
Mark	P-105		P-105a		P-107		P-108		P-110	
Location	MECH RM.		MECH RM.		MECH RM.		MECH RM.		MECH RM.	
Service	HEATING WATER - GLYCOL LOOP		HEATING WATER - GLYCOL LOOP		COOLING WATER - GLYCOL LOOP		COOLING WATER - GLYCOL LOOP		HEATING WATER TO GLYCOL LOOP	
Flow - L/sec (usgpm)	28.40	450	28.40	450	39.12	620	39.12	620	28.40	450
Head - kPa (ft.)	150	50	150	50	180	60	180	60	75	25
Pump Conn. Size - mm (in.)	102	4	102	4	153	6	153	6	153	6
Horsepower	10		10		15		15		5	
Notes	1,2,3		1,2,3		1,2,3		1,2,3		1,2	

Mark	P-110A		P-111		P-111A		P-303		P-303A	
Location	MECH RM.		MECH RM.		MECH RM.		NORTH PENT.		NORTH PENT.	
Service	HEATING WATER TO GLYCOL		COOLING WATER TO GLYCOL		COOLING WATER TO GLYCOL		AHU-302 COOLING LOOP		AHU-302 COOLING LOOP	
Flow - L/sec (usgpm)	28.40	450	42.59	675	42.59	675	5.68	90	5.68	90
Head - kPa (ft.)	75	25	90	30	90	30	117	39	117	39
Pump Conn. Size - mm (in.)	153	6	153	6	153	6	51	2	51	2
Horsepower	5		7.5		7.5		2		2	
Notes	1,2		1,2		1,2		1,2		1,2	

Mark	P-304		P-304A	
Location	NORTH PENTHOUSE		NORTH PENTHOUSE	
Service	AHU-302 HEATING LOOP		AHU-302 HEATING LOOP	
Flow - L/sec (usgpm)	9.78	155	9.78	155
Head - kPa (ft.)	135	45	135	45
Pump Conn. Size - mm (in.)	102	4	102	4
Horsepower	5		5	
Notes	1,2		1,2	

Scheduled pipe size is HWS&R connection size between hot water main and fan coil unit/unit heater.

1. Motors to be suitable for 600/3/60 power and 1750 rpm unless noted otherwise.
2. Pump to be provided with external adjustable speed drive, as specified.
3. Working fluid to be 25 % propylene glycol

EXHAUST FANS				
Mark	EF-301			
Service	Centre Penthouse North			
Model	GB-300-VGD-20			
Air Flow - L/s (cfm)	2454.4	5200		
External S.P. - Pa (in w.g.)	250	1		
Horsepower	2			
RPM	1725			
Voltage/Phase	208/3			
Sones	11			
Notes				

Refer to specification for accessories not scheduled. Refer to drawings for installation details.

Louvres						
Mark	L-1		L-2		L-3	
Location	Crawlspace West		Crawlspace West		Crawlspace East	
Service	Natural ventilation		Natural ventilation		Natural ventilation	
Air Flow - L/s (cfm)	N/A	N/A	N/A	N/A	N/A	N/A
Width - mm (in.)	2286	90	1285	51	1422	56
Height - mm (in.)	1220	48	1220	48	1220	48
Free Area - m^2 (ft^2)	2.79	30.0	1.57	16.9	1.73	18.7
Air PD - Pa (in. w.g.)	N/A	N/A	N/A	N/A	N/A	N/A
Finish						
Notes						

Mark	L-4			
Location	Crawlspace West			
Service	Natural ventilation			
Air Flow - L/s (cfm)	N/A	N/A		
Width - mm (in.)	1285	51		
Height - mm (in.)	1220	48		
Free Area - m^2 (ft^2)	1.57	16.9		
Air PD - Pa (in. w.g.)	N/A	N/A		
Finish				
Notes				

Contractor to confirm required louvre size prior to ordering. Size specified is based upon duct installation as shown on drawings
Louvre to come complete with insect and bird screen.

PLUME DILUTION EXHAUST FANS (PDEFs)				
Mark	PDEF-301			
Service	NorthWest Roof			
Number of Operating Fans	3			
Number of Redundant Fans	1			
Air Flow - L/s (cfm) - Inlet.	40,120	85,000		
Air Flow - L/s (cfm) - Bypass.	2,795	5,921		
Air Flow - L/s (cfm) - Entrained.	19,311	40,914		
Existing system Air Flow - L/s (cfm)	28,886	61,200		
Future allowance Air Flow - L/s (cfm)	11,234	23,800		
Air Flow - L/s (cfm) - Total.	62,219	131,835		
Inlet Static Pressure - Pa (in w.g.)	1000	4		
Horsepower (per fan)	40			
Fan RPM (per fan)	1200			
Voltage/Phase	600V/3ph			
Net sound level at 10 ft	78 dB 'A'			
Notes				

Inlet static pressure has been derated for discharge nozzle, windband, airfoil
Inlet static pressure has been derated for system effects through the mixing box, based on factory recommended duct configurations

SINGLE DUCT AIR TERMINAL UNITS [CONSTANT VOLUME AIR VALVES]						
Mark	V-1		V-2		V-6	
Service	CANOPY #2		CANOPY #1		H1	
Air Flow - L/s (cfm)	458	970	486	1030	321	680
Minimum pressure drop - PA (in w.g.)	150	0.6	150	0.6	150	0.6
Maximum pressure drop - PA (in w.g.)	750	3	750	3	750	3
Valve Size - mm (inches)	305	12	305	12	254	10
Number of valves required	1		1		1	
Notes						

Mark	V-7		V-9		V-10	
Service	BSC09		H1056		H35	
Air Flow - L/s (cfm)	203	430	269	570	229	485
Minimum pressure drop - PA (in w.g.)	75	0.3	150	0.6	150	0.6
Maximum pressure drop - PA (in w.g.)	750	3	750	3	750	3
Valve Size - mm (inches)	254	10	254	10	254	10
Number of valves required	1		1		1	
Notes						

Mark	V-301		V-302		V-303	
Service	H37, H38		H37, H38		H41	
Air Flow - L/s (cfm)	1284	2720	116	245	496	1050
Minimum pressure drop - PA (in w.g.)	150	0.6	75	0.3	150	0.6
Maximum pressure drop - PA (in w.g.)	750	3	750	3	750	3
Valve Size - mm (inches)	356	14	356	14	305	12
Number of valves required	2		1		1	
Notes						

Mark	V-304		V-305		V-306	
Service	H39		H6		H30	
Air Flow - L/s (cfm)	500	1060	425	900	406	860
Minimum pressure drop - PA (in w.g.)	150	0.6	150	0.6	75	0.3
Maximum pressure drop - PA (in w.g.)	750	3	750	3	750	3
Valve Size - mm (inches)	305	12	305	12	305	12
Number of valves required	1		1		1	
Notes						

Mark	V-307		V-308		V-309	
Service	H31		H1		H34	
Air Flow - L/s (cfm)	411	870	387	820	767	1625
Minimum pressure drop - PA (in w.g.)	150	0.6	150	0.6	0	0.6
Maximum pressure drop - PA (in w.g.)	750	3	750	3	750	3
Valve Size - mm (inches)	305	12	305	12	356	14
Number of valves required	1		1		2	
Notes						

Mark	V-310		V-311		V-312	
Service	H35		H4		H3	
Air Flow - L/s (cfm)	788	1670	430	910	415	880
Minimum pressure drop - PA (in w.g.)	75	0.3	150	0.6	75	0.3
Maximum pressure drop - PA (in w.g.)	750	3	750	3	750	3
Valve Size - mm (inches)	356	14	305	12	305	12
Number of valves required	2		1		1	
Notes						

Mark	V-313		V-314		V-315	
Service	H7		H5		H2	
Air Flow - L/s (cfm)	415	880	425	900	368	780
Minimum pressure drop - PA (in w.g.)	75	0.3	150	0.6	75	0.3
Maximum pressure drop - PA (in w.g.)	750	3	750	3	750	3
Valve Size - mm (inches)	305	12	305	12	305	12
Number of valves required	1		1		1	
Notes						

Mark	V-316		V-317		V-318	
Service	H33		H9		H8	
Air Flow - L/s (cfm)	389	825	425	900	411	870
Minimum pressure drop - PA (in w.g.)	75	0.3	150	0.6	75	0.3
Maximum pressure drop - PA (in w.g.)	750	3	750	3	750	3
Valve Size - mm (inches)	305	12	305	12	305	12
Number of valves required	1		1		1	
Notes						

Mark	V-319		V-320		V-321	
Service	H15		H16		H10	
Air Flow - L/s (cfm)	425	900	330	700	408	865
Minimum pressure drop - PA (in w.g.)	150	0.6	150	0.6	75	0.3
Maximum pressure drop - PA (in w.g.)	750	3	750	3	750	3
Valve Size - mm (inches)	305	12	254	10	305	12
Number of valves required	1		1		1	
Notes						

Mark	V-322		V-323		V-324	
Service	H11		H14		H13	
Air Flow - L/s (cfm)	411	870	418	885	463	980
Minimum pressure drop - PA (in w.g.)	75	0.3	75	0.3	150	0.6
Maximum pressure drop - PA (in w.g.)	750	3	750	3	750	3
Valve Size - mm (inches)	305	12	305	12	305	12
Number of valves required	1		1		1	
Notes						

Mark	V-325		V-326		V-327	
Service	H12		H36		H28	
Air Flow - L/s (cfm)	425	900	349	740	392	830
Minimum pressure drop - PA (in w.g.)	150	0.6	150	0.6	75	0.3
Maximum pressure drop - PA (in w.g.)	750	3	750	3	750	3
Valve Size - mm (inches)	305	12	305	12	254	10
Number of valves required	1		1		1	
Notes						

Mark	V-328		V-329		V-330	
Service	H27		H32		H29	
Air Flow - L/s (cfm)	378	800	512	1085	439	930
Minimum pressure drop - PA (in w.g.)	0	0.3	150	0.6	150	0.6
Maximum pressure drop - PA (in w.g.)	750	3	750	3	750	3
Valve Size - mm (inches)	254	10	305	12	305	12
Number of valves required	1		1		1	
Notes						

Mark	V-331		V-332		V-333	
Service	H25		H24		H20	
Air Flow - L/s (cfm)	396	840	401	850	411	870
Minimum pressure drop - PA (in w.g.)	75	0.3	75	0.3	75	0.3
Maximum pressure drop - PA (in w.g.)	750	3	750	3	750	3
Valve Size - mm (inches)	305	12	305	12	305	12
Number of valves required	1		1		1	
Notes						

Mark	V-334		V-335		V-336	
Service	H23		H21		H22	
Air Flow - L/s (cfm)	425	900	250	530	354	750
Minimum pressure drop - PA (in w.g.)	150	0.6	150	0.6	75	0.3
Maximum pressure drop - PA (in w.g.)	750	3	750	3	750	3
Valve Size - mm (inches)	305	12	254	10	305	12
Number of valves required	1		1		1	
Notes						

Mark	V-337		V-338		V-339	
Service	H17		H18		H19	
Air Flow - L/s (cfm)	481	1020	354	750	245	520
Minimum pressure drop - PA (in w.g.)	0	0.6	75	0.3	150	0.6
Maximum pressure drop - PA (in w.g.)	750	3	750	3	750	3
Valve Size - mm (inches)	305	12	305	12	254	10
Number of valves required	1		1		1	
Notes						

Mark	V-340		V-341		V-342	
Service	H26		N/A		N/A	
Air Flow - L/s (cfm)	373	790	463	980	519	1100
Minimum pressure drop - PA (in w.g.)	75	0.3	75	0.3	75	0.3
Maximum pressure drop - PA (in w.g.)	750	3	750	3	750	3
Valve Size - mm (inches)	305	12	356	14	356	14
Number of valves required	1		1		1	
Notes						
Mark	V-343		V-345		V-346	
Service	N/A		N/A		N/A	
Air Flow - L/s (cfm)	80	170	51	108	217	460
Minimum pressure drop - PA (in w.g.)	75	0.3	75	0.3	150	0.6
Maximum pressure drop - PA (in w.g.)	750	3	750	3	750	3
Valve Size - mm (inches)	254	10	203	8	203	8
Number of valves required	1		1		1	
Notes						

Mark	V-347		V-348		V-349	
Service	N/A		N/A		N/A	
Air Flow - L/s (cfm)	293	620	396	840	51	108
Minimum pressure drop - PA (in w.g.)	75	0.3	75	0.3	75	0.3
Maximum pressure drop - PA (in w.g.)	750	3	750	3	750	3
Valve Size - mm (inches)	305	12	305	12	254	10
Number of valves required	1		1		1	
Notes						

Mark	V-350		V-351		V-352	
Service	N/A		N/A		N/A	
Air Flow - L/s (cfm)	106	225	66	140	472	1000
Minimum pressure drop - PA (in w.g.)	75	0.3	75	0.3	75	0.3
Maximum pressure drop - PA (in w.g.)	750	3	750	3	750	3
Valve Size - mm (inches)	254	10	254	10	356	14
Number of valves required	1		1		1	
Notes						

Mark	V-353		V-354		V-355	
Service	N/A		N/A		N/A	
Air Flow - L/s (cfm)	189	400	269	570	54	115
Minimum pressure drop - PA (in w.g.)	75	0.3	75	0.3	0	0.3
Maximum pressure drop - PA (in w.g.)	750	3	750	3	750	3
Valve Size - mm (inches)	305	12	305	12	203	8
Number of valves required	1		1		1	
Notes						

Mark	V-356		V-357		V-358	
Service	N/A		214D CANOPY		216 CANOPY	
Air Flow - L/s (cfm)	146	310	250	530	316	670
Minimum pressure drop - PA (in w.g.)	75	0.3	75	0.3	75	0.3
Maximum pressure drop - PA (in w.g.)	750	3	750	3	750	3
Valve Size - mm (inches)	305	12	305	12	305	12
Number of valves required	1		1		1	
Notes						

Mark	V-365		V-366		V-367	
Service	N/A		N/A		N/A	
Air Flow - L/s (cfm)	33	70	28	60	118	250
Minimum pressure drop - PA (in w.g.)	75	0.3	75	0.3	75	0.3
Maximum pressure drop - PA (in w.g.)	750	3	750	3	750	3
Valve Size - mm (inches)	254	10	254	10	254	10
Number of valves required	1		1		1	
Notes						

Mark	V-368		V-369		V-370	
Service	N/A		N/A		N/A	
Air Flow - L/s (cfm)	53	112	425	900	245	520
Minimum pressure drop - PA (in w.g.)	75	0.3	75	0.3	150	0.6
Maximum pressure drop - PA (in w.g.)	750	3	750	3	750	3
Valve Size - mm (inches)	203	8	356	14	254	10
Number of valves required	1		1		1	
Notes						

Mark	V-372		V-373		V-374	
Service	N/A		N/A		N/A	
Air Flow - L/s (cfm)	146	310	99	210	99	210
Minimum pressure drop - PA (in w.g.)	75	0.3	75	0.3	75	0.3
Maximum pressure drop - PA (in w.g.)	750	3	750	3	750	3
Valve Size - mm (inches)	203	8	203	8	203	8
Number of valves required	1		1		1	
Notes						

Mark	V-375		V-376		V-377	
Service	N/A		N/A		N/A	
Air Flow - L/s (cfm)	99	210	39	82	35	75
Minimum pressure drop - PA (in w.g.)	75	0.3	75	0.3	0	0.3
Maximum pressure drop - PA (in w.g.)	750	3	750	3	750	3
Valve Size - mm (inches)	203	8	203	8	203	8
Number of valves required	1		1		1	
Notes						

Mark	V-378		V-379		V-383	
Service	N/A		N/A		N/A	
Air Flow - L/s (cfm)	33	70	33	70	84	178
Minimum pressure drop - PA (in w.g.)	75	0.3	75	0.3	75	0.3
Maximum pressure drop - PA (in w.g.)	750	3	750	3	750	3
Valve Size - mm (inches)	203	8	203	8	254	10
Number of valves required	1		1		1	
Notes						

Mark	V-384		V-385			
Service	N/A		H40			
Air Flow - L/s (cfm)	26	55	566	1200		
Minimum pressure drop - PA (in w.g.)	75	0.3	150	0.6		
Maximum pressure drop - PA (in w.g.)	750	3	750	3		
Valve Size - mm (inches)	254	10	356	14		
Number of valves required	1		1			
Notes						

Valve bodies and cones to be provided with baked phenolic coating appropriate for use with fume hoods, biosafety cabinets, and snorkels.
Contractor to confirm valve operating range and allowable pressure drop prior to ordering.
Valves to be mounted as noted on the drawings (horizontal or vertical as noted).
Valves to be constant volume. Valves to be provided with airflow feedback potentiometer and base channel to allow for future mounting of an actuator to allow for VAV control.
Valves to be selected for schedule airflow. Scheduled airflow not to exceed 85% of max valve airflow.
Valves to be provided with slip connection (flanged connections are unacceptable).

1.0 GENERAL

1.1 SCOPE

.1 The work described in this specification covers the supply and installation of electrical equipment and materials, testing and commissioning of the systems installed, and other services as described in the various sections of the electrical specifications and as shown on the drawings.

.2 The scope of the electrical work includes, without being limited to the following:

.1 Modifications to the existing normal distribution in Transformer Room 138 to accommodate the power needs of the new air handling unit.

.2 Supply and installation of all power distribution equipment shown on the drawings, including:

.1 power panels and distribution panelboards
.2 dry-type transformers
.3 disconnect switches
.4 cable tray system

.3 Supply and installation of cables, wiring and raceways to equipment installed by the Electrical trade, and power wiring to equipment installed by the Mechanical trade, including:

.1 single and/or multi-conductor cables
.2 conduits, cable trays, and associated support systems

.4 Testing and commissioning of all equipment and systems installed,

.5 All other work required to deliver a complete and functional system, whether or not detailed on the drawings or described in the specifications.

1.2 DEFINITIONS

.1 Wherever the words "equal", "approved", or "approved equal" are used, they shall be understood to mean, "equal", "approved", or "approved equal".

.2 "Concealed" is defined as "out of sight" in "normal" viewing conditions, and includes buried in concrete, above acoustic tile or gypsum board ceilings, within masonry or gypsum board constructed walls, within cable trays or below raised access floors.

.3 Whenever the words “install”, “provide”, or “supply and install”, are used, they shall be understood to mean “provide and install, inclusive of all labour, materials, installation, testing, and connections” for the item to which they refer.

1.3 CODES AND STANDARDS

.1 All work shall meet or exceed the latest applicable Codes and Standards**.** Do complete installation in accordance with the Canadian Electrical Code (the Code) and the requirements of the local Electrical Safety Authority having jurisdiction.

.2 Abbreviations for electrical terms: to CSA Z85.

.3 Unless noted otherwise, reference to a code or standard shall mean the most recent version of that code or standard.

1.4 PERMITS, FEES AND INSPECTIONS

.1 Submit to local Electrical Safety Authority, the necessary number of drawings and specifications for examination and approval prior to commencement of work.

.2 Pay fees associated with such submissions.

.3 Consultant will provide one set of drawings and specifications required for submission to Electrical Inspection Authority at no cost.

.4 Notify the Consultant of any changes required to meet Electrical Safety Authority requirements prior to making changes.

.5 On completion of work, furnish to Owner and Consultant the Certificates of Acceptance from authorities and having jurisdiction.

1.5 DRAWINGS AND SPECIFICATIONS

.1 Drawings and Specifications are intended to cover the scope of work described herein. It is not the intent to show or describe every detail, and it shall be agreed that the Contractor will provide all work and material required to satisfy the intent of the Drawings and Specifications.

.2 Drawings and Specifications are not guaranteed to be free of discrepancies and the Owner and/or Consultant will not be responsible for the absence of any detail the Contractor may require, or for any special work, equipment, material or labour which may be found necessary as the work progresses.

.3 It shall be specifically understood that the omission of any Drawing or Schedule, or reference thereto, or any item from any Drawing or Schedule, or from the Specification, which is required to make the work complete and operational, shall not relieve the Contractor from the obligation of providing the required items and associated labour.

.4 Any discrepancies shall be submitted to the Consultant for his instructions.

1.6 VOLTAGE RATINGS

.1 Operating voltages to: CAN3-C235.

.2 Motors, electric heating, lighting, control and distribution devices and equipment shall operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment shall operate in extreme operating conditions established in above standard, without damage.

1.7 CONSULTANT'S INSTRUCTIONS

.1 During construction, the Consultant will issue such instructions in writing as may be necessary for verification and correction of the work. These instructions shall be binding as part of the Contract Documents.

2.0 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

.1 Equipment and material shall be new and suitable for the use intended.

.2 Equipment and material shall be certified by CSA of such other agency as may be recognized by the Safety Authority. Where there is no alternative to supplying equipment which is not thus certified, obtain special approval from Electrical Safety Authority, and notify the Consultant of any extra costs.

.3 Factory assemble control panels and component assemblies.

.4 Where materials, equipment, apparatus, or other products are specified by a manufacturer's brand name, type or catalogue number, such designation is to establish the standards of desired quality, style or dimensions, and shall be the basis of the Bid. Furnish materials so specified under this Contract unless changed by mutual agreement.

.5 Where the use of equivalent, alternate or substitute equipment alters the design or space requirements indicated on the plans, the Contractor for this contract shall include all items of cost for the revised design and construction, including the cost of all the other trades involved.

.6 Acceptance of the proposed equivalents, alternates or substitutions shall be subject to the review by the Consultant, and if requested, the Contractor shall submit for inspection, samples of both the specified and the proposed alternate items.

.7 In all cases where the use of equivalents, alternates or substitutions is permitted, the Contractor shall bear any extra costs of evaluating the quality of materials and the equipment to be installed by the Consultant.

2.2 EQUIVALENTS AND ALTERNATES

.1 Should the Contractor propose to furnish material and equipment other than those specified, he shall apply in writing to the Consultant for approval of equivalents at least five working days prior to the closing of Tenders, submitting with his request for approvals, complete descriptive and technical data on the item or items he proposes to furnish. Approval for changes in the base bid specifications will be considered only upon the individual requests of the Contractor. No blanket approval for equipment will be given to suppliers, distributors or contractors.

.2 Unless requests for changes in base bid specifications are received and approved prior to the opening of the bids, as defined above, the Contractor will be held to furnish all specified items under his base bid. After the contract is awarded, changes in specifications will be made only as defined in this Section.

.3 For the equipment to be supplied by the Contractor, alternates may be offered in lieu of items named in the specifications. Alternate proposals must be accompanied by full descriptive and technical data on the article proposed, together with a statement of the amount of addition or deduction from the base bid if the alternate is accepted. Prior review by the Consultant is not required on items submitted as alternate bids, but the decision on acceptance of the alternate(s) will rest with the Consultant.

.4 Replace unspecified materials and/or rejected equivalents and alternates built into the work with specified or accepted materials, at no additional cost to the Consultant.

.5 In case of differences in price, the Owner shall receive all benefit of the difference in cost involved in any substitution, and the Contract shall be altered by change order to credit the Owner with any savings so obtained.

.6 Materials and equipment substituted or offered as alternatives shall have spare parts and servicing available and shall fit into the space allocation shown on the drawings.

.7 If any material or equipment being considered for substitution involves additional design, architectural or engineering fees or other costs in checking whether or not the substitute material or equipment is suitable for the project, such fees or costs shall be paid for by the Contractor.

2.3 SHOP DRAWINGS

.1 Submit shop drawings in accordance with relevant Section.

.2 After execution of the Contract, within ten (10) working days, provide a schedule for shop drawing submission and a schedule for the delivery of equipment to the site. At this stage, identify any equipment whose delivery time could negatively impact the project completion date. Failure to do so will require the Contractor to provide temporary equipment until the specified equipment is available.

.3 Specifications and Drawings are intended to cover all electrical systems. It is not the intent to describe or show every detail, and it shall be agreed that the Manufacturer will provide all work and material required to provide equipment according to the requirements and intent of the Drawings and Specifications.

.4 Submitted Shop Drawings must indicate details of construction, dimensions, scale, capacities, weights and electrical performance characteristics of equipment or materials, as well as project name and specification reference Section number.

.5 Shop drawings shall be provided in the form of 5 (five) prints, with sufficient space on the front for all Consultant's and/or Contractor's "review" stamps.

.6 Where applicable, include wiring, single line and schematic design drawings, and diagrams showing interconnections with the work of other suppliers.

.7 Work affected by submittals shall not proceed until review is complete.

.8 Review submittals prior to submission to Consultant. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of the work and Contract Documents.

.9 Changes made to Shop Drawings by the Consultant will not affect the Contract Price.

.1 Shop drawings will be reviewed by the Consultant and returned to the Manufacturer marked "REVIEWED", "REVIEWED AS NOTED" or "RETURNED FOR CORRECTION". Shop drawings noted "RETURNED FOR CORRECTION" shall be corrected and re-submitted.

.2 No equipment shall be delivered to the job site unless the Manufacturer has received a "REVIEWED" or "REVIEWED AS NOTED" copy of the pertinent shop drawing.

.3 The Manufacturer's Schedule shall allow 5 business days for review or return for correction of shop drawings submitted to Consultant with the time period starting at the time of receipt of the Drawings by the Consultant.

3.0 EXECUTION

3.1 INSTALLATION - GENERAL

.1 Lay out of the work of this contract. Take special precautions and note drawing scales. Generally floor plans are drawn at metric scale. Make field verifications of dimensions on plans since actual locations, distances, and level will be governed by actual field conditions.

.2 Wherever differences occur between plans and riser diagrams or schematics, and between specifications and drawings, most stringent conditions shall govern. Bring discrepancies between plans, or between plans and actual field conditions, or between plans and specifications promptly to the attention of the Consultant for clarification.

.3 As the work progresses and before installing apparatus, equipment, fixtures and devices which may interfere with the interior treatment and use of the building, obtain approval from the Consultant with detailed drawings or sketches for the exact location of all electrical raceways, panels, trays/ladders, equipment, fixtures and wiring devices. Failure to do so will make the Contractor responsible for rectification at no cost.

.4 Confer with other trades engaged on the work and arrange the work so that it will be carried out in the best interest of all concerned. Before commencing to work, check and verify with the Consultant all elevations, levels, dimensions etc. to ensure proper and correct installation of the work.

.5 Protect finished and unfinished work and equipment and work of other trades from damage due to the carrying out of the work of this trade.

.6 In addition to the work specifically mentioned in the specifications and shown on the drawings, provide all other items that are required by the authorities having jurisdiction over the work.

.7 Contain all work being performed within the physical area of work which is underway during any particular period of time. Keep the amount of disruption in the existing facility to a minimum.

.8 Should the work within a particular area causes any electrical apparatus in another area to cease to function properly, identify and remedy the problem with the apparatus which has ceased to function properly.

3.2 SCHEDULING OF WORK

.1 For all work to be performed under this contract, adhere to construction schedule detailed in other parts of the contract.

.2 Ensure that all equipment and material is ordered in time to meet the schedule. Provide a schedule of deliveries to the Consultant/Owner. Furnish promptly information required for the construction schedule.

.3 Proceed with the work as quickly as practical so that construction may be completed in as short a time as possible and in accordance with the building schedule.

.4 Co-ordinate all required shutdowns of the existing facilities with the operating staff to maintain any disruption to a minimum. Provide ample notice to Owner before shutting down any existing facility.

3.3 INSTALLATION OF RACEWAYS

.1 Install all conduits, cable trays, etc., to conserve headroom and interfere as little as possible with the free use of the space through which they pass.

.2 Install conduits, wireways, etc., particularly those which may interfere with the inside treatment of the building, or conflicting with other trades, only after the locations have been fully coordinated with other trades.

.3 Take special care in the installation of conduits, wireways etc., which must be concealed to see that they come within the finished lines of floors, walls, and ceilings. Where such bus ducts, conduits, wireways, etc., have been installed in a manner causing interference, remove and reinstall in suitable locations without extra cost.

.4 Do not remove or damage any structural fireproofing. Leave space to permit the fireproofing to be inspected and/or repaired.

3.4 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

.3 Install electrical equipment at following heights unless indicated otherwise.

.1 Panelboards: as required by Code or as indicated.

3.5 CUTTING AND PATCHING

.1 Employ the trade responsible for a particular item of work to do all cutting, patching and repairing of surfaces affected by that work.

.2 Supporting members of any floor, wall or the building structure shall be cut only in such a location and manner as directed by the Consultant/Owner.

.3 All holes and surfaces shall be repaired with the type of material removed by the tradesmen expert in the type of repair required.

.4 Provide fire barriers around all components in holes which penetrate fire separations. The fire barrier medium provided shall make the fire separation equal to or better than the one which was cut away. All materials shall be CSA approved and ULC listed.

.5 All floor sawcutting and drilling required for electrical services shall be performed within hours approved by the Owner. Prior written notice of 48 hours must be given to the Consultant.

3.6 FIRE STOPPING

.1 Provide fire barriers around all components in holes which penetrate fire separations. The fire barrier medium provided shall make the fire separation equal to or better than the one which was cut away. All materials shall be CSA approved and UL listed.

.2 For conduit, cable tray, and cable penetrations of the fire rated floors and walls, provide an ULC-classified and F.M. approved fire seal system to maintain the integrity of the fire separation.

.3 Fill void around conduit, tray or cable opening with silica fibre panels and seal both sides with fire retardant elastomeric coating, in accordance with manufacturer's instructions.

3.7 PAINTING AND FINISHING

.1 All hangers, channels, conduits, etc. shall be delivered to the site galvanized after fabrication and all metal cut and finishes damaged on the job shall be painted to match.

.2 All equipment and materials, panels, luminaires, etc., shall be stored in a dry, clean location, covered if necessary to preserve factory finish.

.3 Where equipment and material is designated unfinished, all exposed metal work, with the exception of chromed locks and hardware, shall be left with a suitable prime coat finish.

.4 Painting of equipment and material requiring a finished coat or touch up after installation shall be carried out wherever required. This does not apply to the making good of damaged factory finishes which shall be done by the Electrical Contractor.

.5 Particular care shall be exercised to avoid formation and spread of zinc whiskers or other metal filings on floors. All metal cut on site shall be wiped clean along the cuts and covered with rust-inhibiting grease or an adequate primer or paint finish.

3.8 EQUIPMENT IDENTIFICATION

.1 Identify electrical equipment with laminated plastic nameplates.

.2 Nameplate colours shall match those of the existing systems.

.3 Nameplate text shall match that of the existing nameplates.

.4 Nameplates shall be secured with screws or rivets.

.5 Wording on nameplates to be approved by Owner and/or Consultant prior to manufacture.

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

.7 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage rating, power flow directions.

.8 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.9 Terminal cabinets and pull boxes: indicate system, voltage and power flow direction.

.10 Transformers: indicate capacity, primary and secondary voltages, power flow direction on primary cable entry and secondary entry, and name assigned by Owner/Consultant.

3.9 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour code: in accordance with the Code.

.4 Use colour coded wires in communication cables, matched throughout system.

3.10 CONDUIT AND CABLE IDENTIFICATION

.1 Colour code conduits, boxes and metallic sheathed cables.

.2 Code with plastic tape or paint at points where conduit or cable enters or exits wall, ceiling, or floor, and at 10 m intervals.

.3 Label all conduits using “P-Touch” or Paint at every entry or exit of wall, ceiling and at 10m intervals.

.4 Colours: 25 mm wide prime colour and 15mm wide auxiliary colour. Prime colours shall be:

31 V to 250 V	blue
251 V to 750 V	yellow
Communication systems	green
Life safety systems	red
Miscellaneous systems	brown
Auxiliary colours shall be:	
Normal power	none
Emergency power	orange
Uninterruptible power	white (or black, if the equipment is white)
Other communications	blue

3.11 WIRING TERMINATIONS

.1 Lugs, terminals, screws used for termination of wiring are to be suitable for copper conductors, according to the material of the wiring being terminated.

.2 Electrical Contractor shall provide cable lugs, terminals, screws, etc. required for wiring terminations.

3.12 MANUFACTURER’S AND APPROVAL LABELS

.1 Provide visible and legible labels after equipment is installed.

3.13 WARNING SIGNS

.1 Provide warning signs to meet requirements of Electrical Inspection Authority and any Authority having jurisdiction.

3.14 TESTING AND COMMISSIONGING

.1 Provide testing and commissioning of all equipment/systems installed, whether supplied by Owner or by the Contractor.

.2 Generally, commissioning shall comprise four stages:

- .1 Pre-functional tests (PFT)
- .2 Functional tests (FT)
- .3 Independent system tests (IST)
- .4 Integrated Operational Systems Test (ISOT)

.3 Pre-functional tests shall include initial visual checks of equipment after arrival on site and following mechanical and electrical installation.

.4 Functional tests shall include individual startup and standalone testing of equipment. Refer to the individual equipment specification for specific testing requirements.

.5 Independent system testing shall include operation of several pieces of equipment as part of one system to validate its standalone performance.

.6 Integrated systems operational tests shall include operation of the entire system as one integrated assembly, under all possible scenarios, to ensure adequate system response, and to validate performance.

.7 Arrange and pay for services of manufacturers' factory service technicians to supervise start-up of installation, check, adjust, balance and calibrate components, wherever required.

.8 Resolve all commissioning issues discovered at each stage before proceeding to the next level of commissioning.

3.15 OPERATOR TRAINING

.1 Instruct Owner and operating personnel in the operation, care and maintenance of equipment.

.2 Prepare training material with a level of detail adequate for each type of equipment/system installed. Provide an outline of the training material to the Owner prior to delivering the training.

.3 Conduct "classroom" training followed by "hands-on" training. Demonstrate the operation of each equipment/ system and its features. Enlist the assistance of manufacturers' representatives where appropriate.

.4 Provide these services for such period, and for as many visits, as necessary to ensure that operating personnel are conversant with all aspects of equipment operation and care. Obtain written acceptance of operating personnel's understanding of the systems.

3.16 CLEANING

.1 During the performance of the work and on completion, remove from the site and premises all debris, rubbish and waste materials caused by the performance of the work for this contract. Remove all tools and surplus materials after acceptance of the work to the Owner and/or Consultant's satisfaction.

.2 Vacuum all equipment thoroughly at the time of final acceptance of the work. Clean plastic components and exposed components of lighting fixtures in accordance with the manufacturer's recommendation.

END OF SECTION

1.0 GENERAL

1.1 REFERENCES

.1 CSA C22.2 No.0.3, Test Methods for Electrical Wires and Cables.

.2 CAN/CSA-C22.2 No.131, Type TECK 90 Cable, 1000 V rated.

2.0 PRODUCTS

2.1 BUILDING WIRES

.1 Conductors: stranded for 8 AWG and larger. Minimum size: 12 AWG.

.2 Copper conductors: size as indicated, with 1000 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.

2.2 TECK CABLE

.1 Cable: to CAN/CSA-C22.2 No.131.

.2 Conductors:

.1 Grounding conductor: copper.

.2 Circuit conductors: copper, size as indicated.

.3 Insulation: cross-linked thermosetting polyethylene rated Type RW90, 1000V.

.4 Inner jacket: PVC.

.5 Overall covering material: PVC

.6 Armour: aluminum interlocking.

2.3 ARMOURED CABLES

.1 Conductors: insulated, copper, size as indicated.

.2 Type: AC90, 1000 V rated.

.3 Armour: interlocking type fabricated from galvanized steel or aluminum strip.

.4 Type: ACWU90 - PVC jacket over armour meeting requirements of Vertical Tray Fire Test of CSA C22.2 No.0.3 with maximum flame travel of 1.2m.

2.5 CONTROL CABLES

.1 Type LVT: soft annealed copper conductors, number and size as indicated, with thermoplastic insulation, and outer covering of thermoplastic jacket.

.2 Low energy 300V control cable: solid annealed copper conductors sized as indicated, with insulation type T90 Nylon.

.3 Fire Alarm Cable: Type FAS – not less than 300V – as required by the Canadian Electrical Code.

2.6 VFD CABLES

.1 Conductors: XLPE insulated, copper, size as indicated.

.2 Shielded.

.3 “J” stranding to accommodate long runs.

3.0 EXECUTION

3.1 INSTALLATION OF BUILDING WIRES

.1 Install wiring in raceways, in trays or exposed, in accordance with the relevant Sections of this Division.

.2 Connect cables as indicated.

3.2 INSTALLATION OF TECK CABLE 0 - 1000V

.1 Install cables, grouping wherever possible on channels.

.2 Terminate cables in accordance with manufacturer's recommendations. Use only non-magnetic connectors, locknuts and ground bushings for terminations.

.3 Connect cables as indicated.

3.3 INSTALLATION OF ARMOURED CABLES

.1 Install cables as indicated, grouping wherever possible.

.2 Terminate and connect cables.

3.4 INSTALLATION OF CONTROL CABLES

.1 Install control cables in raceways, as indicated, and connect.

3.5 INSTALLATION OF VFD CABLES

.1 Install cables as indicated, grouping wherever possible.

.2 Terminate and connect cables.

3.6 FIELD QUALITY CONTROL

.1 Perform tests using qualified personnel and the necessary instruments and equipment.

.2 Identify each phase conductor of each feeder.

.3 Check each feeder for continuity, short circuits and grounds.

.4 Pre-acceptance tests

.1 After installing cable but before splicing and terminating, perform insulation resistance test with megger on each phase conductor. Ensure insulation resistance to ground of circuits is not less than 50 megaohms.

.2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.

.5 Acceptance Tests

.1 Ensure that terminations and accessory equipment are disconnected.

.2 Ground all shields, ground wires, metallic armour and conductors not under test.

.3 High Potential (Hipot) Testing: Conduct Hipot testing at 100% of original factory test voltage in accordance with the more stringent of manufacturer's or ICEA recommendations.

.4 Leakage Current Testing:

.1 Raise voltage in steps from zero to maximum values as specified by ICEA or manufacturer for type of cable being tested.

.2 Hold maximum voltage for time period specified by ICEA or manufacturer.
.3 Record leakage current at each step.

.7 Provide Consultant with list of test results showing location at which each test was made, circuit tested and result of each test.

.8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END OF SECTION

1.0 GENERAL

1.1 REFERENCES

.1 ANSI/IEEE 837-2002, Qualifying Permanent Connections Used in Substation Grounding.

.2 CAN/CSA C 22.2 No. 0.4-04 (R2013) Bonding of Electrical Equipment.

.3 CAN/CSA Z32-09, Electrical Safety and Essential Electrical Systems in Health Care Facilities.

2.0 PRODUCTS

2.1 EQUIPMENT

.1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.

.2 Copper conductor: minimum 6 m long for each concrete encased electrode, bare stranded, soft annealed, size as indicated.

.3 Rod electrodes: galvanized steel 19 mm dia by 3 m long.

.4 Grounding conductors: bare stranded copper, soft annealed, size as indicated.

.5 Insulated grounding conductors: green, type stranded copper, soft annealed, size as indicated.

.6 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.

.7 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:

.1 Grounding and bonding bushings.

.2 Protective type clamps.

.3 Bolted type conductor connectors.

.4 Thermit welded type conductor connectors.

.5 Bonding jumpers, straps.

.6 Pressure wire connectors.

3.0 EXECUTION

3.1 INSTALLATION GENERAL

.1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.

.2 Install connectors in accordance with manufacturer's instructions.

.3 Protect exposed grounding conductors from mechanical injury.

.4 Make buried connections, and connections to conductive water main, electrodes, using permanent mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837.

.5 Use mechanical connectors for grounding connections to equipment provided with lugs.

.6 Soldered joints not permitted.

.7 Install bonding wire for flexible conduit, connected at one end to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

.8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

.9 Install separate ground conductor to outdoor lighting standards.

.10 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

.11 Bond single conductor, metallic armoured cables to cabinet at supply end, and load end.

.12 Ground secondary service pedestals.

3.3 ELECTRODES

.1 Make ground connections to continuously conductive underground water pipe on street side of water meter.

.2 Install water meter shunt.

.3 Install concrete encased electrodes in building foundation footings, with terminal connected to grounding network.

.4 Install rod electrodes and make grounding connections.

.5 Bond separate, multiple electrodes together.

.6 Use size 4/0 AWG copper conductors for connections to electrodes.

.7 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

3.4 SYSTEM AND CIRCUIT GROUNDING

.1 Install system and circuit grounding connections to neutral of primary 600V system, secondary 120V system.

3.5 EQUIPMENT GROUNDING

.1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting.

3.6 GROUNDING BUS

.1 Install copper grounding bus mounted on insulated supports on wall of electrical room.

.2 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size 2/0 AWG.

3.7 COMMUNICATION SYSTEMS

.1 Install grounding connections for telephone, sound, fire alarm, intercommunication systems as follows:

.1 Telephones: make telephone grounding system in accordance with telephone company's requirements.

.2 Sound, fire alarm, intercommunication systems as indicated.

3.8 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 01 – Electrical General Requirements.

.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

1.0 GENERAL

1.1 SCOPE

.1 This section covers the requirements for support systems used with the various power conveyance means used on the project, including cable trays, conduits and cables.

2.0 PRODUCTS

2.1 SUPPORTED CHANNELS

.1 U shape, size 40 x 40 mm, 2.5 mm thick, mounted as required to support the various loads.

3.0 EXECUTION

3.1 INSTALLATION

.1 Secure equipment to solid masonry surfaces with lead anchors.

.2 Secure equipment to poured concrete with expandable inserts.

.3 Secure equipment to hollow walls with toggle bolts.

.4 Support equipment, conduit or cables using clips, spring loaded bolts, or cable clamps designed as accessories to basic channel members.

.5 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.

.6 Suspended support systems.

- .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
- .2 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.

.7 For surface mounting of two or more conduits use channels at 1.2 m spacing.

.8 Provide metal brackets, frames, hangers, clamps and related types of support structures 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

1.0 GENERAL

1.1 SCOPE

.1 This section describes miscellaneous equipment and materials to be used in the electrical installation.

.2 The drawings do not necessarily show junction and pull boxes.

2.0 PRODUCTS

2.1 JUNCTION AND PULL BOXES

.1 Welded steel construction with screw-on flat covers for surface mounting.

.2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

.3 Where wiring from 2 or more sources are contained in or running through pull or junction box, the box shall be labelled with appropriate warning as well as voltage and sources.

3.0 EXECUTION

3.1 JUNCTION AND PULL BOX INSTALLATION

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Install pull boxes so as not to exceed 30 m of conduit run, or two 90° bends, between pull boxes.

3.2 IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01 – Electrical General Requirements.

END OF SECTION

1.0 GENERAL

1.1 REFERENCES

.1 CSA C22.1-2012, Canadian Electrical Code, Part 1 with provincial amendments.

2.0 PRODUCTS

2.1 OUTLET AND CONDUIT BOXES GENERAL

.1 Size boxes in accordance with CSA C22.1.

.2 102 mm square or larger outlet boxes as required for special devices.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 347 V outlet boxes for 347 V switching devices.

.6 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 SHEET STEEL OUTLET BOXES

.1 Electro-galvanized steel single and multigang 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.

.2 Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.

.3 102 mm square or octagonal outlet boxes for lighting fixture outlets.

.4 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished 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 CONDUIT BOXES

.1 Cast FS boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle.

2.6 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLES

.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.

2.7 FITTINGS – GENERAL

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

3.0 EXECUTION

3.1 INSTALLATION

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

.4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

END OF SECTION

1.0 GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CAN/CSA C22.2 No.18, Outlet Boxes, Conduit Boxes, and Fittings.

.2 CSA C22.2 No.56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.

.3 CSA C22.2 No.83, Electrical Metallic Tubing.

1.2 RELATED WORK

.1 Comply with the relevant Sections of this and other Divisions of this Specification.

1.3 APPLICATION

.1 EMT conduits shall be used in all indoor locations, except as excluded herein and provided that it is not susceptible to mechanical injury.

.2 PVC conduit may be used underground

.3 Flexible metallic conduit shall be used for the last 1.0 m in connections to vibrating equipment including, but not limited to motors and transformers.

.4 Flexible metallic conduit may be used for horizontal wiring runs in hollow partitions, and for connections to luminaires in suspended ceilings, as permitted by Code.

.5 Liquid-tight flexible metallic conduit shall be used outdoor for final connection to equipment.

.6 Notwithstanding anything in this Article, a specific direction on the Drawings to use a particular type of conduit shall override this Article.

2.0 PRODUCTS

2.1 CONDUITS

.1 Electrical metallic tubing (EMT): to CSA C22.2 No.83, with couplings.

.2 Flexible metal conduit: to CSA C22.2 No.56, steel and liquid-tight flexible steel.

2.2 CONDUIT FASTENINGS

.1 One-hole steel straps to secure surface conduits 50 mm and smaller. Two-hole steel straps for conduits larger than 50 mm. “Caddy” clips shall not be used.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits at 1.2 m oc.

.4 Threaded rods, 5 mm diameter, to support suspended channels.

2.3 CONDUIT FITTINGS

.1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.

.2 Factory "ells" where 90° bends are required for 25 mm and larger conduits.

.3 Compression watertight connectors and couplings for EMT exposed to moisture.

.4 Set-screw fittings for EMT conduit where acceptable.

2.4 FISH CORD

.1 Install Polypropylene wire in each conduit.

3.0 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 unfinished areas.

.3 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.4 Mechanically bend steel conduit over 20 mm diameter.

.5 Install fish cord in empty conduits.

.6 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.

.7 Dry conduits out before installing wire.

.8 Remove burrs at conduit ends prior to installing wire.

3.2 SURFACE CONDUITS

.1 Run conduits parallel or perpendicular to building lines.

.2 Group conduits wherever possible on channels.

.3 Do not pass conduits through structural members.

.4 Do not locate conduits less than 75 mm parallel to hot water lines with minimum of 25 mm at crossovers.

3.3 CONCEALED CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Do not install horizontal runs in masonry walls.

END OF SECTION

1.0 GENERAL

1.1 RELATED SECTIONS

.1 Section 26 05 01 – Electrical General Requirements.

1.2 REFERENCES

.1 Canadian Standards Association, (CSA International)

.1 CSA C22.2 No. 52-09, Underground Secondary and Service-Entrance Cable

2.0 PRODUCTS

2.1 CABLE PROTECTION

.1 Galvanized wire mesh compacted.

2.2 MARKERS

.1 152 mm wide underground warning tape.

3.0 EXECUTION

3.1 DIRECT BURIAL OF CABLES

.1 After sand bed is in place, lay cables maintaining 75 mm clearance from each side of trench to nearest cable. Do not pull cable into trench.

.2 Provide offsets for thermal action and minor earth movements. Offset cables as indicated in detail drawings, maintaining minimum cable separation and bending radius requirements.

.3 Make termination and splice only as indicated leaving 0.6 m of surplus cable in each direction.

.1 Make splices and terminations in accordance with manufacturer's instructions using approved splicing kits.

.4 Minimum permitted radius at cable bends for rubber, plastic or lead covered cables, 8 times diameter of cable; for metallic armoured cables, 12 times diameter of cables or in accordance with manufacturer's instructions.

.5 Cable separation:

.1 Maintain 75 mm minimum separation between cables of different circuits.

.2 Maintain 300 mm horizontal separation between low and high voltage cables.

.3 When low voltage cables cross high voltage cables maintain 300 mm vertical separation with low voltage cables in upper position.

.4 At crossover, maintain 75 mm minimum vertical separation between low voltage cables and 150 mm between high voltage cables.

.5 Maintain 300 mm minimum lateral and vertical separation for fire alarm and control cables when crossing other cables, with fire alarm and control cables in upper position.

.6 After sand protective cover is in place, install galvanized wire mesh compacted as indicated to cover length of run.

3.2 CABLE INSTALLATION IN DUCTS

.1 Install cables as indicated in ducts. Do not pull spliced cables inside ducts.

.2 Install multiple cables in duct simultaneously.

.3 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.

.4 To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.

.5 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.

.6 After installation of cables, seal duct ends with duct sealing compound.

3.3 MARKERS

.1 Mark cable every 150 m along duct runs and changes in direction.

.2 Mark underground splices.

.3 Where markers are removed to permit installation of additional cables, reinstall existing markers.

.4 Install 152 mm wide underground warning tape.

3.4 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 01 – Electrical General Requirements.

.2 Perform tests using qualified personnel. Provide necessary instruments and equipment.

.3 Check phase rotation and identify each phase conductor of each feeder.

.4 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megaohms.

.5 Pre-acceptance tests.

.1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.

.2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.

.6 Acceptance Tests

.1 Ensure that terminations and accessory equipment are disconnected.

.2 Ground shields, ground wires, metallic armour and conductors not under test.

.3 High Potential (Hipot) Testing.

.1 Conduct Hipot testing at 100% of original factory test voltage in accordance with the more stringent of manufacturer's or ICEA recommendations.

.4 Leakage Current Testing.

.1 Raise voltage in steps from zero to maximum values as specified by ICEA or manufacturer for type of cable being tested.

.2 Hold maximum voltage for time period specified by ICEA or manufacturer.

.3 Record leakage current at each step.

.7 Provide Consultant with list of test results showing location at which each test was made, circuit tested and result of each test.

.8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END OF SECTION

1.0 GENERAL

1.1 PRODUCT DATA

.1 Submit shop drawings showing electrical details of transformers.

.2 Include kVA rating, temperature rise, detailed enclosure dimensions, primary and secondary nominal voltages, primary voltage taps, no load and full load losses, impedances, unit weight, warranty.

1.2 REFERENCES

.1 ANSI/NEMA ST 20-Dry Type Transformer for General Applications

.2 IEEE C57.110-1998

.3 UL, CSA standards

1.3 STORAGE AND HANDLING

.1 Store and handle in strict compliance with manufacturer's instructions and recommendations.

.2 Protect from potential damage from construction operations.

.3 Store so condensation will not form on or in the transformer housing and if necessary, apply temporary heat where required to obtain suitable service conditions.

.4 Handle transformers using proper equipment for lifting and handling, use when necessary lifting eye and/or brackets provided for that purpose.

2.0 PRODUCTS

2.1 TRANSFORMERS

.1 Nameplate rating: 75 kVA, 600 V primary, 208/120 V secondary, linear load, 60Hz.

.2 Standard impedance at 60Hz: 6.5%

.3 Three-phase, common core construction. Convection air cooled

.4 Insulation Class: 220°C system

.5 Temperature rise: 150°C

.6 Taps: 2 x ± 2.5% (2FCAN, 2FCBN)

.7 Core made of high grade non-aging silicon steel laminations or better

.8 Coil conductors: continuous aluminium windings, with terminations brazed or welded

.9 Impregnation: vacuum impregnated polyester resin.

.10 Inrush current: 10 times full load rating (max.)

.11 Sound level to meet NEMA ST-20

.12 Enclosure: Type 2.

.13 Finishes: ANSI 61 Grey

.14 Anti-vibration pads shall be used between the core and the enclosure

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01 - Electrical General Requirements.

.2 Label size: 7.

2.3 MANUFACTURER

.1 Dry-type transformers shall be the product of Delta Transformer, Hammond, Schneider Electric, Siemens, Polygon or equivalent.

3.0 EXECUTION

3.1 INSTALLATION

.1 Ensure adequate clearance around transformers for ventilation.

.2 Install transformers in level upright position.

.3 Remove shipping supports only after transformers are installed and just before putting into service.

.4 Loosen isolation pad bolts until no compression is visible.

.5 Make primary and secondary connections in accordance with wiring diagram.

.6 Energize transformers after installation is complete.

3.2 COMMISSIONING

.1 Before applying loads verify secondary voltages and if necessary adjust secondary taps.

.2 Take Infrared picture to verify connection accuracy. Provide load bank for transformer testing if total load is less than 50%. Load to be applied for at least 8 hours before infrared pictures are taken.

.3 Commissioning Report on transformers shall include:

.1 Primary and secondary voltages

.2 Primary and secondary total harmonic distortion for voltage and current

END OF SECTION

1.0 GENERAL

1.1 SCOPE

.1 The work described in this specification covers the supply and installation of power and distribution panelboards shown on the drawings

1.2 REFERENCE STANDARDS

.1 CSA C22.2 No. 29

1.3 SUBMITTALS

.1 Submit five (5) sets of product data (shop drawings).

.2 Drawings shall include electrical detail of each panel, branch breaker type, quantity, ampacity, and enclosure dimensions.

1.4 PLANT ASSEMBLY

.1 Install circuit breakers in panelboards before shipment.

.2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

2.0 PRODUCTS

2.1 POWER AND DISTRIBUTION PANELS

.1 All panels shall be manufactured to, and be the product of a single manufacturer.

.2 Bus and breakers for both the 600 V distribution and the 120/208 V branch circuit panelboards shall match the interrupting capacity of the previously installed equipment.

.3 Unless otherwise specified all panels shall have copper bus bars rated for the withstand capacity as required.

.4 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number.

.5 Panels shall contain mains, ground and neutral busses, number of circuits, and number and size of branch circuit breakers as indicated.

.6 Provide 2 (two) keys for each panels and key panels alike.

.7 The mains shall be suitable for bolt-on breakers.

.8 The trim and door shall be finished with baked air dried grey enamel

.9 Enclosure: Type 1.

2.2 BREAKERS

.1 Breakers shall have thermal and magnetic trip units.

.2 Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation, with temperature compensation for 40°C ambient.

.3 Common-trip breakers: with single handle for multi-pole applications.

.4 Provide lock-on devices for each breaker loads that should not be switched-off manually.

2.3 EQUIPMENT IDENTIFICATION

.1 Provide nameplate for each panel.

.2 Complete circuit directory with typewritten legend showing location and load of each circuit.

2.4 MANUFACTURERS

.1 Eaton Electric (Cutler-Hammer)

.2 Schneider Electric

.3 Siemens

3.0 EXECUTION

3.1 INSTALLATION

.1 Locate panels where indicated and mount securely, plumb true and square, to adjoining surfaces.

.2 Connect loads to circuits as indicated.

.3 Connect neutral conductors to common neutral bus with respective neutral identified.

.4 Install ground conductor between each panel and the ground bar of the area where panel is located.

END OF SECTION

1.0 GENERAL

1.1 RELATED SECTIONS

.1 Section 26 05 01 – Electrical General Requirements.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)

1. CAN/CSA-C22.2 NO. 60947-4-1-14 - Low-voltage switchgear and controlgear - Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor-starters (Bi-national standard, with UL 60947-1).
2. CAN/CSA-C22.2 NO. 60947-4-2-14 - Low-voltage switchgear and controlgear - Part 4-2: Contactors and motor-starters - AC semiconductor motor controllers and starters (Bi-national standard, with UL 60947-4-2).
3. CSA-C22.2 NO. 254-05 (R2015) - Motor Control Centres (Tri-National standard, with UL 845 and NMX-J-353-ANCE).
4. CSA 22.2 No. 14-13, Industrial Controls.

.2 National Electrical Manufacturer's Association (NEMA)

1. NEMA ICS2-2000(R2005), Controllers, Contactors and Overload Relay Rated 600V.

1.3 PRODUCT DATA

.1 Submit WHMIS MSDS - Material Safety Data Sheets. WHMIS acceptable to Labour Canada, and Health and Welfare Canada.

.2 Submit product data sheets for sills, busbars and compartments. Include product characteristics, physical size and finish.

.3 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence, and cleaning procedures.

1.4 SHOP DRAWINGS

.1 Submit shop drawings.

.2 Indicate:

.1 Outline dimensions

.2 Configuration of identified compartments.

.3 Floor anchoring method and dimensioned foundation template.

.4 [Cable] [Bus duct] entry and exit locations.

.5 Dimensioned position and size of busbars and details of provision for future extension.

.6 Schematic and wiring diagrams.

1.5 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for motor control centre for incorporation into manual.

.2 Include data for each type and style of starter.

1.6 EXTRA MATERIALS

.1 Provide maintenance materials.

2.0 PRODUCTS

2.1 SUPPLY CHARACTERISTICS

.1 600 V, 60Hz, wye connected, 3 phase, 4 wire, ungrounded neutral.

2.2 GENERAL DESCRIPTION

.1 Compartmentalized vertical sections with common power busbars.

.2 Floor mounting, free standing, enclosed dead front.

.3 Indoor CSA 1 gasketted enclosure, front mounting.

.4 Class I Type A.

2.3 VERTICAL SECTION CONSTRUCTION

.1 Independent vertical sections fabricated from rolled flat steel sheets bolted together to form rigid, completely enclosed assembly.

.2 Each vertical section divided into compartment units, minimum 305mm high, as indicated.

.3 Each unit to have complete top and bottom steel plate for isolation between units.

.4 Horizontal wireways, equipped with cable supports, across top and bottom, extending full width of motor control centre, isolated from busbars by steel barriers.

.5 Vertical wireways c/w doors for load and control conductors extending full height of vertical sections, and equipped with cable tie supports. Installation wiring to units accessible with doors open and units in place.

.6 Openings, with removable coverplates, in side of vertical sections for horizontal wiring between sections.

.7 Incoming cables to enter at top.

.8 Provision for outgoing cables to exit via top or bottom.

.9 Removable lifting means.

.10 Provision for future extension of both ends of motor control centre including busbars without need for further drilling, cutting or preparation in field.

.11 Divide assembly for shipment to site complete with hardware and instructions for re-assembly.

2.4 SILLS

.1 Continuous 150mm channel iron floor sills for mounting bases with 19 mm diameter holes for bolts.

2.5 BUSBARS

.1 Main horizontal and branch vertical, three phase [and neutral] high conductivity [tin] plated [copper] [aluminum] busbars in separate compartment [bare] self-cooled, extending entire width and height of motor control centre, supported on insulators and rated:

.1 Main horizontal busbars: 600 A.

.2 Branch vertical busbars: 300 A.

.2 Branch vertical busbars for distribution of power to units in vertical sections.

.3 No other cables, wires, equipment in main and branch busbar compartments.

.4 Brace buswork to withstand effects of short-circuit current of 65 kA rms symmetrical.

.5 Bus supports: with high dielectric strength, low moisture absorption, high impact material and long creepage surface designed to discourage collection of dust.

2.6 GROUND BUS

.1 Copper ground bus extending entire width of motor control centre.

2.7 STARTER UNIT COMPARTMENTS

.1 Units NEMA size 5 and smaller, circuit breaker units 225A and smaller, plug-in type with self-disconnect. Guide rail supports for units to ensure that stabs make positive contact with vertical bus. Provision for units to be installed or removed, off load, while buses energized.

.2 Unit mounting:

.1 Engaged position - unit stabbed into vertical bus.

.2 Withdrawn position - unit isolated from vertical bus but supported by structure. [Terminal block accessible for electrical testing of starter].

.3 Provision for positive latching in either engaged or withdrawn position and padlocking in withdrawn position.

.4 Stab-on connectors free floating tin plated clips, self-aligning, backed up with steel springs.

.3 External operating handle of circuit switch interlocked with door to prevent door opening with switch in "on" position. Provision for 3 padlocks to lock operating handle in "off" position and lock door closed.

.4 Hinge unit doors on same side.

.5 Overload relays manually reset from front with door closed.

.6 Pushbuttons and indicating lights mounted on door front.

.7 Devices and components by one manufacturer to facilitate maintenance.

.8 Pull-apart terminal blocks for power and control to allow removal of starter units without removal of field wiring.

2.8 WIRING IDENTIFICATION

.1 Provide wiring identification in accordance with Section 26 05 01 – Electrical General Requirements.

2.9 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01 – Electrical General Requirements.

.1 Motor control centre main nameplate: size No. 7, engraved as indicated.

.2 Individual compartment nameplates: size No. 5, engraved as indicated.

2.10 FINISHES

.1 Apply finishes in accordance with Section 26 05 01 – Electrical General Requirements.

.2 Paint motor control centre exterior light gray and interiors white.

2.11 SOURCE QUALITY CONTROL

.1 Provide manufacturer's type test certificates including short circuit fault damage certification up to short circuit values specified under bus bracing.

.2 Consultant to witness standard factory testing of complete motor control centre including operation of switches, circuit breakers, starters and controls.

3.0 EXECUTION

3.1 INSTALLATION

.1 Set and secure motor control centre in place on channel bases, rigid, plumb and square to building floor and wall.

.2 Make field power and control connections as indicated.

.3 Ensure correct overload heater elements are installed.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 01 – Electrical General Requirements.

.2 Ensure moving and working parts are lubricated where required.

.3 Operate starters in sequence to prove satisfactory performance of motor control centre during 8 hours period.

END OF SECTION

1.0 GENERAL

1.1 SCOPE OF WORK

.1 This Section covers the supply, installation and commissioning of new fire alarm detection devices and notification appliances to be connected to the existing fire alarm panels serving the Canadian Food Inspection Agency building.

1.2 REFERENCE STANDARDS

.1 Underwriter's Laboratories of Canada (ULC)

.1 CAN/ULC-S524, Installation of Fire Alarm Systems.

.2 ULC-S525, Audible Signal Appliances for Fire Alarm Systems.

.3 CAN/ULC-S526, Visual Signal Appliances, Fire Alarm.

.4 CAN/ULC-S529, Smoke Detectors.

.5 CAN/ULC-S530, Heat Actuated Fire Detectors.

.6 CAN/ULC-S536, Inspection and Testing of Fire Alarm Systems.

.7 CAN/ULC-S537, Verification of Fire Alarm Systems.

.2 National Fire Protection Agency: NFPA 72, National Fire Alarm Code

.3 Canadian Electrical Code (CEC)

1.3 REQUIREMENTS OF REGULATORY AGENCIES

.1 System shall comply with applicable provisions of the National Building Code (NBC) and the National Fire Code of Canada (NFCC), and meet requirements of local authority having jurisdiction.

1.4 SHOP DRAWINGS

.1 Following contract award submit five (5) sets of product data (shop drawings), including:

.1 Overall system riser identifying control equipment, initiating zones, signalling circuits; also identified shall be terminations, terminal numbers, conductors and raceways.

.2 Details of initiating, signalling and ancillary devices.

.3 Step-by-step operating sequence, cross referenced to logic flow diagram.

1.5 CERTIFICATES AND REPORTS

.1 Provide manufacturer’s certificate stating that the system has been installed in accordance to manufacturer’s recommendations.

.2 Provide Test Report indicating that the system has been tested as to its full functionality in all modes of operation.

.3 Provide Verification Report.

.4 Provide FM Global Acceptance Letter.

.5 Provide valid ULC certificate covering one year (12 months) from the installing contractor. Verification report must be clear of all deficiencies and indicate a fully functional system.

1.6 SPARE PARTS

.1 Provide spare parts as per system manufacturer’s recommendations.

.2 Include, as a minimum, glass rods for manual pull box stations, if applicable, and fuses and lamps for the control panel, if applicable.

1.7 QUALITY ASSURANCE

.1 Qualifications: Installer shall be a company specializing in fire alarm system installations with minimum 10 years of documented experience, approved by the manufacturer.

.2 Provide services of manufacturer's representative or service technician experienced in installation and operation of type of system being provided, to supervise installation, adjustment, preliminary testing, and final testing of system.

2.0 PRODUCTS

2.1 SYSTEM DESCRIPTION

.1 Coverage for the building is currently provided by an existing fire alarm panel – Notifier NFS-2-640. The panel reports to the main building fire alarm system as a separate zone. It shall be reused with the relocated detection devices and notification appliances.

.2 Coverage of the Canadian Food Inspection Agency building is currently provided by the building's main fire alarm system. Due to layout reconfiguration for the new air handling unit in the Canadian Food Inspection Agency building, some detection devices and notification appliances shall be relocated and reconnected.

.3 Installation shall include:

.1 Relocating and reinstalling existing devices

.2 Wiring

2.2 EQUIPMENT AND DEVICES

.1 Equipment and devices: ULC listed and labelled, and supplied by single manufacturer.

.2 Audible signal devices: to CAN/ULC-S525.

.3 Visual signal devices: to CAN/ULC-S526.

.4 Thermal detectors: to CAN/ULC-S530.

.5 Smoke detectors: to CAN/ULC-S529.

3.0 EXECUTION

3.1 INSTALLATION

.1 Provide fire protection coverage (fire watch) for the period of time the system is inoperative.

.2 Retain existing ceiling mounted smoke detectors in the building.

.3 Relocate devices where noted and reconnect to existing fire alarm system.

.4 Locate detectors minimum 300 mm away from lighting fixtures.

.5 Relocate notification appliances at the locations shown and reconnect to the existing fire alarm system. Do not exceed 80% of listed rating in amperes of notification appliance circuit. Provide additional circuits above those shown if required to meet this requirement.

.6 For surface mounting devices provide appliance manufacturer's approved back box. Back box finish to match device finish.

.7 Provide necessary raceways, cable and wiring to make interconnections to devices and control panel as required for a complete and functional installation.

.8 Install wiring in EMT conduit. Do not splice wiring inside conduit; use junction boxes for this purpose.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 01 – Electrical General Requirements and CAN/ULC-S537.

.2 Test each device and alarm circuit to ensure manual stations, heat and smoke detectors transmit alarm to control panel and actuate general alarm

.3 Check annunciator panels to ensure zones are shown correctly.

.4 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of systems. Specifically:

.1 Test each conductor on all DCLA addressable links for capability of providing 3 or more subsequent alarm signals on each side of single open-circuit fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.

.2 Test each conductor on all DCLA addressable links for capability of providing 3 or more subsequent alarm signals during ground-fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.

.5 Provide final PROM program re-burn for system incorporating program changes made during construction.

.6 Retain services of an independent third party to perform verification of the system installed and operation integrated with the building's main fire alarm system.

.7 Obtain verification Report that is free of all deficiencies and marked as fully functional and submit to Consultant for review.

3.3 DOCUMENTATION AND TRAINING

.1 Submit data for incorporation into the Operation and Maintenance Manual, including:

.1 Functional description and sequence of operation of completed installation

.2 Detailed operating instructions, including required operator responses.

.3 Complete system input/output program information, with site specific data.

.4 Detailed maintenance instructions for control equipment and each device type, including maintenance schedule in accordance with CAN/ULC-S536-97.

.5 Troubleshooting guide for the installed devices.

.6 Manufacturer's data sheets and installation manuals / instructions for equipment installed.

.7 A copy of the as-built floor plans indicating all devices shall be submitted with each manual. The system address of each addressable device shall be clearly indicated beside each device on the drawings.

.8 Final set of reviewed Record Drawings.

.9 A list of recommended spare parts.

.10 Copy of verification certificate, verification report and warranty certificates for the complete fire alarm system.

.11 Name, address and telephone number of service representative of manufacturer to be contacted during warranty period.

.12 Name, address and telephone number of representative responsible for the future software changes.

.2 Submit the manuals in protective vinyl hard cover 3-ring type binders.

.3 Data sheets shall be original manufacturer's literature or shall be clearly legible if reproductions. If data sheets show more than one product, the proposed product shall be clearly identified by arrows or other suitable means.

.4 Provide training of Owner’s personnel in the operation of system. Prepare training material and conduct site demonstration of system components and operation.

END OF SECTION

PROJECT NO 39903 - 180402
CANADIAN FOOD INSPECTION AGENCY
AHU REPLACEMENT/EXHAUST MANIFOLD
BURNABY, BC

AGGREGATES AND GRANULAR MATERIALS

1.0 GENERAL

1.1 Section 31 05 16 refers to those portions of the Work that are unique to the supply and processing of aggregates. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.2 Related Work

1.2.1 Section 31 05 16 includes specifications for aggregates and granular materials referred to in the following sections:

(a)	Excavating, Trenching, and Backfilling	Section 31 23 33.01
(b)	Roadway Excavation, Embankment and Compaction	Section 31 24 13
(c)	Granular Subbase	Section 32 11 16.01
(d)	Granular Base	Section 32 11 23
(e)	Storm Sewers	Section 33 40 01

1.2.2 Section 31 05 16 does not include specifications for aggregates to be incorporated into controlled density fill, hot-mix asphalt concrete paving, pavement crack filling, ready-mixed concrete or granular materials for landscaping purposes. These specifications are designated as follows:

(a)	Cast-in-Place Concrete for Civil Works	Section 32 30 00
(b)	Hot-Mix Asphalt Concrete Paving	Section 32 12 16

1.3 References

1.3.1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in Quality Assurance and Reference Specifications - Section 01 43 00.

1.4 Approvals

1.4.1 Inform Departmental Representative of proposed source and provide samples or access for sampling at least two weeks prior to commencing production.

1.4.2 If, in opinion of Departmental Representative, materials from proposed source do not meet, or cannot reasonably be processed to meet specified requirements, locate alternative source or demonstrate that materials from source in question can be processed to meet specified requirements.

1.4.3 Should a change of material source be proposed during work, advise Departmental Representative two weeks in advance of proposed change to allow sampling and testing.

1.4.4 Acceptance of material does not preclude future rejection if it is subsequently found to lack uniformity, or if it fails to conform to requirements specified, or if its field performance is found to be unsatisfactory.

1.5 Measurement and Payment

1.5.1 Payment for all work performed as specified in this Section is deemed to be incidental to payment for work specified in other Sections unless specifically noted as a payment item in the Tender Form.

2.0 PRODUCTS

2.1 Materials - General

2.1.1 Gravel to be composed of inert, durable material, reasonably uniform in quality and free from soft or disintegrated particles. In absence of satisfactory performance records over a five year period for particular source of material, soundness to be tested according to ASTM test procedure C-88 or latest revised issue. Maximum weight average losses for coarse and fine aggregates to be 30% when magnesium sulphate is used after five cycles.

2.1.2 All crushed gravel when tested according to ASTM C-136 and ASTM C117, or latest revised issue, to have a generally uniform gradation and conform to following gradation limits and 60% of the material passing each sieve must have one or more fractured faces. Determination of the amount of fractured material shall be in accordance with the Ministry of Transportation and Infrastructure Specification I-11, Fracture Count for Coarse Aggregate, Method “A", which determines fractured faces by count. Plasticity Index for crushed gravel to not exceed 6.0.

2.2 Native Material

2.2.1 Any workable soil free of organic or foreign matter: any material obtained within limits of Contract may be deemed native material for purposes of payment it is approved by Departmental Representative. Native material is not acceptable if it is impracticable to control its water content or compact to specified density. To be readily compactible to minimum 95% Standard Proctor density in compliance with ASTM D698.

2.3 Pit Run Gravel

2.3.1 To be well graded granular material, substantially free from clay lumps, organic matter and other extraneous material, screened to remove all stones in excess of 150 mm. Conform to following gradations:

Sieve Designation	Percent Passing
(300 mm dia)	100
200 mm	100
100 mm	100
75mm	100
50 mm	70-100
25 mm	50-100
4.75 mm	22-100
2.36 mm	10-85
0.075 mm	2-8

2.3.2 Recycled concrete free from contaminated and other extraneous material, conforming to the specified gradations may be used as pit run gravel.

2.4 Pit Run Sand

2.4.1 To be well graded pit run sand, free from organic materials and conform to following gradations:

Sieve Designation	Percent Passing
12.5 mm	100
4.75 mm	35-100
2.36 mm	20-70
1.18 mm	13-50
0.600 mm	8-35
0.300 mm	5-25
0.150 mm	2-15
0.075 mm	0-6

2.5 River Sand

2.5.1 River sand to be used free of organic material and conform to the following gradation:

Sieve Designation	Percent Passing
19mm	100
4.76mm	80-100
0.60mm	20-100
0.42mm	10-100
0.25mm	0-80
0.15mm	0-50
0.074mm	0-4

2.6 Drain Rock

2.6.1 To consist of clean round stone or crushed rock conforming to following gradations:

Sieve Designation	Percent Passing	
	Coarse	Fine (Torpedo Gravel)
25.0mm	100	
19.0mm	0-100	
9.5mm	0- 5	100
4.75mm	0	50-100
2.36mm		10-35
1.18mm		5-15
0.600mm		0-8
0.300mm		0-5
0.150mm		0-2
0.075mm		0

2.6.2 Drain rock to be used only where specified in Contract Documents. Use of drain rock other than as specified requires approval of Departmental Representative after examination of soils against which drain rock will be placed.

2.7 Granular Pipe Bedding and Surround Material

2.7.1 Crushed or graded gravels: to conform to following gradations:

Sieve Designation	Percent Passing	
	Type 1*	Type 2*
25.0mm	100	100
19.0mm	90-100	90-100
12.5mm	65-85	70-100
9.5mm	50-75	
4.75mm	25-50	40-70
2.36mm	10-35	25-52
1.18mm	6-26	15-38
0.600mm	3-17	6-27
0.300mm		3-20
0.075mm	0-5	0-8

*__Type 1:__ *standard gradation*

__*Type 2:__ *to be used only in dry trench conditions and with Departmental Representative's prior approval*

Recycled concrete free from contaminated and other extraneous material, conforming to the Type 1 gradations, may be used as pipe bedding and surround material.

2.7.2 Other permissible materials: where shown on Contract Drawings or directed by Departmental Representative, drain rock, pit run sand, or approved native material may be used for bedding and pipe surround.

2.8 Select Granular Subbase

2.8.1 To be well graded granular material, substantially free from lumps and organic matter, screened if required to conform to the following gradations:

Sieve Designation	Percent Passing
75mm	100
25mm	50-85
0.150mm	0-15
0.075mm	0-8

2.9 Crushed Granular Subbase

2.9.1 To be 75mm crushed gravel conforming to the following gradations:

Sieve Designation	Percent Passing
80mm	
75mm	100
38mm	60-100
25mm	-
19mm	35-80
12.5mm	-
9.5mm	26-60
4.75mm	20-40
2.36mm	15-30
1.18mm	10-20
0.6um	5-15
0.3um	3-10
0.18um	-
0.15um	-
0.075um	0-5

2.10 Granular Base

2.10.1 To be 19mm crushed gravel conforming to the following gradations:

Sieve Designation	Percent Passing
19mm	100
12.5mm	75-100
9.5mm	60-90
4.75mm	40-70
2.36mm	27-55
1.18mm	16-42
0.600mm	8-30
0.300mm	5-20
0.075mm	2-8

2.10.2 Where shown on the contract drawings or directed by the *Departmental Representative*, Type 2_19mm crushed gravel conforming to the following gradations is permissible:

Sieve Designation	Percent Passing
25mm	100
19mm	80-100
9.5mm	50-85
4.75mm	35-70
2.36mm	25-50
1.18mm	15-35
0.300mm	5-20
0.075mm	0-5

2.11 Recycled Aggregate Material

2.11.1 Aggregates containing recycled material may be utilized if approved by the Departmental Representative. In addition to meeting all other conditions of this specification, recycled material should not reduce the quality of construction achievable with quarried materials. Recycled material should consist only of crushed Portland cement concrete; other construction and demolition materials such as asphaltic pavements, bricks, plaster, etc., are not acceptable.

2.12 Pit Fines, Overburden and Cyclone sand

2.12.1 Pit Fines: Fine aggregate which is a by-product of gravel washing and screening, conforming to the following:

Sieve Designation	Percent Passing
4.76mm	100
0.42mm	80-100
0.074mm	0-4

2.12.2 Cyclone Sand: Inorganic fine sand produces as a by-product of gravel processing and conforming to the following:

Sieve Designation	Percent Passing
4.76mm	100
0.42mm	80-100
0.25mm	50-100
0.15mm	0-70
0.074mm	0-20

2.12.3 Overburden: Inorganic, silty, native material as a by-product of gravel mining and conforming to the following:

Sieve Designation	Percent Passing
150mm	100
76.00mm	85-100
4.76mm	45-100
0.42mm	25-100
0.074mm	20-60

3.0 EXECUTION

3.1 Handling

3.1.1 Handle and transport aggregates to avoid segregation, contamination and degradation.

3.1.2 Do not use intermixed or contaminated materials. Remove and dispose of rejected materials as directed by Departmental Representative within 48 hours of rejection.

END OF SECTION

EXCAVATING, TRENCHING AND BACKFILLING

1.0 GENERAL

1.1 Section 31 23 33.01 refers to those portions of the Work that are unique to excavating, trenching, and backfilling of underground utility installations and related structures. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein. This section shall also refer to installation of pipe and conduit installed for telephone and cable television, gas and electrical services.

1.2 Related Work

1.2.1	Storm Sewers	Section 33 40 01
1.2.2	Manholes and Catchbasins	Section 33 44 01

1.3 References

1.3.1 The abbreviated standard specifications for testing, materials, fabrication, and supply, referred to herein, are fully described in Quality Assurance and Reference Specifications - Section 01 43 00.

1.4 Definitions

1.4.1 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation including dense tills, hardpan, partially cemented materials, clay or frozen materials which can be ripped and excavated with heavy construction equipment.

1.4.2 Over-excavation below design elevation of bottom of specified bedding, and including backfilling of resultant excavation with specified material, as authorized by Departmental Representative.

1.4.3 Removals: removal and disposal at an approved location off-site of surface concrete structures and walks, curbs, gutters, manholes, catchbasins, pipes, culverts, endwalls, and any other structures on surface or underground specifically designated on Contract Drawings for removal. Removals to include backfilling of resultant excavation with specified material.

1.4.4 Native Topsoil: material capable of supporting good vegetative growth and deemed suitable by the Departmental Representative for use in top dressing, landscaping, and seeding.

1.5 Protection of Work Property and Public

1.5.1 All hydrants under pressure, valve box covers, valve boxes, curb stop boxes, and all other utility controls and warning systems, shall be left unobstructed and accessible during the construction period.

1.6 Existing Buildings and Surface Features

1.6.1 Conduct, with Departmental Representative, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks and paving, survey bench marks and monuments which may be affected by Work.

1.6.2 Protect existing buildings and surface features which may be affected by Work from damage resulting from Work.

1.6.3 Where excavation necessitates root or branch cutting, do so only as approved by Departmental Representative.

1.7 Disposal

1.7.1 Unless noted otherwise in the Contract Documents, Contractor to be responsible for off-site disposal of all surplus soil from excavations. Suitability of excavated material for use as native bedding or trench backfill will be governed by Part 2 of this Section. Dumping of spoil on private property will be permitted only upon written approval from property owner and provided all necessary permits and approvals have been obtained.

1.7.2 Where a specific disposal site owned, operated, or arranged by the Departmental Representative is designated in the Contract Documents, all material destined for the site shall become the property of the Departmental Representative unless noted otherwise in the Contract Documents.

1.8 Limitations of Open Trench

1.8.1 Excavate trenches only as far in advance of pipe laying operation as safety, traffic and weather conditions permit and, in no case, to exceed 30 m. Do not leave open more than 15 m at end of day's operation.

1.8.2 Before stopping work on last day of work before each weekend or holiday, completely backfill every trench. If circumstances do not permit complete backfilling of all trenches, adequately protect all open trenches or excavations with approved fencing or barricades and, where required, flashing lights.

2.0 PRODUCTS

2.1 General

2.1.1 Unless shown otherwise on Contract Drawings, the materials specified in 2.2 of this Section are approved for their respective uses.

2.2 Use of Specified Materials

2.2.1 Backfill for over-excavated trench or structure excavations to be one of the following:

(a) Drain Rock (only where approved by the Departmental Representative)

(b) Granular Pipe Bedding and surround material

(c) Pit Run Sand

(d) Concrete

(e) Controlled Density Fill

2.2.2 Pipe bedding and surround: See applicable Sections:

(a) Storm Sewers Section 33 40 01

2.2.3 Trench and excavation backfill to be:

(a) Approved Native Material

(b) Pit Run Gravel

(c) Pit Run Sand

2.2.4 Surface treatment to be:

(a) Restoration to match existing conditions

(b) Subgrade, subbase and base for works described in other Sections.

(c) Topsoil, grass, sod, or requirements for landscaping works described in other Sections.

2.3 Materials

2.3.1 Refer to Section 31 05 16 - Aggregates and Granular Materials for specifications for approved granular materials.

2.3.2 Concrete: to Section 32 30 00 - Cast-in-Place Concrete for Civil Works, to be minimum 20 MPa.

2.3.3 Other granular materials: granular materials approved for roadwork (subbase, base) also acceptable for trench backfill subject to approval of Departmental Representative.

3.0 EXECUTION

3.1 Site Preparation

3.1.1 Remove all brush, weeds, grasses, stumps, and accumulated debris from site to an approved off-site location.

3.1.2 Cut pavement or sidewalk neatly along limits of proposed excavation as shown on Contract Drawings in order that surface may break evenly and cleanly. Cut beyond limits shown only if approved by Departmental Representative.

3.1.3 Where trench passes through a lawn, neatly cut and remove sod before trench excavation. Save sod for replacement upon backfilling trench. Keep sod in moist condition and protected from weather in preparation for reinstallation.

3.1.4 Strip topsoil after area has been cleared and stockpile in locations as directed by Departmental Representative. Stockpile height not to exceed 2 m. Avoid mixing topsoil with subsoil. Dispose of unused topsoil as directed by Departmental Representative. Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected.

3.2 Stockpiling

3.2.1 Stockpile fill materials in areas designated by Departmental Representative. Stockpile granular materials in manner to prevent segregation.

3.2.2 All stockpiled materials shall be piled in a manner that will not endanger persons, the work or adjacent properties and will avoid obstructing roads, surface drainage ditches, sidewalks, driveways, hydrants and control devices. Gutters, ditches, and culverts shall be kept clear or other satisfactory provisions shall be made by the Contractor for drainage.

3.3 Excavation

3.3.1 Connection to existing mains:

(a) Prior to or at commencement of construction, check existing main for line and elevation at point of connection. If found different from Contract Drawings report such difference to Departmental Representative immediately, and cease construction pending instructions from Departmental Representative.

(b) Unless specified otherwise in the Contract Documents, connections to existing systems to be made by Contractor under direct supervision of utility. Make all necessary arrangements with utility to schedule work to prevent construction delays. Notify Departmental Representative minimum 48 hours in advance of scheduled connection. Make connection in presence of Departmental Representative,

(c) To prevent damage to existing utilities, excavate last 300 mm over existing utility by hand.

3.3.2 Trench Shoring

(a) Where the sides of the trench or excavation need to be sheathed, shored or braced to protect life, property, the work, structures adjacent to the work or maintaining trench widths, the Contractor shall supply and place all material required at no additional cost. Strictly follow Occupational Health and Safety regulations or a professional geotechnical engineer’s recommendations.

(b) If required, the Contractor shall engage a qualified professional engineer to design and regularly inspect coffer dams, shoring, bracing, and underpinning required for the work.

(c) Construct temporary works to depths, heights and locations as required to prevent failure.

(d) During backfill operations: Unless otherwise indicated or directed by the Departmental Representative, remove sheeting and shoring from the excavations. Do not remove bracing until backfilling has reached the level of such bracing. Pull sheeting in increments that will ensure compacted backfill is maintained at an elevation at least 500 mm above the toe of sheeting.

(e) When sheeting is required to remain in place, cut off tops at elevations indicated or as directed by the Departmental Representative.

3.3.3 Trenching in Poor Ground

(a) If the bottom of the trench is in soil which, in an undisturbed state, has adequate bearing capacity, but becomes “quick” due to soil water pressure or becomes unstable due to the construction activity in the trench, the Contractor shall over-excavate to a depth specified by the Departmental Representative, place geotextile fabric and cover with foundation granular material, all as specified by the Departmental Representative.

(b) If the bottom of the trench is in peat or other unsuitable foundation material, apply one of the following corrective measures as appropriate:

(i) Over-excavate to suitable material and backfill with compacted gravel or washed rock to the underside of bedding if the amount of over-excavation is less than 0.5 m.

(ii) Backfill with controlled density fill if the amount of over-excavation is 0.5 m to 1.0 m.

(iii) Do not over-excavate, but provide structural support for the pipe as specified by the Departmental Representative, if the depth to suitable foundation soil from the bottom of the pipe bedding is greater than 1.0 m.

3.3.4 Surface drainage:

(a) Provide suitable temporary ditches or other approved means of handling drainage prior to excavation and during construction to protect construction area and adjacent and other affected properties. Provide siltation controls to protect natural watercourses or existing municipal drainage facilities.

(b) Comply with Section 01 57 01 – Environmental Protection

3.3.5 Excavation to grade: excavate trenches to allow pipe to be laid to alignment and grades required with allowance for specified pipe bedding.

3.3.6 Excavation below grade: when bottom of excavated trench at subgrade is unstable and, in opinion of Departmental Representative, cannot adequately support pipe, install pipe using concrete bedding as shown on Contract Drawings or over-excavate trench to suitable subgrade or as directed by Departmental Representative. Backfill over-excavation with specified materials and compact to minimum 95% Modified Proctor density in compliance with ASTM D1557. Use drain rock backfill only as authorized by Departmental Representative.

3.3.7 Trench width: excavate trench to section and dimensions shown on Contract Drawings. If width exceeds maximum allowable, Contractor may be required to demonstrate that specified pipe is still adequate or provide pipe with approved higher strength class or provide approved higher class of bedding. All additional requirements as a result of excessive trench width to be to Contractor's cost.

3.3.8 Hand excavation: excavate by hand if necessary to preserve or minimize damage to existing trees, shrubs, buildings and all similar existing features or facilities.

3.3.9 Trench bottom conditions: remove disturbed or softened material and protruding or loose rocks from trench bottom before placing bedding material. Maintain trench free from water and soft materials during placement of pipe bedding, pipe installation and trench backfill to ensure proper compaction of granular materials.

3.3.10 Trench drainage:

(a) During pipe laying, jointing, bedding, and backfilling, keep trench free of water by pumping or other appropriate means. Pumps and dewatering equipment to be provided and precautions taken to prevent any damage to adjoining buildings, structures, roads or land from prolonged or excessive pumping by installing shoring, sheeting, or other supportive measures. Water to be discharged from excavations in such a manner as not to cause nuisance, injury, loss or damage. Contractor to be responsible for any claims or actions arising from such discharge of water.

(b) Keep bell holes free from water during jointing. Diverting trench water through newly laid system not allowed, unless authorized by Departmental Representative.

(c) Where Contractor wishes to use drain rock bedding in wet conditions, in place of specified bedding, do so only with the written permission of the Departmental Representative. Incremental cost for such drain rock bedding shall be solely at the Contractor's expense. The Departmental Representative will review the Contractor's request after the Departmental

Representative has assured themselves that the Contractor has made every reasonable effort within the requirements of this Contract to keep the trench free of water.

3.3.11 Disposal of surplus soil: Side-casting not allowed in restricted areas where, in opinion of the Departmental Representative, side-casting would create interference with flow of traffic. In such case, materials to be temporarily stored or disposed of on approved site. Provisions of Provincial Contaminated Sites Legislation must be met prior to disposal of soil offsite.

3.3.12 Native Backfill: where native backfill is approved for re-use and side-casting not allowed, transport approved material to other locations where material is required or temporarily store at approved site. Protect stored material from contamination, segregation and weather.

3.3.13 Roads used for transporting materials and equipment to be maintained in clean condition. Clean, flush and/or sweep on daily basis and more frequently if directed by Departmental Representative.

3.4 Pipe Installation

3.4.1 Related work: Pipe installation, including bedding, pipe laying, and granular surround to be in accordance with the following sections:

(a)	Storm Sewers	Section 33 40 01
(b)	Manholes and Catchbasins	Section 33 44 01

3.4.2 Concrete encasement: where specified or required by Departmental Representative provide concrete encasement of pipe as shown on Contract Drawings. Do not place backfill materials until concrete has taken its initial set and in no case less than one hour.

3.4.3 Provide a minimum clearance of 150 mm below the pipe, including the pipe bell, in trenches through rock.

3.4.4 Anchor blocks: where specified or required by Departmental Representative provide anchor blocks as shown on Contract Drawings. All concrete anchor blocks to be carried at least 150 mm into undisturbed ground on bottom and sides of trench. Concrete to be of type indicated in these specifications.

3.5 Backfill and Compaction

3.5.1 General

(a) Do not proceed with trench backfilling operations until Departmental Representative has inspected and approved installations.

(b) Place backfill carefully in trench to prevent damage or disturbance to installed pipe.

(c) Ensure trenches are free from debris, snow, ice, and water.

(d) Do not use backfill material which is frozen or contains ice, snow, or debris.

(e) Do not backfill around or over cast-in-place concrete within 24 hours after placing.

(f) Place layers simultaneously on both sides of installed work to equalize loading.

(g) During backfill and compaction of trench, remove shoring or cages in such a manner as to allow proper compaction and to prevent trench walls from collapsing. Remove all bracing and/or shoring from trench.

(h) Place backfill by rolling down a slope or lowering by machine. Prevent backfill from dropping vertically on to the pipeline installation.

(i) Shoring: during backfill and compaction of trench, remove shoring in such a manner as to allow proper compaction and to prevent trench walls from collapsing. Remove all bracing and/or shoring from trench.

3.5.2 Backfill Materials above pipe zone

(a) Boulevards and easements: for trenches in boulevards, easements, or other areas not subject to vehicle loading and outside of ditchlines, backfill to be approved native material, except as shown otherwise on Contract Drawings or directed by the Departmental Representative.

(b) Roads, driveways and shoulders: for trenches in paved or gravelled roads, driveways, shoulders or other areas subjected to vehicle loading, backfill to be approved native material, or imported material as specified on the Contract Drawings or directed by the Departmental Representative.

(c) Road shoulder is that portion of right-of-way between travelled portion of road, either paved or gravelled and road ditch. Where no ditch exists, ensure shoulder width minimum of 1.5 m unless specified otherwise on Contract Drawings.

(d) Ditches: backfill to be approved native material or imported material as specified on the Contract Drawings or directed by the Departmental Representative.

(e) Departmental Representative may permit native material for all above uses subject to suitability of native material for said use. Native material approved for re-use to be handled, stockpiled and compacted using

construction method appropriate for given moisture content and weather conditions.

3.5.3 Compaction: Place backfill and compact to following Modified Proctor densities in compliance with ASTM D1557. (All following references to density imply compliance with ASTM D1557).

(a) Boulevards, easements, and ditches to minimum 90%.

(b) Roads, driveways, shoulders, and sidewalks to minimum 95%.

(c) Use caution in pipe zone to ensure no damage to pipe.

(d) Maximum thickness of lift not to exceed 300 mm in compacted state for granular soils, 200 mm for non-granular soils.

(e) Where additional water is required to obtain the specified density, it shall be applied in such a manner to maintain uniform moisture content. Cost of additional water supply and application shall not be in considered for separate payment.

(f) Motorized compaction equipment shall be used with extreme caution to prevent damage to public or private property or to the new installation.

3.5.4 Moisture Content Requirements

The maximum permitted moisture contents for compacting backfill, based on one-mould Proctor tests, are shown below.

Maximum Moisture Content	Backfill Zone
A. Conventional trenching techniques	
Plastic Limit + (Plasticity Index)/3 To a maximum of 8% above Plastic Limit	From designated subgrade elevation or existing ground level, whichever is lower, to 1.5 m below.
Plastic Limit + (Plasticity Index)/3 To a maximum of 10% above the Plastic Limit	More than 1.5 m below.
B. Uniform Backfill	
Plastic Limit + (Plasticity Index)/2 To a maximum of 10% above the Plastic Limit	From designated subgrade elevation or existing ground level, whichever is lower, to 1.5 m below.
Plastic Limit + (Plasticity Index)/2 To a maximum of 10% above the Plastic Limit	More than 1.5 m below.
C. Alternative backfill techniques and materials	

As defined by a professional geotechnical engineer, to achieve long term stability of trench backfill	Through full depth of trench

The uniform backfill moisture requirements shall apply where the upper 1.5 m of the subgrade is excavated beyond the limits of the trench to include any roadway structures, including monolithic or boulevard walk. The excavated material, if acceptable to the Engineer, shall be replaced and recompacted in lifts not exceeding 300 mm compacted thickness.

3.6 Inspection and Testing

3.6.1 Testing of materials and compaction to be carried out by testing laboratory designated by Departmental Representative. Frequency of tests to be determined by Departmental Representative.

3.6.2 Departmental Representative to pay costs for inspection and initial testing.

3.6.3 If initial test determine materials or compaction not as specified, Contractor to take all steps necessary to correct deficiencies. Subsequent testing to Contractor's cost.

3.7 Surface Restoration

3.7.1 General:

(a) Restore all disturbed surfaces to condition at least equal to that which existed prior to construction.

(b) Make good any damage to adjacent lands or improvements.

(c) Resolve all reasonable claims arising from Contractor's actions and obtain written releases from landowners following restoration.

3.7.2 Boulevards and easements:

(a) Surface restoration to be minimum 100 mm depth.

(b) Restore unimproved surfaces with material equal to that removed at surface.

(c) Restore gardens with topsoil or bark mulch to match existing conditions.

(d) Restore lawns with approved topsoil and seed or sod as noted on Contract Drawings to match existing lawn.

(e) Replace any plants or shrubs killed or removed by construction activities with ones of equal quality, size, variety, and maturity of originals.

(f) Replace any killed or removed by construction activities with ones of similar quality, variety, age and size as originals, up to limit of maximum available size.

(g) Replacement trees and shrubs to be planted at a suitable time of year, in accordance with good horticulture practice, to provide maximum assurance of plant survival.

(h) Restore gravel surfaces with granular materials as noted on Contract Drawings.

(i) Complete final restoration immediately upon completion of trench backfilling.

3.7.3 Gravelled roads and driveways:

(a) Restore surface with minimum 75 mm to 100 mm thick lift of granular base material.

(b) Compact to minimum 95% Modified Proctor density.

(c) Complete final restoration immediately upon completion of trench backfilling.

3.7.4 Ditches:

(a) Shape ditch to specified lines, grades, and sections and restore surface with minimum 300 mm of specified material to ensure stability of ditch slopes and bottom.

(b) Compact to minimum 95% Modified Proctor density.

(c) Complete final restoration immediately upon completion of trench backfilling.

3.7.5 Sub-base and base preparation for paved surfaces:

(a) Paved surfaces to include all paved roads, driveways, sidewalks, and parking areas.

(b) If native material used for backfill, minimum 300 mm granular road subbase materials and additional as required to match existing depth of sub-base in excess of 300 mm or provide specified depth of sub-base as shown on Contract Drawings in accordance with Section 32 11 16.01, (Granular Sub-base).

(c) Place granular base material to specified depth as shown on Contract Drawing and in accordance with Section 32 11 23 (Granular Base) once sub-base layer has been inspected and approved by Departmental Representative.

3.7.6 Temporary pavement patching:

(a) Patch arterial and collector roads same day excavation made.

(b) Patch all other roads within 24 hours of closing trench.

(c) Patching material to be hot-mix asphalt on all roads unless specified otherwise. Cold-mix may be used only where directed by Departmental Representative.

(d) Place temporary pavement to 50 mm minimum thickness.

(e) Maintain temporary patch to ensure safe and smooth conditions.

3.7.7 Permanent pavement restoration:

(a) Install permanent pavement within 30 days of placement of temporary patch or sooner where directed by Departmental Representative.

(b) Sawcut original pavement minimum of 300 mm from edge of broken or cracked pavement as well as any paved areas showing settlement.

(c) Remove pavement from within limits of sawcut and dispose off-site.

(d) Remove underlying granular road base materials as required to permit placement of specified thickness of permanent pavement. Ensure remaining base meets specified thickness. Road base to Granular Base - Section 32 11 23.

(e) Compact base to minimum 95% Modified Proctor density.

(f) Clean edges of cut pavement to remove all loose material. If thickness of existing pavement permits, mill 25 mm depth along saw cut edge of pavement. Dry if necessary and paint clean, dry edge with asphalt emulsion (tack coat).

(g) Place and compact hot-mix pavement material to minimum thickness as shown on Contract Drawings.

(h) Material and placement of hot-mix pavement to Hot-Mix Asphalt Concrete Paving - Section 32 12 16.

(i) Restored surface to be smooth and matching with grade of adjacent pavement.

(j) Maintain restored pavements in complete repair during the Contract Maintenance Period. Effect repairs within 14 days from receipt of written notice from Departmental Representative or immediately if so directed by Departmental Representative if dangerous situation exists.

END OF SECTION

ROADWAY EXCAVATION, EMBANKMENT AND COMPACTION

1.0 GENERAL

1.1 Section 31 24 13 refers to those portions of the Work that are unique to roadway excavation, embankment construction and compaction. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.2 Related Work

1.2.1	Aggregates and Granular Materials	Section 31 05 16
1.2.2	Excavating, Trenching and Backfilling	Section 31 23 33.01

1.3 References

1.3.1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in Quality Assurance and Reference Specifications - Section 01 43 00.

1.4 Definitions

1.4.1 Excavation classes: only two classes of excavation will be recognized, rock excavation and common excavation.

1.4.1.1 Common excavation: To Section 31 23 33.01 – Excavating, Trenching and Backfilling.

1.4.2 Waste material: material unsuitable for use in Work or surplus to requirements.

1.4.3 Borrow material: material obtained from areas outside right-of-way and required for construction of embankments or for other portions of Work.

1.4.4 Embankment (subgrade fill): material derived from usable excavation and placed above original ground or stripped surface up to subgrade elevation.

1.4.5 Imported embankment fill: approved granular material supplied by Contractor and obtained from off-site sources, to be used for embankment fill up to subgrade elevation.

1.4.6 Pavement structure: combination of layers of unbound or stabilized granular subbase, base, and asphalt or concrete surfacing.

1.4.7 Subgrade elevation: elevation immediately below pavement structure.

1.5 Protection of Existing Features

1.5.1 Existing buried utilities and structures:

1.5.1.1 Size, depth and location of existing utilities and structures as shown on Contract Drawings are for guidance only. Completeness and accuracy not guaranteed.

1.5.1.2 Prior to commencing any excavation work, notify applicable owner or authorities, establish location and state of use of buried utilities and structures. Clearly mark such locations to prevent disturbance during work.

1.5.1.3 Conclusively confirm locations of buried utilities in three dimensions by careful test excavations and advise Departmental Representative.

1.5.1.4 Owner will pay for costs to relocate utilities in conflict as authorized by Departmental Representative.

1.5.1.5 Maintain and protect from damage, water, sewer, gas, electric, telephone, and other utilities and structures encountered or shown on Contract Drawings. Obtain direction of Departmental Representative before moving or otherwise disturbing utilities or structures.

1.5.1.6 Record location of maintained, re-routed and abandoned underground lines.

1.5.1.7 Comply with all requirements and conditions specified by utility owner or authority relative to working in and around utilities.

1.5.2 Existing buildings and surface features:

1.5.2.1 Conduct, with Departmental Representative, condition survey of existing buildings, trees, and other plants, lawns, fencing, service poles, wires, rail tracks and paving, survey bench marks and monuments which may be affected by work.

1.5.2.2 Protect existing buildings and surface features which may be affected by work from damage while work is in progress and repair damage resulting from work.

1.5.2.3 Where excavation necessitates root or branch cutting, do so only as approved by Departmental Representative.

1.6 Disposal

1.6.1 Unless noted otherwise in the Contract Documents, Contractor to be responsible for off-site disposal of all surplus spoil from excavations. Suitability of excavated

material for use as native bedding or trench backfill will be governed by Part 2 of this Section. Dumping of spoil on private property will be permitted only upon written approval from property owner and provided all necessary permits and approvals have been obtained.

1.6.2 Where a specific disposal site owned, operated, or arranged by the Departmental Representative is designated in the Contract Documents, all material destined for the site shall be the property of the Departmental Representative.

1.7 Permits and Approvals

1.7.1 Obtain all required permits and approvals from regulatory authorities before commencing any excavation.

2.0 PRODUCTS

2.1 General

2.1.1 Unless shown otherwise on Contract Drawings materials specified in 2.2 following are approved for their respective uses.

2.2 Specified Materials

2.2.1 Embankment fill (subgrade fill) to be:

2.2.1.1 Approved native material.

2.2.1.2 Pit run gravel.

2.2.1.3 Pit run sand.

2.2.1.4 River Sand

2.2.2 Pit fines, cyclone sand and overburden may be utilized if approved by the Departmental Representative, but will not be acceptable if moisture content is too high to permit compaction to the specified density.

2.3 Materials

2.3.1 Refer to Section 31 05 16 - Aggregates and Granular Materials for specifications for approved granular materials.

3.0 EXECUTION

3.1 General

3.1.1 Strip all organic material to specified limits and specified depth or as directed by Departmental Representative. Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected. Remove all debris. Dispose of as specified. Stockpile and place topsoil as specified and/or indicated on Contract Drawings.

3.1.2 Surface drainage:

3.1.2.1 Provide suitable temporary ditches or other approved means of handling-drainage prior to excavation and during construction to protect construction area and adjacent and other affected properties. Provide siltation controls to protect natural watercourses or existing municipal drainage facilities.

3.2 Excavation

3.2.1 Notify Departmental Representative sufficiently in advance of excavation operations for initial cross-sections to be taken.

3.2.2 Notify Departmental Representative whenever unsuitable materials are encountered in cut sections and remove unsuitable materials to depth and extent as directed by Departmental Representative.

3.2.3 If, during excavation, material appearing to conform to classification for rock is encountered, notify Departmental Representative in sufficient time to enable measurements to be made to determine volume of rock.

3.3 Inspection of Prepared Surface

3.3.1 Prior to placing embankment fill, proof roll graded native surface using fully loaded single or dual axle dump truck. Departmental Representative may authorize use of other acceptable proof rolling equipment. Remove soft or other unstable material. Replace with approved embankment fill and compact replacement fill to minimum 95% Modified Proctor density in compliance with ASTM D1557 (All following references to density imply compliance with ASTM D1557).

3.3.2 Do not place embankment fill until finished native surface is inspected and approved by Departmental Representative.

3.4 Placing

3.4.1 Place material only on clean unfrozen surface, properly shaped and compacted and free from snow or ice.

3.4.2 Begin spreading material on crown line or high side of one-way slope.

3.4.3 Place granular materials using methods which do not lead to segregation or degradation.

3.4.4 Place material to full width in uniform layers and compact to specified densities. Layers not to exceed 300 mm compacted depth unless approved otherwise by Departmental Representative.

3.4.5 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.

3.4.6 Remove and replace that portion of any layer in which material becomes segregated during spreading.

3.4.7 Where shown on Contract Drawings or as directed by Departmental Representative, scarify or bench existing slopes in side hill or sloping sections to ensure proper bond between new materials and existing surfaces. Obtain prior approval from Departmental Representative of method to be used.

3.4.8 Where fill material consists principally of rock:

3.4.8.1 Place to full width in layers of sufficient depth to contain maximum sized rocks, but in no case is layer thickness to exceed 1m.

3.4.8.2 Individual rock fragments not exceeding 1.5m in horizontal dimension permitted provided their vertical dimension does not exceed one third of fill section depth.

3.4.8.3 Carefully distribute rock material to fill voids with smaller fragments to form compact mass.

3.4.8.4 Fill surface voids at subgrade level with rock spalls or selected material to form an earth-tight surface.

3.4.8.5 Do not place boulders and rock fragments with dimensions exceeding 150mm within 300mm of pavement subgrade elevation.

3.4.9 Where subgrade is on transition from excavation to embankment, the natural slope (excepting solid rock) shall be excavated to a depth of 1m and replaced with suitable material for a distance of 15 metres in order to prevent abrupt future differential grade changes.

3.5 Compaction

3.5.1 Compaction equipment to be capable of obtaining required densities in materials on project.

3.5.2 Compact to density of not less than 95% Modified Proctor Density or as otherwise specified on the Contract Drawings.

3.5.3 Shape and roll alternately to obtain smooth, even and uniformly compacted layers.

3.5.4 Apply water as necessary during compaction to obtain specified density. If material is excessively moist, aerate by scarifying with suitable equipment until moisture content is suitable for compaction.

3.5.5 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Departmental Representative.

3.5.6 Finish slopes to neat condition, true to line and grade.

3.5.6.1 Remove boulders encountered in cut slopes and fill resulting cavities.

3.5.6.2 Hand finish slopes that cannot be finished satisfactorily by machine.

3.6 Finish Tolerances

3.6.1 Finished subgrade surface to be within plus or minus 15mm of specified grade and cross-section but not uniformly high or low.

3.6.2 Ensure finished subgrade surface has no irregularities exceeding 15mm when checked with a 3m straight edge place in any direction.

3.6.3 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.7 Proof Rolling

3.7.1 For proof rolling Use fully loaded single or dual axle dump truck.

3.7.2 Departmental Representative may authorize use of other acceptable proof rolling equipment.

3.7.3 Proof roll top of embankment fill upon completion of fine grading and compaction.

3.7.4 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.

3.7.5 Where proof rolling reveals areas of defective subgrade fill:

3.7.5.1 Remove embankment material to depth and extent directed by Departmental Representative.

3.7.5.2 Replace embankment material and compact in accordance with this section.

3.8 Place Topsoil

3.8.1 Place, spread and grade topsoil as shown on Contract Drawings.

3.8.2 Restore planted areas with topsoil, ground cover, and plants or shrubs to match existing planted areas as shown on Contract Drawings.

3.9 Borrow Locations

3.9.1 The use of Borrow excavation for constructing embankments will be allowed only after all common excavations have been completed and the resulting suitable material hauled into the embankment, or after all the economic possibilities of obtaining further material by the widening of roadway excavations or ditches have been exhausted.

3.9.2 The Contractor shall excavate, salvage and stockpile the topsoil, If topsoil is to be stockpiled for periods exceeding 2 months or when required by the Departmental Representative, the Contractor shall protect the stockpile from erosion by applying an approved seed mixture or other approved biodegradable stabilizer.

3.9.3 Borrow areas shall be regular in width and, if required, shall be connected with ditches and drained to the nearest watercourse .

3.9.4 Particular care shall be taken to work the area so as to cause a minimum of damage and inconvenience to the land owner.

3.9.5 On completion of the Work, borrow areas shall be trimmed and left in a neat and uniform condition to shapes and dimensions noted on the Contract Drawings.

3.9.6 Stockpiled topsoil shall be spread and contoured as indicated on the Contract Drawings or as directed by the Departmental Representative.

3.9.7 The Contractor shall not operate or park equipment in the borrow locations outside of the limits of the actual borrow area, haul roads or stockpile sites. Any areas disturbed, compacted or otherwise affected by the Contractor's operations shall be reclaimed to their original condition.

3.9.8 Borrow areas will be staked out and cross-sectioned by the Departmental Representative before the Contractor begins work therein. Any material excavated from borrow areas previous to measurement will not be paid for.

3.10 Maintenance

3.10.1 The Contractor shall maintain and protect the subgrade and be responsible at no cost to the Departmental Representative for its protection from vehicular traffic, rain or other damaging causes throughout the term of the Contract. Damaged subgrades shall be scarified to a depth of 300mm and reshaped and compacted to 100% Standard Proctor density at no cost to the Departmental Representative.

END OF SECTION

1.0 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1 Section 03 11 00 - Concrete Formwork

.2 Section 03 31 00 - Cast-in-Place Concrete

1.2 REFERENCE STANDARDS

.1 Micropile installation shall conform to the requirements of the following standards unless otherwise required by this specification:

1. CSA-A23.1 and A23.2.

2. ASTM-A722-Standard Specification for Uncoated High Strength Steel Bar for Prestressing Concrete.

3. “Recommendations for Pre-stressed Rock and Soil Anchors”, Post-Tensioning Institute, USA.

4. 4th Ed. Canadian Foundation Engineering Manual, Canadian Geotechnical Society.

.2 Where the standard is referred to in this specification it shall mean the documents specified in this clause and their referenced documents.

1.3 GEOTECHNICAL INFORMATION

.1 Geotechnical information has been provided in a report for examination and reference. The Contractor shall review and be familiar with the available geotechnical data. It is the responsibility of the Contractor to assess and interpret the data provided. The Departmental Representative, will not be responsible for interpretations of the geotechnical data made by the Contractor without having the opportunity to review those interpretations.

.2 Contractor shall be familiar with the existing site conditions affecting the work prior to tender submission. No claims for additional costs arising from the existing site conditions will be allowed.

1.4 QUALIFICATIONS SUBMITTAL

(Section Deleted)

1.5 SHOP DRAWINGS SUBMITTAL

.1 Submit shop drawings and detailed information regarding installation and testing to the Departmental Representative for review. Allow a minimum of ten (10) days for the review. Work proceeding prior to final review of shop drawings will be at the Contractor’s risk.

.2 Shop drawings and installation and testing details shall be prepared under the supervision of the Specialty Engineer. The Specialty Engineer shall verify, either by sealing the shop drawings or submitting a letter under seal, that the shop drawings were prepared under the Specialty Engineer’s supervision and that the micropile system meets the requirements of the structural drawings and specifications.

.3 The review of the shop drawings will not relieve the Contractor of his responsibility for completing the work successfully in accordance with the contract documents.

1.6 TECHNICAL DATA SUBMITTAL

.1 All technical data on the micropile system proposed for the project shall be submitted to the Departmental Representative for review a minimum of ten (10) working days prior to commencement of the work. Information shall include:

1. Drilling and installation procedures, such as: drilling method; grouting method; post-grouting methods; testing and remedial testing.

2. Equipment description, such as: drilling equipment and equipment used for grouting and post-grouting.

3. Mill test reports for pre-stressing steel bars.

4. Reference design load and bond length requirements for anchors.

5. Mix design, or product data sheets for grout.

6. Micropile visous coating product information, data sheets and methodology for protecting viscous coating during installation.

7. Calibration records for testing equipment used for load testing. Certificates must be less than six (6) months old.

2.0 PRODUCTS

2.1 ANCHOR TENDON

.1 Description

The anchor system for all micropiles shall consist of Reinforcing steel bar Anchors with Double Corrosion Protected System (DCP) in accordance with the tender drawings and specification. A smooth plastic tubing shall fit snugly over the corrosion protected bars in the unbonded length in the free-stressing zone to ensure unobstructed elongation during stressing. The anchor load shall be transferred to the ground in the bond length by means of ground/cement grout bond.

2.2 ANCHOR STEEL

.1 The anchor steel shall be manufactured by the hot-rolled, cold stretched to not less than 80% of the specified tensile strength and stress-relieved method, all in accordance with Canadian Standards CSA G30.18-M92. Cut-thread bars shall not be permitted.

.2 The anchor steel shall have the following mechanical properties:

Minipiles:

-Min. tensile strength	f_u = 800 Mpa
-Minimum yield strength	f_y = 517 Mpa
-Steel area	A_s = 2,581mm^2
-Min. elongation in 600mm gauge length	= 7% @ 0.6 f_y
-Max. relaxation of 0.60 f_u	= 2.5% (at 1,000 hrs)
-E-Modulus	E_s = 200,000 MPa

.3 The contractor shall provide manufacturer's test certificate for all batches of anchors supplied.

2.3 ACCESSORIES

.1 Use anchor plates, anchor nuts and other anchor components which are compatible with the post-tensioning anchor system.

.2 Anchorage and splicing components shall develop at least 125% of the yield strength of the bar tendon.

2.4 CORROSION PROTECTION

.1 Provide double corrosion protection over the entire length of the anchor by means of a pre-grouted corrugated PVC sheathing. Anchorage and splicing shall be corrosion protected in accordance with the approved shop drawings.

.2 Corrugated PVC sheathing for the outer corrosion protection of the anchor tendon shall have a minimum compressive strength of 100 MPa (14,500 psi) and a minimum tensile strength of 48 MPa (7,000 psi) and shall develop a minimum bond stress of 4.8 MPa (700 psi) at a grout strength of 27 MPa (4,000 psi).

.3 Inside spacers, end caps, anchor head assembly, heat shrink sleeves and cement grout shall be in accordance with the standard specifications for double corrosion protected anchors".

.4 The inner layer of corrosion protection shall consist of non-shrink Portland cement grout with a minimum seven (7) day compressive strength of 25 MPa when tested in accordance with CSA Test Method A23.2-1B.

2.5 ANCHOR FABRICATION

.1 All anchors shall be fabricated in an enclosed shop in accordance with approved shop drawings and standard fabrication procedure, using personnel trained and qualified in this type of work.

2.6 VISCOUS COATING

.1 An appropriate visous coating shall be applied to the Micro Pile surface prior to installation for the purpose of reducing soil downdrag. Refer to 2006 Canadian Foundation Engineering Manual Section 18.2.5.2.

.2 The viscous coating shall be protected from damage during Micro Pile installation. Micro Piles with damaged viscous coating shall be replaced at the expense of the Contractor.

.3 The viscous coating shall be in compliance with the projects environmental requirements.

2.7 STORAGE OF MATERIALS

.1 The Contractor shall handle and provide anchors prior to installation to avoid corrosion and physical damage. Any anchor or anchor component (including the protective sheathing) which is damaged during work shall be replaced at expense of the Contractor.

3.0 EXECUTION

3.1 DRILLING

.1 Drill and install DN 200 SCH 40 steel pipe through the approximate 18.3 m of soil overlying the glacial till, and at least 1.5 m into the glacial till.

.2 Micropile welds, where required, shall be full penetration butt welds. All welding will be performed by qualified welders.

.3 Drill a 150 mm diameter hole to a depth of 10.7 m below the bottom of the steel pipe.

.4 Temporary casing is to be provided though all materials, as required. Casing to be withdrawn during grouting procedure where appropriate.

.5 Holes shall be drilled vertically with a variation of not more than 10 mm/m. The top of the Micro Pile shall be centered within 75 mm of the specified location. Allowable deflection of the splice is 1 in 400. The Contractor shall provide equipment for checking Micro Pile alignment during installation and continuously monitor installation to meet the design tolerances.

.6 Keep a record of all drilling data.

3.2 INSTALLATION

.1 Micropiles shall be installed to meet the specified test loads.

.2 Clean out the hole and install anchor tendon through the steel pipe and to the bottom of the 150 mm diameter hole.

.3 Extend the anchor tendon above the top of the steel pipe, in accordance with the tender drawing and specification.

.4 Provide centralizers at 2.5m spacing to ensure that the anchor is centrally located in the borehole. Centralizers must be made of plastic material.

.5 Maintain drilling and installation record showing anchor type, number, and installation date for each anchor.

3.3 GROUTING

.1 Grout for bond length: Shall be non-corrosive expanding; shall have a strength of 45 MPa and shall have a consistency to ensure that free flow will occur into all irregularities in the drilled hole. Strength tests will be required from each batch of grout.

.2 Grout for remainder of embedded length: Shall be non-corrosive, non-shrink, free flowing and of 35 MPa.

.3 The mixing water shall be free of any deleterious material.

.4 Accelerators are not permitted.

.5 Add mixtures containing calcium chloride are not permitted.

.6 Mix-design for grout to be designed by the contractor, meeting the requirements specified herein.

.7 Use equipment capable of continuous mechanical mixing and pump to produce a grout free of lumps and undispersed cement.

.8 Always inject grout at the lowest point of the bond length through a specially provided grout tube.

.9 Washout water from the grouting operation shall be disposed of in accordance with the project's environmental requirements.

.10 After grouting, leave anchors in an undisturbed condition until the necessary grout strength has been achieved.

3.4 INSPECTION AND TESTING

.1 Testing to be performed by the Contractor and witnessed by the Departmental Representative.

.2 Micropiles that fail testing must be replaced at no cost to the Departmental Representative.

.3 Allow free access to all parts of the work for the purposes of inspection and field review by the Departmental Representative. Notify the Departmental Representative when the work is ready. Provide 48 hours advance notification.

.4 The Departmental Representative may reject at any time during the progress of work material which is found to be defective or not in accordance with the specifications, structural drawings, shop drawings or technical data submitted for the project. Improper storage or handling will be considered a reason for rejection. Rejected material shall be replaced at no expense to the Departmental Representative. In case of dispute, the decision of the Departmental Representative shall be final.

.5 Elongations and displacements shall be measured and recorded to the nearest 0.025mm (0.001") with respect to an independent reference point.

.6 Performance Tests

1. The first two Micropiles installed shall be performance tested by the Contractor to a test load equal to 150% of the design load of 400kN (90 kips). Performance testing to begin once grout has reached a minimum compressive strength of 25 MPa.

2. Performance testing shall proceed by loading and unloading the Micro Pile in tension in accordance with Section 8.3.2 of the Post Tensioning Institute "Recommendations for Prestressed Soil and Rock Anchors", 2004 Ed.

.7 Proof Tests

1. All Micropiles not subjected to a performance test shall be proof tested by the Contractor to a test load equal to 150% of the design load of 400kN (90 kips). Proof testing to begin once grout has reached a minimum compressive strength of 25 MPa.

2. Proof testing shall proceed by incremental loading of the Micropile in tension in accordance with Section 8.3.3 of the Post Tensioning Institute "Recommendations for Prestressed Soil and Rock Anchors", 2004 Ed.

.8 Acceptance Criteria

1. Based on extension measurements of the anchor head taken during testing, and anchor will be rejected if any one of the following criteria are not met.

2. The total movement at the anchor head shall be more than 80% of the theoretical elastic elongation of the "Free-stressing length", and less than 100% of the elastic elongation of the "Free-stressing length" plus 50% of the "Bond Length" theoretical elastic elongation.

3. Creep movement shall not exceed 1mm under the test load within the period of 1 to 10 minutes of the creep test. The creep movement at the anchor head shall not exceed 0.05mm/minute in the last minute.

4. If any anchor fails to meet the acceptance criteria, the Departmental Representative will determine what remedial action nis required. The remedial works may include replacing the failed Micropile or installing additional Micropiles, The Contractor shall be responsible for costs of Micropile remedial work. No payment shall be made by the Departmental Representative for any additional Micropiles, or testing required as a result of failure of the acceptance criteria.

END OF SECTION 31 63 33

PAVEMENT SURFACE CLEANING AND REMOVAL OF PAVEMENT MARKINGS

1.0 GENERAL

1.1 Section 32 01 11.01 refers to those portions of the work that are unique to the removal of pavement marking and pavement cleaning. This section must be reference to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.2 Related Work

1.2.1	Asphalt Tack Coat	Section 32 12 13.16
1.2.2	Hot Mix Asphalt Concrete Paving	Section 32 12 16
1.2.3	Painted Pavement Markings	Section 32 17 23

2.0 PRODUCTS

2.1 Materials

2.1.1 Abrasives and solvents used for removal of paint, oil, grease, rubber deposits: proprietary products specially designed for pavement cleaning, subject to approval by Departmental Representative.

3.0 EXECUTION

3.1 Removing Pavement Markings

3.2 In areas designated by Departmental Representative, remove rubber tire deposits and paint markings by sand blasting, rotary grinding, heater planing or other method approved by Departmental Representative.

3.3 Exercise care to avoid dislodging of coarse aggregate particles, excessive removal of fines, damage to bituminous binder or damage to joint and crack sealers.

3.4 When using heater planing equipment do not heat pavement surfaces above 120°C.

4.0 DISPOSE REMOVED PAVEMENT MARKINGS AS SPECIFIED IN CONTRACT DOCUMENTS.

4.1 Pavement Surface Cleaning

4.2 Where directed by Departmental Representative, remove sealing compound which has protruded excessively. Dispose of removed material as directed by Departmental Representative.

PAVEMENT SURFACE CLEANING AND REMOVAL OF PAVEMENT MARKINGS

4.3 Remove, dust, contaminants, loose and foreign materials, oil and grease, in areas designated and by method approved by Departmental Representative.

4.4 Use rotary power brooms supplemented by hand brooming as required.

4.5 Keep drainage system clear of loose and waste materials.

END OF SECTION

GRANULAR SUB-BASE

1.0 GENERAL

1.1 Section 32 11 16.01 refers to those portions of the Work that are unique to the supply and placement of granular subbase materials. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.2 Related Work

1.2.1	Aggregates and Granular Materials	Section 31 05 16
1.2.2	Excavating, Trenching and Backfilling	Section 31 23 33.01
1.2.3	Roadway Excavation, Embankment and Compaction	Section 31 24 13
1.2.4	Granular Base	Section 32 11 23
1.2.5	Dust Control	Section 32 15 60

1.3 The abbreviated standard specifications for testing materials, fabrication, and supply referred to herein, are fully described in Quality Assurance and Reference Specifications - Section 01 43 00.

1.4 Samples may be required.

2.0 PRODUCTS

2.1 Material for road subbase to be:

2.1.1 Select Granular subbase

2.1.2 Crushed Granular Subase

2.1.3 75 mm pit run gravel

2.1.4 Pit run sand

2.1.5 Approved native material

2.1.6 Other approved materials

2.1.7 River Sand

2.2 Material for granular road sub-base to be in conformance with Section 31 05 16 - Aggregates and Granular Materials, for Materials Specification.

2.3 Other granular materials: granular material approved for road base also acceptable for road subbase subject to approval of Departmental Representative.

3.0 EXECUTION

3.1 Inspection of Existing Subgrade Surface

3.1.1 Ensure underlying subgrade surface is true to cross-section and grade and compacted to specified density. Departmental Representative may accept satisfactory proof rolling as evidence of acceptable compaction of undisturbed native subgrade. Do not place granular sub-base until subgrade is inspected and approved by Departmental Representative.

3.2 Placing

3.2.1 Place material only on clean unfrozen surface, properly shaped and compacted and free from snow or ice.

3.2.2 Begin spreading subbase material on crown line or highside of one-way slope.

3.2.3 Place granular sub-base materials using methods which do not lead to segregation or degradation of aggregate.

3.2.4 Place material to full width in uniform layers not exceeding 150 mm compacted thickness. Departmental Representative may authorize thicker lifts if specified compaction can be achieved.

3.2.5 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.

3.2.6 Remove and replace portion of layer in which material has become segregated during spreading.

3.3 Compaction Equipment

3.3.1 Compaction equipment must be capable of obtaining required densities in materials on project.

3.4 Compacting

3.4.1 Compact to density of not less than 95% Modified Proctor density in accordance with ASTM D1557.

3.4.2 Shape and roll alternately to obtain smooth, even and uniformly compacted sub-base.

3.4.3 Apply water as necessary during compaction to obtain specified density. If sub-base is excessively moist, aerate by scarifying with suitable equipment until moisture content is corrected.

3.4.4 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Departmental Representative.

3.5 Finish Tolerances

3.5.1 Check finished surface of granular base to ensure that is meets the following tolerances:

(a) Surface Tolerance: 15 mm maximum variation under 3 m straightedge.

(b) Grade Tolerance: 6 mm maximum variation above designated elevation and 15 mm maximum variation below designated elevation.

3.5.2 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.6 Proof Rolling

3.6.1 For proof rolling use fully loaded single or dual axle dump truck.

3.6.2 Departmental Representative may authorize use of other acceptable proof rolling equipment.

3.6.3 Proof roll at level in sub-base as indicated. If alternative proof rolling equipment is authorized, Departmental Representative will determine level of proof rolling.

3.6.4 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.

3.6.5 Where proof rolling reveals areas of defective subgrade:

(a) Remove sub-base and subgrade material to depth and extent as directed by Departmental Representative.

(b) Backfill excavated subgrade with approved common material and compact in accordance with Section 31 24 13 - Roadway Excavation, Embankment and Compaction.

(c) Replace sub-base material and compact in accordance with this section.

3.6.6 Where proof rolling reveals areas of defective sub-base, remove and replace in accordance with this section at no extra cost.

3.7 Maintenance

3.7.1 Maintain finished sub-base in condition conforming to this section until succeeding base is constructed, or until granular sub-base is accepted by Departmental Representative.

END OF SECTION

RESHAPING GRANULAR ROADBED

1.0 GENERAL

1.1 Section 32 11 17 refers to those portions of the work that are unique to the requirements for scarifying and reshaping existing granular roadbeds, and where required, the supply and placement of additional granular base materials. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.2 Related Work

1.2.1	Aggregates and Granular Material	Section 31 05 16
1.2.2	Roadway Excavation, Embankment and Compaction	Section 31 24 13
1.2.3	Dust Control	Section 32 15 60

1.3 References

The abbreviated standard specifications for testing, materials, fabrication, and supply referred to herein, are fully described in Quality Assurance and Reference Specifications - Section 01 43 00.

1.4 Samples

1.4.1 Samples may be required.

1.5 Definitions

1.5.1 Reshaping granular roadbed: scarifying, blading, reshaping, and recompacting existing granular road surface.

2.0 PRODUCTS

2.1 Materials

2.1.1 Additional granular base material to be in accordance with Section 32 11 23 - Granular Base and Section 31 05 16 - Aggregates and Granular Materials.

3.0 EXECUTION

3.1 Scarifying and Respahing

3.1.1 Scarify roadbed in accordance with width shown on Contract Drawings or as directed by Departmental Representative and to depth as directed by Departmental Representative.

3.1.2 Pulverize and break down scarified material to 19mm maximum particle size.

3.1.3 Blade and trim pulverized material to elevation and cross section dimensions as shown on Contract Drawings or as directed by Departmental Representative.

3.1.4 Where deficiency of material exists, add and blend in specified new granular base material as directed by Departmental Representative.

3.1.5 Dispose excess material off-site.

3.2 Compaction

3.2.1 Compaction equipment to be capable of obtaining required densities in materials on project. Compact to density not less than 95% Modified Proctor density in compliance with ASTM D1557.

3.2.2 Shape and roll alternately to obtain smooth, even and uniformly compacted base.

3.2.3 Apply water as necessary during compaction. If material is excessively moist, aerate by scarifying with suitable equipment until moisture content is suitable for compaction.

3.2.4 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Departmental Representative.

3.3 Repair of Soft Areas

3.3.1 Correct soft areas by removing material to depth and extent as directed by Departmental Representative. Replace with specified material and compact to specified density.Batch and continuous mixing plants:

3.4 Finish Tolerances

3.4.1 Reshaped compacted surface to be within plus or minus 10mm of elevation as shown on Contract Drawings but not uniformly high or low.

3.4.2 Finished surface not to have irregularities exceeding 10mm when checked with a 3 m straight edge placed in any direction.

3.4.3 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.5 Maintenance

3.5.1 Maintain reshaped surface in condition conforming to this section until succeeding material is applied or until reshaped roadbed is accepted by Departmental Representative.

END OF SECTION

PROJECT NO 39903 - 180402
CANADIAN FOOD INSPECTION AGENCY
AHU REPLACEMENT/EXHAUST MANIFOLD
BURNABY, BC

GRANULAR BASE

1.0 GENERAL

1.1 Section 32 11 23 refers to those portions of the Work that are unique to the supply and placement of granular base materials. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.2 Related Work

1.2.1	Aggregates and Granular Materials	Section 31 05 16
1.2.2	Excavating, Trenching and Backfilling	Section 31 23 33.01
1.2.3	Granular Sub-base	Section 32 11 16.01
1.2.4	Hot Mix Asphalt Concrete Paving	Section 32 12 16
1.2.5	Dust Control	Section 32 15 60
1.2.6	Roadway Excavation, Embankment and Compaction	Section 31 24 13
1.2.7	Concrete Walks, Curbs and Gutters	Section 32 16 15

1.3 The abbreviated standard specifications for testing, materials, fabrication, and supply referred to herein, are fully described in Quality Assurance and Reference Specifications - Section 01 43 00.

1.4 Samples may be required.

2.0 PRODUCTS

2.1 Material for road base to be:

2.1.1 As shown on Contract Drawings.

2.1.1.1 Material for granular road base to be in conformance with Section 31 05 16 - Aggregates and Granular Materials, for material specifications.

3.0 EXECUTION

3.1 Inspection of Underlying Sub-base

3.1.1 Ensure underlying subbase surface true to cross-section and grade, and of the specified material compacted to 95% Modified Proctor density in compliance with ASTM D1557. Do not place granular base until finished sub-base surface is inspected and approved by Departmental Representative.

3.2 Placing

3.2.1 Place material only on clean unfrozen surface, properly shaped and compacted and free from snow and ice.

3.2.2 Begin spreading base material on crown line or on high side of one-way slope.

3.2.3 Place base material using methods which do not lead to segregation or degradation of aggregate.

3.2.4 Place material to full width in uniform layers not exceeding 150mm compacted thickness. Departmental Representative may authorize thicker lifts if specified compaction can be achieved.

3.2.5 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.

3.2.6 Remove and replace that portion of layer in which material becomes segregated during spreading.

3.3 Compaction Equipment

3.3.1 Compaction equipment must be capable of obtaining required densities in materials on project.

3.4 Compacting

3.4.1 Compact to density not less than 95% Modified Proctor density in accordance with ASTM D1557.

3.4.2 Shape and roll alternately to obtain smooth, even and uniformly compacted base.

3.4.3 Apply water as necessary during compacting to obtain specified density. If materials is excessively moist, aerate by scarifying with suitable equipment until moisture content is corrected.

3.4.4 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Departmental Representative.

3.5 Finish Tolerance

3.5.1 Finished base surface to be within plus or minus 10 mm of established grade and cross section but not uniformly high or low.

3.5.2 Ensure finished surface has no irregularities exceeding 10 mm when checked with a 3 m straight edge place in any direction.

3.5.3 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.6 Proof Rolling

3.6.1 For proof rolling use roller of 45,400 kg gross mass with four pneumatic tires each carrying 11,350 kg and inflated to 620 kPa. Four tires arranged abreast with centre to centre spacing of 915 mm maximum.

3.6.2 Departmental Representative may authorize use of other acceptable proof rolling equipment. If alternative proof rolling equipment is authorized, Departmental Representative will determine level of proof rolling.

3.6.3 Proof roll top of base upon completion of fine grading and compaction.

3.6.4 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.

3.6.5 Where proof rolling reveals areas of defective subgrade:

3.6.5.1 Remove base, subbase and subgrade material to depth and extent as directed by Departmental Representative.

3.6.5.2 Backfill excavated subgrade with approved common material and compact in accordance with Section 31 24 13 - Roadway Excavation, Embankment and Compaction.

3.6.5.3 Replace sub-base material and compact in accordance with Section 32 11 16.01.

3.6.5.4 Replace base material and compact in accordance with this Section.

3.6.6 Where proof rolling reveals areas of unsuitable base or subbase, remove unsuitable materials to depth and extent directed by Departmental Representative and replace with new materials in accordance with Section 32 11 16.01 Granular Subbase and this Section at no extra cost.

3.7 Maintenance

3.7.1 Maintain finished base in condition conforming to this section until succeeding material is applied or until acceptance by Departmental Representative.

END OF SECTION

ASPHALT TACK COAT

1.0 GENERAL

1.1 Section 32 12 13.16 refers to those portions of the Work that are unique to the supply and application of asphalt tack coat. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.2 Related Work

1.2.1 Hot Mix Asphalt Concrete Paving Section 32 12 16

1.3 References

1.3.1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in Quality Assurance and Reference Specifications - Section 01 43 00.

1.4 Samples

1.4.1 Provide access on tanker for Departmental Representative to sample asphalt material to be incorporated into work, in accordance with ASTM D140.

1.5 Asphalt Material Certification

1.5.1 Upon request by Departmental Representative, submit manufacturer's test data and certification that asphalt tack coat material meets requirements of this section.

2.0 PRODUCTS

2.1 Materials

2.1.1 Emulsified asphalt: to CAN/CGSB - 16.2, grade SS-1

3.0 EXECUTION

3.1 Equipment

3.1.1 Pressure distributor:

(a) Designed, equipped, maintained and operated that asphalt material at even temperature may be applied uniformly on variable widths of surface up to 5 m at readily determined and controlled rates from 0.2 - 5.4 L/m² with uniform pressure, and with an allowable variation from any specified rate not exceeding 0.1 L/m².

(b) Capable of distributing asphalt material in uniform spray without atomization at temperature required.

(c) Equipped with meter registering metres of travel per minute, visibly located to enable truck driver to maintain constant speed required for application at specified rate.

(d) Pump equipped with flow meter graduated in units of 5 L or less per minute passing through nozzles and readily visible to operator. Pump to operate by separate power unit independent of truck power unit.

(e) Equipped with an easily read, accurate and sensitive device which registers temperature of liquid in reservoir.

(f) Equipped with accurate volume measuring device or calibrated tank.

(g) Nozzles to be of same make and dimensions, adjustable for fan width and orientation.

(h) Hand Sprayer: For small and/or inaccessible areas, a pressurized hand-held spray want may be used.

3.2 Application

3.2.1 Obtain Departmental Representative's approval of surface before applying asphalt tack coat.

3.2.2 Dilute asphalt emulsion with water at 1:1 ration for application. Mix thoroughly by pumping or other method approved by Departmental Representative.

3.2.3 Apply tack coat to pavement surface at rate as directed by Departmental Representative, but do not exceed 0.7 L/m² when diluted with water at 1:1 ratio.

3.2.4 Apply only on clean, dry surface.

3.2.5 Paint contact surfaces of curbs, gutters, headers, manholes, and like structures with thin, uniform coat of asphalt tack coat material.

3.2.6 Do not apply asphalt tack coat when air temperature is less than 5°C, when rain is forecast within 2 hours or application, or wind conditions are hazardous enough to cause damage to surrounding propersty.

3.2.7 Apply tack coat only to surfaces that are expected to be overlayed on same day.

3.2.8 Evenly distribute excessive deposits of tack coat by brooming.

3.2.9 Where traffic is to be maintained, treat no more than one half of width of surface in one application.

3.2.10 Keep traffic off tacked areas until tack coat has set.

3.2.11 Re-tack contaminated or disturbed areas.

3.2.12 Permit tack coat to set before placing asphalt paving.

END OF SECTION

ASPHALT PRIME

1.0 GENERAL

1.1 Section 32 12 13.23 refers to those portions of the Work that are unique to the supply and application of asphalt prime coat. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.2 Related Work

1.2.1	Granular Base	Section 32 11 23
1.2.2	Hot Mix Asphalt Concrete Paving	Section 32 12 16

1.3 References

1.3.1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in Quality Assurance and Reference Specifications - Section 01 43 00.

1.4 Samples

1.4.1 Provide access on tanker for Departmental Representative to sample asphalt material to be incorporated into work, in accordance with ASTM D140.

1.5 Asphalt Material Certification

1.5.1 Upon request from Departmental Representative, submit manufacturer's test data and certification that asphalt prime material meets requirements of this section.

2.0 PRODUCTS

2.1 Material

2.1.1 Asphalt Prime: to CAN/CGSB-16.1 grade RM-20, MC-70 or, emulsified asphalt to CAN/CGSB-16.2 grade SS-1h or approved equal, and shall conform to the standards of the Asphalt Institute.

2.1.2 Sand Blotter:

Clean granular material passing 4.75 mm sieve and free from organic matter or other deleterious materials.

3.0 EXECUTION

3.1 Equipment

3.1.1 Pressure distributor:

(a) Designed, equipped, maintained and operated so that asphalt material at even temperature may be applied uniformly on variable widths of surface up to 5m at readily determined and controlled rate of 2 L/m2 at dilation rate

of 1:1 with uniform pressure, and with an allowable variation from any specified rate not exceeding 0.1 L/m².

(b) Capable of distributing asphalt material in uniform spray without atomization at temperature required.

(c) Equipped with meter registering metres of travel per minute visibly located to enable truck driver to maintain constant speed required for application at specified rate.

(d) Pump equipped with flow meter graduated in units of 5 L or less per minute passing through nozzles and readily visible to operator. The pump shall operate by separate power unit independent of truck power unit.

(e) Equipped with an easily read, accurate and sensitive device which registers temperature of liquid in reservoir.

(f) Equipped with accurate volume measuring device or calibrated tank.

(g) Nozzles to be of same make dimensions, adjustable for fan width and orientation.

3.1.2 Hand Sprayer: For small and/or inaccessible areas, a pressurized hand-held spray want may be used.

3.2 Application

3.2.1 Obtain Departmental Representative's approval of granular base surface before applying asphalt prime.

3.2.2 Cutback asphalt:

(a) Heat MC70 asphalt prime to 60-70°C for pumping and spraying in accordance with manufacturer’s instructions. For other grades refer to appropriate material section.

(b) Apply asphalt prime to granular base at a rate of 1.35 to 2.20 L per m^2.

(c) Apply on damp surface unless otherwise directed by Departmental Representative.

3.2.3 Emulsified asphalt:

(a) Dilute asphalt emulsion with clean water at 1:1 ratio for application. Mix thoroughly.

(b) Apply diluted asphalt emulsion at rate as required but do not exceed 5 L/m^2.

(c) Apply on damp surface unless otherwise directed by Departmental Representative.

3.2.4 Paint contact surfaces of curbs, gutters, headers, manholes, and like structures with thin, uniform coat of asphalt prime material.

3.2.5 Do not apply prime when air temperature is less than 5°C, when rain is forecast within 2 hours, or when wind conditions are hazardous enough to cause damage to surrounding property.

3.2.6 Where traffic is to be maintained, treat no more than one-half width of surface in one application.

3.2.7 Prevent overlap at junction of spreads.

3.2.8 Do not prime surfaces that will be visible when paving is complete.

3.2.9 Apply additional material to areas not sufficiently covered as directed by Departmental Representative.

3.2.10 Keep traffic off primed areas until asphalt prime has cured.

3.2.11 Permit prime to cure before placing asphalt paving.

3.3 Use of Sand Blotter

3.3.1 If asphalt prime fails to penetrate within 24 hours, spread sand blotter material in amounts required to absorb excess material.

3.3.2 Sweep and remove excess blotter material.s

END OF SECTION

PROJECT NO 39903 - 180402
CANADIAN FOOD INSPECTION AGENCY
AHU REPLACEMENT/EXHAUST MANIFOLD
BURNABY, BC

HOT-MIX ASPHALT CONCRETE PAVING

1.0 GENERAL

1.1 Section 32 12 16 refers to those portions of the Work that are unique to the supply and placement of hot-mix asphalt concrete paving. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.2 Related Work

1.2.1	Aggregates and Granular Material	Section 31 05 16
1.2.2	Asphalt Prime	Section 32 12 13.23
1.2.3	Asphalt Tack Coat	Section 32 12 13.16
1.2.4	Excavation, Trenching and Backfilling	Section 31 23 33.01
1.2.5	Pavement Surface Cleaning and Removal of Pavement Markings	Section 32 01 11.01
1.2.6	Granular Base	Section 32 11 23

1.3 References

The abbreviated standard specifications for testing, materials, fabrication, and supply referred to herein, are fully described in Quality Assurance and Reference Specifications - Section 01 43 00.

1.4 Material Certification

1.4.1 At least two weeks prior to commencing work submit viscosity - temperature chart for asphalt cement to be supplied showing Kinematic Viscosity in centistokes, temperature range 105 to 175°C.

1.4.2 Upon request submit manufacturer's test data and certification that asphalt cement meets requirements of this section.

1.5 Submission

1.5.1 Submit asphalt concrete mix design and trial mix test results to Departmental Representative for review at least one week prior to commencing work.

1.6 Delivery and Storage

1.6.1 When necessary to blend aggregates from one or more sources to produce required gradation, do not blend in stockpiles.

1.6.2 When dryer drum mixing plant is used, stockpile fine aggregate separately from coarse aggregate.

1.6.3 Provide approved storage, heating tanks and pumping facilities for asphalt cement.

2.0 PRODUCTS

2.1 Asphalt Cement: to CGSB-16-3-M90, Grade 80-100.

2.2 Reclaimed asphalt pavement (RAP): Crush and screen so that 100% of reclaimed asphalt pavement material passes 37.5mm screen before mixing

2.3 Aggregates: to Section 31 05 17 – Aggregates and Granular Materials and following requirements:

2.3.1 Crushed stone or gravel consisting of hard, durable, angular particles, free from clay lumps, cementation, organic material, frozen material and other deleterious materials.

2.3.2 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117

Sieve Designation	Percent Passing				
	Lower Course #1	Lower Course #2	Upper Course #1	Upper Course #2	Fine Mix
25.0mm	100	-	-	-	-
19.0mm	-	100	100	-	-
12.5mm	70-85	84-99	84-99	100	-
9.5mm	-	73-88	73-88	-	100
4.75mm	40-65	50-68	50-68	55-75	80-100
2.36mm	32-53	35-55	35-55	38-58	64-89
1.18mm	26-44	27-46	27-46	28-47	48-76
0.600mm	18-36	18-36	18-36	20-36	32-60
0.300mm	10-26	10-26	10-26	10-26	16-42
0.150mm	4-17	4-17	4-17	4-17	6-23
0.075mm	3-8	3-8	3-8	3-8	4-10

***Footnote to asphalt mix-type selection**

Lower Course #1: Arterial an collector, lower course only

Lower Course #2: Local, lower course only

Upper Course #1: Arterial and collector, upper course only

Upper Course #2: Local, surface course only

Fin Mix: Skim patch on existing asphalt surface

2.3.3 Course aggregate is aggregate retained on 4.75mm sieve and fine aggregate is aggregate passing 4.75mm sieve when tested to ASTM C136.

2.3.4 When dryer drum or plant without hot screening is used, process fine aggregates through 4.75mm sieve and stockpile separately from coarse aggregate.

2.3.5 Do not use aggregates having known polishing characteristics in mixes for upper courses.

2.3.6 Sand equivalent: to ASTM D2410. Min: 40

2.3.7 Magnesium Sulphate soundness: to ASTM C88.

Max % loss by mass after five cycles:

(a) Coarse aggregate: 15

(b) Fine aggregate: 18

2.3.8 Los Angeles abrasion: Grading B, to ASTM C131.

Max % loss by mass after five cycles:

(a) Coarse aggregate, upper course: 25

(b) Coarse aggregate, lower course: 35

2.3.9 Absorption: to ASTM C127.

Max % by mass:

(a) Coarse aggregate, upper course: 1.75

(b) Coarse aggregate, lower course: 2.00

2.3.10 Loss by washing: to ASTM C117.

Max % passing 0.075mm sieve:

(a) Coarse aggregate, upper course: 1.75

(b) Coarse aggregate, lower course: 2.0

2.3.11 Flat and elongated particles: (with length to thickness ration greater than 3):

Max % by mass:

(a) Coarse aggregate, upper course: 10

(b) Coarse aggregate, lower course: 10

2.3.12 Crushed fragments: at least 60% of particles by mass within each of the following sieve designation ranges, to have at least 2 freshly fractured faces. Material to be tested according to ASTM C136 and ASTM C117.

Determination of amount of fractured material will be in accordance with Ministry of Transportation and Highways' Specification I-11, Fracture Count for Coarse Aggregate, Method "B", which determines fracture faces by mass.

Passing	Retained on
25mm 12.5mm	12.5m 4.75mm

2.3.13 Regardless of compliance with specified physical requirements, fine aggregates may be accepted or rejected on basis of past field performance.

2.3.14 Mineral filler:

(a) Finely ground particles of limestone, hydrated lime, Portland cement, or other approved non-plastic mineral matter, thoroughly dry and free from lumps.

(b) Add mineral filler when necessary to meet job mix aggregate gradation or as directed to improve mix properties.

(c) Mineral filler to be dry and free flowing when added to aggregate.

2.4 Mix Design

2.4.1 Submit job mix formula to Departmental Representative for review and approval.

2.4.2 Mix may contain up to maximum 20% by mass RAP without a special mix design. Departmental Representative may approve higher proportion of RAP if Contractor demonstrates ability to produce mix meeting requirements of specification.

2.4.3 Design of mix: by Marshall method to requirements below.

(a) Compaction blows on each face of test specimens: 75

(b) Mix physical requirements:

Property		Pavement Course	
Marshall Stability at 60°C	kN min	6.4	Lower course
		5.5	Upper course
		5.5	fine
Flow Value	mm	2-4	
Air Voids in Mixture	%	3-6	lower course
		3-5	upper course
		3-5	fine
Voids in Mineral Aggregate	% min.	13	lower course 1
		14	lower course 2
		14	upper course 1
		15	upper course 2
		15	fine
Index of Retained Stability	% min	75	

(c) Measure physical requirements as follows:

(i) Marshall load and flow value: to ASTM D1559

(ii) Air voids to: ASTM D3203

(iii) Index of Retained Stability: measure in accordance with Marshall Immersion Test (ASTM D1559)

(iv) Do not change job-mix without prior approval of Departmental Representative. Should change in material source be proposed, new job-mix formula to be submitted to Departmental Representative for review and approval.

3.0 EXECUTION

3.1 Plant and Mixing Requirements

3.1.1 Batch and continuous mixing plants:

(a) To ASTM D995.

(b) Heat asphalt cement and aggregate to mixing temperature directed by Departmental Representative. Do not heat asphalt cement above 160°C.

(c) Before mixing, dry aggregate to a moisture content not greater than 1% by mass or to a lesser moisture content if required to meet mix design requirements.

(d) Make available current asphalt cement viscosity data at plant. With information relative to viscosity of asphalt being used, Contractor will determine temperature of completed mix at plant and at paver after considering hauling and placing conditions. Departmental Representative will monitor temperature of completed mix at plant and at paver after considering hauling and placing conditions.

(e) Feed aggregates from individual stockpiles through separate bins to cold elevator feeders.

(f) Feed cold aggregates to plant in proportions that will ensure continuous operations.

(g) Immediately after drying, screen aggregates into hot storage bins in sizes to permit recombining into gradation meeting job-mix requirements.

(h) Store hot screened aggregates in a manner to minimize segregation and temperature loss.

(i) Where RAP is to be incorporated into mix:

(i) Feed from separate cold feed bin specially designed to minimize consolidation of material. Provide 37.5 mm scalping screen on cold feed to remove oversized pieces of RAP.

(ii) Ensure positive and accurate control of RAP cold feed by use of hydraulic motor or electric clutch and equip with anti-rollback device to prevent material from sliding backward on feed belt.

(iii) Combine RAP and new aggregates in proportions as specified. Dry mix thoroughly, until uniform temperature within plus or minus 5°C of mix temperature is achieved prior to adding new asphalt cement. Do not add new asphalt cement where temperature of dry mix material is above 160°C.

(j) Maintain temperature of materials within plus or minus 5°C of specified mix temperature during mixing.

(k) Mixing Time:

(i) In batch plants, both dry and wet mixing times as directed by Departmental Representative. Continue wet mixing as long as necessary to obtain a thoroughly blended mix but no less than 30 s or more than 75 s.

(ii) In continuous mixing plants, mixing time as directed by Departmental Representative but not less than 45 s.

(iii) Do not alter mixing time unless directed by Departmental Representative.

3.1.2 Dryer drum mixing plant:

(a) Where RAP to be incorporated into mix, dryer drum mixer to be designed to prevent direct contact of RAP with burner flame or with exhaust gases hotter than 180°C.

(b) Feed aggregates to burner end of dryer drum by means of a multi-bin cold feed unit and blend to meet job-mix requirements by adjustments of variable speed feed belts and gates on each bin.

(c) Feed RAP from separate cold feed bin designed to minimize reconsolidation of material.

(d) Meter total flow of aggregate by an electric weigh belt system with an indicator that can be monitored by plant operator and which is interlocked with asphalt pump so that proportions of aggregate and asphalt entering mixer remain constant.

(e) Provide for easy calibration of weighing systems for aggregates without having material enter mixer.

(f) Make provision for conveniently sampling the full flow of materials from the cold feed.

(g) Provide screens or other suitable devices to reject oversize particles or lumps of aggregate from cold feed prior to entering drum.

(h) Provide a system interlock which will stop all feed components if either asphalt or aggregate from any bin stops flowing.

(i) Accomplish heating and mixing of asphalt mix in an approved parallel flow dryer-mixer in which aggregate and asphalt enter drum at burner end and travel parallel to flame and exhaust gas steam. Control heating to prevent fracture of aggregate or excessive oxidation of asphalt. Equip system with automatic burner controls and provide for continuous temperature sensing of asphalt mixture at discharge, with a printing recorder that can be monitored by plant operator. Submit printed record of mix temperatures at end of each day.

(j) Mixing period and temperature to produce a uniform mixture in which particles are thoroughly coated, and moisture content of materials as it leaves mixer to be less than 0.5%.

3.1.3 Temporary storage of hot mix:

(a) Provide mix storage of sufficient capacity to permit continuous operation and designed to prevent segregation.

(b) Do not store asphalt mix in storage bins in excess of three hour.

3.1.4 While producing asphalt mix for this project, do not produce mix for other users unless separate storage and pumping facilities are provided for materials supplied to this project.

3.1.5 Mixing tolerances:

(a) Permissible variation in aggregate gradation from job mix (percent total mass):

(i)	4.75mm sieve and larger	5.5
(ii)	2.36mm sieve	4.5
(iii)	0.600mm sieve	3.5
(iv)	0.150mm sieve	2.5
(v)	0.075mm sieve	1.5

(b) Permissible variation of asphalt cement from job mix, 0.3%

(c) Permissible variation of mix temperature at discharge from plant, 5°C

3.2 Equipment

3.2.1 Pavers:

(a) Mechanical, automatic grade controlled, self-powered pavers capable of spreading mix within 0.5 mm/m, true to line, grade, and crown indicated. Paver shall be equipped with an activated screed and strike-off that are heated.

3.2.2 Rollers, General:

(a) Sufficient number of rollers of type and weight to obtain specified density of compacted mix.

3.2.3 Vibratory Rollers:

(a) Minimum drum diameter: 1200 mm

(b) Maximum amplitude of vibration (machine setting): 0.5 mm for lifts less than 40 mm thick.

3.2.4 Haul Trucks:

(a) Haul trucks of adequate size, speed, and condition to ensure orderly and continuous operation.

(b) The hauling vehicles shall have tight, smooth, metal boxes cleaned of all accumulations of asphalt concrete and foreign materials. Prior to loading, the truck box may be lightly lubricated with a heat resistant asphalt releasing emulsion, having a maximum silicone content of 1 part per 1000 parts of diluted emulsion. Lubrication with diesel fuel will not be permitted.

(c) Covers of sufficient size and weight to completely cover and protect asphalt mix when truck fully loaded.

(d) In cool weather or for long hauls, insulate entire contact area of each box.

(e) Trucks which cannot be weighed in a single operation on scales supplied will not be accepted.

(f) Hauling vehicles shall be in sound mechanical condition and free from oil and fuel leaks.

3.2.5 Hand tools:

(a) Lutes or rakes with covered teeth for spreading and finishing operations.

(b) Tamping irons having mass not less than 12 kg and a bearing area not exceeding 310 cm^2 for compacting material along curbs, gutters, and other

structures inaccessible to roller. Mechanical compaction equipment, when approved by Departmental Representative, may be used instead of tamping irons.

(c) Straight edges, 3.0 m in length, to test finished surface.

3.3 Preparation

3.3.1 Reshape granular or asphalt pavement in accordance with Section 32 11 17 – Reshaping Granular Roadbed and Section 32 01 16.08 – Full Depth Reclamation, if required.

3.3.2 When paving over existing asphalt surface, clean pavement surface in accordance with Section 32 01 11.01 - Pavement Surface Cleaning and Removal of Pavement Markings. When levelling course is not required, patch and correct depressions and other irregularities to approval of Departmental Representative before beginning paving operations.

3.3.3 Apply prime coat and tack coat in accordance with Section 32 12 13.23 - Asphalt Prime and 32 12 13.16 Asphalt Tack Coat, prior to paving.

3.3.4 Prior to laying mix, clean surfaces of loose and foreign material.

3.4 Transportation of Mix

3.4.1 Transport mix to job site in vehicles cleaned of foreign material.

3.4.2 Paint or spray truck beds with light oil, limewater, soap or detergent solution, at least once a day or as required. Elevate truck bed and thoroughly drain. No excess solution will be permitted.

3.4.3 Schedule delivery of material for placing in daylight, unless Departmental Representative approves artificial light.

3.4.4 Deliver material to paver at a uniform rate and in an amount within capacity of paving and compacting equipment.

3.4.5 Deliver loads continuously in covered vehicles and immediately spread and compact. Deliver and place mixes at temperature within range as directed by Departmental Representative, but not less than 135°C.

3.5 Placing

3.5.1 Obtain Departmental Representative's approval of base, existing surface, tack coat, or prime coat prior to placing asphalt.

3.5.2 Place asphalt concrete to thicknesses, grades, and lines as shown on Contract Drawings or as directed by Departmental Representative.

3.5.3 Placing conditions:

(a) Place asphalt mixtures only when air temperature is above 5°C.

(b) When temperature of surface on which material is to be placed falls below 10°C, provide extra rollers as necessary to obtain required compaction before cooling.

(c) Do not place hot-mix asphalt when pools of standing water exist on surface to be paved, during rain, or when surface is damp.

3.5.4 Place asphalt concrete in compacted lifts of thickness as follows:

Mix Type	Minimum (mm)	Maximum (mm)
Leveling Course(s)	35	100
Lower Course	35	100
Surface Course	35	60

3.5.5 Where possible do tapering and levelling where required in lower lifts. Overlap joints by not less than 300 mm.

3.5.6 Commence spreading at high side of pavement or at crown and span crowned centrelines with initial strip.

3.5.7 Spread and strike off mixture with self-propelled mechanical finisher.

(a) Construct longitudinal joints and edges true to line markings. Position and operate paver to follow established line closely.

(b) When using pavers in echelon, have first paver follow marks or lines, and second paver follow edge of material placed by first paver. Work pavers as close together as possible and in no case permit them to be more than 30 m apart.

(c) If segregation occurs, immediately suspend spreading operation until cause is determined and corrected.

(d) Correct irregularities in alignment left by paver by trimming directly behind machine.

(e) Correct irregularities in surface of pavement course directly behind paver. Remove by shovel or lute excess material forming high spots. Fill and smooth indented areas with hot mix. Do not broadcast material over such areas.

(f) Do not throw surplus material on freshly screeded surfaces.

3.5.8 When hand spreading is used:

(a) Approved wood or steel forms, rigidly supported to assure correct grade and cross section, may be used. Use measuring blocks and intermediate strips to aid in obtaining required cross-section.

(b) Distribute material uniformly. Do not broadcast material.

(c) During spreading operation, thoroughly loosen and uniformly distribute material that has formed into lumps and does not break down readily. Reject material that has formed into lumps and does not break down readily.

(d) After placing and before rolling, check surface with templates and straightedges and correct irregularities.

(e) Provide heating equipment to keep hand tools free from asphalt. Avoid high temperatures which may burn material. Do not use tools at a higher temperature than temperature of mix being placed.

3.6 Compaction

3.6.1 Roll asphalt continuously to average density not less than 97% of 75 blow Marshall density in accordance with ASTM D1559 with no individual test less than 95%.

3.6.2 General:

(a) Provide at least two rollers and as many additional rollers as necessary to achieve specified pavement density. When more than two rollers are required, one roller to be pneumatic tired type.

(b) Start rolling operations as soon as placed mix can bear weight of roller without undue displacement of material or cracking of surface.

(c) Operate roller slowly initially to avoid displacement of material. For subsequent rolling do not exceed 5 km/h for static steel-wheeled rollers and 8 km/h for pneumatic-tired rollers.

(d) For lifts 50 mm thick and greater, adjust speed and vibration frequency of vibratory rollers to produce minimum of 20 impacts per metre of travel. For lifts less than 50 mm thick, impact spacing should not exceed compacted lift thickness.

(e) Overlap successive passes of roller by at least one half width of roller and vary pass lengths.

(f) Keep wheels of roller slightly moistened with water to prevent pick-up of material but do not over-water.

(g) Do not stop vibratory rollers on pavement that is being compacted with vibratory mechanism operating.

(h) Do not permit heavy equipment or rollers to stand on finished surface before it has been compacted and has thoroughly cooled.

(i) After traverse and longitudinal joints and outside edge have been compacted, start rolling longitudinally at low side and progress to high side.

(j) When paving in echelon, leave unrolled 50 to 75 mm of edge which second paver is following and roll when joint between lanes is rolled.

(k) Where rolling causes displacement of material, loosen affected areas at once with lutes or shovels and restore to original grade of loose material before re-rolling.

3.6.3 Breakdown rolling:

(a) Commence breakdown rolling immediately following rolling of transverse and longitudinal joint and edges.

(b) Operate rollers as close to paver as necessary to obtain adequate density without causing undue displacement.

(c) Operate breakdown roller with drive roll or wheel nearest finishing machine. Exceptions may be made when working on steep slopes or super-elevated sections.

(d) Use only experienced roller operators for this work.

3.6.4 Second rolling:

(a) Use pneumatic-tired, steel wheel or vibratory rollers and follow breakdown rolling as closely as possible and while paving mix temperature allows maximum density from this operation.

(b) Rolling to be continuous after initial rolling until mix placed has been thoroughly compacted.

3.6.5 Finish rolling:

(a) Accomplish finish rolling with steel wheel rollers while material is still warm enough for removal of roller marks. If necessary to obtain desired surface

finish, Departmental Representative may specify use of pneumatic-tired rollers.

(b) Conduct rolling operations in close sequence.

3.7 Joints

3.7.1 General

(a) Remove surplus material from surface of previously laid strip. Do not dispose on surface of freshly laid strip.

(b) Construct joints between asphalt concrete pavement and Portland cement concrete pavement as specified.

(c) Paint contact surfaces of existing structures such as manholes, curbs or gutters with bituminous material prior to placing adjacent pavement.

3.7.2 Transverse joints:

(a) Offset transverse joint in succeeding lifts by at least 600 mm.

(b) Cut back to full depth vertical face and tack face with thin coat of asphalt prior to continuing paving.

(c) Compact transverse joints to provide a smooth riding surface.

3.7.3 Longitudinal joints:

(a) Offset longitudinal joints in succeeding lifts by at least 150 mm.

(b) Cold joint is defined as joint where asphalt mix is placed, compacted and left to cool below 100°C prior to paving of adjacent lane.

(i) If cold joint cannot be avoided, tack face of adjacent lane with thin coat of asphalt prior to continuing paving.

(c) Overlap previously laid strip with spreader by 100 mm.

(d) Before rolling, carefully remove and discard coarse aggregate in material overlapping joint with a lute or rake.

(e) Roll longitudinal joints directly behind paving operation.

(f) When rolling with static roller, shift roller over onto previously placed lane in order that 100 to 150 mm of drum width rides on newly laid lane, then operate roller to pinch and press fines gradually across joint. Continue rolling until thoroughly compacted neat joint is obtained.

(g) When rolling with vibratory roller, have most of drum width ride on newly placed lane with remaining 100 to 150 mm extending onto previously placed and compacted lane.

3.7.4 Construct feather joints so that thinner portion of joint contains fine graded material obtained by changed mix design or by raking out coarse aggregate in mix. Place and compact joint so that joint is smooth and without visible breaks in grade. Location of feather joint as specified.

3.7.5 Construct butt joints at locations and to details as shown on Contract Drawings.

3.7.6 Wherever practical, locate joints under future traffic markings (paint lines).

3.8 Pavement Patching

3.8.1 Ensure temporary and permanent pavement patching done by handwork conforms to all standards specified for machine placed asphaltic concrete.

3.8.2 Subbase and base preparation as specified in Section 31 11 16.1 – Granular Subbase and Section 32 11 23 – Granular Base respectively, unless shown otherwise on Contract Drawings.

3.9 Sidewalk, Driveways, and Curbs

3.9.1 Hot-mix asphalt concrete sidewalks, driveways and curbs as shown on Contract Drawings.

3.9.2 Machine placed where practical

3.9.3 Ensure placement by handworks conforms to all standards specified for machine placed asphaltic concrete.

3.9.4 Other than requirements relating specifically to Portland cement concrete, ensure hot-mix asphalt concrete sidewalks and curbs comply with all requirements of Section 32 16 15 – Concrete Walks, Curbs and Gutters.

3.9.5 Ensure hot-mix asphalt concrete driveways comply with all requirements of Section 32 12 16 – Hot-mix asphalt concrete paving.

3.10 Finish Tolerances

3.10.1 Finished asphalt surface to be within 6 mm of design elevation but not uniformly high or low.

3.10.2 Finished asphalt surface not to have irregularities exceeding 6 mm when checked with a 3 m straight edge placed in any direction.

3.10.3 Water ponding not permitted.

3.10.4 Grade: ±6 mm maximum variation from designated grade elevations.

3.11 Defective Work

3.11.1 Correct irregularities which develop before completion of rolling by loosening surface mix and removing or adding material as required. If irregularities or defects remain after final compaction, remove surface course promptly and lay new material to form a true and even surface and compact immediately to specified density.

3.11.2 Repair areas showing, checking, or rippling.

3.11.3 Adjust roller operation and screed settings on paver to prevent further defects such as rippling and checking of pavement.

3.12 Clean-up

3.12.1 Remove lids or covers from all castings and clean any prime, tack coat or hot-mix asphaltic concrete from frames, lids and covers of all castings.

END OF SECTION

PROJECT NO 39903 - 180402
CANADIAN FOOD INSPECTION AGENCY
AHU REPLACEMENT/EXHAUST MANIFOLD
BURNABY, BC

DUST CONTROL

1.0 GENERAL

1.1 Section 32 15 60 refers to those portions of the work that are unique to the supply and application of materials for dust control. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.2 Related Work

1.2.1	Excavating, Trenching and Backfilling	Section 31 23 33.01
1.2.2	Roadway Excavation, Embankment and Compaction	Section 31 24 13
1.2.3	Granular Subbase	Section 32 11 16.01
1.2.4	Reshaping Granular Roadbed	Section 32 11 17
1.2.5	Granular Base	Section 32 11 23

1.3 References

1.3.1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in Quality Assurance and Reference Specifications - Section 01 43 00.

1.4 Samples

1.4.1 Samples may be required.

1.5 Delivery, Storage and Handling

1.5.1 Deliver calcium chloride to site in substantial and moisture-proof bags indicating name of manufacturer, name of product, net weight or mass, and percentage of calcium chloride guaranteed by manufacturer.

1.5.2 Store bags of calcium chloride in weather-proof enclosures.

2.0 PRODUCTS

2.1 Materials

2.1.1 Calcium chloride: to CGSB 15.1 Type 1-Regular (77%) or as liquid at 35% solution concentration.

2.1.2 Magnesium chloride as 29 to 35% solution concentration.

2.1.3 Water: to Departmental Representative's approval.

2.1.4 Aqueous magnesium chloride or calcium chloride may be used provided

2.1.5 Lignosulphonates may be used subject to conditions specified in 3.2.

2.1.6 Used oil or "cut back" bitumen products not permitted.

3.0 EXECUTION

3.1 Application

3.1.1 Control dust at all times for duration of Contract.

3.1.2 Apply aqueous solutions with distributors equipped with spray system that will ensure uniform application and with means of shut-off.

3.1.3 Apply aqueous solutions at following rates:

(a) Calcium chloride (25%) at 2.4 L/m^2 on roads not previously treated and 3.0 L/m^2 for road stabilization.

(b) Calcium chloride (35%) or magnesium chloride (30%) at 1.6 L/m^2 on roads not previously treated and 2.0 L/m^2 for road stabilization.

(c) Apply flake calcium chloride at rate of 1.00 kg/m^2.

3.2 Environmental Restrictions

3.2.1 No application on slopes where precipitation may cause chemical to drain into watercourses.

3.2.2 No application within 10 minutes minimum on either side of watercourses.

3.2.3 No application of lignosulphonates in residential areas when air temperature exceeds 26°C.

3.2.4 No application of lignosulphonates when rain is imminent as minimum drying time of six hours is required.

END OF SECTION

CONCRETE WALKS, CURBS AND GUTTERS

1.0 GENERAL

1.1 Section 32 16 15 refers to those portions of the Work that are unique to the construction of Portland cement concrete walks, curbs and gutters. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.2 Related Work

1.2.1	Roadway Excavation, Embankment, and Compaction	Section 31 24 13
1.2.2	Granular Subbase	Section 32 11 16.01
1.2.3	Granular Base	Section 32 11 23
1.2.4	Cast-in-Place Concrete for Civil Works	Section 32 30 00
1.2.5	Storm Sewers	Section 33 40 01
1.2.6	Aggregates and Granular Material	Section 31 05 16

1.3 References

1.3.1 The abbreviated standard specification for testing, materials, fabrication and supply, referred to herein, are fully described in Quality Assurance and Reference Specifications - Section 01 43 00.

2.0 PRODUCTS

2.1 Materials

2.1.1 Borrow material: to Section 31 24 13 - Roadway Excavation, Embankment, and Compaction.

2.1.2 Granular subbase: to Section 31 05 16 - Aggregates and Granular Materials.

2.1.3 Granular base: to Section 31 05 16 - Aggregates and Granular Materials.

2.1.4 Non-staining type form release agent: chemically active release agents containing compounds that react with free lime to provide water soluble soap.

2.1.5 Concrete mixes and materials: to Section 32 30 00 - Cast-in-Place Concrete for Civil Works with the following criteria specific to this Section:

(a) Hand-formed and hand placed concrete:

(i) Slump: 80 mm

(ii) Air entrainment: 5 to 8%

(iii) Maximum aggregate size: 19 mm

(iv) Minimum cement content: 350 kg/m³

(v) Minimum 28 day compressive strength: 32 MPa.

(b) Extruded concrete:

(i) Slump: 0 – 25 mm

(ii) Air entrainment: 6 to 9%

(iii) Maximum aggregate size: 9.5 mm

(iv) Fitness modulus: 2.1 to 2.4

(v) Minimum cement content: 335 kg/m³

(vi) Minimum 28 day compressive strength: 32 MPa.

2.1.6 Joint filler and Curing Compound: to Section 32 30 00 – Cast-in-Place Concrete for Civil Works.

3.0 EXECUTION

3.1 Subgrade Preparation

3.1.1 Excavate or fill to design subgrade.

3.1.2 Compact to minimum 95% Modified Proctor density in compliance with ASTM D1557 (all following references to density imply compliance with ASTM D1557).

3.2 Granular Subbase and Base

3.2.1 Place subbase and minimum of 100 mm granular base material to design grade as shown on Contract Drawings, including Standard Detail Drawings.

3.2.2 Compact subbase and base to specification density.

3.2.3 Obtain Departmental Representative's approval of compacted base prior to placing forms or control devices for extruding equipment.

3.3 Formwork

3.3.1 Steel forms to be of approved design and free from twists and warp.

3.3.2 Wood forms to be of select dressed lumber, straight and free from defects and thoroughly cleaned.

3.3.3 Flexible forms to be used for all curves less than 60 m radius.

3.3.4 After obtaining Departmental Representative's approval of compacted base, set forms to line and grade as shown on Contract Drawings, free from waves or irregularities in line or grade.

3.3.5 Set special isolation forms as required around catchbasins, manholes, poles or other objects as shown on Contract Drawings or as directed by Departmental Representative.

3.3.6 Tolerances:

(a) Maximum horizontal deviation: 6 mm.

(b) Maximum vertical deviation: 6 mm.

(c) Maximum deflection from horizontal or vertical alignment to be 6 mm in 3 m.

3.3.7 Forms to be to shape, lines and full dimensions of work being formed.

3.3.8 Adequately brace forms to maintain specified tolerances after concrete is placed.

3.3.9 Treat forms lightly with approved form release agent and remove surplus agent.

3.4 Extruded Sections

3.4.1 Extruding machine to be of type approved by Departmental Representative and fitted with approved template consistent with sections shown on Standard Detail Drawings.

3.5 Inspection

3.5.1 Immediately prior to placement of concrete, carefully inspect all formwork to ensure forms are properly set at required horizontal and vertical alignment, sufficiently rigid, clean, surface treated and ready for placement of concrete. Obtain Departmental Representative's approval of formwork and compacted base.

3.6 Concrete Placement

3.6.1 Place concrete to Section 32 30 00 - Cast-in-Place Concrete for Civil Works and the following criteria specific to this Section.

3.6.2 Do not place concrete during rain or on wet or frozen base.

3.6.3 Do not place concrete when air temperature appears likely to fall below 5°C within 24 hours, unless specified precautions are taken and approved by Departmental Representative.

3.6.4 Schedule concrete placement to ensure sufficient daylight hours available to permit edging and finishing.

3.6.5 Moisten granular base immediately prior to placing concrete.

3.6.6 Place concrete within 1.5 hours of batching time.

3.6.7 Place concrete continuously until the scheduled pour is complete. Arrange the rate of concrete delivery to ensure that the discharge interval between successive loads does not exceed 30 minutes. If the discharge interval is greater than 30 minutes, place a construction joint.

3.6.8 Place concrete in forms, ensuring no segregation of aggregate and consolidate with approved mechanical vibrator or power screed.

3.6.9 Concrete to be placed in continuous operation until entire panel or section completed. Do not place fresh concrete on concrete which has achieved partial set.

3.6.10 Incorporate all castings into concrete at time of placement.

3.6.11 Discontinue placement at expansion, construction, or isolation joints only.

3.6.12 Remove face forms as soon as practical to permit face finishing. Do not leave face forms in place overnight.

3.7 Extruded Sections

3.7.1 Extruded sections to be true to line, grade, and cross-section.

3.7.2 Finished appearance, quality, and workmanship to comply with all Contract Drawings and conditions of this Specification and with Standard Detail Drawings.

3.7.3 Where Departmental Representative is not satisfied with finished product, approval of extruding equipment may be withdrawn, defective product removed and replacement and subsequent work done by hand placement procedures.

3.7.4 Cost of removal of defective work at Contractor's cost.

3.7.5 Subsequent hand placed concrete to be paid at tendered price for extruded product.

3.8 Driveway Crossings and Wheel Chair Ramps

3.8.1 Construct driveway crossings and wheelchair ramps where shown on Contract Drawings and to Standard Detail Drawings.

3.9 Expansion Joints

3.9.1 Form transverse expansion joints at both ends of curb returns and at a maximum spacing of 9 m for sidewalks, 9 m for curb and gutter, at each end of driveway crossings and at tangent points on circular walk.

3.9.2 Extend through full depth of concrete.

3.9.3 Fill with 13 mm approved expansion joint material.

3.9.4 Bond break compound may be used in lieu of expansion joint between sidewalk and back of abutting curb and gutter or where applicable between sidewalk and back of abutting utility strip or sidewalk infill.

3.10 Control Joints

3.10.1 In sidewalks, construct control joints at maximum 3 m intervals.

3.10.2 In curb or curb gutter construct control joints at maximum 3 m intervals and match with control joints in abutting sidewalk.

3.10.3 Construct 3 mm to 5 mm wide at the following depths:

(a) For curb and gutter: 50 mm minimum to a maximum of 25% of the gutter depth

(b) For walk and slabs: 25 mm minimum to a maximum of 25% of the walk or slab thickness.

(c) Or, as otherwise shown on Standard Detail Drawings.

3.10.4 Use proper tool to make cut while concrete is still green or saw cut after concrete has hardened.

3.11 Isolation Joints

3.11.1 Form isolation joints around all poles, hydrants, manholes and all structures or fixed objects located within the concrete section by using approved bond breaking compound.

3.11.2 Form longitudinal isolation joints between sidewalk and abutting curb and gutter, abutting utility strips, abutting structures using 13 mm approved joint filling material.

3.11.3 Use 13 mm pre-moulded hardboard joint material to form isolation joints between sidewalks and abutting walls and structures.

3.11.4 Bond break compound may be used in lieu of joint filler material between sidewalk and back of abutting curb and gutter.

3.12 Finishing

3.12.1 Finish surface of concrete sidewalks and utility strips to smooth surface with magnesium or wood float trowel and brush or broom to provide uniform non-skid surface.

3.12.2 Broom or brush crossways or as otherwise required to match adjacent finish or as directed by Departmental Representative.

3.12.3 Grooves or scoring (dummy joints) used for aesthetic purposes as shown on the Contract Drawings or as directed by Departmental Representative, to be marked with proper tools and set 5 mm wide by 10 mm deep.

3.12.4 Finish driveway crossing and wheel chair ramps as shown on Standard Detail Drawings.

3.12.5 Round edges with steel edging tool to a width of 50 mm around perimeter of each panel and round edges to a 6 mm radius or as shown on Standard Detail Drawings or as directed otherwise by Departmental Representative.

3.12.6 Under no circumstances is concrete to be overworked by trowelling, dusted with dry cement or finished with a mortar coat.

3.12.7 Finished surface to be as specified and to satisfaction of Departmental Representative.

3.12.8 Ensure surface of hand-formed curb and gutter is smooth magnesium or wood float finish. Ensure extruded curb and gutter is smooth finished and hand floated as required to correct irregularities.

3.13 Protection

3.13.1 Protect freshly finished concrete from dust, rain or frost by using tarpaulins or other suitable protective coverings. Keep clear of finished surface.

3.13.2 Place and maintain suitable barriers to protect finished concrete from equipment, vehicles or pedestrian traffic.

3.13.3 Provide personnel as required to prevent vandalism until concrete has set.

3.13.4 Do not run vehicles or construction equipment on concrete for at least 7 days or as directed by Departmental Representative.

3.14 Curing

3.14.1 Apply approved curing compound to all exposed concrete surfaces at rate recommended by manufacturer or alternatively, use moist curing procedures for a minimum of 7 days.

3.14.2 When temperature is below 5°C, maintain all concrete at temperature not less than 10°C for at least 72 hours and protect from freezing for at least another 72 hours or such time as required to ensure proper curing of concrete. Admixtures are not to be used for prevention of freezing.

3.15 Drain Tile

3.15.1 Where shown on Contract Drawings or where directed by Departmental Representative install perforated drain pipe adjacent to sidewalk or curb and gutter. Placement details to Standard Detail Drawings and Section 33 40 01 – Storm Sewers.

3.15.2 Drain pipe to be 100 mm minimum.

3.15.3 Connect to catchbasins.

3.16 Acceptance

3.16.1 Before acceptance of finished concrete, all irregular, cracked, or otherwise defective sections to be entirely removed and replaced to satisfaction of Departmental Representative.

3.17 Adjustment of Existing Catchbasins

3.17.1 Adjust existing catchbasins to specified alignment and elevation using concrete bricks and mortar or concrete adjusting rings.

3.17.2 Remove all debris from inside catchbasin.

END OF SECTION

PROJECT NO 39903 - 180402
CANADIAN FOOD INSPECTION AGENCY
AHU REPLACEMENT/EXHAUST MANIFOLD
BURNABY, BC

PAINTED PAVEMENT MARKINGS

1.0 GENERAL

1.1 Section 32 17 23 refers to those portions of the Work that are unique to the application of application of taped temporary and permanent painted paving markings. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.2 Related Work

1.2.1 Pavement Surface Cleaning and Removal of Removal of Payment Markings Section 32 01 11.01

1.3 Scope

1.3.1 Pavement Markings: Miscellaneous taped temporary and permanent pavement paint markings including pedestrian cross walk, merge, and diverge markings, stop lines, solid and broken line road lane markings including edge lines of merge and diverge markings etc., as directed by Departmental Representative and shown on Contract Drawings. Thermoplastic markings may be specified as an option of the Contract Drawings.

1.4 References

1.4.1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in Quality Assurance and Reference Specifications - Section 01 43 00.

1.5 Samples

1.5.1 Submit to Departmental Representative following material sample quantities at least 2 weeks prior to commencing work.

(a) Two 1 L samples of each type of paint.

(b) One 1 kg sample of glass beads.

(c) Sampling to CGSB 1-GP.

(d) One sample of each colour of Thermoplastic material to be used.

1.5.2 Mark samples with name of project and location, manufacturer’s name and address, name of paint, CGSB specification number, formulation number and batch number.

2.0 PRODUCTS

2.1 Materials

2.1.1 Paint:

(a) To CGSB 1-GP-74M, alkyd traffic paint.

(b) To CGSB 1-GP-149M, alkyd reflectorized traffic paint.

(c) Colour: to CGSB 1-GP-12C, yellow 505-308, black 512-301, white 513-301.

(d) Upon request, Departmental Representative will supply a qualified product list of paints applicable to work. Qualified paints may be used but Departmental Representative reserves right to perform further tests.

2.1.2 Thinner: to CGSB 1-GP-5M.

2.1.3 Glass Beads:

(a) Overlay type: to CGSB 1-GP-74M.

2.1.4 Temporary pavement marking tape:

(a) Material composition shall be at the discretion of the manufacturer subject to the approval of the Departmental Representative. Each formulation shall be identified by a code number.

(b) No retained water when tested by ASTM D570.

(c) Specific gravity of the supplied product shall be within 3% of that specified for the selected formulation.

(d) Material shall not deteriorate upon contact with de-icing chemicals, gasoline, diesel fuel or grease dropped by traffic.

(e) Material shall not break down, deteriorate scorch or discolour, if held within the application temperature range specified by the manufacturer for a period of four hours and it must be able to be reheated from room temperature to the application temperature four times without showing any of these detrimental effects.

(f) When applied at the temperature recommended by the manufacturer and at a film thickness of 2 to 4 mm, the material shall set solid and show no tracking under traffic after elapsed times as follows:

(i) Two minutes at an air temperature of 10°C, relative humidity less than 65%, and road surface temperature from 10°C to 20°C.

(ii) Five minutes at an air temperature of 32°C, relative humidity less than 75%, and road surface temperature from 35°C to 50°C.

(iii) The drying time under conditions intermediate between the two air temperatures shall be interpolated using a straight line model.

(g) The quantity, type, and gradation of the component reflecting glass sphere premixed in the thermoplastic material shall be at the discretion of the manufacturer, but shall provide retro-reflection levels specified below.

(h) The colour of the marking to be brilliant white or yellow as specified. The brightness value shall exceed 70% for white and 45% for yellow obtained with a Gardner Multi-purpose Reflectometer when measuring 0° – 45° daylight luminous directional reflectance with the green filter.

(i) The material shall have a softening point not less than 103° when tested in accordance with ASTM D36 (AASHTO M 249).

3.0 EXECUTION

3.1 Equipment Requirements

3.1.1 Paint applicator to be approved pressure type mobile distributor capable of applying paint in single, double, and dashed lines. Applicator to have positive shut-off and to be capable of applying marking components uniformly, at rates specified, and to dimensions shown on Contract Drawings.

3.1.2 Distributor to be capable of applying reflective glass beads as an overlay on freshly applied paint.

3.2 Condition of Surfaces

3.2.1 Pavement surface to be free from surface water, frost, ice, dust, oil, grease, and other foreign materials.

3.3 Application

3.3.1 Temporary Markings:

(a) Application and removal to manufacturer’s instructions.

(b) Temporary traffic lines and stop bars shall be placed immediately following laying of the asphalt pavement.

(c) The traffic line shall be a 100 mm x 300 mm strip of prefabricated reflective yellow tape having an adhesive backing and shall be placed at 10 m intervals along the centre of pavement.

(d) The stop bar shall be 2 – 100 mm continuous strips of prefabricated reflective white tape having an adhesive backing and placed across the travel lanes at traffic control intersections.

(e) Remove the tape when instructed.

3.3.2 Painted Markings:

(a) Lay out pavement markings.

(b) Unless approved otherwise by Departmental Representative, apply paint only when air temperature is above 10°C and no rain is forecast.

(c) Apply traffic paint evenly at rate of 3 m²/L.

(d) Do not thin paint unless approved by Departmental Representative.

(e) Symbols and letters to conform to dimensions shown on Standard Detail Drawings.

(f) Paint lines to be of uniform colour and density with sharp edges.

(g) Thoroughly clean distributor tank before refilling with paint of different colour.

(h) Apply glass beads at rate specified in supplemental specifications.

(i) Apply other specified marking materials as directed by Departmental Representative.

(j) All pavement markings to be in accordance with latest edition of TAC Manual of Uniform Traffic Control Devices.

3.3.3 Thermoplastic Markings:

(a) Pavement shall be clean and dry and free of sand, gravel, loose dust and foreign matter.

(b) Temperature of surface to be marked shall not be less than 50°C.

(c) Thermoplastic material shall be heated in the melter to a temperature of 382°C.

(d) Thermoplastic material thickness shall be:

(i) Lane Lines 0.090” (2.286 mm)

(ii) Stop bars and crosswalks 0.125” (3.157 mm)

(e) Testing of material thickness to be determined by placing metal plate of known thickness in the area to be painted. Once applied the sample is removed and the material plus metal plate is measured.

(f) Immediately following application glass spheres shall be dropped onto the molten surface. Spheres to be applied at a rate of 300 g/m^2 of line area.

3.4 Tolerance

3.4.1 Paint markings to be within plus or minus 10 mm of specified dimensions.

3.5 Protection of Completed Work

3.5.1 Protect pavement markings until dry.

END OF SECTION

CONCRETE REINFORCEMENT FOR CIVIL WORKS

1.0 GENERAL

1.1 Section 32 20 00 refers to those portions of the Work that require nominal reinforcement such as cast-in-place manholes, small valve chambers and storm sewer endwalls. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.2 This Specification is NOT to be used for any structural facilities such as buildings, bridges, retaining walls, or any similar structures requiring site specific structural engineering design.

1.3 Related Work

1.3.1	Excavating, Trenching, and Backfill	Section 31 23 33.01
1.3.2	Cast-in-Place Concrete for Civil Works	Section 32 30 00
1.3.3	Storm Sewers	Section 33 40 01
1.3.4	Manholes and Catchbasins	Section 33 44 01

1.4 References

1.4.1 The abbreviated standard specifications for testing, materials, fabrication, and supply referred to herein, are fully described in Quality Assurance and Reference Specifications – Section 01 43 00.

1.5 Certification

1.5.1 Inform Departmental Representative of proposed source of material to be supplied.

1.5.2 Provide certifications if required.

1.6 Shop Drawings

1.6.1 Submit Shop drawings consisting of bar bending details, lists and placing drawings.

1.6.2 On placing drawings, indicated sizes, spacing, location and quantities of reinforcement and mechanical splices, with identifying code marks to permit correct placement without reference to structural drawings. Indicate sizes spacing and location of chairs, spacers and hangers, Drawings to be prepared in accordance with ACI 315R, Manual of Contract Administrating and Placing Drawings for Reinforced Concrete Structure.

1.6.3 Detail lap lengths and bar development lengths to CAN3-A23.3. Provide required tension lap splices.

1.6.4 Substitution of different size bars permitted only upon written approval of Departmental Representative.

2.0 PRODUCTS

2.1 Materials

2.1.1 Reinforcing steel: billet steel, grade as specified on Contract Drawings, deformed bars to CSA G30.12, unless indicated otherwise.

2.1.2 Reinforcing steel: weldable low alloy steel deformed bars to CSA G30.16.

2.1.3 Cold-drawn annealed steel wire ties: to CSA G30.3, uncoated; to ASTM D3963 for epoxy coated.

2.1.4 Deformed steel wire for concrete reinforcement: to CSA G30.14.

2.1.5 Welded steel wire fabric: to CSA G30.5, uncoated; to ASTM D3963 for epoxy coated.

2.1.6 Welded deformed steel wire fabric: CSA G30.15. Provide in flat sheets only.

2.1.7 Epoxy coating of non-pre-stressed reinforcement: to ASTM A775/A775M.

2.1.8 Galvanizing of non-pre-stressed reinforcement: to CSA G164, minimum zinc coating 610 g/m².

2.1.9 Chairs, bolsters, bar supports, spacers: to CAN/CSA-A23.1.

2.1.10 Mechanical splices: where specified or otherwise subject to approval of Departmental Representative.

2.2 Fabrication

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

2.2.2 Fabricate reinforcing in accordance with CAN/CSA-A23.1, ANSI/ACI 315, and ACI 315R, Manual of Engineering and Placing Drawings for Reinforced Concrete Structures.

2.2.3 Obtain Departmental Representative's approval for locations of reinforcement splices other than shown on placing drawings.

2.2.4 Upon approval of Departmental Representative, weld reinforcement in accordance with CSA W186.

2.2.5 Protect epoxy and paint coated portions of bars with covering during transportation and handling.

3.0 EXECUTION

3.1 Field Bending

3.1.1 Do not field bend reinforcement except where specified or authorized by Departmental Representative.

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

3.1.3 Replace bars which develop cracks or splits.

3.2 Placing Reinforcement

3.2.1 Place reinforcing steel as shown on reviewed placing drawings and in accordance with CAN/CSA-A23.1 and CSA-W186.

3.2.2 Prior to placing concrete, obtain Departmental Representative's approval of reinforcing material and placement.

3.3 Field Touch-Up

3.3.1 Touch up damaged parts and cut ends of epoxy coated or galvanized reinforcing steel with compatible finish to provide continuous coating.

END OF SECTION

CAST-IN-PLACE CONCRETE FOR CIVIL WORKS

1.0 GENERAL

1.1 Section 32 30 00 refers to those portions of the Work that are unique to the construction of pavements, sidewalks, curbs and gutters, manholes and catchbasins, concrete works associated with the installation of watermains and sewers, and similar works incidental to municipal services type construction. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.2 This Specification is NOT to be used for any structural facilities such as buildings, bridges, retaining walls, or any similar structure requiring site specific structural engineering design.

1.3 Except where specifically stated otherwise, all materials and methods in this Section to conform to requirements of the latest version of CAN/CSA-A23.1

1.4 Related Work

1.4.1	Excavating, Trenching, and Backfilling	Section 31 23 01.01
1.4.2	Concrete Walks, Curbs, and Gutter	Section 32 16 15
1.4.3	Concrete Reinforcement for Civil Works	Section 32 20 00
1.4.4	Storm Sewers	Section 33 40 01
1.4.5	Manholes and Catchbasins	Section 33 44 01

1.5 References

1.5.1 The abbreviated standard specifications for testing, materials, fabrication, and supply referred to herein, are fully described in Quality Assurance and Reference Specifications - Section 01 43 00.

1.6 Certification

1.6.1 Minimum 14 days prior to starting concrete work submit to Departmental Representative manufacturer's test data and certification by qualified independent inspection and testing laboratory that following materials will meet specified requirements:

(a) Portland cement

(b) Blended hydraulic cement

(c) Supplementary cementing materials

(d) Grout

(e) Admixtures

(f) Aggregates

(g) Water

(h) Waterstrops

(i) Waterstop joints

(j) Joint filler

1.6.2 Provide certification acceptable to Departmental Representative that plant, equipment, and material to be used in concrete comply with requirements of CAN/CSA-A23.1.

1.6.3 Provide certification acceptable to Departmental Representative that mix proportions selected will produce concrete of specified quality, durability and yield and that strength will comply with CAN/CSA-A23.1.

1.7 Construction Quality Control

1.7.1 Submit proposed quality control procedures for Departmental Representative's approval.

2.0 PRODUCTS

2.1 Materials

2.1.1 Portland cement: to CAN/CSA-A3000, A3001-03 of the following types:

(a) Type GU – General use hydraulic cement

(b) Type HE – High early-strength hydraulic cement

(c) Type HS – High sulphate-resistant hydraulic cement

2.1.2 Supplementary cementing materials: to CAN/CSA-A23.5.

2.1.3 Water: to CAN/CSA-A23.1.

2.1.4 Aggregates: to CAN/CSA-A23.1, testing shall include but not be limited to: unconfined Freeze-thaw in coarse aggregate, $MgSO_4$ soundness loss, petrographic examination, alkali-aggregate reactivity, and ironstone content.

2.1.5 Air entraining admixture: to ASTM C260

2.1.6 Chemical admixtures: to ASTM C494, including water-reducing agents, retarders and accelerators. Chemical admixtures shall not be used unless permitted in writing by the Departmental Representative. Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.

2.1.7 Fly Ash: to CAN/CSA-A3000, A3001-03 possolan types F of Cl.

2.1.8 Grouts:

(a) Provide grout certification prior to use.

(b) To be approved by Departmental Representative prior to use.

(c) Use in accordance with manufacturer's recommendations.

2.1.9 Curing compound:

(a) To be spray applied, liquid type conforming to ASTM C309 containing a fugitive dye.

(b) To be applied in accordance with manufacturer's recommendations.

(c) Other curing methods such as sheet material and burlap mats, subject to Departmental Representative's approval.

2.1.10 Premoulded joint fillers:

(a) Bituminous impregnated fibre board: to ASTM D1751.

2.2 Concrete Mixes

2.2.1 Proportion concrete in accordance with CAN/CSA-A23.1, Table 11. Alternative 1, unless noted otherwise in the Contract Documents:

(a) Cement type: to be Type 10 Portland Cement.

(b) Minimum compressive strength at 28 days: 20 MPa.

(c) Nominal maximum aggregate size: 19 mm.

(d) Slump at time and point of discharge: 75 mm.

(e) Air content: 5 to 7%.

2.3 Forms

2.3.1 Forms to CAN/CSA-A23.1.11.

2.3.2 Free from surface defects for all concrete faces exposed to view.

2.3.3 Form ties to metal and of type such that no metal left within 25 mm of concrete surface when forms removed.

2.4 Form Release Agent

2.4.1 Non-staining material type form release agent: chemically active release agents containing compounds that react with free lime to provide water soluble soap.

3.0 EXECUTION

3.1 General

3.1.1 Do cast-in-place concrete work, including surface tolerances, finishing and field quality control, in accordance with CAN/CSA-A23.1 except where specifically stated otherwise.

3.2 Formwork

3.2.1 Formwork to conform to shape, lines, and dimensions shown on Contract Drawings.

3.2.2 Formwork to be substantial, sufficiently tight to prevent leakage of mortar and braced and tied to maintain position and shape.

3.2.3 Formwork to be unlined unless specified otherwise on Contract Drawings.

3.3 Workmanship

3.3.1 Obtain Departmental Representative 's approval before placing concrete. Provide minimum 24 hours notice prior to placing of concrete.

3.3.2 Pumping of concrete is permitted only after the Departmental Representative’s approval of equipment and mix.

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

3.3.4 Prior to placing of concrete, obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing.

3.3.5 Ensure placement and compaction procedures to CAN/CSA-A23.1 and to approval of Departmental Representative.

3.3.6 Protect exposed surfaces from weather and vandalism during initial set period.

3.3.7 Strip forms ensuring no damage to concrete.

3.3.8 Ensure curing procedures consistent with weather and temperature conditions.

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

3.3.10 Do not place load upon new concrete until authorized by Departmental Representative.

3.4 Joint Fillers

3.4.1 Furnish filler for each joint in single piece for depth and width required for joint, unless authorized otherwise by Departmental Representative. When more than one piece is required for a joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.

3.4.2 Locate and form all joints as specified or as directed by Departmental Representative. Install joint filler where applicable.

3.4.3 Use 13 mm thick joint filler to separate slabs-on-grade from vertical surfaces and extend joint filler from bottom of slab to finished slab surface unless indicated otherwise.

3.5 Field Quality Control

3.5.1 Inspection and testing of concrete and concrete materials will be carried out by a CSA certified laboratory designated by Departmental Representative.

3.5.2 Departmental Representative will pay costs for inspection and initial testing.

3.5.3 If initial tests determine materials or construction not as specified, Contractor to take all steps necessary to correct deficiencies. Subsequent testing to Contractor's cost.

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

3.5.5 Non-destructive Methods for Testing Concrete to be in accordance with CAN/CSA-A23.2.

3.5.6 Inspection or testing by Departmental Representative will not augment or replace Contractor quality control nor relieve him of his contractual responsibility.

END OF SECTION

PROJECT NO 39903 - 180402
CANADIAN FOOD INSPECTION AGENCY
AHU REPLACEMENT/EXHAUST MANIFOLD
BURNABY, BC

CHAIN LINK FENCES AND GATES

1.0 GENERAL

1.1 Description

1.1.1 This section specifies requirements for chain link fencing.

1.2 Related Work

1.2.1 Section 32 30 00 - Cast-in-Place Concrete for Civil Works

1.3 Quality Assurance

1.3.1 Fence layout details to be approved on site by the Departmental Representative prior to installation.

1.3.2 Fence erection shall be carried out by experienced fence construction personnel.

1.3.3 Supply materials to CGSB-138.1.

2.0 PRODUCTS

2.1 Fabric

2.1.1 Fabric height as indicated on Drawings.

2.1.2 Chain Link 50 mm x 9 gauge wire finished as indicated on Drawings; knuckled selvage top and bottom

(a) Galvanized to CAN/CGSB-138.1

(b) Vinyl coated to 0.045 mm dry film thickness minimum

2.2 Wire

2.2.1 Tension wire – single strand 4.5 mm galvanized steel.

2.2.2 Wire Ties - 5 mm aluminum or 3 mm galvanized steel

2.2.3 Barbed wire – 2mm diameter galvanized steel with 4 point barbs at 150 mm spacing to ASTM-A121

2.3 Posts and Rails

2.3.1 Schedule 40 galvanized steel pipe to CAN/CGSB-138.2

2.3.2 Line Posts - 60 mm O.D. c/w tops.

(a) Terminal Posts - for ends, gates and corners - 90 mm with gate posts as specified in Article 2.5.

(b) Top Rail - 42 mm O.D.

(c) Bracing - 42 mm O.D.

2.3.3 Posts heights to be suitable for hole depths, specified height and barbed wire overhang, if indicated.

2.4 Fittings

2.4.1 Top rail ends, brace bands, tension bars, arms, tops, sleeves, hinges and latches in accordance with Drawings.

2.4.2 All fittings to be hot dipped galvanized steel or cast aluminum.

2.4.3 Terminal and gate posts to have dome tops.

2.4.4 Stretcher Bars - min 5 x 20 steel.

2.5 Gates

2.5.1 Gates to be framed with steel pipe ASTM-A120 standard weight galvanized after welding. Use 42 mm O.D. pipe for outside frame and 35 mm O.D. pipe for bracing.

2.5.2 Gate fabric to be the same as fence fabric.

2.5.3 Gate posts to conform to the following:

Opening	**Gate Post O.D.**
Single to 3.0 m and double to 6.0 m	90 mm
Single from 3.0 to 4.2 m double to 8.5 m	114 mm
Single from 4.3 m to 7.6 m and double from 8.5 m to 12 m	170 mm

2.5.4 Gate hardware to include galvanized malleable iron hinges, lockable latch and latch catch accessible from both sides of gate.

2.5.5 Double gates to have centre rest with drop bolt for closed position and chain hook to hold gate in open position.

2.5.6 Gate braces to be 45 mm O.D. galvanized steel.

2.6 Concrete

2.6.1 Compressive strength 20 MPa at 28 days.

2.6.2 Use type 50 sulphate resistant cement.

3.0 EXECUTION

3.1 General

3.1.1 Install fence to CGSB-138.3.

3.2 Grading

3.2.1 Remove debris and grade between posts to provide ground clearance between 40 mm and 70 mm.

3.3 Post Setting

3.3.1 Line post holes to be 1060 mm deep, 250 mm diameter.

3.3.2 Terminal post holes to be 1220 mm deep, 300 mm diameter.

3.3.3 Line posts to be spaced maximum 3.0 m.

3.3.4 Set posts in line and plumb so that the fence forms a straight line between corner posts.

3.3.5 Set posts in concrete and extend concrete 40mm above grade for drainage.

3.3.6 Install straining posts at equal intervals not exceeding 150 m spacing, and at top and bottom of sharp grade changes.

3.3.7 Install corner post where change in alignment exceeds 10o.

3.3.8 Install end posts at end of fence runs, at buildings and at changes in fence height.

3.3.9 Install gate posts at both sides of gate.

3.4 Fence Erection

3.4.1 Allow concrete to cure sufficiently before erecting fence - minimum 5 days.

3.4.2 Set braces between end posts, gate posts and line posts.

3.4.3 Install bottom tension wire, stretch tightly and fasten securely to end, corner, gate and straining posts with turnbuckles and tension bar bands.

3.4.4 Lay out fabric, stretch tightly to tension recommended by manufacturer and secure to end, corner, gate and straining posts with tension bar secured to posts with tension bar bands at 375 mm spacing.

3.4.5 Install top rail and fasten to posts with caps.

3.4.6 Secure fabric with tie wires at 450 mm intervals to top and line posts and to tension wire.

3.5 Gate Installation

3.5.1 Locations and sizes of gates are shown on the drawings.

3.5.2 Level grade between gateposts and set gate bottom 40 mm above ground surface.

3.5.3 Determine location for centre gate rest for double gate and cast concrete gate rest with domed top and cast-in pipe to take drop bolt.

3.6 Cleanup

3.6.1 Touch up damaged galvanized by cleaning with a wire brush and applying two (2) coats of organic zinc-rich paint for galvanized metal.

3.6.2 Clean up debris and earth removed from posts holes and trim areas disturbed.

END OF SECTION

PROJECT NO 39903 - 180402
CANADIAN FOOD INSPECTION AGENCY
AHU REPLACEMENT/EXHAUST MANIFOLD
BURNABY, BC

PRECAST CONCRETE FOR CIVIL WORKS

1.0 GENERAL

1.1 Section 32 40 01 refers to those portions of the precast concrete work that are unique to the construction of pavements, sidewalks, curbs and gutters, manholes and catchbasins, and similar works incidental to municipal infrastructure. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.2 This Specification is NOT to be used for any structural facilities such as buildings, bridges, retaining walls, or any similar structures requiring site specific structural engineering design.

1.3 Except where specifically stated otherwise, all materials and methods in this Section to conform to requirements of the latest version of CAN/CSA-A23.1.

1.4 Related Work

1.4.1 Excavating, Trenching, and Backfill — Section 31 23 33.01

1.5 References

1.5.1 The abbreviated standard specifications for testing, materials, fabrication, and supply referred to herein, are fully described in Quality Assurance and Reference Specifications – Section 01 43 00.

1.6 Construction Quality Control

1.6.1 Submit proposed quality control procedures for *Departmental Representative* approval.

2.0 PRODUCTS

2.1 Materials

2.1.1 Precast concrete units to be constructed in accordance with CAN/CSA-A23.1 unless stated otherwise.

3.0 EXECUTION

3.1 General

3.1.1 Install precast concrete units, including surface tolerances, finishing and field quality control, in accordance with Contract Drawings.

Protection, storage and handling of precast concrete units to Manufacturer's recommendations.

END OF SECTION

CCTV INSPECTION OF PIPELINES

1.0 GENERAL

1.1 Section 33 01 30.01 refers to those portions of the Work that are unique to the requirements for inspecting new and existing sanitary sewers, storm and combined sewers and pipe culverts by closed circuit television.

1.2 Related Work

1.2.1 Cleaning of Sewers Section 33 01 30.2

1.3 References

1.3.1 These specifications must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.3.2 Reference standards, specification or publications.

(a) Water Research Centre (WRc) publication Manual of Sewer Condition Classification (MSCC), Third Edition, 1993 including Addendum - February 1996.

1.3.3 Nomenclature

(a) NAAPI – North American Association of Pipeline Inspectors)

(b) CCTV – Closed Circuit Television

(c) JPEG – Joint Photographic Experts Group

(d) MPEG – Movie Photographic Experts Group

(e) S-VHS – Super VHS format

1.3.4 Submission of Certification

(a) Cleaning of Sewers Section 33 01 30.2

1.3.5 Submission of Certification

(a) Submit copy of the CCTV operator's training certification to the Departmental Representative at least one week prior to the start of the CCTV inspection operations.

(b) Submit copy of certificate for each CCTV operator working on the contract.

1.3.6 Work Regulations

(a) Work to conform to all applicable regulations of WorkSafe BC. Confirm training compliance in the following:

(i) Confined space entry

(ii) Ventilation

(iii) Atmospheric monitoring

(iv) Personal protective equipment

(b) Provide written confirmation to the Departmental Representative that workers have knowledge of confined space entry practices and of equipment required for confined space entry.

1.3.7 Scheduling of Work

(a) Schedule work to minimize interruptions to existing services.

(b) Maintain existing flow during inspection survey unless flow reduction measures required (see Clause 3.11).

2.0 PRODUCTS

2.1 Equipment

2.1.1 Survey Vehicle to contain a separate area for viewing, recording and controlling the CCTV operation.

(a) Viewing and control area to be insulated against noise and extremes in temperature. External and internal sources of light to be controlled to ensure the light does not impede the view of the monitor screen. Proper seating accommodation to be provided to enable one person in addition to the operator to clearly view the monitor screen.

(b) All equipment utilized within the pipeline to be stored outside the viewing, recording and control area.

(c) Vehicle to be equipped with a telephone for communication with the Departmental Representative for the duration of the work.

(d) Electrical power for the system to be self-contained. External power sources from public or private sources not permitted.

2.1.2 Survey Equipment to have sufficient cables to view the lengths of pipe as specified.

(a) Survey unit to be a self-propelled crawler type with a means of transporting the CCTV camera in a stable condition through the pipeline.

(b) Each unit to carry sufficient numbers of guides and rollers such that, when surveying, all cables are supported away from pipe and manhole edges. All CCTV cables and lines used to measure the camera’s location within the pipeline shall be maintained in a taut manner and set at right angles, where possible, to run through or over the measuring equipment.

(c) Each unit to interface with a data generator and appropriate software to record the alpha-numeric data associated with the pipeline condition and header reference location information.

2.1.3 Camera to be capable of producing high quality colour imagery and provide complete inspections and view of all laterals and deficiencies.

(a) Camera to be “Pan & Tilt“ and have the capability of panning the pipe at 360° with tilt capability of 270°.

(b) Live picture to be visible with no interference and capable of registering a minimum number of 400 lines of resolution at the periphery.

(c) Focus and iris adjustment to allow optimum picture quality to be achieved and to be remotely adjusted. The adjustment of focus and iris shall provide a focal range from 150 mm in front of the camera’s lens to infinity. The distance along the sewer in focus from the initial point of observation shall be a minimum of twice the vertical height of the sewer.

(d) Camera to be waterproof with a self-contained lighting system capable of being remotely adjusted. Lights to provide an even distribution of light around the pipeline perimeter without the loss of contrast or flare out or picture shadowing.

2.1.4 Digital video files shall be MPEG2 and conform to the following requirements:

(a) Picture Size: NTSC 704 x 480 at 29.97 frames per second

(b) Digital video files to be stored on new, unused DVD media.

2.1.5 Photographs to be colour, minimum image size 90 mm x 70 mm and reproduced on premium glossy ink jet paper when required, as specified in the Contract Documents.

3.0 EXECUTION

3.1 CCTV Inspection

3.1.1 CCTV operator to have received training by NAAPI or NASSCO.

3.1.2 Submit sample of inspection reports, video in DVD format together with corresponding digital data file for review within one week of receipt of notice to proceed with contract. Submission to satisfy all of the specifications contained herein and the accepted report submission will be used as a benchmark for subsequent inspection report submissions.

3.1.3 No inspection surveys to be carried out under this contract until an acceptable sample inspection report has been approved by the Departmental Representative.

3.1.4 Flow in the pipeline not to exceed approximately 20% of the pipe diameter. Notify Departmental Representative of excessive flows, inspect using flow reduction method (See Clause 3.11).

3.1.5 Eliminate steaming and fogging encountered during the inspection survey by introducing forced air flow by means of fan.

3.1.6 Camera lens to remain free of grease or other deleterious matter to ensure optimal clarity.

3.1.7 Inspection video image to be produced in MPEG2 format:

(a) Create separate digital file for each individual manhole to manhole inspection report.

3.1.8 Set zero chainage at face of every manhole or on entrance into pipe or start or pipe culvert.

3.1.9 Report and record on full length of pipeline from inside face to inside face between manhole or outlet end of pipes and from one end of pipe culvert to the other.

3.1.10 Note condition of pipe joints at manhole walls at the beginning and end of each pipeline.

3.1.11 Data generator to electronically generate and clearly display on the viewing monitor and video recording a record of data in alpha-numeric form containing the following minimum information prior to the start of each run:

(a) Manhole (from-to) / pipe length reference numbers.

(b) Pipeline dimensions

(c) Pipe material (i.e. vitrified clay, concrete, PVC, etc.)

(d) Type or use of pipe (i.e. sanitary, storm, or combined sewer)

(e) Date of survey (yyyy-mm-dd)

(f) Road name/location

(g) Direction of travel of survey equipment (U or D, Upstream or Downstream)

(h) Inspection (report) number

(i) Verbal description of all the above on screen information.

3.1.12 Note condition of pipe joints at manhole walls at the beginning and end of each pipeline.

3.1.13 Data generator to continuously electronically generate and clearly display on the viewing monitor and video recording a record of data in alpha-numeric form containing the following minimum information during each run:

(a) Automatic update of the camera's metre reading position from adjusted zero.

(b) Manhole/pipe length reference numbers.

(c) Type or use of pipe (ie sanitary, storm or combined sewer)

(d) The unique inspection/report number of the run.

(e) Display digital information such that it will not interfere with the video image on the screen.

3.1.14 Stop camera at each defect, change of condition of pipe and service connection to record defect in accordance with WRc codes.

3.1.15 Pan each service connection (junction) such that the camera looks down the centerline of the service, pause for a minimum of five seconds and note condition of the joint and /or pipe/service interface.

3.1.16 Immediately notify Departmental Representative of any blockage or obstruction that will not allow passage of survey equipment.

3.1.17 Restart inspection survey from the opposite end of pipeline or culvert when blockage or obstruction is encountered unless directed by Departmental Representative.

3.2 Recording Resolution

3.2.1 At the beginning of each video tape, day of inspection or when a substitute camera is introduced perform necessary checks to ensure recording resolution satisfies these specifications.

3.3 Site Coding Sheets

3.3.1 Each pipeline length to be recorded according to the MSCC. Any variation from the manual to be noted in the survey report.

3.3.2 Standard coding form shown on page 14 of MSCC to be modified as follows:

(a) Line 2, field 8 (date) to be eight (8) characters in the format of yyyy-mm-dd (year, month, day)

(b) Condition detail number (video count) to be six characters in the format of hh.mm.ss (hours, minutes, seconds)

(c) Note observations as to condition of service connections beyond mainline in remarks column using standard codes as per MSCC

3.4 Camera Position

3.4.1 Position camera lens centrally in the pipeline with a positioning tolerance of ±10% off the vertical centerline axis of the pipeline. For elliptical pipe the camera to be positioned 2/3 the height of the pipe measured from the invert.

3.4.2 Position camera lens looking along the longitudinal axis of pipeline except when viewing service connections or panning defects.

3.5 Camera Travel Speed

3.5.1 Travelling speed of the camera in the pipeline to be as follows:

(a) 6 m/min for pipeline of diameter less than 200 mm.

(b) 9 m/min for diameters 200 mm and larger but not exceeding 310 mm: and

(c) 12 m/s for diameters exceeding 310 mm.

3.6 Camera Position Chainage Device

3.6.1 Use a chainage device which enables the cable length to be accurately measured to indicate the location of the camera

(a) Chainage information to be transmitted electronically to control area and displayed on the monitor.

(b) Chainage device to be accurate to within 0.3 m up to the first 50 m and within ±1% for lengths exceeding 50 m.

(c) Chainage tolerance to be checked at the start of contract and a minimum of once every two weeks thereafter or every 5,000 m of pipeline inspected, whichever is greater.

(d) Provide audit form showing dates and distances checked to meet both tolerance requirements. Chainage linear measurement to be checked by use of a cable calibration device or tape or electronic measurement between fixed points.

3.7 Photographs and/or Digital Images

3.7.1 Photograph all major defects as defined by condition codes: B, CXI, D, FC, FL, FM, H, IR, IG, JDL, JX, OB, OJL, RM, and X

3.7.2 Overlay on photographs the following data in alpha-numeric form such that it will not interfere with the defect condition reported:

(a) Report/job number

(b) Metre reading position (chainage)

(c) Manhole/pipe length reference numbers (from - to)

(d) Photograph number

(e) WRc. condition defect code

(f) Date of survey (yyyy-mm-dd)

3.7.3 Capture photograph and alpha-numeric data as a digital image in a JPEG. file format if required, as specified in Contract Documents.

3.7.4 Co-ordinate photographs with the hard-copy report by reference number and inserting into the report following the relevant section of pipeline inspected.

3.8 Inspection Reporting Hard copies & Digital Format

3.8.1 Submit reports to Departmental Representative within ten working days of completion of the field work on a continuous basis as the inspection area or pipeline types are finalized.

3.8.2 Present machine printed (hard copy) and computer generated data base reports according to the MSCC format.

(a) Each binder to commence with an index of all survey inspection reports contained within.

(b) Hard copy reports to be presented in tabular form in accordance with WRc MSCC

(c) Reports to be presented in sections or drainage areas and/or by pipeline type or as specified in the contract documents.

(d) Computer database file to contain identical survey report information as the printed report exclusive of photographs.

(e) Digital information to be presented in tabular configuration in accordance with the Departmental Representative’s standard file format in Microsoft ACCESS (.MDB)

(f) Provide CD ROM of digital photographs. Disk to be labelled with photo and contract numbers.

(g) Include Departmental Representative supplied, scale drawings showing highlight inspected pipeline. Drawing to be attached to inspection condition report for each section of sewer pipeline surveyed.

3.8.3 Present report in 215 mm x 280 mm three ring (D type) binder. DVD’s containing relevant CCTV inspections surveys to be included in the binder.

3.8.4 Attach computer disks in three hole plastic diskette sheet holder in back of binder.

3.8.5 Attach identical identification labels on the three ring binder, DVD's (video files) and CD's (database and still digital images).

3.8.6 All dimensions and chainages in the reports to be metric.

3.9 Cleaning

3.9.1 Clean pipelines to Section 33 01 30.02 immediately prior to CCTV inspection survey, unless otherwise specified in the Contract Documents.

3.10 Root Cutting & Removal

3.10.1 Remove roots to Section 33 01 30.02 for condition codes RT and RM where required, to allow for CCTV equipment to pass.

3.11 Flow Reduction

3.11.1 Reduce flow in pipeline to approximately 20% of pipe diameter to allow CCTV inspection by combination of the following:

3.11.2 Schedule work for off peak flow times.

3.11.3 Plug or block flow at upstream manhole.

(a) Plug designed to either plug all flow or impede flow ("flow through" plug) to the approximate 20% of pipe diameter.

(b) Obtain Departmental Representative's approval prior to plugging or impeding any flow.

(c) Remove plug or blocks to slowly return flow to normal without surge or surcharging downstream pipeline.

3.11.4 Temporary bypass pump flow around inspection section when Contractor demonstrates that off peak inspection, plugging and /or the use of sewer cleaning equipment cannot effectively reduce flow levels to specified levels. Bypass pump plugs to be flow through with hoses and pump of sufficient capacity to handle the peak flow. Hoses and couplings to be leak free. Flow to be pumped to downstream manhole on same system or run as inspection is to take place. Obtain Departmental Representative's approval prior to setting up temporary bypass pump system.

3.12 Coding Accuracy

3.12.1 Coding accuracy to be a function of the number of defects or construction features not recorded (omissions) and the correctness of the coding and classification recorded. Coding accuracy to satisfy the following requirements:

(a) header accuracy - 95%

(b) detail accuracy - 85%

3.12.2 Contractor to implement a formal coding accuracy verification system at the onset of the work. Coding accuracy to be verified by the Contractor on a random basis on a minimum of 10% of the inspection reports. Departmental Representative to be entitled to review the accuracy verification system and results and be present when the assessments are being conducted.

3.12.3 A minimum of two accuracy verifications to be performed for each operator for each working week. Coding not satisfying the accuracy requirements to be re-coded and the accuracy of the inspection report immediately preceding and following the non-compliant inspection to be verified. Process to be repeated until the proceeding and subsequent inspections meet accuracy requirements.

END OF SECTION

CLEANING OF SEWERS

1.0 GENERAL

1.1 Section 33 01 30.02 refers to those portions of the work that are unique to the requirements for cleaning of new and existing sanitary, storm and combined sewer pipe and pipe culverts.

1.2 Related Work

1.2.1 CCTV Pipeline Inspection Section 33 01 30.1

1.3 References

1.3.1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in Quality Assurance and Reference Specifications - Section 01 43 00. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the Work described herein.

1.4 Work Regulations

1.4.1 Work to conform to all applicable regulations of WorkSafe BC. Confirm training compliance in the following:

(a) Confined space rescue and entry procedures

(b) Atmospheric monitoring and ventilation methods

(c) Self contained breathing apparatus

(d) Personal protective equipment

1.5 Terminology

1.5.1 Flushing is defined as a maximum of three passes of high pressure jetting equipment to allow for passage of CCTV or other forms of inspection equipment.

1.5.2 Cleaning is defined as the removal of all debris by means of high pressure jetting equipment including: gravel, sand, rocks (to 300 mm in diameter), grease and other deleterious material.

1.6 Submissions

1.6.1 Submit the following information seven days prior to the commencement of work;

(a) Provide schedule and sequence of flushing or cleaning activities

(b) Provide written confirmation to the Departmental Representative that workers have knowledge of confined space entry practices and of equipment required for confined space entry

1.7 Scheduling

1.7.1 Schedule work to minimize interruptions to existing services.

1.7.2 Hours of work to comply with noise restriction bylaw unless granted exemption by Municipality.

1.7.3 Maintain existing flow during sewer cleaning and debris removal unless directed otherwise in contract document.

2.0 PRODUCTS

2.1 Equipment

2.1.1 High velocity cleaning equipment to be capable of providing a minimum flow of 200 L/min (60 GPM) at 140 bar (2000 psi). Cleaning nozzle to be hydraulically or hydro-dynamically propelled and capable of producing a scouring action from 15-45°. A variety of ancillary equipment and nozzles to be available including; standard flushing nozzles, high efficiency , spinning jet and plough jet to address all anticipated debris conditions. The equipment to include a water tank, pumps and hydraulically driven hose reel. Equipment to include a wash down gun for cleaning manholes and an approved back flow preventing device for water tank filling.

2.1.2 Debris removal equipment to consist of a vacuum pump complete with positive displacement pumps or fans producing a minimum of 700 L/s air movement. Equipment to be capable of removing debris at a minimum of 4.5 m vertical head. Suction hose to be a minimum of 150 mm diameter. Debris tank to be water tight and capable of returning the liquid portion of the debris to the sewer.

2.1.3 Debris cutting equipment to be an accessory or attachment to hydraulic cleaning equipment. Equipment to be capable of removing heavy roots and solid debris such as encrustation and grease.

2.1.4 Backflow prevention valves for the purpose of drawing water from hydrants to have air gap and must be pre-approved by the utility having jurisdiction.

3.0 EXECUTION

3.1 Clean or Flush

3.1.1 Clean or flush all pipelines as specified in Contract Documents. Notify Departmental Representative immediately in the event that roots, grease or unusual quantities of debris is observed after three passes.

3.1.2 Notify all affected residence connected to the sanitary sewers in writing of proposed sewer cleaning and CCTV inspection process as specified in the Contract Documents. Notice to be distributed two working days in advance of flushing. Notice to include Contractor’s name and contact information.

3.1.3 Begin cleaning or flushing from the upstream sewer in the system and proceed downstream. Under no circumstances is the sewer cleaning of flushing process to

proceed downstream until all contributing upstream sewers have been cleaned. Sewers to be cleaned or flushed in the direction of flow.

3.1.4 Manholes to be washed down with high pressure wand AFTER manhole inspection has been completed.

3.1.5 Remove debris by vacuum pumping at each manhole. Do not pass debris from manhole to manhole.

3.1.6 Dispose of debris at an approved landfill site

3.1.7 Comply with applicable Provincial and Municipal environmental laws with regard to the decanting of accumulated waste water with respect to spills and discharge of contaminants.

3.1.8 Decanting of liquid waste accumulated during debris removal is permitted at a controlled release rate of a maximum of 8 L/s.

3.2 Water Supply

3.2.1 Water may be obtained from designated water supply station at the Public Works Yard. Fees for this will be waived for the duration of this Contract.

3.3 Root Removal

3.3.1 Inform Departmental Representative prior to undertaking any root cutting or grease removal where cutting equipment is required.

3.3.2 Run root cutter through entire section of pipeline from manhole to manhole or end of pipe to end of pipe

3.3.3 Select root cutting devise or grease removal nozzle of appropriately size and configuration for the diameter of the pipeline.

END OF SECTION

PROJECT NO 39903 - 180402
CANADIAN FOOD INSPECTION AGENCY
AHU REPLACEMENT/EXHAUST MANIFOLD
BURNABY, BC

STORM SEWERS

1.0 GENERAL

1.1 Section 33 40 01 refers to those portions of the Work that are unique to the supply and installation of storm sewers and service connections. Related appurtenances are included in other sections. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.2 Related Work

1.2.1	Excavating, Trenching and Backfilling	Section 31 23 33.01
1.2.2	Concrete Reinforcement for Civil Works	Section 32 20 00
1.2.3	Cast-in-Place Concrete for Civil Works	Section 32 30 00
1.2.4	Manholes and Catchbasins	Section 33 44 01
1.2.5	CCTV Inspection of Pipelines	Section 33 01 30.01
1.2.6	Aggregates and Granular Materials	Section 31 05 16

1.3 References

1.3.1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in Quality Assurance and Reference Specifications - Section 01 43 00.

1.4 Samples

1.4.1 Samples may be required.

1.5 Material Certification

1.5.1 Products have CSA certification to be used where readily available. Product to be certified to CSA standard(s) by an approved independent third party certification body accredited by the Standards Council of Canada and that is acceptable to the Departmental Representative. Products to be marked with certification body logo and CSA standard markings.

1.5.2 At least 10 Business Days prior to commencing work, submit to Departmental Representative the material manufacturer’s recent test data and certification that materials to be incorporated into works are representative and meet requirements of this section. Include manufacturer’s drawings where pertinent.

1.6 Scheduling of Work

1.6.1 Schedule work to minimize interruptions to existing services.

1.6.2 Maintain existing flow during construction.

1.6.3 Submit schedule of expected interruptions for approval by Departmental Representative and adhere to approved schedule.

2.0 PRODUCTS

2.1 Concrete Pipe

2.1.1 Non-reinforced circular concrete pipe and fittings: to ASTM C14M maximum diameter 900 mm, strength class as shown on Contract Drawings, designed for flexible rubber gasket joints to ASTM C443M.

2.1.2 Reinforced circular concrete pipe and fittings: to ASTM C76M for all pipe greater than 900 mm diameter, strength class as shown on Contract Drawings, designed for flexible rubber gasket joints to ASTM C443M.

2.1.3 Reinforced concrete arch pipe: to ASTM C506M.

2.1.4 Reinforced concrete elliptical pipe: to ASTM C507M.

2.1.5 Lifting holes:

(a) Pipe 900 mm and less diameter: no lift holes.

(b) Pipe greater than 900 mm diameter: engineered lift insert systems designed for the weight of the pipe cast into the pipe walls during manufacture. Not to exceed two in piece of pipe.

(c) Manufacturer to provide properly rated lifting clutches to be used with lift insert cast into pipe.

(d) Lift insert opening not required to be grouted provided it does not extend beyond the depth of the engineered design.

(e) Provide pre-fabricated plugs to seal lift holes water tight after installation of pipe.

(f) At request of the Departmental Representative, manufacturer shall supply design information confirming suitability of lift insert system used.

(g) Pretesting: not required unless specified in Supplementary Specification. If specified, pretest in accordance with Sanitary Sewers – Section 33 30 01.

(h) Seal lift holes watertight after installation of pipe.

2.2 Plastic Pipe, Mainline Smooth Profile

2.2.1 Type PSM polyvinyl chloride (PVC) up to 1200 mm in diameter. Pipes to have minimum pipe stiffness (F/Y) of 320 kPa at 5.0% deflection, ASTM D2412. Pipe to be manufactured to specifications for pipe size ranges as follows:

(a) 100 mm dia. – 375 mm dia. to ASTM D3034

(b) 450 mm dia. – 1200 mm dia. to ASTM F679

2.2.2 Pipes to be certified CAN/CSA B182.2 (100 mm to 1200 mm diameter)

2.2.3 Dimension Ratio (DR): 35 for 200 mm to 1200 mm and 28 for 100 mm to 150 mm.

2.2.4 Joints: push-on type comprised of integral bell with single elastomeric gasket to ASTM D3212 and ASTM F477.

(a) Pipe joints to withstand minimum hydrostatic pressure of 345 kPa without leakage.

(b) Pipe joints in pipes with pipe stiffness less than 320 kPa to withstand 550 kPa.

2.2.5 Normal pipe laying length joint to joint to be 4.0 m.

2.2.6 Maximum installed short term deflection not to exceed 5.0% of the base inside diameter.

2.3 Plastic Pipe, Mainline Ribbed Profile

2.3.1 Open profile ribbed PVC pipe and fittings conforming to ASTM F794 and certified to CSA B182.4, 200 mm to 1200 mm diameters. Fittings to be certified to CSA B182.2 and conform to ASTM D3034 and ASTM F679.

2.3.2 Pipe stiffness of 320 kPa at 5.0% deflections, when tested in accordance with ASTM D2412. Pipe to be marked to clearly indicate class rating as required under ASTM F794.

2.3.3 Joints: push-on type comprised of single elastomeric gasket to ASTM D3212 and ASTM F477.

2.3.4 Normal pipe laying length joint to joint to be 4.0 m.

2.3.5 Maximum installed short term deflection not to exceed 5.0% of the base inside diameter.

2.3.6 Pipe shall be installed within two years from the production date indicated on the pipe.

2.4 HDPE Pipe, Mainline Open Profile

2.4.1 HDPE Open Profile Pipe (Corrugated Exterior, Smooth Inner Wall) and Fittings certified to CSA B 182.8, 100 mm to 900 mm diameter.

2.4.2 Pipe to have a minimum pipe stiffness of 320 kPa at 5.0% deflection, when tested in accordance with ASTM D2412. Exterior pipe corrugation to be embossed with a stiffness rating as required by CSA B182.8.

2.4.3 Pipe to have factory assembled spigot gaskets and integral bell joint features certified to CSA B182.8. Joints to conform to all requirements of ASTM D3212 elastomeric gaskets to conform to ASTM F477.

2.4.4 Maximum short term installed deflection not to exceed 5.0% of base inside diameter.

2.5 Spiral Rib Pipe-Steel

2.5.1 Spiral Rib Pipe: to CAN3-G401 except external helical corrugation pattern to be 19 mm x 19 mm x 190 mm, as described in AASHTO M36 or ASTM A760.

2.5.2 Pipe Material: Galvanized or Aluminized Steel Type II to CAN3-G401.

2.5.3 Pipe Wall Thickness: In accordance with manufacturer's recommendations given minimum and maximum cover limits and conditions.

2.5.4 Couplers: Hugger Band type couplers complete with o-ring gaskets conforming to CAN3-G401. Coupler width to be 500 mm wide.

2.5.5 Pipe Laying Lengths: Up to 10 m, or as specified on Contract Drawings.

2.5.6 Maximum installed vertical deflection not to exceed 5.0% of base inside diameter. Maximum installed horizontal deflection not to exceed 3% of base inside diameter.

2.6 Service Connections

2.6.1 Minimum diameter 100 mm, maximum diameter as specified on Contract Drawings. Storm sewer service connections greater than 150 mm diameter to be of size and material specified on Contract Drawings and to conform to applicable specification for mainline pipe.

2.6.2 All 100 mm and 150 mm storm sewer connections to be PVC type PSM sewer pipe, Dimension Ratio (DR) 28. . Pipe to have a minimum pipe stiffness of 625 kPa. Pipe to be manufactured to ASTM D3034 and certified by Canadian Standards Association to CSA B182.2.

2.6.3 Extrusion moulded PVC wyes or fabricated PVC fittings manufactured to ASTM D3034 and CSA B182.2 to be used for all connections to new PVC mainline pipe.

2.6.4 All connections to new non-reinforced or reinforced concrete mainline pipe to be made using sanded PVC pipe male end stud with integral bell by either:

(a) Stub grouted into neatly chipped hole in pipe wall by concrete pipe manufacturer. Grout to be Portland cement based grout.

(b) Stub epoxy resin cemented in neatly cored hole in pipe wall by concrete pipe manufacturer.

2.6.5 Stub and bell orientation to be 45° to centreline of mainline pipe (wyes) for concrete pipe, less than 1050 mm diameter. Orientation may be 90° to centreline of mainline pipe (tees) for concrete pipe 1050 mm diameter or larger. No section of service stubs to protrude past inside of concrete pipe wall.

2.6.6 PVC pipe stub and bell to conform to ASTM D3034 complete with locked-in single elastomeric gasket conforming to ASTM D3212 and ASTM F477.

2.6.7 Field installed tees and wyes:

(a) In-situ installation of tees and wyes into concrete, open profile HDPE pipe, PVC pipe or steel spiral rib mainline pipe shall be made with approved PVC saddle installed to the manufacturers' specifications into a neatly cored hole in the pipe wall.

(b) Connections to profile PVC pipe or open profile HDPE pipe to be made with a preformed tee or wye filling when connection is up to two sizes smaller than mainline pipe. For connection more than two sizes smaller than the mainline, an insertable tee for PVC pipe or open profile HDPE pipe is permitted. When an insertable tee is used, cut hole into mainline pipe to cut as few ribs as possible.

2.6.8 Pipe and fitting joints for service piping materials other than PVC type PSM as sewer pipe to be as specified for applicable mainline pipe.

2.6.9 Fittings: PVC to ASTM D3034.

2.6.10 Pipe and fitting joints: push-on type comprised of integral bell with single locked in elastomeric gasket to ASTM D3212 and ASTM F477.

2.6.11 Normal pipe laying length joint to joint to be 4.0 m.

2.7 Perforated Drain Pipe

2.7.1 Pipe to be 100 mm minimum.

2.7.2 PVC Pipe to be certified to CSA B182.2 for 100 mm and 150 mm diameters. For pipe diameters 200 mm and larger, pipe to be certified to CSA B182.2 and CSA B182.4.

2.7.3 HDPE open profile drain pipe diameter 100 mm and larger to be certified to CSA B182.8.

2.7.4 Concrete pipe shall conform to either ASTM C76M (Reinforced) or ASTM C14M (non-reinforced) with perforation conforming to ASTM C444-03 "Standard Specification for Perforated Concrete Pipe"

2.8 Concrete

2.8.1 Concrete mixes and materials required for bedding cradles, encasement, and incidental uses: to Section 32 30 00 - Cast-in-Place Concrete for Civil Works.

2.8.2 Concrete to be minimum 20 MPa.

2.9 Granular Pipe Bedding and Surround Material

2.9.1 As shown on Contract Drawings.

(a) Refer to Section 31 05 16 - Aggregates and Granular Materials for material specifications.

2.10 Backfill Material

2.10.1 As shown on Contract Drawings.

2.10.2 Refer to Section 31 05 16 - Aggregates and Granular Materials for material specifications.

2.11 Oil Interceptor Units

2.11.1 To be installed within a manhole or vault structure and provide oil/water separation to the following specifications:

Temperature	5°C
Design Flow	5 L/s
Oil Specific Gravity	0.85
Oil Influent	100 mg/L
Oil Effluent	<10 mg/L
Coalescing Plate Spacing	8mm

3.0 EXECUTION

3.1 General

3.1.1 Pipe bedding details, including granular surround (pipe cushion) and material specifications to be as shown on Contract Drawings, including Standard Detail Drawings.

3.2 Preparation

3.2.1 Clean pipes and fittings of debris and water before installation. Carefully inspect materials for defects before installing. Remove defective materials from site.

3.3 Trenching

3.3.1 Do trenching in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.3.2 Trench alignment and depth as shown on Contract Drawings or as approved otherwise by Departmental Representative.

3.4 Concrete Bedding and Encasement

3.4.1 Do concrete work to Section 32 30 00 - Cast-in-Place Concrete for Civil Works. Place concrete to details as shown on Contract Drawings or as directed by Departmental Representative.

3.4.2 Pipe may be positioned on concrete blocks to facilitate placing of concrete. When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.

3.4.3 Do not backfill over concrete within 24 hours after placing.

3.5 Granular Bedding

3.5.1 Fill over-excavation below design elevation of bottom of specified bedding with approved drain rock or granular bedding placed and compacted in accordance with 3.6.2 and 3.6.5 of this Section. Drain rock may be used for backfill of over-excavation only with Departmental Representatives approval.

3.5.2 Place granular bedding material across full width of trench bottom in uniform layers not exceeding 150 mm compacted thickness to depth as shown on Contract Drawings.

3.5.3 Shape bed true to grade to provide continuous, uniform bearing surface for pipe. Do not use blocks when bedding pipe.

3.5.4 Shape transverse depressions in bedding as required to suit joints.

3.5.5 Compact each layer of full width of bed to minimum 95% Modified Proctor Density in compliance with ASTM D1557. (All following references to density imply in compliance with ASTM D1557).

3.5.6 For Spiral Rib Pipe, shape bedding to fit lower segment of corrugated pipe exterior so that width of at least 50% of pipe diameter is in close contact with bedding.

3.6 Pipe Installation

3.6.1 Handle pipe in accordance with manufacturer's recommendations. Do not use chains or cables passed through pipe bore so that weight of pipe bears upon pipe ends.

3.6.2 Lay and join pipes to manufacturer's instructions and specification except as noted otherwise herein. Concrete pipe as specified herein, PVC pipe and open profile HDPE pipe to .to CSA B182.11, Steel Spiral Rib Pipe to CAN3-G401 and in general compliance with Section 33 42 13 Pipe Culverts.

3.6.3 Horizontal tolerances: plus or minus 50 mm from specified alignment.

Vertical tolerances: plus or minus 10 mm from specified grade. Reverse grade is not acceptable

(Refer to Clause 3.14.5 for acceptable post installation ponding tolerances.)

3.6.4 Lay pipes on prepared bed, true to line and grade. Ensure barrel of each pipe is in contact with shaped bed throughout its full length.

3.6.5 Commence laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.

3.6.6 Pipes on curved alignments:

(a) Concrete pipe, PVC, ribbed profile PVC plastic pipe and open profile HDPE pipe. Do not exceed one-half permissible joint deflection recommended by pipe manufacturer.

(b) Smooth profile PVC pipe: for 100 mm to 300 mm sizes conform to required curvature by bending pipe barrel. In no case is radius of curvature to exceed 300 times outside diameter of the barrel. For sizes larger than 300 mm do not exceed one-half permissible joint deflection recommended by pipe manufacturer.

(c) Spiral Rib Pipe: Conform to required curvature by bending pipe barrel in accordance with manufacturer recommendations. In no case is radius of curvature to be less than 45 m for pipes greater than 450 mm in diameter. Deflection at the coupler not permitted.

3.6.7 Keep jointing materials and installed pipe free of dirt, water, and other foreign materials. Whenever work is stopped, install removable watertight bulkhead at open end of last pipe laid to prevent entry of water and foreign materials.

3.6.8 Cut pipes as required, as recommended by pipe manufacturer without damaging pipe and leave smooth end at right angles to axis of pipe.

3.6.9 Joints:

(a) Install gaskets as recommended by manufacturer on all pipe unless specified otherwise in Supplementary Specifications.

(b) Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.

(c) Align pipes carefully before joining.

(d) Maintain pipe joints free from mud, silt, gravel, and other foreign material.

(e) Avoid displacing gasket or contaminating with dirt or other foreign material. Remove disturbed or dirty gaskets; clean, lubricate and replace before joining is attempted.

(f) Complete each joint before laying next length of pipe.

(g) Minimize joint deflection after joint has been made to avoid joint damage.

(h) Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.

3.6.10 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise specified.

3.6.11 When any stoppage of work occurs, restrain pipes in an approved manner to prevent "creep" during down time.

3.6.12 Plug lifting holes with approved prefabricated plugs, to pipe suppliers' recommendations for sealing methods.

3.6.13 Make watertight connections to manholes. Use shrinkage compensating grout when suitable gaskets are not available. Core neat circular holes in walls of existing manholes. Do not hammer or chip except as approved by Departmental Representative.

3.6.14 Use prefabricated saddles or approved field connections for connecting pipes to existing sewer pipes. Core or saw circular holes in existing pipe walls. Do not create holes by hammering nor chipping. Joint to be structurally sound and watertight without encroachment into inner circle of mainline sewer pipe.

3.6.15 Where groundwater and soil characteristics may contribute to the migration of soil fines into or out of the bedding and haunch zones with the native soils, foundation materials, and/or other backfill materials; methods to prevent migration shall be provided.

3.7 Pipe Surround

3.7.1 Upon completion of pipe laying and after Departmental Representative has inspected work in place, surround and cover pipes as shown on Contract Drawings. Do not backfill until the Departmental Representative has inspected the work.

3.7.2 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness simultaneously on both sides. Do not dump material within 1 m of pipe.

3.7.3 Compact each layer from pipe invert to underside of backfill to minimum 95% Modified Proctor Density.

3.8 Connections to Existing Mainline Pipes

3.8.1 Use prefabricated saddles or approved field connection materials and techniques to connect service pipes to existing mainline sewer pipes. Ensure joint structurally sound and watertight without encroachment into inner circle of mainline sewer pipe.

3.8.2 Where feasible, make connection to existing non-reinforced or reinforced concrete mainline pipe by coring or sawing circular holes in existing pipe walls. Where not feasible, make as follows:

(a) Break in to pipe by drilling small diameter holes, spaced at approximately 50 mm along pipe axis, using a drill or chipping gun. Use hammer to strike concrete adjacent to centre holes to create small core, and similarly expand core dimensions of stub.

(b) Core dimensions to allow maximum 20 mm clearance around stub at any point.

(c) Trim stub to conform closely to shape of pipe interior when installed.

(d) Insert stub into core, ensuring that no portion of stub protrudes beyond interior of pipe.

(e) Prepare non-shrink, fast-setting cementitious grout to ‘dry pack’ consistency. Pack grout tightly into void between stub and pipe.

(f) Hand finish interior and exterior grout surfaces to smooth surface.

3.8.3 For new connection to existing PVC mainline sewers, drill hole in mainline to exact dimension of new connection. Use saddle or insertable tee for connection more than two sizes smaller than mainline. Insertable tee may be used for all types of gravity mains provided Insertable tee designed for applicable pipe thickness is used.

3.8.4 For new connections to existing PVC pipe or open profile HDPE pipe mainline sewers use preformed tee or wye fitting when connection is up to two sizes smaller

than mainline pipe. For these pipes, in-situ installation of tees or wyes involved cutting across pipe ribs not permitted. For connections more than two sizes smaller than mainline pipe, an insertable tee for PVC pipe or open profile HPDE pipe is permitted. When insertable tee is use, hole cut into mainline pipe to cut as few ribs as possible.

3.9 Backfill

3.9.1 Place and compact backfill material in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.9.2 Backfill requirements, including type of material and compaction requirements, as shown on Contract Drawings, including Standard Detail Drawings.

3.10 Service Connection Installation

3.10.1 Install service connections to 3.7 and as shown on Standard Detail Drawings.

3.10.2 Install 40 mm x 90 mm marker stake at service terminus. Paint and mark as shown on Standard Detail Drawings.

3.10.3 Where specified install inspection chamber at specified location, set plumb and to specified elevation as shown on Standard Detail Drawing. If inspection chamber is located in driveway, lane or paved surface install cover or lid as shown on Standard Detail Drawing.

3.10.4 Sawcut adjacent curb on alignment of service connection and paint green.

3.11 Cleaning and Flushing

3.11.1 Before flushing and testing, ensure sewer system is completely finished and make arrangements with City for scheduling of testing.

3.11.2 Contractor may obtain water from Municipality as specified below:

(a) Water may be supplied from fire hydrants upon application for a Hydrant Use Permit.

3.11.3 Obtain municipal approval prior to discharging flushing water to municipal sewers or drainage ditches.

3.11.4 Provide Departmental Representative with all required approvals prior to discharging flushing water.

3.11.5 Repair or replace pipe, pipe joints or bedding found defective.

3.11.6 Remove foreign material from pipe and related appurtenances by flushing with water. Main to be flushed at water velocities as high as can be obtained from available water sources. Flushing to continue at least until flow from most distant point has reached discharge point and until water discharged is clean and clear.

3.12 Testing

3.12.1 Infiltration and exfiltration testing is not required.

3.12.2 Video Inspection of completed storm sewers under 900 mm in diameter following completion of installation per Section 33 01 30.01 – CCTV Inspection of Pipelines.

3.12.3 Additional testing may include passing rubber ball, mandrel or test plug having a minimum dimension of 95% of diameter of sewer pipe completely through pipes and appurtenances. A light test maybe performed in lieu of ball test at discretion of Departmental Representative.

3.12.4 Curvilinear sewers to be video inspected immediately following completion of installation of individual sections. Deficiencies found to be promptly remedied in accordance with following 3.12.

3.13 Installation Standard

3.13.1 Repair visible leaks regardless of test results.

3.13.2 Repair procedures and material subject to approval of Departmental Representative.

3.13.3 All pipes to be installed without any repairs to inside of pipe and joints. Contractor to either repair installation from outside of pipe or replace whole installation at Contractor's sole cost.

3.13.4 Test procedures, including video inspection, to be repeated and repairs made until satisfactory results are obtained. Contractor to be responsible for any and all inspection and testing costs including video inspection costs incurred by Departmental Representative.

3.13.5 Acceptable Ponding:

(a) Connections: 10 mm maximum ponding of 4 m length of pipeline.

(b) Mainline PVC sewers:

(i) 300 mm diameter or less: 20 mm maximum ponding over 4 m length of pipe.

(ii) Greater than 300 mm diameter: 30 mm maximum ponding over 4 m length of pipeline

(c) Mainline Concrete sewers:

(i) 300 mm diameter or less: 20 mm maximum ponding over 5 m length of pipeline

(ii) Greater than 300 mm diameter: 30 mm ponding over 5 m length of pipeline

3.14 Connections to Existing Mains

3.14.1 Make connections to existing storm sewer systems unless shown otherwise on Contract Drawings. Notify Departmental Representative minimum 48 hours in advance of scheduled connection.

3.14.2 Make connection in presence of Departmental Representative. To prevent damage to existing utilities, excavate last 300 mm over utility by hand.

3.15 Perforated Drain Pipe

3.15.1 Where shown on Contract Drawings or where directed by Departmental Representative install perforated drain pipe adjacent to sidewalk or curb and gutter.

3.15.2 Drain pipe to be 100 mm minimum.

3.15.3 Connect to catchbasins.

3.15.4 Install other perforated drain pipes as shown on Contract Drawings.

3.15.5 Install sweep bend and cap at ground grade at upstream end of run.

3.15.6 Install with perforations downward.

END OF SECTION

MANHOLES AND CATCHBASINS

1.0 GENERAL

1.1 Section 33 44 01 refers to those portions of the Work that are unique to the supply and installation of manholes, cleanouts, catchbasins, storm sewer endwalls, lawn drains and related appurtenances. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.2 Related Work

1.2.1	Concrete Reinforcement	Section 03 20 00
1.2.2	Cast-in-Place Concrete	Section 03 30 00
1.2.3	Aggregates and Granular Materials	Section 31 05 16
1.2.4	Excavating, Trenching and Backfilling	Section 31 23 33.01
1.2.5	Storm Sewers	Section 33 40 01

1.3 References

1.3.1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in Quality Assurance and Reference Specifications - Section 01 43 00.

1.4 Samples

1.4.1 Samples may be requested

1.5 Material Certification

1.5.1 Products having CSA certification to be used where readily available. Product to be certified to CSA standards(s) by an approved independent third party certification body accredited by the Standards Council of Canada and that is acceptable to the Departmental Representative. Products to be marked with certification body logo and CSA standard markings.

1.5.2 At least 14 days prior to commencing work, submit to the Departmental Representative manufacturer's recent test data and certification that materials meet requirements of this section. Include manufacturer's drawings, information and shop drawings where pertinent.

1.5.3 For cast iron products, provide load tests results performed by an independent laboratory for each casting lot as defined by ASTM A48.

2.0 PRODUCTS

2.1 Materials

2.1.1 Concrete:

(a) To Section 03 30 00 - Cast-in-Place Concrete.

(b) Concrete to be minimum 20 MPa or as specified otherwise on Contract Drawings.

2.1.2 Concrete reinforcement: to Section 03 20 00 - Concrete Reinforcement.

2.1.3 Precast manhole sections to be precast reinforced spun concrete to ASTM C478M complete with ladder rungs to ASTM A615.

2.1.4 Precast "Tee" Sections: precast "Tee" sections constructed as an integral component of mainline pipe will only be acceptable where shown on Contract Drawings as an approved alternative.

2.1.5 Manhole lids: to be precast reinforced concrete shall be designed to withstand H20 loading.

2.1.6 Cast iron frame and cover: as shown on Contract Drawings.

(a) Frame and cover must conform to ASTM A48 and be designed to withstand H20 loading.

(b) Frame and cover must bear manufacturer identification on castings.

(c) Castings to be sand blasted or cleaned and ground to eliminate surface imperfections and coated with two applications of asphalt varnish.

2.1.7 Ladder rungs to be:

(a) As shown on Contract Drawings.

(b) To conform to ASTM C497, ASTM C478M load test.

(c) 20 mm cold rolled steel, hot dipped after bending to CSA G164, welded to reinforcing bars and cast with manhole sections or epoxy grouted into manhole walls.

(d) 20 mm aluminum alloy #6351-T6 (CSA-S157 and NBC 1977), complete with polyethylene anchor insulating sleeves and installed in 25 mm or 26 mm precast or drilled holes in manholes sections.

(e) Polypropylene encased steel ladder rungs: polypropylene ASTM D4101 steel core to be 12 mm diameter grade 60 as per ASTM A615M.

(f) Distance from top of manhole cover to top rung to be maximum 500 mm where no handhold provided. Maximum distance may be extended to 660 mm where handhold provided.

(g) In compliance with all Workers' Compensation Board requirements.

(h) Safety platform: to be installed as shown on Contract Drawings in all manholes in excess of 6 m deep.

(i) Precast catchbasin sections:

(i) As shown on Contract Drawings.

(ii) To be precast reinforced concrete to ASTM C478M.

(j) Catchbasin leads to be minimum 150 mm diameter and PVC DR 35.

(k) Catchbasin lids: to be designed to withstand H20 loading.

(l) Cast iron catchbasin frame and grate: as shown on Contract Drawings.

(i) Frame and grate must conform to ASTM A48 and be designed to withstand H20 loading.

(ii) Frame and grate must bear manufacturers identification on casting.

(m) Joints: to be made watertight using rubber gaskets to ASTM C443M or cement mortar.

(n) Inspection Chambers: as shown on Contract Drawings.

(o) Mortar:

(p) To requirements of CSA-A179, Type S using type 50 sulphate resistant Portland cement.Adjusting rings manufactured to:

(i) Concrete ASTM C478M

(ii) HDPE to ASTM D1248

(q) Concrete Brick: to CAN3-A165 Series.

(r) Drop manhole pipe: to be as shown on Contract Drawings.

(s) Lawn drains to be:

(i) As shown on Contract Drawings.

(t) Concrete bags to be: Jute, burlap or synthetic bag of suitable size and texture filled to 2/3 capacity with mixture of 1 part Portland cement to 2 parts sand, thoroughly mixed, and weighing approximately 27 kg.

(u) Concrete blocks: to be H type concrete construction blocks conforming to latest ASTM specifications.

(v) Prebenched manhole bases:

(i) Where precast manhole sections are incorporated into precast base by bonding to concrete benching, use precast reinforced concrete manhole section to ASTM C478M complete with ladder rungs above benching.

(ii) Where base benching is cast monolithically with manhole walls, reinforce wall and joint sections as specified in ASTM C478M.

(iii) Precast concrete bases section minimum thickness to be 120 mm, measured from underside of base to lowest point in concrete channelling.

(w) Pre-fabricated Corrugated Steel Pipe Manholes may be used with installation of Corrugated Steel Storm Sewers. Pre-fabricated Steel Pipe Manholes to be as shown on the Contract Drawings and in accordance with the manufacturers specifications.

3.0 EXECUTION

3.1 Excavation and Backfill

3.1.1 Excavate and backfill in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.2 Concrete Work

3.2.1 Place concrete reinforcement in accordance with Section 03 20 00 - Concrete Reinforcement.

3.2.2 Do concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete.

3.3 Manhole Installation

3.3.1 Install manholes as shown on Contract Drawings, concurrently with pipe laying. Maximum of three uncompleted units behind point of pipe laying permitted.

3.3.2 Excavation to be free of water prior to placing concrete. Remove soft, frozen and foreign material.

3.3.3 Place minimum 100 mm of 25 mm granular base under base compacted to minimum 95% Modified Proctor density in compliance with ASTM D1557.

3.3.4 Construct base to ensure first precast riser section is set plumb.

3.3.5 Set all inlet and outlet pipes to specified alignments and elevations.

3.3.6 Connect PVC pipe into manhole using "manhole adaptor ring" or approved equal.

3.3.7 Connect concrete pipe into manhole using spigot or bell precast into manhole wall or, alternatively, grout pipe into pre-formed rough core in manhole wall using fast-setting grout.

3.3.8 Ensure placement of concrete does not disturb connecting pipes.

3.3.9 Manholes are to be oriented so that safety steps are on the centreline perpendicular to the main floor channel. Safety steps should be aligned so that a person exiting from the manhole would face oncoming traffic, where this does not conflict with the previous requirement.

3.3.10 Set remaining precast riser sections plumb with joints to eliminate ground water infiltration.

3.3.11 Where possible, form channelling using half-sections of pipe or suitable fillings. Benching to direct flow parallel to main flow of sewer. Top of benching to be at least as high as crown of sewer pipe. Finish concrete to smooth surface using steel trowel.

3.3.12 Brace capped or plugged inlets or stubs to withstand hydrostatic testing head.

3.3.13 Installation of Masonry & Cementitious Riser Rings:

(a) Allowable number of courses is three and minimum is one.

(b) Allowable products is; precast concrete risers, and cast-in place form system

(c) Due regard must be observed to the maximum distance to the first step.

(d) Pre-wet all joints before placing Mortar.

(e) "Butter" inside and outside faces of bricks with mortar to ensure neat even finish. Pre-wet all joints before placing mortar.

(f) Grout inside and outside paces of brick with mortar to ensure neat even grout.

3.3.14 Installation of interlocking High Density Polyethylene Manhole Adjustment Riser Rings.

(a) Ensure base has a flat seating area, remove all protrusions.

(b) Dry stack (without sealant) necessary flat and bevelled rings to provide necessary grade and cross fall with casting.

(c) Apply a vertical strip of paint to allow identical reassembly, after disassembling casting and rings.

(d) Apply a 12 mm bead of approved sealant to the underside circumference of the ring against the male lip. A second bead is required for the base ring and may be applied directly to the concrete base.

(e) Continue with 13.4 until all adjustment rings are sealed together.

(f) Also place sealant on the top of the last ring prior to installing the casting.

(g) Provide a dry mix around the stack, protecting the rings from contact with hot asphalt.

(h) Approved sealants as per the manufacturer, conforming to ASTM D1850.

3.3.15 Plug lifting holes in pipe.

3.3.16 Install drop structures where required on Contract Drawings.

3.3.17 Clean units of debris and foreign materials. Remove fins and sharp projections. Prevent debris from entering system.

3.3.18 Ensure frames conform to contour of pavement or existing surface.

3.3.19 Paint manhole covers as specified on Contract Drawings.

3.3.20 Pre-fabricated Corrugated Steel Pipe Manholes to be installed as shown on the Contract Drawings and to manufacturers' specifications.

3.4 Cleanout and Inspection Chamber Installation

3.4.1 Install cleanouts and inspection chambers as shown on Contract Drawings, to standards and installation procedures described in 3.3

3.5 Catchbasin Installation

3.5.1 Install catchbasins as shown on Contract Drawings, to general standards and installation procedures described in 3.3.

3.5.2 Place minimum of 100 mm of granular base under base. Compact to 95% Modified Proctor density in compliance with ASTM D1557.

3.5.3 Install catchbasin leads in accordance with Section 33 40 01 - Storm Sewers.

3.6 Lawn Drain Installation

3.6.1 Install lawn drains as shown on Contract Drawings.

3.7 Endwall Installation

3.7.1 Install concrete bag or sand bag endwalls as shown on Contract Drawings.

3.7.2 Install concrete block endwalls as shown on Contract Drawings using Type H concrete construction blocks.

3.7.3 Install reinforced concrete endwalls as shown on Contract Drawings and in accordance with Section 03 20 00 - Concrete Reinforcement and Section 03 30 00 - Cast-in-Place concrete.

3.7.4 Precast concrete endwalls may be installed where shown on Contract Drawings as on approved alternative.

3.8 Grillage Trash Screens

3.8.1 Where specified, install grillage trash screens as shown on Contract Drawings.

3.9 Adjusting Tops of Existing Units

3.9.1 Remove existing gratings, frames and store for re-use at locations indicated on Contract Drawings.

3.9.2 Precast units:

(a) Raise or lower precast units by adding or removing precast sections as required.

(b) When amount of raise is less than 300 mm use pre-cast riser rings or cast-in-place form system.

3.9.3 Cast-in-Place units:

(a) Raise cast-in-place units by roughening existing top to ensure proper bond and extend to required elevation with cast-in-place concrete.

(b) Lower cast-in-place units with straight wall by removing concrete to elevation indicated for rebuilding.

(c) Install additional manhole ladder rungs in adjusted portion of units as required.

(d) Re-use existing gratings, frames, and covers.

3.10 Remove Existing Units

3.10.1 Remove existing structures where shown on Contract Drawings. Backfill in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

END OF SECTION

CANADIAN FOOD INSPECTION AGENCY

AHU REPLACEMENT EXHAUST MANIFOLD

BURNABY, BC

APPENDIX A

CFIA ACIA EXHAUST MANIFOLD PHASING

EXHAUST FAN #	SERVICE	LOCATION	ROOM	CABINET	COMMENTS
7	1/F PCR1	SOUTH PENTHOUSE	115/H4	F-NV	Low use equipment- no time constraints or seasonality- can be shut off where ever is most efficient for the project. Micro staff hours of work 7am-5pm;7 days a week
6	1/F PCR1	SOUTH PENTHOUSE	115		Low use equipment- no time constraints or seasonality- can be shut off where ever is most efficient for the project. Micro staff hours of work 7am-5pm; 7 days a week
2	1/F MT-1 CANOPY	NORTH PENTHOUSE	140B		M-F; 7:00am- 4:30pm, FRI-MON shutdown preferred
9	2/F CH-7 CANOPY/HIST	SOUTH PENTHOUSE	214C		CH7 **X** CH9 - 1 Canopy down at a time;M-F; 7:00am-4:30pm
357	2/F CH-9 CANOPY/DA	SOUTH PENTHOUSE	214D		CH7 **X** CH9
330	2/F CH12(H29)	CENTRE PENTHOUSE	214	F-NV	H29:H1056; M-F; 7:00am- 4:30pm; 1 week max downtime
10	2/F CH-12/1056	SOUTH PENTHOUSE	214	A-NV	H29:H1056; M-F; 7:00am- 4:30pm; 1 week max downtime
8	2/F CH-6 CANOPY/SO2	CENTRE PENTHOUSE	213		M-F;7:00am- 4:30pm, HIGH PRIORITY; FRI-MON shutdown
1	1/F/CH SAMPLE PREP	NORTH PENTHOUSE	139A		M-F;7:00am- 4:30pm, 1 week max downtime
11	Spot Vents	ROOF	214		South
3	Bio-assay canopy	ROOF	139E		
5A/5B	Micro gen exhaust	ROOF	MICRO		1 month notice, minimum shutdown
4	1st Floor Condenser	ROOF	MASH		Walk-in cooler
11	MASH Gen. Exhaust	ROOF	MASH		
358	MicroWasher Canopy	SOUTH PENTHOUSE	216		
357	Central washup	SOUTH PENTHOUSE	216		

Legend: **X : cannot be done with another group**

F : Flammables

V: Vented

NV: Not Vented

A : Acid

* cross lab shutdown possible

Staff Hours of Work: M-F : 7am - 4:30 pm except in Microbiology (7 days a week)

Advance Notice: 2 weeks

Shutdown in Microbiology will require 1 month notice to inform clients that samples will not be received during the week of shutdown

WRL EXHAUST MANIFOLD PROJECT Phasing Plan 2017

EXHAUST FAN #	SERVICE	LOCATION	ROOM	CABINET	COMMENTS
384	ACID STORAGE	NORTH PENTHOUSE			North
383	SOLVENT STORAGE	NORTH PENTHOUSE			North
369	SAMPLE PREP	NORTH PENTHOUSE	231		
314	H5	NORTH PENTHOUSE	227	F-V	**H4:H3 X H34:H2:H1 X H5:H7 X** H33:H35
313	H7	NORTH PENTHOUSE	231B	F-NV	H5:H7; together, 1 week
311	H4	NORTH PENTHOUSE	227	A/Ca-V	**H4:H3 X H34:H2:H1 X H5:H7 X** H33:H35
312	H3	NORTH PENTHOUSE	227	F-V	H4:H3; together, 1 week shutdown
309	H34	NORTH PENTHOUSE	227	F-V	**H4:H3 X H34:H2:H1 X H5:H7 X** H33:H35
315	H2	NORTH PENTHOUSE	227	F-V	H34:H2:H1; together, 1 week shutdown
308	H1	NORTH PENTHOUSE	227	F-V	
316	H33	NORTH PENTHOUSE	229	F-V	**H4:H3 X H34:H2:H1 X H5:H7 X** H33:H35
310	H35	NORTH PENTHOUSE	227	F-V	H33:H35;together- 1 week shutdown
307	H31	NORTH PENTHOUSE	225	F-V	H30:H31:H6: together
306	H30	NORTH PENTHOUSE	221	F-V	1 week shutdown
305	H6	NORTH PENTHOUSE	223A	F-V	can be done together with H37:H38:H39:H40:H41
385	H40	NORTH PENTHOUSE	222	A-V	
304	H39	NORTH PENTHOUSE	222	F-V	H37:H38:H39:H40:H41
303	H41	NORTH PENTHOUSE	222	Ch-V	1 MONTH WARNING-SHUTDOWN AT THE SAME TIME
302	H37/38	NORTH PENTHOUSE	222	F-V	1 week shutdown
301	H37/38	NORTH PENTHOUSE	222	F-V	can be done together with H30:H31:H6
368	ACID STORAGE	ROOF	WRL		North
367	SOLVENT STORAGE	ROOF	WRL		North
365	SPOT VENT	ROOF	222		Containment Lab
366	INST/BENCH VENT	ROOF	223		General venting

Legend:

X : cannot be done with another group

F : Flammables

V: Vented

NV: Not Vented

A : Acid

Ch : Chemical

Ca : Caustic

* cross lab shutdown possible

Staff Hours of Work: M-F : 6am - 5 pm

Advance Notice: 2 weeks except Rm 222 (1 month warning)

Max. downtime: 1 week by group

Note: In the Existing 2nd floor Hood Exhaust Location and Phasing in Sheet A203 Revision 3 Grouping D Note Air exchange is needed to keep instruments on in Rm 225 and not Rm 243

DAS EXHAUST MANIFOLD PROJECT Phasing Plan 2017

EXHAUST FAN #	SERVICE	LOCATION	ROOM	CABINET	COMMENTS	*Additional comments due to significantincreasae in workload and new instruments
340	H26	SOUTH PENTHOUSE	208	S-V	H26:H19:H18 **X H32**	H17 and H18 should no longer be grouped together
339	H19	SOUTH PENTHOUSE	208	Ch-V	H26:H19:H18 - 1 week downtime	2 week down time is no longer acceptable. Maximum 1 week for 18, 19, 26 group
338	H18	SOUTH PENTHOUSE	206	S-V		
337	H17	SOUTH PENTHOUSE	206	F/A-V	H 17, Maximum downtime (3 days)	Hood #17 will be used to vent 2 new essential LC/MSs. Max down time is 3 work days
335	H21	SOUTH PENTHOUSE	208	Ca-V	H 21, Maximum downtime (3 days)	(Spray hood)
334	H23	SOUTH PENTHOUSE	208	Ch/F-V	Flexible	(water bath-blow down)
336	H22	SOUTH PENTHOUSE	208	A-V	H22: H20; do 1 at a time	maximum 3 working days each (heaviest use)
333	H20	SOUTH PENTHOUSE	208	S-V	not at the same time	
332	H24	SOUTH PENTHOUSE	208	S-V	H24:H25 X H20:H22	H24:H25 can not be done at same time as H20 or H22, (TLC)
331	H25	SOUTH PENTHOUSE	208	S-V	1 week downtime	
329	H32	CENTRE PENTHOUSE	207	S-V	Flexible	
328	H27	CENTRE PENTHOUSE	211	Ch/F-V	H27 X H28; do 1 at a time	
327	H28	CENTRE PENTHOUSE	211	Ch/F-V	not at the same time	
347	SPOT VENT	ROOF	206-209		bench vents	bench vent for room 206 will be used to vent 2 new essential LC/MSs.
379	SPOT VENT	ROOF	206		bench vents -LC/MSs	Max down time is 3 work days. Best to group with H17 so instruments can be taken out of
378	ACID STORAGE	ROOF	DAS		South	service only once.
377	OLD BENCH EXHAUST	ROOF	206-209		bench vents	
376	SOLVENT STORAGE	ROOF	DAS		South	Note: Room 206 is Room 208 in Existing 2nd floor Hood Exhaust Location and Phasing
345	SOLVENT STORAGE	ROOF	DAS		?	in Sheet A203 Revision 3

Legend: **X : cannot be done with another group**

F : Flammables
V: Vented
NV: Not Vented
A : Acid
Ch : Chemical
Ca : Caustic

* cross lab shutdown possible

A DAS staff must be present to work in this lab area
Staff Hours of Work: M-F : 7am - 6 pm
Advance Notice: 2 weeks
Max. downtime: 1 week by group except as specified
H 21 - Critical fume hood, filter from H 19 to be relocated here

DAS has experienced a 20% increase in work since the last time we did this exercise.
A large part of this increase will be directed toward LC/MS work in room 206 .
This results in a greater demand for these hoods and vents in 206

FTA EXHAUST MANIFOLD PROJECT Phasing Plan 2017

EXHAUST FAN #	SERVICE	LOCATION	ROOM	CABINET	COMMENTS
325	H12	CENTRE PENTHOUSE	237	rt - NV	H12 -limited use
324	H13	CENTRE PENTHOUSE	239	A-V	H13 **X** H14
323	H14	CENTRE PENTHOUSE	239	S-V	H13 **X** H14 cannot be done at the same time
322	H11	CENTRE PENTHOUSE	237	A-V	H10 and H11 **X** **H8 and H9** cannot be done at the same time
321	H10	CENTRE PENTHOUSE	237	S-V	H10 and H11 can be done together but not at same time as H8 and H9
320	H16	CENTRE PENTHOUSE	243A	A-V	H15, H16, H36 - **1** has to be operational
319	H15	CENTRE PENTHOUSE	243A	Ca-V	
326	H36	CENTRE PENTHOUSE	243A	A-V	
318	H8	NORTH PENTHOUSE	235	rt-NV	**H8 and H9** can be done together but not at same time as **H10 and H11**
317	H9	NORTH PENTHOUSE	235	S-V	**H8 and H9 X** H10 and H11 cannot be done at the same time
375	SPOT VENT	ROOF	241		SPOT VENT
374	SPOT VENT	ROOF	241		FTA spot vents
373	ACID STORAGE	ROOF	FTA		East side
372	SOLVENT STORAGE	ROOF	FTA		East side
370	Muffle Furnace	ROOF	237		East side
387		ROOF	231		
349		ROOF	243A		Trace metals on label

Legend:

X : cannot be done with another group

F : Flammables

V: Vented

NV: Not Vented

A : Acid

Ch : Chemical

Ca : Caustic

rt: right side

Busy times: July, Aug, Mar

Hours of work: 7AM -4:00 PM Mon to Fri

Advance Notice: 2 weeks

Max. downtime: 1 week

* cross lab shutdown possible

EXHAUST MANIFOLD PROJECT Phasing Plan 2017

EXHAUST FAN #	SERVICE	LOCATION	ROOM
356	BOARDROOM	MAIN PENTHOUSE	101A
353	BOARD ROOM	MAIN PENTHOUSE	101B
355	ELEVATOR	MAIN PENTHOUSE	133
354	SOLVENT STORAGE	MAIN PENTHOUSE	MAIN
353	BOARD ROOM	MAIN PENTHOUSE	101B
352	CYLINDER ROOM	MAIN PENTHOUSE	143B
351	ACID STORAGE	MAIN PENTHOUSE	MAIN
350	STORAGE/WRKSHOP	MAIN PENTHOUSE	134/136
349	TRACE METAL	MAIN PENTHOUSE	231FTA
348	WASHROOM/JANITOR	MAIN PENTHOUSE	131/135
347	SPOT VENT	MAIN PENTHOUSE	DAS , Bench vents
346	DRY CHEM STORAGE	MAIN PENTHOUSE	COMMON
345	SOLVENT STORAGE	MAIN PENTHOUSE	DAS and SO2
343	LUNCH ROOM	MAIN PENTHOUSE	116
342	TRANSFORMER ROOM	MAIN PENTHOUSE	138A
341	STORAGE/WASHROOM	MAIN PENTHOUSE	242/240
11	2F GEN EXH	ROOF	MASH
364	UNFINISHED RM 285	ROOF	
363	LOADING DOCK	ROOF	142
362/381	CRAWL SPACE	ROOF	
380	LOBBY	ROOF	100
382	LOUNGE	ROOF	
371	WASHROOM	ROOF	119/120

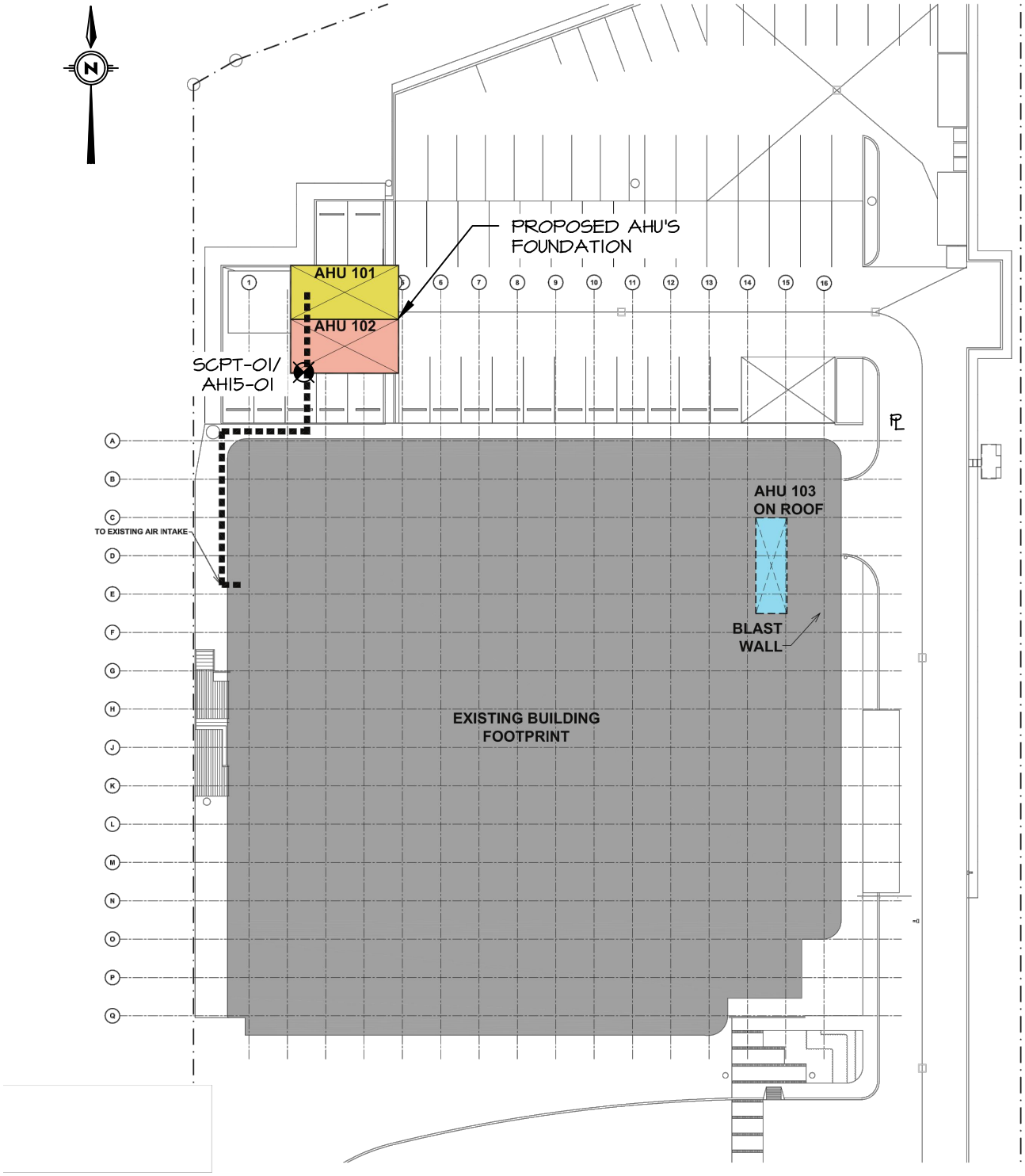
CANADIAN FOOD INSPECTION AGENCY

AHU REPLACEMENT EXHAUST MANIFOLD

BURNABY, BC

APPENDIX B

GEOTECHNICAL REPORT



WILLINGDON GREEN

LEGEND

Approximate location of Seismic Cone Penetration Test/ Machine Auger Hole

Base plan referenced from Chernoff Thompson Architects drawing 'A6', dated September 23, 2015.

No.	DRAWN	DATE	REVISIONS/ISSUE

LEVELTON
Levelton Consultants Ltd.
150-12791 Clarke Place
Richmond, B.C.
Tel: 604 278-1411
Fax: 604 278-1042

TEST HOLE LOCATION PLAN

PROJECT: 3155 WILLINGDON GREEN
BURNABY, BC

CLIENT: READ JONES CHRISTOFFERSEN

DRAWN: KTD	SCALE: 1:500
REVIEWED: GM	DATE: DEC 2015
FILE NUMBER: R715-1902-00	
DRAWING NUMBER: 1	REV: -

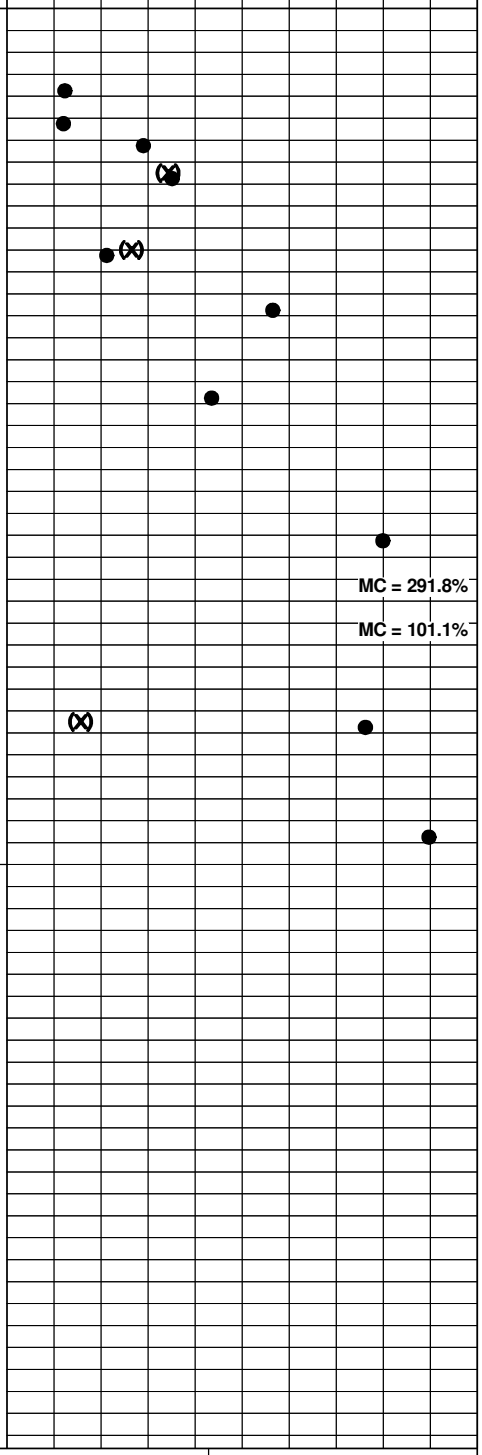
AH15-01

Levelton Consultants Ltd.
#150 - 12791 Clarke Place
Richmond, B.C., V6V 2H9
Tel: 604-278-1411
Fax: 604-278-1042
www.levelton.com

3155 Willingdon Green
Burnaby, BC

Project No: R715-1902-00

Depth (m)	Depth (ft)	Description	C	N	Type	Water Level
		2" of Asphalt			G	
		FILL - 6" of crushed Gravel, over compact br. Sand & Gravel			G	
	5	FILL - br. gr. sandy Silt, some gravel			G	Nov 30 2015
2		Firm br. gr. clayey SILT, trace organics			G	
					G	
	10	Soft gr. SILT, some fine sand			G	
4		Soft br. clayey SILT, some organics, some sand layers			G	
	15				G	
					G	
6	20	Loose gr. coarse SAND, some fine gravel			G	
		Soft gr. br. clayey SILT, some organics, some sand			G	
	25				G	
8		Br. fiberous PEAT			G	
		Soft br. organic SILT			G	
	30					
10		Soft grey silty CLAY			G	
	35					
					G	
12	40	Bottom of hole at 39.0 feet.				
	45					
14						
	50					
16						
	55					
18						
	60					
	65					



C: Condition of Sample
Good
Disturbed
No Recovery

Type: Type of Sampler
SPT : 2 in. standard
ST : Shelby
FP : Fixed Piston
G : Grab
CORE

N: Number of Blows
WH : Weight of Hammer
WR : Weight of Rod
Standard Penetration Test : ASTM D1586
Hammer Type:

DYNAMIC CONE PENETRATION TEST:
Blow Count: Number of blows of a 140 lb (64 kg) hammer dropped 30in. (750mm) to produce 12in. (300mm) of penetration of a 2in. (50mm) diameter cone.

- ● Moisture Content %
- ► Plastic Limit %
- ◄ Liquid Limit %
- ▼ Ground Water Level
- ⊗ Shear strength in kPa (Torvane or Penetrometer)
- X Shear strength in kPa (Unconfined)
- ⊗ Shear strength in kPa (field vane)
- ⊠ Remolded strength in kPa
- ■ Percent Passing # 200 sieve

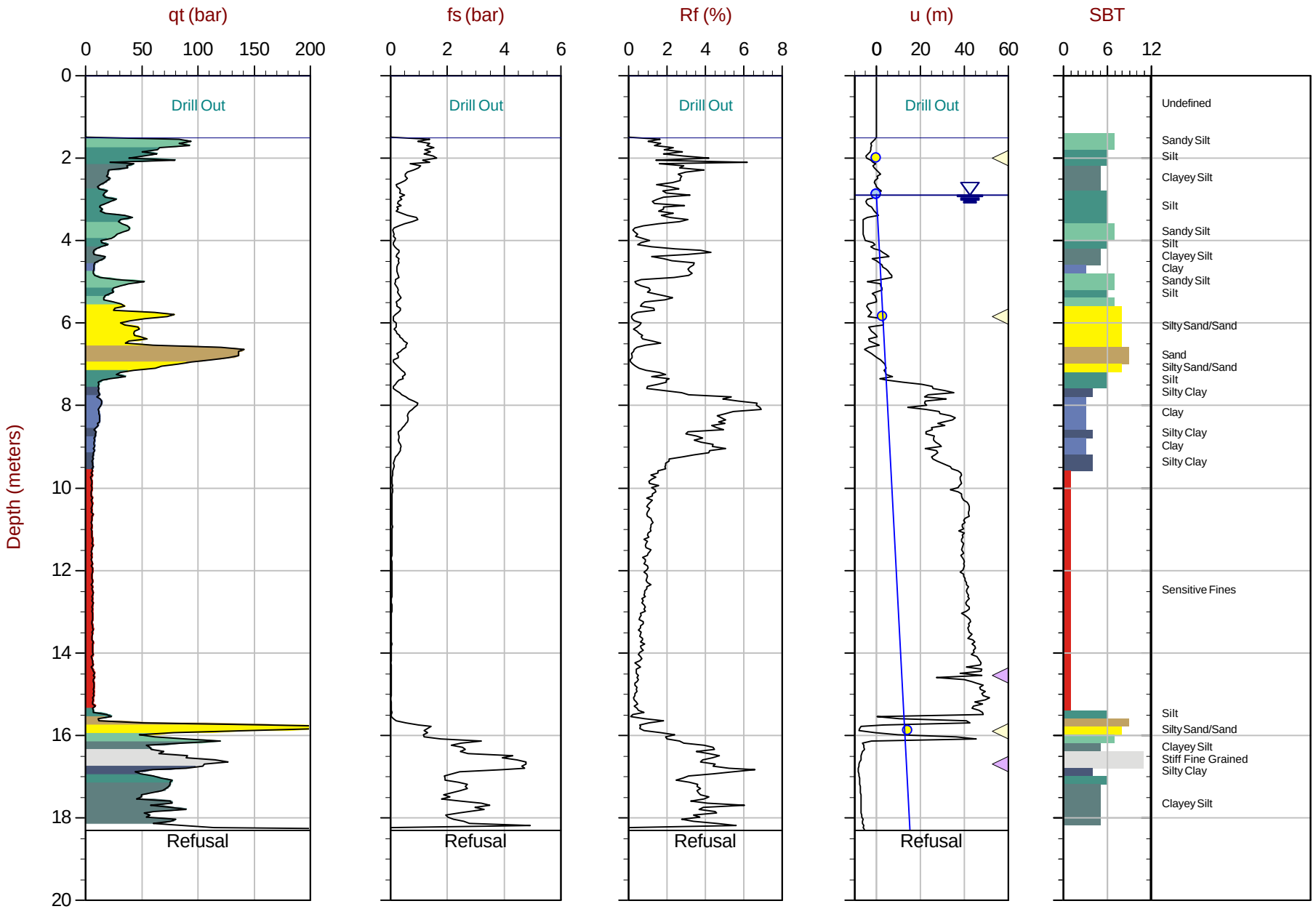
Drill Method:
Solid Stem Auger / DCPT
Date Drilled: 01/12/2015
By: KTD

CONETEC

Levelton

Job No: 15-02119
Date: 12:01:15 10:11
Site: 3155 Willingdon Green, Burnaby, BC

Sounding: SCPT15-01
Cone: 353:T1500F15U500



Max Depth: 18.300 m / 60.04 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.200 m

File: 15-02119_SP01.COR
Unit Wt: SBT Zones

SBT: Robertson and Campanella, 1986
Coords: UTM 10N N: 5455983m E: 499970m
Sheet No: 1 of 1

Equilibrium Pore Pressure (Ueq)
Assumed Ueq
Dissipation, Ueq achieved
Dissipation, Ueq not achieved
Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CANADIAN FOOD INSPECTION AGENCY

AHU REPLACEMENT EXHAUST MANIFOLD

BURNABY, BC

APPENDIX C

01 91 00.01 COMMISSIONING PLAN

JULY 17, 2017

CFIA- Burnaby Lab
AHU Replacement/Exhaust Manifold

Commissioning Plan

KD ENGINEERING co.

3735 Myrtle Street
Burnaby, B.C. V5C 4E7
Phone: 604-872-8651
Fax: 604-872-8653

Contact Person:
Ed Joson, P. Eng., LEED AP, CMVP
email: ejoson@teamkd.com

Table of Contents

1.0 Introduction to Commissioning Plan (CP)

The Commissioning Plan (CP) describes the commissioning process and documentation requirements for this project so that all commissioning team members (especially those being contracted) fully understand the required commissioning process and documentation requirements for this project.

It is noted that this CP has been written by the Commissioning Authority (CA). The CA has an overseeing, multi-disciplinary role (oversees the work of the Mechanical and Electrical Commissioning Agents and/or contractors of specific disciplines.).

The commissioning process described by this commissioning plan was written with reference to the following documentation:

- a brief overview of the commissioning process
- a list of all systems and assemblies included in the Commissioning Authority's scope of work
- identification of Commissioning Team and its responsibilities
- description of the management, communication and reporting of the commissioning process
- overview of the commissioning process activities for this project includes construction, and Occupancy and operations phases, including:
    - review of submittals (construction phase)
    - construction phase verification (construction phase)
    - functional performance test development (construction phase)
    - functional performance test implementation (construction phase), and
- a list of the expected work products
- a list of key commissioning process milestones

Note that this commissioning plan may be revised and re-issued over the course of the project several times so that it is as accurate and as useful as is possible.

The commissioning process responsibilities must be integrated in the construction contract documents and must clearly describe the {following} components:

- commissioning team involvement
- submittal review procedures
- operations and maintenance documentation requirements
- training plan development
- construction verification procedures
- start-up plan development and implementation
- functional performance testing
- milestones
- training
- warranty review site visit"

Because this Commissioning Plan is included in the specifications, the above components have been clearly described to the contractors.

2.0) Brief Overview of the Project and the Commissioning Process

2.1 Project Overview

It is understood that the project is the CFIA Laboratory which is located at 3155 Willingdon Green in Burnaby, BC. Building is a two story concrete structure constructed in 1984 with the gross floor area of 4646m2 and a crawl space below the first floor. The first floor houses offices, mechanical, and service spaces while the second floor houses laboratory spaces.

We also understand that the services of a qualified Commissioning Authority are required to oversee the commissioning process on the project as per the PWGSC Terms of Reference. KD Engineering intends to follow the process outlined in the Commissioning specification sections noted in Section 01 91 00 - Commissioning.

We also understand that the following organizations who will be involved in the commissioning process:

- PGWSC-CFIA
- Chernoff Thompson Architects
- Integral Group
- Morrison Hershfield Limited
- CFIA Facilities
- General Contractor -TBD
- Mechanical Contractor -TBD
- Electrical Contractor -TBD
- Mechanical Commissioning Agent –TBD
- Electrical Commissioning Agent - TBD
- Controls Contractor -TBD

2.2 Commissioning Defined (for this project)

The commissioning process is a quality assurance method adopted by an owner to consistently achieve successful construction projects. It is not an additional layer of construction or project management – it is the owner's means of verifying that the planning, design, construction and operational processes are achieving their goals, and ensures the delivery of a well-performing building (or renovated portion of a building) with high quality and asset value.

The commissioning process involves the owner, users, occupants, operations and maintenance staff, design professionals and contractors.

The commissioning process:

- Begins at project inception
- has ongoing verification of achievement of the owner's project requirements
- requires integration of contractor-completed commissioning process activities into the construction documents
- aids in the coordination of static and dynamic testing that acceptance is based on
- verifies staff training, and
- completes with warranty verifications

The Commissioning Authority serves as an objective advocate for the owner, plans and directs the commissioning process, and presents final recommendations to the owner regarding the performance of commissioned systems and assemblies. The Commissioning Authority introduces standards and strategies early in the planning process and then verifies implementation of the commissioning process activities by clearly specifying the requirements in construction documents.

It is noted that the Commissioning Authority (CA) leads the commissioning team but that the commissioning work is divided among the commissioning team members. It is important that this delineation of work be kept in mind throughout the project.

Please refer to Appendix C (Commissioning Services of this Project) of this plan for the commissioning requirements. Appendix C also describes the expected contributions from the various commissioning team members.

The building industry has come to understand that building commissioning is an essential and cost-effective process which serves to ensure that the building operates as designed and that the building is designed according to the owner's requirements. The successful completion of the commissioning process together with other sustainable building design and construction practices result in more than just ensuring that designed resource savings are actualized. When a building performs properly, as is verified through the commissioning process, there is lasting value to the owners/occupants through the realization of a comfortable and enjoyable space in which to live, work and play.

Also, a project that is properly commissioned, by assuring that the owner's requirements are achieved, ensures long term prestige to all those who were involved with the project.

2.3 The Commissioning Authority

The Commissioning Authority (CA) leads the commissioning team but that the commissioning work is divided among the commissioning team members. In this plan we have made every effort to highlight the distinction between the various roles of the commissioning team members.

The Commissioning Authority (CA) provides the services in support of the commissioning requirements of and for the overall commissioning of the project. The CA is to provide technical comments or advice to the Project team as the design documentation advances and is to assemble a Commissioning Plan (CP) to be followed by the commissioning team such that the project can be properly commissioned. By following the Commissioning Plan (CP), the commissioning team can assure that the "commissioned systems" properly function in accordance with the owner's requirements and the consultant's design intent.

The CA is to report to the Owner or to parties as designated by the Owner during the course of performing the services. Generally, documentation produced by the Commissioning Authority is sent to the entire commissioning team.

It is important to note the clear distinction between the Commissioning Authority and the Commissioning Agents (Mechanical & Electrical). The Commissioning Authority is responsible for overseeing the overall multi-discipline commissioning process while the Commissioning Agents perform and document the testing of the various mechanical and associated electrical "commissioned systems".

3.0) Commissioning Scope of Work

This section is intended to describe both the systems to be commissioned as well as the specific tasks to be carried out as per this plan.

3.1) Commissioned Systems

The following is a list of the systems to be commissioned by the Commissioning Team for this project.

Mechanical & Electrical for the following systems:
• Replacement of AHU-101
• Replacement of AHU-102
• Replacement of AHU-103
• Replacement of Existing Exhaust System by Installation of New Exhaust Manifold System
• Energy Management & Control System (EMCS)

To be clear, the following lists the systems not referenced by as requiring commissioning and therefore are not addressed in the commissioning process (or this plan):

- Telecommunications
- Wireless Communications
- Audio/Visual Systems
- Fire Alarm System
- Fire Sprinkler Systems
- Building Envelope
- Site Services

3.2) Overview of the Commissioning Tasks and Expected Commissioning Work Products

Please refer to Appendix C (Commissioning Services of this Project) of this plan for the commissioning requirements. Appendix C also describes the expected contributions from the various commissioning team members as per as well as the expected commissioning results and documentations.

It is noted that the Commissioning Authority is not responsible for design, construction, construction scheduling, cost estimating, or construction management, but may assist with problem solving or resolving non-conformance issues or deficiencies. A clear distinction is made between the role of the Commissioning Authority and that of the contracted commissioning agents. Appendix C of this Commissioning Plan highlights the distinction between the roles of the commissioning team members with special emphasis on what the Commissioning Authority does and does not do.

4.0) Identification of the Commissioning Team and its Responsibilities

Commissioning is a methodical, team-based process. Each member of the commissioning team must fulfill his or her commissioning functions, as described herein, in order for this process to be successful.

The Commissioning Team is responsible for accomplishing the commissioning process activities and provides leadership for identifying and resolving all commissioning process issues. For this project the commissioning team will be comprised of the parties as shown in Appendix A, at a minimum (team to evolve as the project progresses – also during the construction phase the contracted team members will be added such as the mechanical and electrical contractors and the mechanical and electrical commissioning agents).

5.0) Management, Communication and Reporting of the Commissioning Process

KD Engineering has been tasked with the role of Commissioning Authority for this project and will oversee the commissioning teams for this project. The commissioning team will expand to include tendered commissioning team members such as the mechanical and electrical contractors and the mechanical and electrical commissioning agents.

The post-tender commissioning team is comprised of the Owner Personnel, Design Consultants and Contractors/Suppliers as will be listed in a revised Commissioning Plan Appendix A (to be issued post-tender).

All commissioning-related documentation is to be copied to the Commissioning Authority. All commissioning issues are to be brought to the attention of the Commissioning Authority in a timely manner. All commissioning team members are to assist in the creation of all commissioning and commissioning-related documentation (the creation of these documents is by various members of the commissioning team as specified).

From our experience in performing commissioning consultant services, we would like to highlight the following specific issues of particular importance, which must be kept in mind throughout the project such that the commissioning goals are achieved. These are:

- Good Communication

It is especially important that the Commissioning Authority is kept abreast of all information as it becomes available throughout the design process.

- Design Documentation

Also, it is important that commissioning is treated as an important part of the overall design process and that the various design briefs are created and passed on to the Commissioning Authority.

- Sufficient Time Allowance

To properly perform the various commissioning tasks, sufficient time needs to be allowed for especially during the final phases of construction. Also, time allowances are the most important prior to tender for such tasks as the design review.

- Clarity of Design Ownership

It is important to maintain clear ownership of design with the design consultants (not the commissioning consultant).

- Clarity of Commissioning in the General Contract

It is very important that all contracted parties understand their role in the team process of commissioning. Failure of any team member to fulfill their role can result in a failure of the commissioning process as a whole.

6.0) List of Key Commissioning Process Milestones

Appendix B lists the key commissioning process milestones in a table organized by commissioning/project phase. This table shows the various commissioning steps, its expected completion date and the commissioning team members involve with each step.

7.0) Summary (of this Commissioning Plan)

Together with other referenced documentation, this commissioning plan is intended to describe the commissioning process, procedures and documentation for this project. It is intended that this commissioning plan be modified as is required throughout the project such that it maintains a highly useful function as the prime source for understanding the commissioning process.

8.0) Appendix A - Identification of the Commissioning Team and its Roles and Responsibilities

Commissioning is a methodical, team-based process. Each member of the commissioning team must fulfill the following listed commissioning-related responsibilities in order for the commissioning process to be successful.

Identification of the Commissioning Team:

Commissioning Team Member	Abbr.	Person	Organization/Company
1. Owner Personnel			
1.1 Owner	O	Craig Armitage	PWGSC-CFIA
1.2 Owner's Representative	OR	David Fauteux	CFIA
1.3 Building Operation & Maintenance	BOM	Ian Murdoch	CFIA
2. Key Commissioning Personnel			
2.1 Commissioning Authority	CM	Ed Joson	KD Engineering Co.
2.2 Commissioning Agent - Mechanical	CAg-M	TBD	TBD
2.2 Commissioning Agent - Electrical	CAg-E	TBD	TBD
3. Design Consultants			
3.1 Design Consultant – Architectural	DC-A	Russell Chernoff	Chernoff Thompson Architects
3.2 Design Consultant – Mechanical	DC-M	Mladen Markovic	Integral Group
3.3 Design Consultant – Electrical	DC-E	Boriana Aquirova	Morrison Hershfield
4. Contractors/Suppliers			
4.1 Contractor - General	C-G	TBD	TBD

4.2 Subcontractor - Mechanical	C-M	TBD	TBD
4.3 Subcontractor - Electrical	C-E	TBD	TBD
4.4 Subcontractor – Controls	C-C	TBD	TBD
4.5 Subcontractor - Balancing	C-B	TBD	TBD

The roles and responsibilities of the commissioning team members:

0. All Commissioning Team Members

All Commissioning Team Members to perform the following tasks:

- Perform tasks and submit documentation as outlined in this Commissioning Plan.
- Provide any required documentation promptly.
- Attend commissioning meetings (as required).
- Attend commissioning testing/verification sessions (as required).
- Identify and announce any commissioning-related issues discovered by your own forces in a timely manner.
- Be responsible for accomplishing your own commissioning process activities and assist in identifying and resolving all commissioning-related issues.
- Provide accurate information as requested such that a realistic commissioning schedule can be developed.
- Provide schedule-tracking information including reasons for any foreseen delays.
- Direct own forces such the commissioning schedule can be maintained.
- Cooperate with other commissioning team members to further the commissioning process and to complete the project as efficiently as possible.
- Minimize construction delays due to the process of initiating, pricing and approving any changes in the contract (i.e. site instructions, change orders, and addenda).
- Be available during the warranty period to address any commissioning-related issues.

1. Owner Personnel

All Owner Personnel to perform the following tasks:

- (see also “All Commissioning Team Members” section above).
- Adhere to the Roles & Responsibilities of the commissioning team members listed under the Commissioning Plan (CP) provided by the Commissioning Authority (CA).
- Advise Commissioning Authority of any changes in building occupancy and/or usage.
- Operate “commissioned systems” after project “hand-over”.
- Assign a staff member to be responsible for detailed EMCS system knowledge and operation.

1.1 Owner’s Representative

Owner’s Representative to perform the following listed tasks in addition to the tasks listed under “Owner Personnel” above:

- (see also “Owner Personnel” section above)
- Adhere to the Roles & Responsibilities of the commissioning team members listed under the Commissioning Plan (CP) provided by the Commissioning Authority (CA).

- Assign a staff member to be responsible for overall project knowledge, communications and decision-making.
- Assign a staff member to be responsible for detailed EMCS system knowledge and operation.
- Organize owner's own forces to be demonstrated to and trained.
- Sign-off the "Demonstration to the Owner".
- Operate "commissioned systems" after project "hand-over".

1.2 Building Operation & Maintenance (BOM) Representative

BOM's Representative to perform the following listed tasks in addition to the tasks listed under "Owner Personnel" above:

- (see also "Owner Personnel" section above).
- Adhere to the Roles & Responsibilities of the commissioning team members listed under the Commissioning Plan (CP) provided by the Commissioning Authority (CA).
- Assign a staff member to be responsible for overall project knowledge, communications and decision-making.
- Assign a staff member to be responsible for detailed EMCS system knowledge and operation.
- Organize BOM personnel to be demonstrated to and trained.
- Sign-off the "Demonstration to the Owner".
- Operate "commissioned systems" after project "hand-over".

2. Key Commissioning Personnel

All Key Commissioning Personnel to perform the following tasks:

- (see also "All Commissioning Team Members" section above)

2.1 Commissioning Authority

Commissioning Authority to perform the following listed tasks in addition to the tasks listed under "Key Commissioning Personnel" above:

- (see also "Key Commissioning Personnel" section above)
- Adhere to the Roles & Responsibilities of the commissioning team members listed under the Commissioning Plan (CP) provided by the Commissioning Authority (CA).
- Oversee the commissioning process.
- Function to coordinate commissioning throughout the construction and warranty periods of the project.
- Accomplish Commissioning tasks (as per the Commissioning Plan).

2.2 Mechanical Commissioning Agent

Mechanical Commissioning Agent to perform the following listed tasks in addition to the tasks listed under "Key Commissioning Personnel" above:

- (see also "Key Commissioning Personnel" section above).
- Adhere to the Roles & Responsibilities of the commissioning team members listed under the Commissioning Plan (CP) provided by the Commissioning Authority (CA).
- To follow Mechanical Specifications with reference to Section 23 08 00 –Commissioning of Mechanical Systems & Section 23 08 00.01-Commissioning System Testing.
- Develop detailed pre-startup, startup, and functional verification forms specifically developed for each of the mechanical "commissioned systems" and equipment installed on the project (to the approval of the Mechanical Consultant and the Commissioning Authority).

- Hold and minute Design Intent Meeting with consultant and appropriate other parties to review “commissioned systems” to be installed such that design intent is understood and supported in the installed systems and such that the commissioning agent knows what is to be commissioned.
- Ensure entire mechanical commissioning process of the “commissioned systems” is documented with copies sent to the Commissioning Authority.
- Assist the mechanical contractor in mechanical contractor’s overall responsibility of commissioning the mechanical “commissioned systems”.
- Advise mechanical contractor of mechanical “commissioned systems” commissioning issues and their resolution as they occur.
- Derive the mechanical commissioning schedule as part of the overall project construction schedule and monitor for accuracy.
- Hold mechanical commissioning meetings for the “commissioned systems”, and generate and distribute minutes.
- Conduct and document mechanical “commissioned systems” functional verifications to the satisfaction of the Commissioning Authority.
- Ensure that any documentation by others related to the mechanical “commissioned systems” is obtained (copy to the Commissioning Authority).
- Coordinate and attend demonstration of mechanical “commissioned systems” to the CA, the engineer and the owner.
- Issue mechanical commissioning report.
- Provide information for the operation & maintenance manual as required.

2.3 Electrical Commissioning Agent

Electrical Commissioning Agent to perform the following listed tasks in addition to the tasks listed under “Key Commissioning Personnel” above:

- (see also “Key Commissioning Personnel” section above).
- Adhere to the Roles & Responsibilities of the commissioning team members listed under the Commissioning Plan (CP) provided by the Commissioning Authority (CA).
- To follow Electrical Specifications with reference to Section 26 05 01 –electrical General Requirements specifically item #3.14- Testing and Commissioning pertaining to the electrical equipment associated with the upgraded mechanical systems.
- Develop detailed functional verification forms specifically developed for each of the electrical “commissioned systems” and equipment installed on the project (to the approval of the Electrical Consultant and the Commissioning Authority).
- Hold and minute Design Intent Meeting with consultant and appropriate other parties to review “commissioned systems” to be installed such that design intent is understood and supported in the installed systems and such that the commissioning agent knows what is to be commissioned.
- Conduct and document electrical “commissioned systems” functional verifications to the satisfaction of the Commissioning Authority.
- Ensure entire electrical commissioning process of the “commissioned systems” is documented with copies sent to the Commissioning Authority.
- Derive the electrical commissioning schedule as part of the overall project construction schedule and monitor for accuracy.
- Hold electrical commissioning meetings for the “commissioned systems”, as is required, and generate and distribute minutes.
- Conduct and document electrical “commissioned systems” verifications.

- Ensure that any documentation by others related to the electrical “commissioned systems” is obtained (copy to the Commissioning Authority).
- Coordinate and attend demonstration of electrical “commissioned systems” to the CA, the engineer and the owner.
- Issue electrical commissioning report.
- Provide information for the operation & maintenance manual as required.

3.0 Design Consultants

All Design Consultants to perform the following tasks:

- (see also “All Commissioning Team Members” section above)
- Provide design intent and basis of design documentation such as design narratives to the Commissioning Authority.
- Specify the creation of an adequate operating and maintenance manual for the “commissioned systems” (mechanical and electrical).
- Take part in design intent review process with appropriate contractor and commissioning agent.
- Produce and clarify, as is necessary, contract documents (drawings and specifications) as required with regards to Commissioning requirements.
- Conduct periodic inspections of work in progress to ensure that all systems and equipment of “commissioned systems” are installed according to specifications.
- Provide exclusive review of “commissioned systems” from project beginning to startup (static completion review).
- Provide additional review of “commissioned systems” from startup to full functionality.
- Ensure tests associated with static completion have been performed and documented.
- Regardless of the commissioning process, retain ultimate responsibility for evaluation and inspections of the “commissioned systems” as well as the adequacy of these systems to meet the owner’s requirements, the design intent and all applicable codes.
- Provide information for the operation & maintenance manual as required.

3.1 Architect

Architect to perform the following listed tasks in addition to the tasks listed under “Design Consultants” above:

- (see also “Design Consultants” section above).
- Oversee and administer contracts.
- Be aware of the state of the commissioning process and provide direction as is required to ensure process remains active.
- Direct other consultants as is required.
- Include Commissioning Plan in contract documents and include language in the specifications supporting the Commissioning Plan.

3.2 Mechanical Consultant

Mechanical Consultant to perform the following listed tasks in addition to the tasks listed under “Design Consultants” above:

- (see also “Design Consultants” section above).
- Sign-off the "Demonstration to the Consultant".

- Specify commissioning tasks as outlined in the Commissioning Plan to be performed by the mechanical contractor with the assistance of the mechanical commissioning agent.
- Review balancing as is required – especially after balancing report has been issued.

3.3 Electrical Consultant

Electrical Consultant to perform the following listed tasks in addition to the tasks listed under "Design Consultants" above:

- (see also "Design Consultants" section above)
- Sign-off the "Demonstration to the Consultant".
- Specify commissioning tasks as outlined in the Commissioning Plan to be performed by the electrical contractor (aka the electrical commissioning agent).
- Provide design light intensity levels and required reading locations to the electrical contractor so the electrical contractor can take measurements and compare them to design.

4.0 Contractors/Suppliers

All Contractor/Suppliers to perform the following tasks:

- (see also "All Commissioning Team Members" section above)
- Adhere to the Roles & Responsibilities of the commissioning team members listed under the Commissioning Plan (CP) provided by the Commissioning Authority (CA).
- Ensure agreed to commissioning schedule is maintained (commissioning schedule forms part of the overall project construction schedule).
- Include cost for commissioning requirements (as per the commissioning plan) in the contract price.
- Perform corrective work for issues identified through the commissioning process as required in a timely manner.
- Sub-contractors and suppliers for the "commissioned systems" to cooperation and participate in the commissioning process as is required.
- Major equipment manufacturers/suppliers to participate in appropriate testing and training activities.
- Installing trade to assist the appropriate commissioning agent (mechanical, electrical) in all verifications and functional performance checks by completing all appropriate checklists and forward these checklists to the appropriate commissioning agent for review. Address any issues that may be indicated on the checklists. Address any concerns the appropriate commissioning agent may have with the checklists.
- Gather and assemble operation and maintenance data on all equipment of the "commissioned systems" and provide to the appropriate commissioning agent (mechanical, electrical). Also provide same to the Commissioning Authority. Include all review stamps and cover letters/sheets with this documentation.
- Provide a minimum of 5 working days notice prior to testing or startup events to the appropriate Commissioning Agent and the Commissioning Authority.
- Participate in and schedule vendors and sub-contractors of the "commissioned systems" within your scope to participate in any training sessions for these systems.
- Provide information for the operation & maintenance manual as required.

4.1 General Contractor

General Contractor to perform the following listed tasks in addition to the tasks listed under "Contractors/Suppliers" above:

- (see also "Contractors/Suppliers" section above)
- Adhere to the Roles & Responsibilities of the commissioning team members listed under the Commissioning Plan (CP) provided by the Commissioning Authority (CA).
- Oversee completion of contract.
- Direct all contracted trades.
- Incorporate an agreed-to commissioning schedule (by commissioning agents) into an agreed-to overall project construction schedule and ensure that this overall project schedule is maintained.
- Ensure prerequisite work allowing testing of "commissioned systems" is scheduled and completed such that testing of "commissioned systems" can occur as scheduled.
- Ensure cooperation of all sub-contractors and suppliers with each other and all commissioning team members such that the commissioning process can be efficiently and effectively carried out.

4.2 Mechanical Contractor

Mechanical Contractor to perform the following listed tasks in addition to the tasks listed under "Contractors/Suppliers" above:

- (see also "Contractors/Suppliers" section above)
- Adhere to the Roles & Responsibilities of the commissioning team members listed under the Commissioning Plan (CP) provided by the Commissioning Authority (CA).
- To follow Mechanical Specifications with reference to Section 23 08 00 –Commissioning of Mechanical Systems and related sections.
- Keep mechanical commissioning agent fully informed on all aspects of the project (change orders, supplier delays, scheduling problems, system/equipment operational problems etc.).
- Provide copies of the approved equipment shop drawing to mechanical commissioning agent.
- Provide complete schedule to mechanical commissioning agent for individual equipment installation, hydrostatic pressure test, hydronic flushing & chemical treatment, and start-up.
- Sign-off equipment checklist and check-out verification sheets related to mechanical installation provided by commissioning agent.
- Provide copies of individual equipment start-up reports to the mechanical commissioning agent.
- Perform mechanical equipment startups (with suppliers as required).
- Participate in and schedule vendors and sub-contractors of the "commissioned systems" within your scope to participate in any commissioning meeting, and training sessions for the commissioned systems.
- Operate mechanical equipment during tests and as is necessary (for balancing for example) until hand-over.
- Act on issues identified through the commissioning process which are related to the "commissioned systems" installed by your forces or sub-trades.
- Organize, hold and document the mechanical demonstration to the mechanical consultant to the owner.
- Provide equipment related information to the Commissioning Authority for insertion into the "Systems Manual".

- Participate in the post warranty review “Review Building Operations after Substantial Completion”.
- Provide Operation & Maintenance Manual.

4.3 Electrical Contractor

Electrical Contractor to perform the following listed tasks in addition to the tasks listed under “Contractors/Suppliers” above:

- (see also “Contractors/Suppliers” section above)
- Adhere to the Roles & Responsibilities of the commissioning team members listed under the Commissioning Plan (CP) provided by the Commissioning Authority (CA).
- Designate an Electrical Commissioning Agent to coordinate and facilitate the electrical commissioning process as directed by the Commissioning Authority.
- Perform electrical equipment startups related to the “commissioned systems” (with suppliers as required).
- Sign-off equipment checklist and check-out verification sheets related to electrical installation for all mechanical equipment. The equipment checklist and check-out sheets will be compiled in a commissioning binder provided by the mechanical commissioning agent.
- Operate electrical equipment during tests and as is necessary until hand-over.
- Act on issues identified through the commissioning process which are related to the “commissioned systems” installed by your forces or sub-trades.
- Organize, hold and document the electrical demonstration to the mechanical consultant and to the owner.
- Provide final complete electrical commissioning report to the Commissioning Authority.
- Provide equipment related information to the Commissioning Authority for insertion into the “Systems Manual”.
- Participate in the post warranty review “Review Building Operations after Substantial Completion”.
- Provide Operation & Maintenance Manual.

4.4 Controls Contractor

Controls Contractor to perform the following listed tasks in addition to the tasks listed under “Contractors/Suppliers” above:

- (see also “Contractors/Suppliers” section above)
- Adhere to the Roles & Responsibilities of the commissioning team members listed under the Commissioning Plan (CP) provided by the Commissioning Authority (CA).
- Coordinate the engineer's approval of a detailed sequence of operation.
- Provide copies of the approved controls shop drawings to the Mechanical Commissioning Agent & Commissioning Authority.
- Perform own controls testing & commissioning.
- Sign-off equipment checklist and check-out verification sheets related to controls installation provided by mechanical commissioning agent.
- Submit completed controls end to end check sheets to commissioning agent prior to functional verification of each mechanical/HVAC controls equipment.
- Provide schedule of individual equipment functional verification to the mechanical commissioning agent.

- Show mechanical commissioning agent control system in sufficient detail (including necessary simulations) to allow mechanical commissioning agent and CA to perform necessary functional verification checks.
- Attend the demonstration to the consultant and the demonstration to the owner.
- Setup and monitor trendlogs in order to prove satisfactory system functionality.
- Provide mechanical commissioning agent sufficient trendlogs (in chart and text format) such that mechanical commissioning agent and CA can verify proper system operation.
- Provide information for the operation & maintenance manual as required.

4.5 Balancing Contractor

Balancing Contractor to perform the following listed tasks in addition to the tasks listed under "Contractors/Suppliers" above:

- (see also "Contractors/Suppliers" section above)
- Adhere to the Roles & Responsibilities of the commissioning team members listed under the Commissioning Plan (CP) provided by the Commissioning Authority (CA).
- Report commissioning-related balancing issues as they are encountered to the Mechanical Commissioning Agent and the Commissioning Authority.
- Produce an independent balancing report to the approval of the mechanical engineer.

4.6 Other Contractors & Suppliers

All other contractors and suppliers involved with the "commissioned systems" are to perform the following listed tasks in addition to the tasks listed under "Contractors/Suppliers" above:

- (see also "Contractors/Suppliers" section above).
- Adhere to the Roles & Responsibilities of the commissioning team members listed under the Commissioning Plan (CP) provided by the Commissioning Authority (CA).
- Provide information for the Operation & Maintenance Manual.

9.0) Appendix B - List of Key Commissioning Process Milestones

Commissioning is a methodical, team-based process. Each step of the commissioning process must be completed progressively in order for the commissioning process to be successful. This appendix lists the four basic phases of the project and the commissioning steps within each of those phases.

Commissioning Phase	Date	Parties Involved	Completed
Construction Phase			
Review of Contractor Submittals	TBD	CA, DC's	
Verification Form Creation	TBD	CAg's	
Pre-Startup Verifications	TBD	C's, CAg's	
Startup Verifications	TBD	C's, CAg's	
Testing & Balancing	TBD	C-B	
Functional Verifications	TBD	CAg's, C's	
Develop an O & M Manual	TBD	CAg's, C's	
Submit Mechanical Commissioning Report	TBD	CAg-M	

Submit Electrical Commissioning Report	TBD	CAg-E	
Submit Overall Commissioning Report	TBD	CA	
Occupancy and Operations Phase			
Orientation/Training Plan Creations	TBD	CA, CAg's, C's	
Orientation/Training Conducted-Mechanical & Electrical System	TBD	C's, CAg's	
Near Warranty-End Review	TBD	CA, CAg's, C's	

10.0) Appendix C - Commissioning Services for this Project

This appendix describes the required commissioning tasks and written commissioning results and documentations for this project. This appendix to the commissioning plan highlights the distinction between the roles of the commissioning team members with special emphasis on what the Commissioning Authority does verses what the other Commissioning Team members do.

This appendix also lists the timing, and any required work products of the various commissioning tasks.

The following tables lists the commissioning team member abbreviations and other abbreviations used in this appendix.

Commissioning Team Members

Abbreviation	Description
O	Owner
OR	Owner's Representative
BOM	Building Operation & Maintenance
CA (or CxA)	Commissioning Authority (overseeing, multiple discipline role)
DC-A	Design Consultant – Architectural
DC-E	Design Consultant – Electrical
DC-M	Design Consultant – Mechanical
DC's	All (related) Design Consultants
C-G	Contractor – General
C-E	Subcontractor – Electrical
C-M	Subcontractor – Mechanical
C-C	Subcontractor – Controls
C-B	Subcontractor – Balancing
C's	All (related) Contractors
CAg-M	Commissioning Agent – Mechanical
CAg-E	Commissioning Agent – Electrical
CAg's	All (related) Commissioning Agents

This appendix describes the required commissioning tasks and written commissioning work products for this project. These tasks are organized according to the five (5) requirements of Building Systems Commissioning.

As a quick summary, these requirements are as:

Project Phase	**Commissioning Tasks (Steps 1-6)**
Equipment procurement, Equipment installation	**Step 1 – Review Contractor Submittals Applicable to the Systems Being Commissioned** **Step #1 "The CA for the purposes of this plan should review contractor submittals applicable to the systems being commissioned for compliance with the owner's project requirements and basis of design."**
Functional testing, test and balance, performance testing acceptance	**Step 2 – Verify Installation and Performance of Commissioned Systems** **Step #2 "Verify the installation and performance of the systems to be commissioned." Deficiency list will be provided if necessary.**
Building Management (Operation & Maintenance) Manual	**Step 3 – Develop Operation & Maintenance (O&M) Manual for Commissioned Systems** **Step #3 "Develop an Operation & Maintenance Manual that gives future operating staff the information needed to understand and optimally operate the commissioned systems."**
O&M training	**Step 4 – Verify that Requirements for Training are Completed** **Step #4 "Verify that the requirements for training operating personnel and building occupants have been completed."**
Substantial completion	**Step 5 – Complete a Summary Commissioning Report** **Step #5 "Complete a summary commissioning report."**
Warranty period	**Step 6 – Follow-up Visits during the Warranty Period** **Step #6 "Follow-up visits during the warranty period."**

Step 1 – Review Contractor Submittals Applicable to the Systems Being Commissioned

Step #1 "The (CxA (CA for the purposes of this plan)) should review contractor submittals applicable to the systems being commissioned for compliance with the owner's project requirements and basis of design. This review must be concurrent with the architect's or engineer's reviews and submitted to the design team and the owner.

Task No.	Task Description	Task by	Timing	Others involved	Notes
1	Review normal contractor submittals for systems being commissioned for compliance with commissioning needs.	CA	Construction Phase	DC-A, DC-M, DC-E, O, G-C	▪ G-C to forward copy of submittals (a.k.a. shop drawings) to the CA at the same time that the consultant review takes place
2	Verify mechanical operation and maintenance documentation.	CA, DC-M	Construction Phase	C-M	▪ CA reviews O&M documentation prior to review by DC-M. ▪ DC-M to include CA comments in DC-M review. ▪ C-M to revise documentation as is necessary and re-submit.
3	Verify electrical operation and maintenance documentation.	CA, DC-E	Construction Phase	C-E	▪ CA reviews O&M documentation prior to review by DC-E. ▪ DC-E to include CA comments in DC-E review. ▪ C-E to revise documentation as is necessary and re-submit.

Step 2 – Verify Installation and Performance of Commissioned Systems

Step #2 "Verify the installation and performance of the systems to be commissioned.

Task No.	Task Description	Task by	Timing	Others involved	Notes
1	Verify and document proper operation of mechanical systems (installation, start-up and initial checkout, and functional performance).	DC-M, CAg-M	Construction Phase	CA, C-M	▪ DC-M to specify work by CAg-M. ▪ CAg-M to notify CA in advance of work. ▪ CAg-M to perform work. ▪ CAg-M to provide completed checklists to CA. ▪ CA to oversee verification (using sampling). ▪ C-M to install systems and facilitate testing by CAg-M.
2	Verify and document proper operation of electrical systems (installation, start-up and initial checkout, and functional performance).	DC-E, CAg-E	Construction Phase	CA, C-E	▪ DC-E to specify work by CAg-E. ▪ CAg-E to notify CA in advance of work. ▪ CAg-E to perform work. ▪ CAg-E to provide completed checklists to CA. ▪ CA to oversee verification (using sampling). ▪ C-E to install systems and facilitate testing by CAg-E.
3	Conduct CA commissioning meetings and record and distribute meeting minutes.	CA	Construction Phase	CAg-M, CAg-E, C-G, C-M, C-E, DC-M, DC-E, O	▪ CA to conduct regular commissioning meeting and distribute meeting minutes.

Step 2 – Verify Installation and Performance of Commissioned Systems

Step #2 "Verify the installation and performance of the systems to be commissioned.

Task No.	Task Description	Task by	Timing	Others involved	Notes
4	Perform site visits, as necessary, to observe component and system installations.	CA	Construction Phase	CAg-M, CAg-E, C-G, C-M, C-E, DC-A, DC-M, DC-E, O	▪ CA to conduct site visits to witness system installation.
5	Attend selected jobsite meetings to obtain information on construction progress.	CA	Construction Phase	CAg-M, CAg-E, C-G, C-M, C-E, DC-A, DC-M, DC-E, O	▪ CA to attend selected job meetings to obtain information on construction progress as required.
6	Direct the commissioning activities.	CA	Construction Phase	CAg-M, CAg-E, C-G, C-M, C-E, DC-A, DC-M, DC-E, O	▪ CA to witness commissioning activities randomly.
7	Ensure construction checklists are being completed for commissioned equipment.	CA	Construction Phase	CAg-M, CAg-E, C-G, C-M, C-E, DC-A, DC-M, DC-E, O	▪ CA to review commissioning checklist submitted by all Commissioning Agents.
8	Ensure the commissioning activities are being scheduled into the master schedule.	CA	Construction Phase	CAg-M, CAg-E, C-G, C-M, C-E, DC-A, DC-M, DC-E, O	▪ CA to review and verify commissioning schedule submitted by all Commissioning Agents.
9	Review and revise, as necessary, the Commissioning Plan (CP), developed earlier, to reflect current project realities.	CA	Construction Phase	CAg-M, CAg-E, C-G, C-M, C-E, DC-A, DC-M, DC-E, O	▪ CA to review and revise CP as required.
10	Assist in resolving any discrepancies discovered through the commissioning process.	CA	Construction Phase	CAg-M, CAg-E, C-G, C-M, C-E, DC-A, DC-M, DC-E, O	▪ CA to assist Commissioning Agents in resolving any discrepancies in the commissioning process..
11	Meet all review, documentation, planning and implementation requirements provide a completed submission	CA	Construction Phase	CAg-M, CAg-E, C-G, C-M, C-E, DC-A, DC-M, DC-E, O	▪ CA to review documentations submitted by all commissioning Agents.

Step 3 – Develop Operation & Maintenance (O & M) for Commissioned Systems

Step #3 "Develop operating & maintenance manual as per specification section 01 78 00.

Task No.	Task Description	Task by	Timing	Others involved	Notes
1	Provide the owner with an operating & maintenance (O & M) manual that contains the information as per specification section 01 78 00 –Closeout Submittals.	C-G, C-M, C-E	Construction Phase Occupancy & Operations Phase	CA, CAg-M, CAg-E, C-G, DC-A, DC-M, DC-E, O	▪ Consultants to specify work required to be performed by contractors such that this manual can be created. ▪ Contractors to provide information and documentation as required (refer to Specification section 01 78 00) for inclusion in this manual.

Step 4 – Verify that Requirements for Demonstration/Training Agenda

Step #4 "Verify that the requirements for training operating personnel and building occupants have been completed

Task No.	Task Description	Task by	Timing	Others involved	Notes
1	Provide and execute training plan (schedules, agendas, minutes, sign-off letters etc.) as per specification section 01 79 00-Demonstration and Training.	CAg-M, CAg-E, C-G, C-M, C-E,	Construction Phase	CAg-M, CAg-E, C-G, C-M, C-E, DC-A, DC-M, DC-E, O	▪ DC's to specify work by CAg's and Contractors. ▪ Contractors and CAg's to prepare training plans for commissioned systems (refer to specification section 01 79 00). ▪ CAg's to notify CA in advance of work. ▪ Contractors & CAg's to perform work. ▪ CA to oversee training by reviewing training completion report by contractors.

Step 5 – Complete a Summary Commissioning Report

Step #5 "Complete a summary commissioning report"

Task No.	Task Description	Task by	Timing	Others involved	Notes
1	Complete a mechanical commissioning report.	CAg-M	Construction Phase	CA, C-M, DC-M	▪ CA to review, CAg to revise as required. ▪ Contractors to address any construction-related items such that a final commissioning report can be compiled.
2	Complete an electrical commissioning report.	CAg-E	Construction Phase	CA, C-E, DC-E	▪ CA to review, CAg to revise as required. ▪ Contractors to address any construction-related items such that a final commissioning report can be compiled.
3	Complete a Commissioning Report.	CA	Construction Phase Occupancy & Operations Phase	DC-A, DC-M, DC-E, O	▪ Design Consultants to review and address any remaining design-related items such that a final commissioning report can be compiled. ▪ Design Consultants to provide information as is required to the Commissioning Authority for this report. ▪ CAg's to provide own commissioning reports for inclusion in Final Commissioning Report.

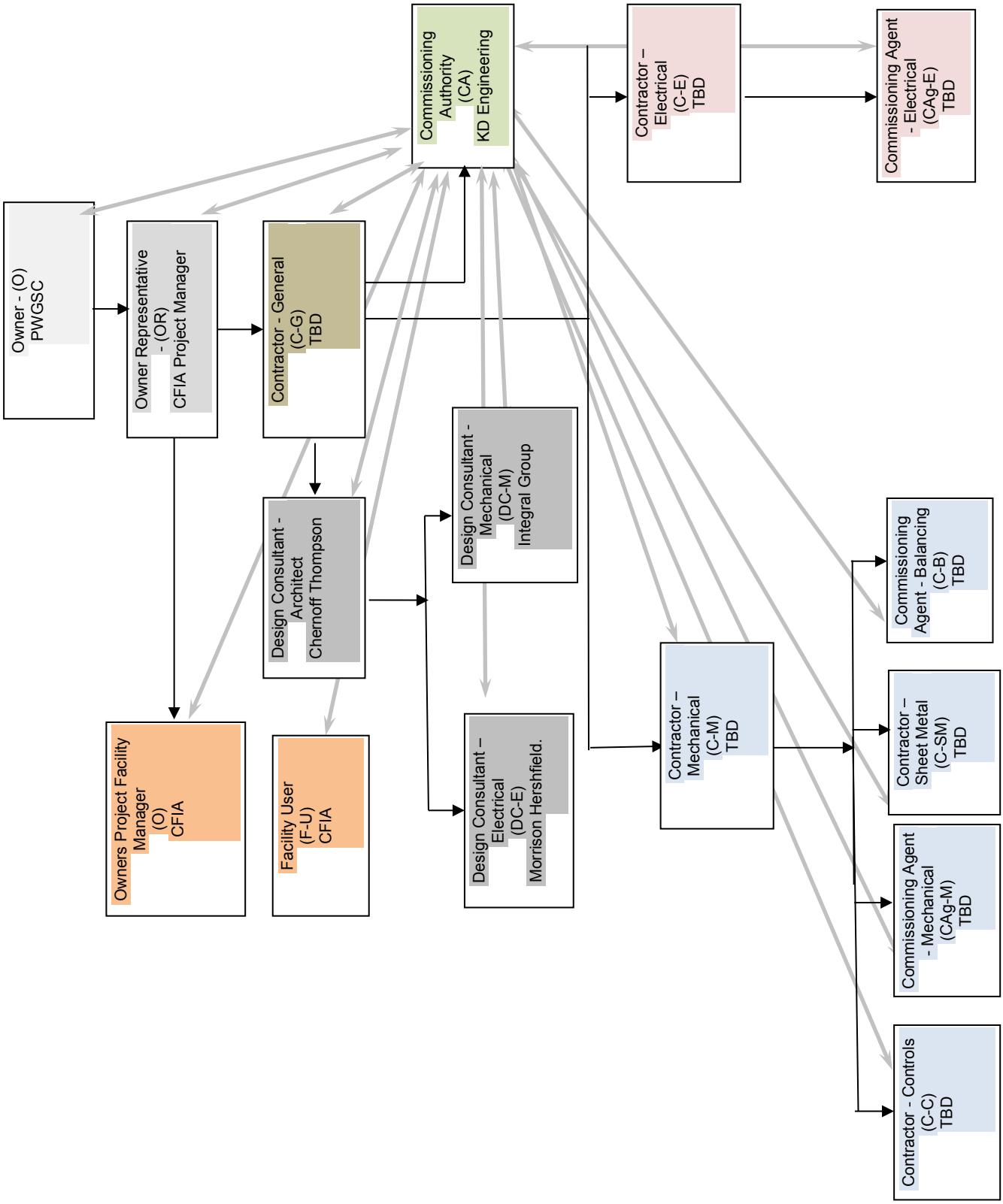
Step 6 – Complete a Final Commissioning Report at the end of Warranty Period

Step #6 "Complete a final commissioning report at the end of warranty period"

Task No.	Task Description	Task By	Timing	Others involved	Notes
1	Perform near-end warranty review. CA meets with Owner and Commissioning team, prior to the expiration of the warranty, to discuss the operation of the building and assembles a written plan to address any operational deficiencies.	CA	Warranty Phase	DC-A, DC-M, DC-E, O, OR, BOM	▪ Design Consultants to respond to design related issues as identified by the CA in the near-end warranty review. ▪ Contractors to perform near-end warranty review as directed by CA. ▪ CAg's to perform near-end warranty review as directed by CA.
2	Update the Final Commissioning Report to include post warranty review information and any updated commissioning test forms.	CA	Warranty Phase	DC-A, DC-M, DC-E, O, OR, BOM	▪ Design Consultants to respond to design related issues as identified by the CA in the near-end warranty review. ▪ Contractors to address any construction-related warranty items such that a final commissioning report can be compiled. ▪ CAg's to update own commissioning reports for inclusion in Final Commissioning Report at the end of Warranty Period.

11.0) Appendix D - Organizational Chart

In the following chart of parties most-related to commissioning, the black arrows generally represent contractual relationships while the grey arrows represent primary working relationship with the Commissioning Authority.



CANADIAN FOOD INSPECTION AGENCY

AHU REPLACEMENT EXHAUST MANIFOLD

BURNABY, BC

APPENDIX D

BURNABY LABORATORY

FACILITY ORIENTATION FOR CONSTRUCTION

AND SERVICE CONTRACTORS

Canadian Food Inspection Agency | Agence canadienne d'inspection des aliments

BURNABY LABORATORY

3155 Willingdon Green
Burnaby, British Columbia

FACILITY ORIENTATION FOR CONSTRUCTION AND SERVICE CONTRACTORS

Building Main Contact Numbers:

Name	Organisation	Position/Role	Office	Mobile
Ian Murdoch	CFIA-ACIA	Facilities Manager	604-292-6060	778-877-0294
Neil Randlesome	CFIA-ACIA	Maintenance Specialist	604-292-6061	604-834-6861
Elmer Castro	CFIA-ACIA	Building Maintainer	604-292-6062	604-834-6623
Security/Reception		Commissionaire	604-292-6001	
Dave Graham	CFIA-ACIA	Director	604-292-6066	
Jenny Lomas	CFIA-ACIA	Lab Safety Coordinator	604-292-6065	

Facility Protocols

CFIA Facilities Management and the client occupants of this building have agreed that the following procedures will apply to all persons carrying out work at this site.

THIS LIST IS NOT LIMITED TO THE ITEMS MENTIONED, AND MAY BE SUBJECT TO CHANGE WITHOUT NOTICE.

Visitor / Contractor Safety

To ensure the health and safety for all staff and visitors, please read this binder before entering this laboratory facility.

- All visitors must sign in and wear a visitor pass.
- All contractors must sign the Visitor's Log and the Laboratory Contractor Safety Checklist prior to commencing any work in laboratory areas or any exterior work that will compromise the integrity of the building envelope.
- Smoking is NOT PERMITTED in any areas.

No Unauthorised Disruption in Services

48 hours advance written authorisation is required for all planned requirements for building access, key authorisation, fire alarm by-passes, life safety, electrical, heating, ventilation and air conditioning systems.

Switching of electrical breakers, cutting, drilling, welding / soldering, use of power tools, noise disturbances, any interior or exterior work that will compromise the integrity of a lab's envelope, and any other unauthorised disruption of services are strictly forbidden. This facility is protected by sensitive heat & smoke detection and computer control systems. Contractor assumes all responsibility for unauthorised disruption to client operations.

NO WORK OF ANY KIND, INTERIOR OR EXTERIOR, IS PERMITTED TO BE STARTED WITHOUT FIRST CONTACTING THE MAINTENANCE SPECIALIST OR THE BUILDING OPERATOR. CONTACT NUMBERS ARE ON THE FIRST PAGE OF THIS DOCUMENT.

General

CLEANING OF WORK SITES: Each contractor must clean the work area on an ongoing basis, and upon completion of the work or project. The building cleaners are not responsible for post construction clean-ups.

ELECTRICAL DISRUPTION / LOGBOOK: Arrangements for written authorisation must be made a minimum of 72 hours in advance. On completion of any new or substantial electrical repair work, the electrical inspection logbook located at the maintenance operations office must be filled out indicating type of work completed.

EMERGENCY: In the event of an emergency (fire, personnel accident, etc) call 911. If fire is detected and you are not able to suppress it, pull nearest pull station located at each exit and evacuate. For floods and emergency shutoffs call the Maintenance operations staff.

EXPLOSIVE TOOLS: Use of powder-activated tools is strictly prohibited.

FIRE ALARM BYPASSES: Arrangements for written authorisation must be made with CFIA maintenance operations a minimum of 48 hours in advance.

FIRE EXTINGUISHERS: Fire extinguishers are located throughout the building.

FIRE PLAN & EVACUATION: A copy of the evacuation plan indicating emergency exit locations is posted in the building. The contractor is responsible to familiarise themselves and their crew with the egress routes.

FREIGHT ELEVATOR: The freight elevator is available for use through arrangement with the Facility Manager / Project Manager. Extensive use of the freight elevator must be arranged 24 hours in advance. Maximum height is 7'6" and depth is 10'. Government staff and suppliers are given priority for the use. Users are expected to follow proper operating/safety procedures and capacity limits posted.

HVAC: Arrangements for written authorisation must be made a minimum of 48 hours in advance, for any disruption to the Heating, Ventilation or Air Conditioning systems.

HEALTH & SAFETY: There will be zero tolerance with respect to Health and Safety issues. Contractor(s) must adhere to all applicable federal and provincial Occupational Health and Safety regulations, use best safety practices at all times, and follow the rules governing this site. The principal contractor will be monitored and reported on their compliance.

HOLIDAY SCHEDULE: This facility recognises all federal and provincial holidays, in addition to Remembrance Day on November 11th.

HOURS OF OPERATION: Business hours are 08:00 to 16:00. If you require adjustments to the set schedules in order to perform your work; please make your requests to the Facilities Manager / Project Manager.

KEYS / ACCESS CARDS: Arrangements for written authorisation must be made with Facilities Manager / Project Manager a minimum of 48 hours in advance. Keys will not be released to contractors without prior written consent from CFIA Maintenance Operations.

KNOWN HAZARDS: This facility is heated by natural gas. Existing material safety data sheets for substances in use on site are available, designated substances reports are also available on site.

LOADING DOCK: The loading dock is for the loading and unloading of material only. Regular hours of operation are 08:00 – 16:00. There are no after-hours deliveries unless arranged in advance. Government staff and suppliers will be given priority at the loading dock. Safe work practices are to be followed in the loading and unloading of material.

NO SMOKING POLICY: Federal regulations do not permit smoking within the facility.

NO FOOD POLICY: Eating and drinking is not permitted in laboratory areas. The use of drugs or alcohol on CFIA facilities is strictly forbidden.

PARKING: Parking is restricted to assigned spaces for the time posted only; additional parking must be arranged through the Facilities Manager / Project Manager and approved.

SECURITY / ESCORTS: If the contractor holds a valid security clearance, escort requirements may not apply. Arrangements for written authorisation must be made a minimum of 48 hours in advance. All contractors must satisfy security requirements, visibly wear building pass at all times, and be readily identifiable by company name.

Security escorts may be required when working in certain areas. Regular hours of operation are between 08:00 and 16:00 hrs. The facility requires the names of persons requiring entry, locations requiring access, start and anticipated length of stay, and completion date of the work or project. The Facility / Project Manager are the main point of contact for making all arrangements. Failure to cancel, overbook, or underutilise security escort personnel could result in the contractor being back charged a minimum of 4 hours labour if 24 hours cancellation notice is not provided.

SUB-CONTRACTING: If the contract and work involves subcontracting any part of the Scope of Work, a representative from the contractors firm must accompany any sub trades and be responsible for their actions at all times while onsite. They must also ensure that this compliance checklist is signed off by the subcontractor.

WORKERS COMPENSATION: All contractors must be registered with and in good standing with Work Safe BC.

SIGNAGE: English or graphic symbol hazard signage is to be posted on every job site warning workers and visitors of dangers in the area.

TOOL USE: All tools, equipment and machinery are to be provided by the contractor to carry out the tasks of the contracted work. No tools will be loaned for this purpose.

WHMIS / MSDS: Workplace Hazard Management Information System (WHMIS) is to be followed and instructed to all contractor and subcontractor employees. Material Safety Data Sheets (MSDS) are to be supplied prior or at the time all WHMIS regulated material arrives on site.

WASHROOMS: Washrooms are located on all floors. Contractors shall use only assigned washrooms.

WASTE REMOVAL: Unless otherwise specified, materials for removal become the contractor's property and shall be taken from site. No construction waste whatsoever is to be discarded in the building waste removal system(s). This facility is committed to industry best practices with respect to sustainable development of Reduce, Reuse and Recycle. All contractors are encouraged to abide to this whenever possible. Please discuss the possibility of recycling construction materials with the facility / project manager. Recycling centres for glass, cans, paper and cardboard are available throughout the facility for personal use.

WELDING / SOLDERING: Arrangements for written authorisation must be made with Facility / Project Manager a minimum of 48 hours in advance. A "Hot Permit" will be issued following confirmation of specific details and arrangements.

Evacuation Procedures

- If fire alarm sounds, stop what you are doing immediately.
- For contractors working in the crawl space, an additional evacuation signal will be provided using an air horn (two short blasts, one long), as the fire bells are difficult to hear in some areas of the crawl space.
- Shut off electrical equipment if possible.
- Leave the building by the nearest posted fire exit.
- Assemble in the muster area and notify a CFIA employee that you are safe.
- Do not re-enter the premises until instructed by an authorised person that it is safe to do so.

In Case of Fire

- Sound the fire alarm.
- Leave fire area immediately. Do not stop to gather work or personal belongings.
- Call 911 (internal phones dial 8-911)
- Exit building to the muster area.
- Notify a CFIA employee that you have exited as others may be looking for you.
- If hazardous materials have been left behind, advise the CFIA employee who will alert the Fire Department.
- Fire extinguishers are located in key areas of the laboratory facility. Use only if the fire is small and manageable. Do not jeopardise your own or other peoples safety.

Work Safe

- All work requires prior approval from CFIA and a Laboratory Contractor Safety Checklist must be signed.
- Warning signs and isolation barriers must be used when appropriate.
- Plastic poly sheets must be used to protect surfaces and equipment when required by the laboratory.
- Signs must specify the danger if performing welding or other hazardous function.
- Please ask permission if plugging in electrical equipment or unplugging any laboratory equipment.
- Tools must never be left in an overhead work area and areas below must be isolated.
- Aisles and passageways near the work area must not be obstructed by any materials.
- Lock-Out / Tag-Out procedures must be followed where required by regulation.
- You must obtain permission before accessing other areas.

Laboratory Areas

If you are entering the laboratory area, you will be escorted to an assigned area.

- Please do not leave the assigned area without an escort.
- Laboratory Coats/Gowns and Personal Protective Equipment (PPE) must be worn in designated areas. You will be advised what is required. If not provided by your employer, CFIA will provide them.
- Please request permission when taking pictures. We have areas where photographs are not permitted as it will compromise our analyses.
- No open-toed or open-heeled shoes, and we recommend that everyone wear shoes with good traction as there are a lot of wet working areas.
- No food items of any kind (gum, mints, etc.) or beverage is to be brought in laboratory areas.
- Do not place items on work surfaces (pens, paper, etc) to minimise risk of cross-contamination.
- Please wash your hands when entering or exiting laboratory areas. There are hand wash stations and hand disinfectants in all the entrances/exits in all laboratory areas in Microbiology.

Biological Safety

- Biological materials may be found at the facility and may be considered hazardous and can potentially transmit disease.
- Do not touch or remove any biological materials yourself and always ask laboratory staff.
- Decontamination of equipment may be required before being removed from the facility.

Chemical Safety

- Hazardous chemicals are on site for which Material Safety Data Sheets (MSDS) are available. You must consult with the laboratory supervisor before handling or introducing new hazardous chemicals into the facility.

- Eyewash stations are located throughout the facility and some locations have emergency showers. Please ask for nearest location.
- Specific Personal Protective Equipment, required for use when handling chemical hazards, is mandatory. Please consult with the lab for the appropriate equipment.

In Case of Chemical Spill

Do not attempt to clean up the spill yourself. Always inform a laboratory supervisor to determine the appropriate response.

In Case of Chemical Contact

- Call for nearby help immediately.
- Flush eyes or skin with water immediately and continue for at least 15 minutes.
- Remove contaminated clothing as you rinse.

In Case of Injury

- Report all injuries to the laboratory supervisor and to your employer.
- Emergency First Aid can be provided.
- An incident form may need to be completed depending on the injury.
- Accident hazards must be reported to a laboratory supervisor.

Emergency Response Plan Summary

Fire

If you discover a fire, see smoke or smell gas:

- Warn persons nearby and leave the area of danger.
- Activate the nearest fire alarm pull station.
- Fight the fire using an appropriate extinguisher ONLY if you have been trained to do so.
- DO NOT FIGHT A FIRE when:
    - the fire is spreading beyond the spot where it started;
    - you can't fight the fire with your back to an escape exit;
    - the fire can block your only escape;
    - You have the slightest doubt about whether to fight or not to fight.

Evacuation

On steady ringing of the fire alarm, or following air horn blast (two short, one long):

- Turn off equipment as designated for your section and secure information.
- Leave the building using the nearest safe exit, closing all doors behind you.
- Proceed directly to the fire muster area outside, and report to your Area Warden.
- Obey all instructions of the Emergency Wardens and Fire Department or other Emergency Responders.
- DO NOT LEAVE THE MUSTER AREA.
- DO NOT return to the building until you have been given clearance by the Chief Emergency Warden.

Earthquake

- Take immediate shelter under any object that will offer protection against flying glass and debris. Adopt the "crash" position. Move away from windows.
- Stay under cover until the shaking stops. If you are capable of moving and it appears safe to do so, make your way to the BOARD ROOM and report to your Area Warden.
- Do not move injured individuals unless they are in immediate danger. Make a note of their location to pass on to the ERT. If you have an injury that prevents you from moving, stay where you are and await the arrival of emergency personnel.
- If the instruction to evacuate the building is given by the Chief Emergency Warden, using the nearest safe exit, proceed out of the building to the muster area. If the muster area is not safe, seek an open area away from power lines, trees, etc. that might be knocked down during the earthquake and/or its aftershocks. WATCH OUT FOR FALLING DEBRIS. DO NOT attempt to re-enter the building.

Evacuation Cues and Muster Areas

Evacuate the building:	On steady ringing of the fire alarms or following air horn blast (two short, one long)
Evacuation Muster Area:	South sidewalk on Willingdon Green
Earthquake Muster Area:	Ground floor main board room

Contractor Safety Checklist

Contractor Safety Minimum Compliance Requirements

The following checklist is the minimum standard for the orientation of contractors before beginning work in a Canadian Food Inspection Agency Laboratory.

- ☑ There is a designated site contact from the Laboratory Directorate while the contractor is on the site. The Contact will regularly monitor the activities of the contractor.

- ☑ The contractor/service provider acknowledges that all work is to be carried out in a safe and responsible manner and that all practices shall follow both federal and provincial OSH regulations. In case of any discrepancies, the most stringent code shall prevail and be adhered to.

- ☑ The contractor attends a pre-job meeting before work begins and is introduced to the on-site Contact for the Laboratory. This Contact is the person the contractor reports any hazardous occurrences to.

- ☑ The contractor will be given a walk-through of the work areas they will be working in or near, explaining the location and use of emergency eyewash stations, emergency showers, drench hoses, emergency exits, emergency spill kits and their application, fire extinguisher locations, safety board and what to do if they hear the fire evacuation alarm. They must also be given a contact name and phone number in case of an emergency.

- ☑ The contractor must be given a hazard awareness walk-through in their work location(s) to identify any hazards and precautions to be taken.

- ☑ The contractor must be given a thorough review of the security procedures used at the worksite.

- ☑ The contractor reads the safe work procedures for contractors working in a CFIA laboratory and signs the document to indicate they have read and understood it.
- ☑ The contractor must read safe work procedures document for contractors working in a CFIA laboratory. The contractor must also sign a record to indicate that they have read and understood it.

- ☑ For contracts >1 month, the contractor's site supervisor must complete a regular OSH workplace inspection report. A copy shall be given to the CFIA-designated contact.

- ☑ The contractor is required to perform pre-start and job completion OSH workplace inspections of their immediate work area. A report must be given to the CFIA site contact immediately after the inspections are completed.

- ☑ The contractor must supply copies of records of their regular safety meetings, as well as copies of their regular Worker's Compensation Board contributions (as applicable, based on the length of the project).

- ☑ The contractor must have on-site WHMIS/GHS safety data sheets for all materials being used at that site, and provide SDSs to site authorities before chemicals are brought onto the property.

- ☑ Storage of any materials on-site must be authorised by the site contact.

- ☑ If the contract and work involves subcontracting any part of the Scope of Work, a representative from the contractor's firm must accompany any sub trades and be responsible for their actions at all times while on-site. They must also ensure that this compliance checklist is signed off by the subcontractor.

- ☑ Any use of open flames or other hot work like grinding or cutting can only be done with the approval of the site Contact and appropriate Hot Work Permits.

- ☑ If fire occurs as a result of the work, workers must immediately activate the nearest fire alarm pull station. If the fire can be put out safely without danger, then the worker(s) should attempt to extinguish the fire. Report all fires. When a fire bell sounds, all workers must immediately proceed to the nearest point of exit.

- ☑ CFIA laboratories require 48 hours advance notice for taking fire alarm / sprinkler systems off-line.

- ☑ Canadian Food Inspection Agency strictly prohibits smoking on site.

- ☑ Eating and drinking is not permitted in laboratory areas.

- ☑ The use of drugs or alcohol on CFIA facilities is strictly forbidden.

Confidentiality Agreement

Every employee of the Public Service of Canada is required to take an Oath of Office and Secrecy when they are hired. Employees are bound by its requirements to protect confidential information. Employees cannot disclose information about policies, programs, practices or procedures of the Canadian Food Inspection Agency (CFIA) to which the public does not have official access. Employees must also take special care to maintain the confidentiality of any privileged information obtained from CFIA customers regarding their business affairs.

Specific safeguards are identified in the Government Security Policy and Standards and in corresponding departmental or organisational policies which apply to classified and designated information and assets. Classified or designated information and assets must be returned immediately to the appropriate institutional authority when notification is given that the person named herein no longer requires access to such information or assets.

If an individual fails to safeguard, releases without appropriate authority or uses information or assets for unauthorised purposes, such action may constitute a contravention of the Official Secrets Act, the Access to Information Act, the Privacy Act or other Acts of Parliament, a breach of the Government Security Policy or the Oath of the Government of Canada.

As a contractor of Canadian Food Inspection Agency - Burnaby, Willingdon Green Laboratory:

"I, my company and its employees solemnly affirm and declare that we will not, without due authority, disclose or make known any matter that comes to our knowledge by reason of such employment. Once any employment with CFIA concludes, we will continue to respect the confidentiality of any information obtained while working at the CFIA facility."

Contractor Safety, Security and Confidentiality Sign-Off

I acknowledge that I have read, understood, and agree to the terms and conditions of:

- Facility Orientation for Construction and Service Contractors Binder
- Emergency Response Plan Summary
- Canadian Food Inspection Agency Contractor Safety Compliance Checklist
- Confidentiality Agreement
- Canadian Food Inspection Agency Occupational Safety and Health Policy

Company	Name	Date	Reason for Visit	Signature