

Consultant for Building:



Architect



Structural Engineer



Mechanical Engineer



Electrical Engineer

END OF SECTION

Division 0 - Procurement and Contracting Requirements

00 00 00 - SPECIFICATION TITLE SHEET 1
00 01 07 - PROFESSIONAL SEALS PAGE 1
00 01 10 - TABLE OF CONTENTS 3
00 31 26 - EXISTING HAZARDOUS MATERIAL INFORMATION 2

Division 1 - General Requirements

01 11 00 - SUMMARY OF WORK 2
01 14 00 - WORK RESTRICTIONS 2
01 31 19 - PROJECT MEETINGS 2
01 32 16 - CONSTRUCTION PROGRESS SCHEDULE BAR (GANTT) CHART 3
01 33 00 - SUBMITTAL PROCEDURES 5
01 35 13 - SPECIAL PROJECT PROCEDURES FOR CSC FACILITIES 7
01 35 29 - HEALTH AND SAFETY REQUIREMENTS 5
01 35 43 - ENVIRONMENTAL PROCEDURES 8
01 41 00 - REGULATORY REQUIREMENTS 2
01 45 00 - QUALITY CONTROL 3
01 51 00 - TEMPORARY UTILITIES 3
01 52 00 - CONSTRUCTION FACILITIES 4
01 56 00 - TEMPORARY BARRIERS 3
01 61 00 - COMMON PRODUCT REQUIREMENTS 5
01 73 00 - EXECUTION 2
01 74 11 - CLEANING 2
01 74 20 - CONSTRUCTION/DEMOLITION WASTE MANAGEMENT 2
01 77 00 - CLOSEOUT PROCEDURES 1
01 78 00 - CLOSEOUT SUBMITTALS 6
01 79 00 - DEMONSTRATION AND TRAINING 2
01 91 13 - GENERAL COMMISSIONING (Cx) 9

Division 2 - Existing Conditions

02 41 99 - DEMOLITION 3
02 42 93 - DECONSTRUCTION AND WASTE PRODUCTS WORKPLAN SUMMARY 7
02 82 00.02 - ASBESTOS ABATEMENT - INTERMEDIATE PRECAUTIONS 9
02 83 10 - LEAD-BASE PAINT ABATEMENT - MINIMUM PRECAUTIONS 7

Division 4 - Masonry

04 05 12 - MASONRY MORTAR AND GROUT 6
04 05 19 - MASONRY ANCHORAGE AND REINFORCING 5
04 05 23 - MASONRY ACCESSORIES 4
04 22 00 - CONCRETE UNIT MASONRY 5

Division 5 - Metals

05 05 23 - POST-INSTALLED FASTENINGS 5
05 12 23 - STRUCTURAL STEEL FOR BUILDINGS 4
05 50 00 - METAL FABRICATIONS 5

Division 6 – Wood, Plastics, and Composites

06 10 00.01 - ROUGH CARPENTRY 3

Division 7 - Thermal and Moisture Protection

07 01 52 - ROOFING REPAIRS 4
07 21 13 - BOARD INSULATION 3
07 26 00 - VAPOUR RETARDERS..... 3
07 62 00 - SHEET METAL FLASHING AND TRIM..... 5
07 84 00 - FIRE STOPPING 5
07 92 00 - JOINT SEALANTS..... 5

Division 8 - Openings

08 11 00 - METAL DOORS AND FRAMES 6
08 71 00 - DOOR HARDWARE..... 6

Division 9 - Finishes

09 21 16 - GYPSUM BOARD ASSEMBLIES 7
09 65 99 – RESILIENT FLOORING 3
09 91 99 - PAINTING 6
09 96 00 – HIGH PERFORMANCE COATINGS 7

Division 11 – Equipment

11 19 12 – DETENTION HARDWARE..... 4
11 19 13 – DETENTION DOORS AND FRAMES..... 5
11 53 13 – FUME HOODS..... 9

Division 21 - Fire Suppression

21 05 01 - COMMON WORK RESULTS - MECHANICAL 10
21 05 05 - COMMON WORK RESULTS FOR FIRE SUPPRESSION..... 4
21 13 13 - WET PIPE SPRINKLER SYSTEMS..... 6

Division 22 - Plumbing

22 05 00 - COMMON WORK RESULTS FOR PLUMBING..... 6
22 11 16 - DOMESTIC WATER PIPING..... 5
22 13 17 - DRAINAGE WASTE AND VENT PIPING - CAST IRON AND COPPER..... 3
22 15 00 - GENERAL SERVICE COMPRESSED AIR SYSTEMS 4

Division 23 - Heating, Ventilating and Air Conditioning

23 03 01 - USE OF MECHANICAL SYSTEMS DURING CONSTRUCTION..... 2
23 05 05 - INSTALLATION OF PIPEWORK..... 5
23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT..... 3
23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT 7
23 05 48 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT 3
23 05 53.01 - MECHANICAL IDENTIFICATION..... 6

23 05 93 - TESTING, ADJUSTING AND BALANCING FOR HVAC 10
23 05 93.13 – TESTING, ADJUSTING AND BALANCING OF FUME HOODS 5
23 05 94 - PRESSURE TESTING OF DUCTED AIR SYSTEMS 3
23 07 13 - DUCT INSULATION 6
23 23 00 - REFRIGERANT PIPING 5
23 31 13.01 - METAL DUCTS - LOW PRESSURE TO 500 PA 6
23 31 13.02 – METAL DUCTS – HIGH PRESSURE TO 2500 PA 5
23 33 14 - DAMPERS - BALANCING 3
23 33 15 - DAMPERS - OPERATING 3
23 33 16 - DAMPERS - FIRE AND SMOKE 4
23 33 46 - FLEXIBLE DUCTS 3
23 33 53 - DUCT LINING 4
23 34 00 - HVAC FANS 4
23 37 13 - DIFFUSERS, REGISTERS AND GRILLES 3
23 37 20 - LOUVRES, INTAKES AND VENTS 3
23 44 00 - HVAC AIR FILTRATION 3
23 73 11 - AIR HANDLING UNITS – PACKAGED 8
23 81 40 - AIR SOURCE UNITARY HEAT PUMPS 7

Division 26 - Electrical

26 00 01 - ELECTRICAL PROJECT SPECIFICATIONS 12

Appendices

Designated Substance and Hazardous Materials Survey 46

END OF TABLE OF CONTENTS

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 02 82 00.02 – Asbestos Abatement

1.2 DEFINITIONS

- .1 Hazardous Materials Report: Information prepared by a specialist consultant hired directly by the Departmental Representative, and for which the Consultant is including as information documents related to Project and identified in the Appendices as such, and only as specifically referenced in the Appendices.
- .2 Contract Documents: All documents and information of any type and in any form, specifically prepared for use of Contract by Consultant and as defined in Contractor's Agreement Form.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Status of Hazardous Materials Report: Hazardous Materials Report identified in the Appendices; or any part thereof, are not part of Contract Documents prepared by the Consultant and are made available to Bidder for the purpose of providing Bidder with access to information available to Departmental Representative and Consultant under the following conditions:
- .1 Hazardous Materials Report shall not be considered a representation or warranty that information contained therein is accurate, complete, or appropriate.
- .2 Bidder shall interpret and draw conclusions about Hazardous Materials Report and are encouraged to obtain specialist advice with regards to this information.
- .3 Departmental Representative and Consultant assume no responsibility for such interpretations and conclusions.
- .4 Information contained in Hazardous Materials Report may be time sensitive and dates shall be considered when interpreting Hazardous Materials Report.
- .5 Bidder may rely upon data contained in Hazardous Materials Report; or parts thereof, which are specifically incorporated into Contract Documents by means of copying, transcribing or referencing, but shall draw their own conclusions from such data and shall not rely on opinions or interpretations contained therein.
- .2 Hazardous Materials Report: A Hazardous Materials Report was prepared for this project and is attached as an Appendices, but is not incorporated into the Contract Documents:

XCG Consultants Ltd.
Suite 300, 2620 Bristol Circle,
Oakville, Ontario L6H 6Z7

Title: Designated Substance and Hazardous Materials Survey
Warkworth Institution
Campbellford, Ontario

Submitted to: Mr. Lee Chan, Public Works and Government Services Canada
File No.: XCG 3-336-128-02
Date: March 30th, 2005

- .3 Direct inquiries during Bid period to person identified within the Hazardous Materials Report to receive inquiries; the Consultant will not accept direct enquiries with regards to hazardous materials removal.

Part 2 Products

2.1 USE OF HAZARDOUS MATERIALS REPORT

- .1 Information presented in the Hazardous Materials Report was commissioned by the Departmental Representative; recommendations contained in the Hazardous Materials Report were used by the Consultant to assess relative risk of exposure to hazardous materials and the level of involvement of all parties contributing to the Contract Documents.
- .2 Information contained in the Hazardous Materials Report may be useful to the Contractor, and is made available for review with no implied or express warranty from the Consultant as to the accuracy or completeness of this Document.

Part 3 Execution

3.1 HAZARDOUS MATERIALS REPORT

- .1 A copy of the Hazardous Materials Report in the Appendices.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 Title and description of Work.
- .2 Contract Method.
- .3 Work by others.
- .4 Contractor use of premises.
- .5 Owner occupancy.

1.2 PRECEDENCE

- .1 For Federal Government projects, Division 01 Sections take precedence over technical specification sections in other Divisions of this Project Manual.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

- .1 Work of this Contract comprises renovation of CSC Warkworth Institution Building WW27, located at 15847 County Road 29, Cambellford, Ontario and further identified as PWGSC Project Number R.069651.001.
- .2 The project includes the retrofitting of the existing armoury space in the basement, combining SMO work area with the armoury and upgrades to electrical, mechanical and structural systems.

1.4 CONTRACT METHOD

- .1 Construct Work under single, lump sum contract.

1.5 COST BREAKDOWN

- .1 Within 48 hours of notification of acceptance of bid furnish a cost breakdown by Section aggregating contract price.
- .2 Within 48 hours of acceptance of bid submit a list of subcontractors.

1.6 WORK SEQUENCE

- .1 Construct Work in stages to accommodate Owner's continued use of premises during construction.
- .2 Construct work according to schedule authorized by Departmental Representative.
- .3 Maintain fire access/control.

1.7 CONTRACTOR USE OF PREMISES

- .1 Contractor shall limit use of premises for Work, and for access, to allow:
 - .1 Owner occupancy.
 - .2 Coordinate use of premises under direction of Departmental Representative.
-

1.8 OWNER OCCUPANCY

- .1 Owner will occupy premises during entire construction period for execution of normal operations.
- .2 Cooperate with Owner in scheduling operations to minimize conflict and to facilitate Owner usage.

1.9 ALTERATIONS TO EXISTING BUILDING

- .1 Remove and recycle, compost, anaerobically digest, sell material for reuse or dispose of:
 - .1 New mechanical and electrical items as indicated.
- .2 Remove in good order, turn over to Department, and store within building where designated by Departmental Representative:
 - .1 Mechanical and electrical items as indicated.
- .3 Remove, temporarily store, clean, alter to suit and reinstall:
 - .1 Door Frames
 - .2 Door Hardware
 - .3 Mechanical and electrical items as indicated.
 - .4 Provide new door frames and hardware as required, new finishes as shown on drawings.
- .4 Remove, temporarily store and turn over to other sections for building in:
 - .1 Mechanical and electrical items as indicated.
- .5 Provide new openings required in existing construction.
- .6 Block in openings where items removed with material and finish to match existing adjoining construction.
- .7 Undercut existing doors as required.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not used.

END OF SECTION

Part 1 GENERAL

1.1 ACCESS AND EGRESS

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

1.2 USE OF SITE AND FACILITIES

- .1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with Departmental Representative to facilitate work as stated.
- .2 Maintain existing services to building and provide for personnel and vehicle access.
- .3 Where security is reduced by work provide temporary means to maintain security.
- .4 Contractor shall provide sanitary facilities for their own personnel. Contractor may use existing facilities if approved by Departmental Representative. Keep facilities clean.
- .5 Closures: protect work temporarily until permanent enclosures are completed.

1.3 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

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

1.4 EXISTING SERVICES

- .1 Notify Departmental Representative and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give Departmental Representative 7 days of notice for necessary interruption of mechanical or electrical service throughout course of work. Keep duration of interruptions minimum. Interruption of mechanical or electrical service shall not commence without obtaining written permission of the Director.
- .3 Construct barriers in accordance with Section 01 56 00.

1.5 SPECIAL REQUIREMENTS

- .1 Submit schedule in accordance with Section 01 32 16.
 - .2 Ensure Contractor's personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.
 - .3 Keep within limits of work and avenues of ingress and egress.
 - .4 Ingress and egress of Contractor vehicles at site is limited to areas noted on Drawings.
 - .5 Prior to cutting or drilling horizontal or vertical surfaces including concrete, concrete block or other structural substrate, determine location of reinforcing, service lines, pipes, conduits or other items by x-ray, ground penetrating radar or other appropriate method. Submit findings to Departmental Representative prior to cutting or drilling.
-

1.6 SECURITY

- .1 Where security has been reduced by Work of Contract, provide temporary means to maintain security.
- .2 Security clearances: to Section 01 35 13.
 - .1 Personnel employed on this project will be subject to security check. Obtain clearance, as instructed, for each individual who will require to enter premises.
 - .2 Obtain requisite clearance, as instructed, for each individual required to enter premises.
 - .3 Personnel will be checked daily at start of work shift and provided with pass which must be worn at all times. Pass must be returned at end of work shift and personnel checked out.

1.7 BUILDING SMOKING ENVIRONMENT

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

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 ADMINISTRATIVE

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

1.2 PRECONSTRUCTION MEETING

- .1 Within 15 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
- .2 Departmental Representative, Contractor, major Subcontractors, field inspectors and supervisors will be in attendance.
- .3 Establish time and location of meeting and notify parties concerned minimum 5 days before meeting.
- .4 Incorporate mutually agreed variations to Contract Documents into Agreement, prior to signing.
- .5 Agenda to include:
 - .1 Appointment of official representative of participants in the Work.
 - .2 Schedule of Work: in accordance with Section 01 32 16.
 - .3 Schedule of submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00.
 - .4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences in accordance with Section 01 52 00.
 - .5 Delivery schedule of specified equipment.
 - .6 Site security.
 - .7 Health and safety in accordance with Section 01 35 29.
 - .1 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.

- .2 Departmental Representative- provided products.
- .3 Record drawings and specifications in accordance with Section 01 33 00.
- .4 Maintenance manuals in accordance with Section 01 78 00.
- .5 Commissioning in accordance with Section 01 91 13.
- .6 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00.
- .7 Monthly progress claims, administrative procedures, photographs, hold backs.
- .8 Appointment of inspection and testing agencies or firms.
- .9 Insurances, transcript of policies.

1.3 PROGRESS MEETINGS

- .1 Schedule progress meeting bi-weekly.
- .2 Provide two week look ahead schedule at each progress meeting.
- .3 Contractor, major Subcontractors involved in Work and Departmental Representative shall be in attendance.
- .4 Notify parties minimum 5 days prior to meetings.
- .5 Provide updated schedule in GANT chart format at each progress meeting.
- .6 Agenda to include the following:
 - .1 Review, approval of minutes of previous meeting.
 - .2 Review of Work progress since previous meeting.
 - .3 Field observations, problems, conflicts.
 - .4 Review of off-site fabrication delivery schedules.
 - .5 Corrective measures and procedures to regain projected schedule.
 - .6 Revision to construction schedule.
 - .7 Progress schedule, during succeeding work period.
 - .8 Review submittal schedules: expedite as required.
 - .9 Review Requests for Information (RFI), Proposed Change Order (PCN) and Change Order (CO) logs, expedite as required.
 - .10 Maintenance of quality standards.
 - .11 Review proposed change orders for effect on construction schedule and on completion date.
 - .12 Other business.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 DEFINITIONS

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

1.2 REQUIREMENTS

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

1.3 SUBMITTALS

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

- .2 Submit to Departmental Representative within 10 working days of Award of Contract Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of project progress.
- .3 Submit Project Schedule to Departmental Representative within 5 working days of receipt of acceptance of Master Plan.

1.4 MASTER PLAN

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

1.5 PROJECT SCHEDULE

- .1 Develop detailed Project Schedule derived from Master Plan.
- .2 Ensure detailed Project Schedule includes as minimum milestone and activity types as follows:
 - .1 Award.
 - .2 Shop Drawings, Samples.
 - .3 Permits.
 - .4 Mobilization.
 - .5 Heating, Ventilating, and Air Conditioning
 - .6 Piping.
 - .7 Plumbing
 - .8 Roofing.
 - .9 Interior Architecture (Walls, Floors and Ceiling).
 - .10 Lighting.
 - .11 Electrical.
 - .12 Controls.
 - .13 Testing and Commissioning.

1.6 PROJECT SCHEDULE REPORTING

- .1 Update Project Schedule on weekly basis reflecting activity changes and completions, as well as activities in progress.
 - .2 Include as part of Project Schedule, narrative report identifying Work status to date, comparing current progress to baseline, presenting current forecasts, defining problem areas, anticipated delays and impact with possible mitigation.
 - .3 Provide updated schedule in GANTT chart format at each progress meeting.
-

1.7 PROJECT MEETINGS

- .1 Discuss Project Schedule at regular site meetings specified in Section 01 31 19, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.
- .2 Weather related delays with their remedial measures will be discussed and negotiated.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not used.

END OF SECTION

Part 1 GENERAL

1.1 ADMINISTRATIVE

- .1 Submit to Departmental Representative submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Do not proceed with Work affected by submittal until review is complete.
- .3 Present shop drawings, product data, and samples 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 coordinated 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 Submit number of hard copies specified for each type and format of submittal and also submit in electronic format as pdf files. Forward pdf, MS Word, MS Excel, MS Project and Autocad dwg files on USB compatible with PWGSC encryption requirements or through email or alternate electronic file sharing service such as ftp, as directed 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 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario 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 5 working days for Departmental Representative's review of each submission.
 - .5 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Amount. 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 shall 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 one electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request. Submit two hard copies and one electronic copy of all approved and final shop drawings with Operations and Maintenance Data binders.
-

- .11 Submit two hard copies and one electronic copy 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 two hard copies and one electronic copy 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 two hard copies and one electronic copy 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 two hard copies and one electronic copy of manufacturers instructions for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
 - .15 Submit two hard copies and one electronic copy 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 two hard copies and one electronic copy 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, 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 PWGSC approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.
 - .2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

1.3 SAMPLES

- .1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to Departmental Representative's business address.
- .3 Notify Departmental Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .4 Where colour, pattern or texture is criterion, submit full range of samples.
- .5 Adjustments made on samples by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .6 Make changes in samples which Departmental Representative may require, consistent with Contract Documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.
 - .1 Accepted samples shall be kept and remain on site for review purposes, for duration of construction contract.

1.4 PHOTOGRAPHIC DOCUMENTATION

- .1 Submit electronic and hard 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 Number of viewpoints:
 - .1 Viewpoints and their location as determined by Departmental Representative.
- .4 Frequency of photographic documentation: as directed by Departmental Representative.
 - .1 Upon completion of: excavation, foundation, framing and services before concealment of Work, and as directed by Departmental Representative.
- .5 Include hard copy of complete compilation of photographic documentation in Operation and Maintenance Manual specified Section 01 78 00.

- .6 All photographs must be taken with or by the departmental Representative using their photography equipment.
- .7 Provide photographs of all work prior to enclosing construction as indicated by departmental Representative.

1.5 CERTIFICATES AND TRANSCRIPTS

- .1 Immediately after award of Contract, submit Workers' Safety and Insurance Board Experience Report.
- .2 Submit transcription of insurance immediately after award of Contract.

1.6 FEES, PERMITS AND CERTIFICATES

- .1 Provide authorities having jurisdiction with information requested.
- .2 Pay fees and obtain certificates and permits required.
- .3 Furnish certificates and permits.
- .4 Submit acceptable certificate stating that suspended ceiling systems provide adequate support for electrical fixtures, as required by current bulletin of Electrical Inspection Department of Ontario Hydro.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 PURPOSE

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

1.2 DEFINITIONS

- .1 "Contraband" means:
 - .1 An intoxicant, including alcoholic beverages, drugs and narcotics.
 - .2 Tobacco or associated tobacco products.
 - .3 An igniting device, lighter or matches.
 - .4 A weapon or a component thereof, ammunition for a weapon, and anything that is designed to kill, injure or disable a person or that is altered so as to be capable of killing, injuring or disabling a person, when possessed without prior authorization.
 - .5 An explosive or a bomb or a component thereof.
 - .6 Currency over any applicable prescribed limit, \$25.00 when possessed by an inmate without prior authorization.
 - .7 Any item not described in paragraphs 1.2.1.1 to 1.2.1.6 that could jeopardize the security of a Penitentiary or the safety of persons, when that item is possessed without prior authorization.
- .2 "Unauthorized Smoking and related Items" means all smoking items including, but not limited to, cigarettes, cigars, tobacco, chewing tobacco, cigarette making machines, matches and lighters.
- .2 "Commercial Vehicle" means any motor vehicle used for the shipment of material, equipment and tools required for the construction project.
- .3 "CSC" means Correctional Service Canada.
- .4 "Director" means Director, Warden or Superintendent of the Institution as applicable.
- .5 "Construction Employees" means persons working for the General Contractor, the sub-contractors, equipment operators, material suppliers, testing and inspection companies and regulatory agencies.
- .6 "Departmental Representative" means the project manager from Public Works and Government Services Canada.
- .7 "Perimeter" means the fenced or walled area of the Institution that restrains the movement of the inmates.
- .8 "Construction Limits" means the area as shown on the contract drawings that the Contractor will be allowed to work". This area may or may not be isolated from the security area of the Institution.

1.3 PRELIMINARY PROCEEDINGS

- .1 Prior to the commencement of work, the Contractor shall meet with the Director or his representative to:
 - .1 Discuss the nature and extent of all activities involved in the Project.
 - .2 Establish mutually acceptable security procedures in accordance with this instruction and the institution's particular requirements.
- .2 Contractor shall:
 - .1 Ensure that all Construction Employees are aware of the security requirements.
 - .2 Ensure that a copy of the security requirements is always prominently on display at the job site.
 - .3 Co-operate with institutional personnel in ensuring that security requirements are observed by all Construction Employees.

1.4 CONSTRUCTION EMPLOYEES

- .1 Submit to the Director a list of the names with date of birth of all Construction Employees on the construction site and a security clearance form for each employee.
- .2 Allow two (2) weeks for processing of security clearances. Employees will not be admitted to the Institution without a valid security clearance in place and a recent picture identification such as a provincial driver's license. Security clearances obtained from other CSC Institutions are not valid at this Institution.
- .3 The Director may require that facial photographs may be taken of Construction Employees and these photographs may be displayed at appropriate locations in the Institution or in an electronic database for identification purposes. The Director may require that these photographs be displayed prominently on the Construction Employees clothing while employees are in the Institution.
- .4 Entry to Institutional Property will be refused to any person there may be reason to believe may be a security risk.
- .5 Any person employed on the construction site will be subject to immediate removal from Institutional Property if they:
 - .1 Appear to be under the influence of alcohol, drugs or narcotics.
 - .2 Behave in an unusual or disorderly manner.
 - .3 Are in possession of contraband.
- .6 Smoking is prohibited anywhere on CSC property.

1.5 VEHICLES

- .1 All unattended vehicles on CSC property shall have windows closed; doors and trunks shall be locked and keys removed. The keys shall be securely in the possession of the owner or an employee of the company that owns the vehicle.
 - .2 The Director may limit at any time the number and type of vehicles allowed within the Institution.
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- .3 Drivers of delivery vehicles for material required by the project will not require security clearances but must remain with their vehicle the entire time that the vehicle is in the Institution. The Director may require that these vehicles be escorted by Institutional Staff or Commissionaires while in the Institution.
- .4 If the Director permits trailers to be left inside the secure perimeter of the Institution, these trailer doors will be locked at all times. All windows will be securely locked when left unoccupied. All trailer windows shall be covered with expanded metal mesh. All storage trailers inside and outside the perimeter shall be locked when not in use.

1.6 PARKING

- .1 Parking area(s) to be used by Construction Employees will be designated by the Director. Parking in other locations will be prohibited and vehicles may be subject to removal.

1.7 SHIPMENTS

- .1 All shipments of project material, equipment and tools shall be addressed in the Contractor's name to avoid confusion with the Institution's own shipments. The Contractor must have his/her own employees on site to receive any deliveries or shipments. CSC staff will NOT accept receipt of deliveries or shipments of any material equipment or tools.

1.8 TELEPHONES

- .1 The installation of telephones, facsimile machines and computers with Internet connections requires the prior approval of the Director.
- .2 The Director will ensure that approved telephones, facsimile machine and computers with internet connections are located where they are not accessible to inmates. All computers will have an approved password protection that will stop an internet connection to unauthorized personnel.
- .3 Wireless cellular and digital telephones are not permitted within the Institution unless approved by the Director. If wireless cellular telephones are permitted, the user will not permit their use by any inmate.
- .4 The Director may approve but limit the use of two way radios.

1.9 WORK HOURS

- .1 Work hours within the Institution are: Monday to Friday 08:00 hrs. to 15:45 hrs.
- .2 Work will not be permitted during weekends and statutory holidays without the permission of the Director. A minimum of seven days advance notice will be required to obtain the required permission.

1.10 OVERTIME WORK

- .1 No overtime work will be allowed without permission of the Director. Give a minimum forty-eight (48) hours advance notice when overtime work on the construction project is necessary and approved. If overtime work is required because of an emergency such the completion of a concrete pour or work to make the construction safe and secure, the Contractor shall advise the Director as soon as this condition is known and follow the directions given by the Director. Costs to the Crown for such events may be attributed to the Contractor.
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- .2 When overtime work, weekend statutory holiday work is required and approved by the Director, extra staff members may be posted by the Director or his designate, to maintain the security surveillance. The Departmental Representative may post extra staff for inspection of construction activities. The actual cost of this extra staff may be subject to reclamation by the Crown.

1.11 TOOLS AND EQUIPMENT

- .1 Maintain a complete list of all tools and equipment to be used during the construction project. Make this inventory available for inspection when required.
- .2 Throughout the construction project maintain up-to-date the list of tools and equipment specified above.
- .3 Keep all tools and equipment under constant supervision, particularly power-driven and cartridge-driven tools, cartridges, files, saw blades, rod saws, wire, rope, ladders and any sort of jacking device.
- .4 Store all tools and equipment in approved secure locations.
- .5 Lock all tool boxes when not in use. Keys to remain in the possession of the employees of the contractor.
- .6 All missing or lost tools or equipment shall be reported immediately to the Director.
- .7 The Director will ensure that the security staff members carry out checks of the Contractor's tools and equipment against the list provided by the Contractor. These checks may be carried out at the following intervals:
 - .1 At the beginning and conclusion of every construction project.
 - .2 Weekly, when the construction project extends longer than a one week period.
- .8 Certain tools/equipment such as cartridges and hacksaw blades are highly controlled items. The Contractor will be given at the beginning of the day, a quantity that will permit one day's work. Used blades/cartridges will be returned to the Director's representative at the end of each day.
- .9 If propane or natural gas is used for heating the construction, the Institution may require that an employee supervise the construction site during non-working hours.

1.12 PRESCRIPTION DRUGS

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

1.13 CONTRABAND

- .1 Weapons, ammunition, explosives, alcoholic beverages, drugs and narcotics are prohibited on Institutional Property.
- .2 Discovery of Contraband on the construction site and the identification of the person(s) responsible for the Contraband shall be reported immediately to the Director.
- .3 Contractors shall be vigilant with both their staff and the staff of their sub-contractors and suppliers that the discovery of Contraband may result in cancellation of the security clearance of the affected employee. Serious infractions may result in the removal of the company from the Institution for the duration of the construction.

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

1.14 SEARCHES

- .1 All vehicles and persons entering Institutional property may be subject to search.
- .2 When the Director suspects, on reasonable grounds, that an employee of the Contractor is in possession of Contraband, he may order that person to be searched.
- .3 All employees entering the Institution may be subject to screening of personal effects for traces of Contraband drug residue.

1.15 ACCESS TO AND REMOVAL FROM INSTITUTION PROPERTY

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

1.16 MOVEMENT OF VEHICLES

- .1 Escorted commercial vehicles will be allowed to enter or leave the Institution through the vehicle access gate during the following hours:
 - .1 08:00 hrs. to 11:30 hrs. and 13:00 to 16:00 hrs.
- .2 Construction vehicles shall not leave the Institution until an inmate count is completed.
- .3 The Contractor shall advise the Director twenty four (24) hours in advance to the arrival on the site of heavy equipment such as concrete trucks, cranes, etc.
- .4 Vehicles being loaded with soil or other debris, or any vehicle considered impossible to search, must be under continuous supervision by CSC Staff or Commissionaires working under the authority of the Director.
- .5 Commercial Vehicles will only be allowed access to Institutional Property when their contents are certified by the Contractor or his/her representative as being strictly necessary to the execution of the construction project.
- .6 Vehicles shall be refused access to Institutional Property if, in the opinion of the Director, they contain any article which may jeopardize the security of the Institution.
- .7 Private vehicles of Construction Employees will not be allowed within the security wall or fence of medium or maximum security Institutions without the permission of the Director.
- .8 With prior approval of the Director, a vehicle may be used in the morning and evening to transport a group of employees to the work site. This vehicle will not remain within the Institution the remainder of the day.
- .9 With the approval of the Director, certain equipment may be permitted to remain on the construction site overnight or over the weekend. This equipment must be securely locked, with the battery removed. The Director may require that the equipment be secured with a chain and padlock to another solid object.
- .10 Construction vehicles should expect searches and delays prior to entry and exit of access gate.

1.17 MOVEMENT OF CONSTRUCTION EMPLOYEES ON INSTITUTIONAL PROPERTY

- .1 Subject to the requirements of good security, the Director will permit the Contractor and his employees as much freedom of action and movement as is possible.
- .2 However, notwithstanding paragraph above, the Director may:
- .3 Prohibit or restrict access to any part of the Institution.
- .4 Require that in certain areas of the Institution, either during the entire construction project or at certain intervals, Construction Employees only be allowed access when accompanied by a member of the CSC security staff.
- .5 During the lunch and coffee breaks, all employees will remain within the construction site. Employees are not permitted to eat in the officer's lounge and dining room.
- .6 Contractor movement outside of the work area will be restricted during inmate movement times. CSC will advise of dates and times prior to inmate movement.

1.18 SURVEILLANCE AND INSPECTION

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

1.19 STOPPAGE OF WORK

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

1.20 CONTACT WITH INMATES

- .1 Unless specifically authorized, it is forbidden to come into contact with inmates, to talk with them, to receive objects from them or to give them objects. Any employee doing any of the above will be removed from the site and his/her security clearance revoked.
- .2 It is forbidden to take pictures of inmates, of CSC staff members or of any part of the Institution other than those required as part of this Contract.

1.21 COMPLETION OF CONSTRUCTION PROJECT

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

Part 2 PRODUCTS

2.1 NOT USED

.1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA): Canada
 - .1 CSA S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.
- .2 National Building Code 2010 (NBC):
 - .1 NBC 2010, Division B, Part 8 Safety Measures at Construction and Demolition Sites.
- .3 National Fire Code 2010 (NFC):
 - .1 NFC 2010, Division B, Part 5 Hazardous Processes and Operations, subsection 5.6.1.3 Fire Safety Plan.
- .4 Province of Ontario:
 - .1 Occupational Health and Safety Act Revised Statutes of Ontario 1990, Chapter O.1 as amended, and Regulations for Construction Projects, O. Reg. 213/91 as amended.
 - .2 O. Reg. 490/09, Designated Substances.
 - .3 Workplace Safety and Insurance Act, 1997.
 - .4 Municipal statutes and authorities.
- .5 Treasury Board of Canada Secretariat (TBS):
 - .1 Treasury Board, Fire Protection Standard April 1, 2010
www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=17316§ion=text.

1.2 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00.
- .2 Submit site-specific Health and Safety Plan: Within 7 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
 - .1 Results of site specific safety hazard assessment.
 - .2 Results of safety and health risk or hazard analysis for site tasks and operations found in work plan.
 - .3 Measures and controls to be implemented to address identified safety hazards and risks.
 - .4 Provide a Fire Safety Plan, specific to the work location, in accordance with NBC, Division B, Article 8.1.1.3 prior to commencement of work. The plan shall be coordinated with, and integrated into, the existing Facility Emergency Procedures and Evacuation Plan in place at the site. Departmental Representative will provide Facility Emergency Procedures and Evacuation Plan. Deliver two copies of the Fire Safety Plan to the Departmental Representative not later than 14 days before commencing work.
 - .5 Contractor's and Sub-contractors' Safety Communication Plan.

- .6 Contingency and Emergency Response Plan addressing standard operating procedures specific to the project site to be implemented during emergency situations. Coordinate plan with existing Facility Emergency Response requirements and procedures provided by Departmental Representative.
- .3 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 3 days after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative within 3 days after receipt of comments from Departmental Representative.
- .4 Departmental Representative's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.
- .5 Submit names of personnel and alternates responsible for site safety and health.
- .6 Submit records of Contractor's Health and Safety meetings when requested.
- .7 Submit 2 copies of Contractor's authorized representative's work site health and safety inspection reports to Departmental Representative, weekly.
- .8 Submit copies of orders, directions or reports issued by health and safety inspectors of the authorities having jurisdiction.
- .9 Submit copies of incident and accident reports.
- .10 Submit Material Safety Data Sheets (MSDS).
- .11 Submit Workplace Safety and Insurance Board (WSIB) - Experience Rating Report.
- .12 Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel, in accordance with O. Reg. 490, prior to commencement of Work, and submit additional certifications for any new site personnel to Departmental Representative.

1.3 FILING OF NOTICE

- .1 File Notice of Project with Provincial authorities prior to commencement of Work.

1.4 WORK PERMIT

- .1 Apply for building permits in accordance with General Conditions of the Contract.

1.5 SAFETY ASSESSMENT

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

1.6 MEETINGS

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

1.7 REGULATORY REQUIREMENTS

- .1 Comply with the Acts and regulations of the Province of Ontario.
 - .2 Comply with specified standards and regulations to ensure safe operations at site.
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1.8 PROJECT/SITE CONDITIONS

- .1 Work at site will involve contact with:
 - .1 Silica in concrete, concrete block, concrete brick, ceramic tile.
 - .2 Mercury in switches, flourescent light tubes, thermostats and pressure-sensing devices.
 - .3 Asbestos in window caulking and ceiling tile mastic.
 - .4 Lead in paint, solder in electronic equipment, solder caulking in ball fittings of cast iron pipes, and solder used on domestic water lines.
 - .5 PCBs in ballasts.
 - .6 Mould on gypsum board and tile ceiling.
 - .7 HCFC-22 and CFC-based Ozone Depleting Substances in air conditioning units.
- .2 Refer to the Designated Substances and Hazardous Materials Survey attached to this Project Manual, for further information on designated substances, hazardous and contaminated materials.
- .3 Confined spaces in attic and crawl space.

1.9 GENERAL REQUIREMENTS

- .1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.
- .2 Departmental Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns either accepting or requesting improvements.
- .3 Relief from or substitution for any portion or provision of minimum Health and Safety standards specified herein or reviewed site-specific Health and Safety Plan shall be submitted to Departmental Representative in writing.

1.10 COMPLIANCE REQUIREMENTS

- .1 Comply with Ontario Occupational Health and Safety Act, R.S.O. 1990 Chapter 0.1, as amended.

1.11 RESPONSIBILITY

- .1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.
- .3 Where applicable the Contractor shall be designated "Constructor", as defined by Occupational Health and Safety Act for the Province of Ontario.

1.12 UNFORESEEN HAZARDS

- .1 Should any unforeseen or peculiar safety-related factor, hazard, or condition become evident during performance of Work, immediately stop work and advise Departmental Representative verbally and in writing.
- .2 Follow procedures in place for Employees Right to Refuse Work as specified in the Occupational Health and Safety Act for the Province of Ontario.

1.13 HEALTH AND SAFETY CO-ORDINATOR

- .1 Employ and assign to Work, competent and authorized representative as Health and Safety Co-ordinator. Health and Safety Co-ordinator must:
 - .1 Have site-related working experience specific to activities associated with the project.
 - .2 Have working knowledge of occupational safety and health regulations.
 - .3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.
 - .4 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.
 - .5 Be on site during execution of Work and report directly to and be under direction of site supervisor.

1.14 POSTING OF DOCUMENTS

- .1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Province of Ontario, and in consultation with Departmental Representative.
 - .1 Contractor's Safety Policy.
 - .2 Constructor's Name.
 - .3 Notice of Project.
 - .4 Name, trade, and employer of Health and Safety Representative or Joint Health and Safety Committee members (if applicable).
 - .5 Ministry of Labour Orders and reports.
 - .6 Occupational Health and Safety Act and Regulations for Construction Projects for Province of Ontario.
 - .7 Address and phone number of nearest Ministry of Labour office.
 - .8 Material Safety Data Sheets.
 - .9 Written Emergency Response Plan.
 - .10 Site Specific Safety Plan.
 - .11 Valid certificate of first aider on duty.
 - .12 WSIB "In Case of Injury At Work" poster.
 - .13 Location of toilet and cleanup facilities.
 - .14 Location of nearest hospital.

1.15 CORRECTION OF NON-COMPLIANCE

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Departmental Representative.
- .2 Provide Departmental Representative with written report of action taken to correct non-compliance of health and safety issues identified.
- .3 Departmental Representative may stop Work if non-compliance of health and safety regulations is not corrected.

1.16 POWDER ACTUATED DEVICES

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

1.17 WORK STOPPAGE

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

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not used.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Definitions:
 - .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humans; or degrade environment aesthetically, culturally and/or historically.
 - .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction.
- .2 Reference Standards:
 - .1 U.S. Environmental Protection Agency (EPA)/Office of Water
 - .1 EPA 832/R-92-005-92, Storm Water Management for Construction Activities, Chapter 3.
 - .2 EPA General Construction Permit (GCP) 2012.
 - .2 Comply with the rules and regulations of authorities having jurisdiction.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
 - .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit 2 copies of WHMIS MSDS.
 - .3 Before commencing construction activities or delivery of materials to site, submit Environmental Protection Plan for review and approval by Departmental Representative.
 - .4 Environmental Protection Plan must include comprehensive overview of known or potential environmental issues to be addressed during construction.
 - .5 Address topics at level of detail commensurate with environmental issue and required construction tasks.
 - .6 Include in Environmental Protection Plan:
 - .1 Names of persons responsible for ensuring adherence to Environmental Protection Plan.
 - .2 Names and qualifications of persons responsible for manifesting hazardous waste to be removed from site.
 - .3 Names and qualifications of persons responsible for training site personnel.
 - .4 Descriptions of environmental protection personnel training program.
-

- .5 Erosion and sediment control plan identifying type and location of erosion and sediment controls to be provided including monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations and EPA 832/R-92-005, Chapter 3.
- .6 Drawings indicating locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on site.
- .7 Traffic Control Plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather.
 - .1 Plans to include measures to minimize amount of material transported onto paved public roads by vehicles or runoff.
- .8 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use.
 - .1 Plan to include measures for marking limits of use areas and methods for protection of features to be preserved within authorized work areas.
- .9 Spill Control Plan to include procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.
- .10 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.
- .11 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, are contained on project site.
- .12 Contaminant Prevention Plan identifying potentially hazardous substances to be used on job site; intended actions to prevent introduction of such materials into air, water, or ground; and detailing provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.
- .13 Waste Water Management Plan identifying methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines.
- .14 Historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands.
- .15 Pesticide treatment plan to be included and updated, as required.

1.3 FIRES

- .1 Fires and burning of rubbish on site is not permitted.
- .2 Provide supervision, attendance and fire protection measures as directed.

1.4 DISPOSAL OF WASTES

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

- .2 Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner into waterways, storm or sanitary sewers.
- .3 Do not discharge wastes into streams or water ways.
- .4 Separate and dispose of accumulated waste materials off-site in accordance with R.R.O. 1990, Reg. 347 General Waste Management, to MOE approved disposal facilities or approved transfer stations, including, but no limited to, the following:
 - .1 Debris including excess construction material.
 - .2 Non-contaminated litter and rubbish.
 - .3 Disposable PPE worn during final cleaning.
 - .4 Wastewater removed from wastewater storage tank.
 - .5 Wastewater generated from final decontamination operations including wastewater storage tank cleaning.
 - .6 Lumber from decontamination pads.
- .5 Appropriate procedures shall be implemented for handling, temporary storage, transport and disposal of impacted soils during all phases of the project. Refer to Land Disposal Restrictions in O.Reg. 347 - General Waste Disposal under Ontario EPA and MOE Fact Sheet "Summary of Land Disposal Restrictions, Treatment and Notification Requirements for Waste Generators". Off-site disposal will be by licensed haulers to a MOE-approved disposal facility.
- .6 Disposal/recycling of other waste generated during the project shall be done in compliance with Ontario Waste Regulations and the facilities used will be approved by the Departmental Representative.

1.5 VEHICULAR ACCESS AND PARKING

- .1 Maintenance and Use:
 - .1 Prevent contamination of access roads. Immediately scrape up debris or material on access roads which is suspected to be contaminated as determined by Departmental Representative; transport and place into designated area approved by Departmental Representative. Clean access roads at least once per shift.
 - .2 Departmental Representative may collect soil samples for chemical analyses from traveling surfaces of constructed and existing access routes prior to, during, and upon completion of Work. Excavate and dispose of clean soil contaminated by Contractor's activities at no additional cost to Departmental Representative.
- .2 Vehicles/equipment shall be in good working order and not be leaking any fuel or fluids.
- .3 Restrict access of vehicles from creek banks to protect slope stability.
- .4 During construction designated fuelling area(s) will be established.
- .5 Refuelling of vehicles and equipment shall not be conducted near watercourses.
- .6 Traffic management measures (such as 'flag man') shall be implemented if required at site access points to direct traffic.

1.6 EQUIPMENT DECONTAMINATION

- .1 Commence Work involving equipment contact with potentially contaminated material only after Equipment Decontamination Pads are operational.

- .2 Decontaminate equipment after working in potentially contaminated work areas and prior to subsequent work or travel on clean areas.
- .3 Perform equipment decontamination on Contractor-constructed equipment decontamination pad to prevent cross contaminating unimpacted areas.
- .4 Equipment Decontamination Pads to include pad, potable wash water system, and a lined, dyked containment area with a water collection sump. Equipment decontamination pads shall be removed prior to conclusion of the project.
- .5 At minimum, perform following steps during equipment decontamination: mechanically remove packed dirt, grit, and debris by scraping and brushing without using steam or high-pressure water to reduce amount of water needed and to reduce amount of contaminated rinsate generated. Use high-pressure, low-volume, hot water or steam supplemented by detergents or solvents as appropriate and as approved by Departmental Representative. Pay particular attention to tire treads, equipment tracks, springs, joints, sprockets, and undercarriages. Scrub surfaces with long handle scrub brushes and cleaning agent. Rinse off and collect cleaning agent. Air dry equipment in Clean Zone before removing from site or travelling on clean areas. Perform assessment as directed by Departmental Representative to determine effectiveness of decontamination.
- .6 Each piece of equipment will be inspected by Departmental Representative after decontamination and prior to removal from site and/or travel on clean areas. Departmental Representative will have right to require additional decontamination to be completed if deemed necessary.
- .7 Take appropriate measures necessary to minimize drift of mist and spray during decontamination including provision of wind screens.
- .8 Collect decontamination wastewaters and sediments which accumulate on equipment decontamination pad. Transfer wastewaters to designated wastewater storage tank.
- .9 Transfer sediments to a designated area approved by the Departmental Representative.
- .10 Furnish and equip personnel engaged in equipment decontamination with protective equipment including suitable disposable clothing, respiratory protection, and face shields.
- .11 Provide sufficient pumping equipment, of adequate pumping capacity and associated machinery and piping in good working condition for ordinary emergencies, including power outage, and competent workers for operation of pumping equipment. Maintain piping and connections in good condition and leak-free.

1.7 DRAINAGE

- .1 Develop and submit erosion and Sediment Control Plan (ESC) identifying type and location of erosion and sediment controls provided. Plan to include monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations, EPA 832/R-92-005, Chapter 3.
- .2 Storm Water Pollution Prevention Plan (SWPPP) to be substituted for erosion and sediment control plan.
- .3 Provide temporary drainage and pumping required to keep excavations and site free from water.

- .4 Ensure pumped water into waterways, sewer or drainage systems is free of suspended materials.
- .5 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

1.8 SURFACE WATER AND GROUNDWATER QUALITY

- .1 Materials and equipment shall be operated and stored in a manner that prevents deleterious substances (e.g., petroleum products, silt, etc.) as defined by the Fisheries Act from entering surface water.
- .2 Impacted groundwater entering excavations shall be collected and disposed of at a facility approved by the Departmental Representative.

1.9 VEGETATION

- .1 Protect vegetation that does not have to be removed by fencing/ delineating construction working and/or storage areas.
- .2 Operated construction machinery in a manner that minimizes damage to adjacent vegetation.

1.10 POLLUTION CONTROL

- .1 Maintain temporary erosion and pollution control features installed under this Contract.
 - .2 Control emissions from equipment and plant in accordance with local authorities' emission requirements.
 - .3 Prevent sandblasting and other extraneous materials from contaminating air and waterways beyond application area.
 - .1 Provide temporary enclosures where directed by Departmental Representative.
 - .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.
 - .5 Fuelling activities shall be conducted offsite.
 - .6 Ensure hazardous substances (including fuel) are stored, handled and applied in a manner to prevent release to the environment and in a legal manner in accordance with hazardous waste regulations.
 - .7 Secure all materials at non-productive times (night and shut-down).
 - .8 Vehicles shall be shut off when not in use. No vehicle idling on-site.
 - .9 Store hazardous or toxic substances in a designated area.
 - .10 Comply with requirements of WHMIS regarding use, handling, storage and disposal of hazardous materials; and regarding labelling and provision of MSDS acceptable to Authorities Having Jurisdiction.
-

1.11 SPILLS OR RELEASE OF DELETERIOUS SUBSTANCES

- .1 Immediately contain, limit spread and clean up in accordance with provincial regulatory requirements.
 - .2 All workers shall be fully aware of the spill prevention and response procedures including notification of Departmental Representative.
 - .3 The Ontario Ministry of Environment Spills Action Centre must be notified immediately at 1-800-268-6060.
 - .4 The Departmental Representative shall be immediately informed of all spills that occur onsite.
 - .5 Further information on dangerous goods emergency cleanup and precautions including a list of companies performing this work can be obtained from the Transport Canada 24-hour number (613) 996-6666 collect.
 - .6 Spill kits will be kept on-site during all project phases.
 - .7 Contractor shall take due care to ensure no deleterious materials including sediment-laden runoff leave the worksite, or enter any: surface water, storm water, or sanitary sewers at or near the worksite.
 - .8 Equipment fuelling or lubricating shall occur in a designated area with proper controls to prevent the release of deleterious substances, and shall be conducted away from any surface water drains or collection points.
 - .9 In accordance with the Fisheries Act, approval must be obtained from DFO for use of any paints, corrosion protective coatings, wood preservatives or any other hazardous material that will be applied to surfaces that will have contact with the marine environment.
 - .10 Any equipment remaining on site overnight shall have appropriately placed drip pans.
 - .11 The rinse, cleaning water or solvents for glues, wood preservatives and other potentially harmful or toxic substances should be controlled so as to prevent leakage, loss or discharge into the storm drain system or into the marine environment.
 - .12 Protect the roadways from tracking of mud, soil, and debris throughout the work.
 - .13 Prevent discharges containing asphalt, grout, concrete or other waste materials from reaching storm drains or the marine environment. This includes, but is not limited to:
 - .1 Minimizing the washing of sand or gravel from new asphalt, debris from drilling or cutting or other materials into storm drains and the marine environment by sweeping.
 - .2 Application of fog seals, tack coats or other coatings, if required, during periods when rainfall is unlikely to occur during application.
 - .3 Cleaning equipment off site.
 - .4 Protection of drainage structures with filter fences if required.
 - .14 Concrete wash water or concrete from trucks shall not enter any surface water or storm water system. Concrete pour or grouting should not be performed if significant precipitation are expected within 72 hours. If concrete leachate is generated within 72 hours of concrete pouring or grouting, measures shall be taken to ensure the leachate does not enter the surface or storm water systems.
-

- .15 During the purging of tanks and associated lines, procedures must prevent the release of any fuels to the surface, surface water, catch basins or soils within or surrounding the worksite.

1.12 NOISE CONTROL

- .1 All construction equipment shall be operated with exhaust systems in good repair to minimize noise.
- .2 Construction activities that could create excessive noise shall be restricted to daylight hours and adhere to the municipal noise by-law.
- .3 If work is to be undertaken outside the specified period in the local noise by-law, then approval for an exemption to the by-law shall be obtained by the Contractor from the municipality.
- .4 Ensure that noise control devices (i.e. mufflers, silencers) on construction equipment are properly maintained.

1.13 HISTORICAL/ ARCHAEOLOGICAL CONTROL

- .1 Provide historical, archaeological, cultural resources, biological resources, and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands known to be on project site: and identifies procedures to be followed if historical archaeological, cultural resources, biological resources and wetlands not previously known to be onsite or in area are discovered during construction.
- .2 Plan: include methods to assure protection of known or discovered resources and identify lines of communication between Contractor personnel and Departmental Representative.
- .3 If archaeological deposits are discovered during the project work shall stop immediately and the Departmental Representative shall immediately be notified.
- .4 Archaeologically significant material, if found on the property, remains the property of the Crown and shall not be removed from the site.
- .5 Management of the archaeological materials will be coordinated through Departmental Representative.

1.14 NOTIFICATION

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

1.15 COMPLIANCE WITH ENVIRONMENTAL EFFECTS EVALUATION REPORT

- .1 Contractor shall comply with the requirements and recommendations of the Environmental Effects Evaluation (EEE) Report, attached as an appendix to this document.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
- .2 Bury rubbish and waste materials on site where directed after receipt of written approval from Departmental Representative.
- .3 Ensure public waterways, storm and sanitary sewers remain free of waste and volatile materials disposal.
- .4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .5 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES AND CODES

- .1 Perform Work in accordance with National Building Code of Canada (NBC) 2010, and National Fire Code of Canada (NFC) 2010 and Ontario Building Code (OBC) 2012, including all amendments up to bid closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.
- .2 Meet or exceed requirements of:
 - .1 Contract documents.
 - .2 Specified standards, codes and referenced documents.

1.2 HAZARDOUS MATERIAL DISCOVERY

- .1 Stop work immediately and notify Departmental Representative if materials which may contain designated substances or PCB's, other than those identified in Sections 01 11 00, 01 35 29 are discovered in course of work.

1.3 BUILDING SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions.

1.4 IAQ - INDOOR AIR QUALITY

- .1 Comply with CSA-Z204-94(R1999), Guideline for Managing Indoor Air Quality in Office Buildings and CSA B651-12.

1.5 ACCESSIBLE DESIGN

- .1 Comply with CSA B651-12, Accessible Design for the Built Environment, unless specified otherwise. In any case of conflict or discrepancy between the building codes and CSA B651, the requirements of CSA B651 shall apply.

1.6 STATISTICAL INFORMATION

- .1 Provide statistical information to Departmental Representative:
 - .1 Within ten working days after March 31 and September 30 occurring between commencement of work and final completion
 - .2 Within ten working days after final completion.
- .2 Include in statistical information:
 - .1 Statement of total person days of labour used on site in performance of contract, including labour provided under sub-contracts.
 - .2 Estimate of total value in dollars of material delivered to site and installed, including material provided and installed under sub-contracts.
- .3 This information is required by Government of Canada solely to provide statistics that will aid in assessing socio-economic benefits of this project.

1.7 TAXES

- .1 Pay applicable Federal, Provincial and Municipal taxes.

1.8 EXAMINATION

- .1 Examine existing conditions and determine conditions affecting work.
- .2 Conduct concrete floor moisture testing using Calcium Chloride moisture tests.
 - .1 Submit test results to Departmental Representative for approval prior to installing any flooring. Conduct one test per 100 m² of area being covered.

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 SECTION INCLUDES

- .1 Inspection and testing, administrative and enforcement requirements.
- .2 Tests and mix designs.
- .3 Mill tests.
- .4 Equipment and system adjust and balance.

1.2 INSPECTION

- .1 Allow Departmental Representative access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Departmental Representative instructions, or law of Place of Work.
- .3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.
- .4 Departmental Representative may order any part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, Departmental Representative shall pay cost of examination and replacement.

1.3 INDEPENDENT INSPECTION AGENCIES

- .1 Independent Inspection/Testing Agencies will be engaged by Departmental Representative for purpose of inspecting and/or testing portions of Work, above and beyond those required of the Contractor.
- .2 Provide equipment required for executing inspection and testing by appointed agencies.
- .3 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Departmental Representative at no cost to Departmental Representative. Pay costs for retesting and reinspection.

1.4 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.

1.5 PROCEDURES

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

- .2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in Work.
- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.6 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, Departmental Representative may deduct from Contract Amount difference in value between Work performed and that called for by Contract Documents, amount of which shall be determined by Departmental Representative.

1.7 REPORTS

- .1 Submit 4 copies of inspection and test reports to Departmental Representative.
- .2 Provide copies to Subcontractor of work being inspected or tested, manufacturer or fabricator of material being inspected or tested.

1.8 TESTS AND MIX DESIGNS

- .1 Furnish test results and mix designs as may be requested.
- .2 The cost of tests and mix designs beyond those called for in Contract Documents or beyond those required by law of Place of Work shall be appraised by Departmental Representative and may be authorized as recoverable.

1.9 MILL TESTS

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

1.10 EQUIPMENT AND SYSTEMS

- .1 Submit testing, adjusting and balancing reports for mechanical, electrical and building equipment systems.
- .2 Submit Commissioning Documentation in accordance with Section 01 91 13.

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 SECTION INCLUDES

- .1 Temporary utilities.

1.2 REFERENCES

- .1 U.S. Environmental Protection Agency (EPA) / Office of Water
 - .1 EPA 833-R-06-004, May 2007, Developing Your Stormwater Pollution Prevention Plan - A Guide for Construction Sites.

1.3 SUBMITTALS

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

1.4 INSTALLATION AND REMOVAL

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

1.5 WATER SUPPLY

- .1 Departmental Representative will provide continuous supply of potable water for construction use.
- .2 Departmental Representative will pay for utility charges at prevailing rates.

1.6 TEMPORARY HEATING AND VENTILATION

- .1 Provide temporary heating required during construction period, including attendance, maintenance and fuel.
- .2 Construction heaters used inside building must be vented to outside or be non-flameless type. Solid fuel salamanders are not permitted.
- .3 Provide temporary heat and ventilation in enclosed areas as required to:
 - .1 Facilitate progress of Work.
 - .2 Protect Work and products against dampness and cold.
 - .3 Prevent moisture condensation on surfaces.
 - .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
 - .5 Provide adequate ventilation to meet health regulations for safe working environment.
- .4 Maintain temperatures of minimum 10°C in areas where construction is in progress.
- .5 Ventilating:
 - .1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.

- .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
- .3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
- .4 Ventilate storage spaces containing hazardous or volatile materials.
- .5 Ventilate temporary sanitary facilities.
- .6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.
- .6 Pay costs for maintaining temporary heat, when using permanent heating system.
- .7 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
 - .1 Conform with applicable codes and standards.
 - .2 Enforce safe practices.
 - .3 Prevent abuse of services.
 - .4 Prevent damage to finishes.
 - .5 Vent direct-fired combustion units to outside.
- .8 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

1.7 TEMPORARY POWER AND LIGHT

- .1 Use electric power from Owner's existing system without metering and without payment of use charges to levels available. Temporary power for electric cranes and other equipment requiring in excess of above is responsibility of Contractor.
- .2 Provide and maintain temporary lighting throughout project. Ensure level of illumination on all floors and stairs is not less than 162 lx.
 - .1 Refer to each Section, including Section 03 35 00, for additional environmental, power and lighting requirements specific to the work of that Section.
- .3 Electrical power and lighting systems installed under this Contract may be used for construction requirements only with prior approval of Departmental Representative provided that guarantees are not affected. Make good damage to electrical system caused by use under this Contract. Replace lamps which have been used for more than 3 months.

1.8 TEMPORARY COMMUNICATION FACILITIES

- .1 Provide and pay for temporary telephone, fax, data hook up, lines and equipment necessary for own use and use of Departmental Representative.

1.9 FIRE PROTECTION

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

Part 2 PRODUCTS

2.1 NOT USED

.1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 Construction aids.
- .2 Offices and sheds.
- .3 Parking.
- .4 Project identification.

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.189-2000, Exterior Alkyd Primer for Wood.
 - .2 CAN/CGSB-1.59-97, Alkyd Exterior Gloss Enamel.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA 0121-08 (R2013), Douglas Fir Plywood.
 - .3 CSA Z797-09 (R2014), Code of practice for Access Scaffold.
 - .4 CAN/CSA-Z321-96 (R2006), Signs and Symbols for the Occupational Environment, withdrawn but still available from CSA, CCOHS and Techstreet.
- .3 U.S. Environmental Protection Agency (EPA)/ Office of Water
 - .1 EPA 833-R-06-004, May 2007, Developing Your Stormwater Pollution Prevention Plan - A Guide for Construction Sites.

1.3 SUBMITTALS

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

1.4 INSTALLATION AND REMOVAL

- .1 Prepare site plan indicating proposed location and dimensions of area to be fenced and used by Contractor, number of trailers to be used, avenues of ingress/egress to fenced area and details of fence installation.
- .2 Identify areas which have to be gravelled to prevent tracking of mud.
- .3 Indicate use of supplemental or other staging area.
- .4 Provide construction facilities in order to execute work expeditiously.
- .5 Remove from site all such work after use.

1.5 SCAFFOLDING

- .1 Scaffolding in accordance with CSA Z797.
 - .2 Provide and maintain scaffolding, ramps and ladders.
-

1.6 HOISTING

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

1.7 SITE STORAGE/LOADING

- .1 Confine work and operations of employees to areas defined by Contract Documents. Do not unreasonably encumber premises with products.
- .2 Do not load or permit to load any part of Work with a weight or force that will endanger the Work.

1.8 CONSTRUCTION PARKING

- .1 Parking will be permitted on site, provided it does not disrupt performance of Work.
- .2 Provide and maintain adequate access to project site.
- .3 Build and maintain temporary roads where indicated or directed by Departmental Representative, and provide snow removal during period of Work.

1.9 OFFICES

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

1.10 EQUIPMENT, TOOL AND MATERIALS STORAGE

- .1 Provide and maintain, in a clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.
- .2 Locate materials not required to be stored in weatherproof sheds on site in a manner to cause least interference with work activities.

1.11 SANITARY FACILITIES

- .1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.
- .2 Post notices and take such precautions as required by local health authorities. Keep area and premises in sanitary condition.

1.12 CONSTRUCTION SIGNAGE

- .1 Provide and erect, within three weeks of signing Contract, a project sign in a location designated by Departmental Representative.
- .2 Construction sign of wood frame and plywood construction painted with exhibit lettering produced by a professional sign painter.
- .3 Indicate on sign, name of Owner, Consultant and Contractor and Subcontractor, of a design style established by Departmental Representative.

- .4 No other signs or advertisements, other than warning signs, are permitted on site.
- .5 Provide project identification site sign comprising foundation, framing, and one 1200 x 2400 mm signboard as detailed and as described below.
 - .1 Foundations: 15 MPa concrete to CSA A23.1/A23.2 minimum 200 mm x 900 mm deep.
 - .2 Framework and battens: SPF, pressure treated minimum 89 x 89 mm.
 - .3 Signboard: 19 mm Medium Density Overlaid Douglas Fir Plywood to CSA O121.
 - .4 Paint: alkyd enamel to CAN/CGSB-1.59 over exterior alkyd primer to CAN/CGSB-1.189.
 - .5 Fasteners: hot-dip galvanized steel nails and carriage bolts.
 - .6 Vinyl sign face: printed project identification, self adhesive, vinyl film overlay, supplied by Departmental Representative.
- .6 Locate project identification sign as directed by Departmental Representative and construct as follows:
 - .1 Build concrete foundation, erect framework, and attach signboard to framing.
 - .2 Paint all surfaces of signboard and framing with one coat primer and two coats enamel. Colour white on signboard face, black on other surfaces.
 - .3 Apply vinyl sign face overlay to painted signboard face in accordance with installation instruction supplied.
- .7 Direct requests for approval to erect a project signboard to Departmental Representative. For consideration general appearance of project signboard must conform to project identification site sign. Wording shall be in both official languages.
- .8 Signs and notices for safety and instruction shall be in both official languages. Graphic symbols shall conform to CAN/CSA-Z321.
- .9 Maintain approved signs and notices in good condition for duration of project, and dispose of off site on completion of project or earlier if directed by Departmental Representative.

1.13 PROTECTION AND MAINTENANCE OF TRAFFIC

- .1 Provide access and temporary relocated roads as necessary to maintain traffic.
 - .2 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to roads and cleaning off dirt caused by construction operations.
 - .3 Construct access and haul roads necessary.
 - .4 Haul roads: constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided.
 - .5 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.
 - .6 Dust control: adequate to ensure safe operation at all times.
 - .7 Location, grade, width, and alignment of construction and hauling roads: subject to approval by Departmental Representative.
 - .8 Lighting: to assure full and clear visibility for full width of haul road and work areas during night work operations.
-

- .9 Provide snow removal during period of Work.
- .10 Remove, upon completion of work, haul roads designated by Departmental Representative.

1.14 CLEAN-UP

- .1 Remove construction debris, waste materials, packaging material from work site daily.
- .2 Clean dirt or mud tracked onto paved or surfaced roadways.
- .3 Store materials resulting from demolition activities that are salvageable.
- .4 Stack stored new or salvaged material.

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 SECTION INCLUDES

- .1 Barriers.
- .2 Environmental Controls.
- .3 Traffic Controls.
- .4 Fire Routes.

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-1.189-2000, Exterior Alkyd Primer for Wood.
 - .2 CAN/CGSB-1.59-97, Alkyd Exterior Gloss Enamel.
- .2 Canadian Standards Association (CSA):
 - .1 CSA-O121-08 (R2013), Douglas Fir Plywood.

1.3 INSTALLATION AND REMOVAL

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

1.4 HOARDING

- .1 Erect temporary site enclosure using new 1.2 m high snow fence wired to rolled steel "T" bar fence posts spaced at 2.4 m o.c. Provide one lockable truck gate. Maintain fence in good repair.
- .2 Provide barriers around trees and plants designated to remain. Protect from damage by equipment and construction procedures.
- .3 Erect temporary site enclosure using modular freestanding fencing: galvanized, minimum 1.8 m high, chain link or welded steel mesh, pipe rail. Provide one lockable truck entrance gate and at least one pedestrian door as directed and conforming to applicable traffic restrictions on adjacent streets. Equip gates with locks and keys. Maintain fence in good repair.

1.5 GUARD RAILS AND BARRICADES

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

1.6 WEATHER ENCLOSURES

- .1 Provide weather tight closures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.

- .2 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.
- .3 Design enclosures to withstand wind pressure and snow loading.

1.7 DUST TIGHT SCREENS

- .1 Provide dust tight screens or partitions to localize dust generating activities, and for protection of workers, finished areas of Work and public.
- .2 Maintain and relocate protection until such work is complete.

1.8 ACCESS TO SITE

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

1.9 PUBLIC TRAFFIC FLOW

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

1.10 FIRE ROUTES

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

1.11 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

- .1 Protect surrounding private and public property from damage during performance of Work.
- .2 Be responsible for damage incurred.

1.12 PROTECTION OF BUILDING FINISHES

- .1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.
- .2 Provide necessary screens, covers, and hoardings.
- .3 Confirm with Departmental Representative locations and installation schedule 3 days prior to installation.
- .4 Be responsible for damage incurred due to lack of or improper protection.

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 SECTION INCLUDES

- .1 Product quality, availability, storage, handling, protection, and transportation.
- .2 Manufacturer's instructions.
- .3 Quality of Work, coordination and fastenings.
- .4 Existing facilities.

1.2 REFERENCES

- .1 Within text of specifications, reference may be made to reference standards.
- .2 Conform to these standards, in whole or in part as specifically requested in specifications.
- .3 If there is question as to whether any product or system is in conformance with applicable standards, Departmental Representative reserves right to have such products or systems tested to prove or disprove conformance.
- .4 The cost for such testing will be born by Departmental Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.
- .5 Conform to latest date of issue of referenced standards in effect on date of submission of Bids, except where specific date or issue is specifically noted.
- .6 OPSS Ontario Provincial Standard Specifications and OPSD Ontario Provincial Standard Drawings quoted in these specifications are available online at <http://www.raqsa.mto.gov.on.ca/techpubs/ops.nsf/OPSHomepage>.

1.3 QUALITY

- .1 Products, materials, equipment and articles (referred to as products throughout specifications) incorporated in Work shall be new, not damaged or defective, and of best quality (compatible with specifications) for purpose intended. If requested, furnish evidence as to type, source and quality of Products provided.
- .2 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- .3 Should any dispute arise as to quality or fitness of products, decision rests strictly with Departmental Representative based upon requirements of Contract Documents.
- .4 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .5 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.4 AVAILABILITY

- .1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for any items. If delays in supply of products are foreseeable, notify Departmental Representative of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.
- .2 In event of failure to notify Departmental Representative at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Departmental Representative reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

1.5 METRIC SIZED MATERIALS

- .1 SI metric units of measurement are used exclusively on the drawings and in the specifications for this project.
- .2 The Contractor is required to provide metric products in the sizes called for in the Contract Documents except where a valid claim can be made that a particular product is not available on the Canadian market.
- .3 Claims for exemptions from use of metric sized products shall be in writing and fully substantiated with supportive documentation. Promptly submit application to Departmental Representative for consideration and ruling. Non-metric sized products may not be used unless Contractor's application has been approved in writing by the Departmental Representative.
- .4 Difficulties caused by the Contractor's lack of planning and effort to obtain modular metric sized products which are available on the Canadian market will not be considered sufficient reasons for claiming that they cannot be provided.
- .5 Claims for additional costs due to provision of specified modular metric sized products will not be considered.

1.6 STORAGE, HANDLING AND PROTECTION

- .1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
 - .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
 - .3 Store products subject to damage from weather in weatherproof enclosures.
 - .4 Store cementitious products clear of earth or concrete floors, and away from walls.
 - .5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
 - .6 Store sheet materials and lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.
 - .7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
-

- .8 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.
- .9 Touch-up damaged factory finished surfaces to Departmental Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.7 TRANSPORTATION

- .1 Pay costs of transportation of products required in performance of Work.
- .2 Transportation cost of products supplied by Owner will be paid for by Departmental Representative. Unload, handle and store such products.

1.8 MANUFACTURER'S INSTRUCTIONS

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

1.9 QUALITY OF WORK

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

1.10 CO-ORDINATION

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

1.11 CONCEALMENT

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

1.12 REMEDIAL WORK

- .1 Refer to Section 01 73 00.

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

1.13 LOCATION OF FIXTURES

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

1.14 FASTENINGS

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

1.15 FASTENINGS - EQUIPMENT

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

1.16 PROTECTION OF WORK IN PROGRESS

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

1.17 EXISTING UTILITIES

- .1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work, pedestrian and vehicular traffic.

- .2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 SUBMITTALS

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

1.2 MATERIALS

- .1 Required for original installation.
- .2 Change in Materials: Submit request for substitution in accordance with Section 01 33 00.

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 Submit proposed materials, finishes and installation method for patching to Departmental Representative for approval, prior to patching.
- .11 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.
- .12 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .13 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with firestopping material in accordance with Section 07 84 00, full thickness of the construction element.
- .14 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 reuse, recycling, composting and anaerobic digestion in accordance with Section 01 74 20.

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 SECTION INCLUDES

- .1 Progressive cleaning.
- .2 Final cleaning.

1.2 PROJECT CLEANLINESS

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris, other than that caused by Owner or other Contractors.
- .2 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site.
- .3 Clear snow and ice from access to building.
- .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 clearly marked separate bins for recycling. Refer to Section 01 74 20.
- .7 Remove waste material and debris from site and deposit in waste container at end of each working day.
- .8 Dispose of waste materials and debris off site.
- .9 Clean interior areas prior to start of finish work, and maintain areas free of dust and other contaminants during finishing operations.
- .10 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .11 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .12 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .13 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.3 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 other than that caused by Owner or other Contractors.
-

- .5 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site.
- .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .7 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.
- .8 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, and floors.
- .9 Clean lighting reflectors, lenses, and other lighting surfaces.
- .10 HEPA vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .11 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.
- .12 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .13 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .14 Remove dirt and other disfiguration from exterior surfaces.
- .15 Clean and sweep roofs, gutters, areaways, and sunken wells.
- .16 Sweep and wash clean paved areas.
- .17 Clean equipment and fixtures to a sanitary condition; clean or replace filters of mechanical equipment.
- .18 Clean roofs, downspouts, and drainage systems.
- .19 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.
- .20 Remove snow and ice from access to building.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 CONSTRUCTION & DEMOLITION WASTE

- .1 Carefully deconstruct and source separate materials/equipment and divert, from D&C waste destined for landfill to maximum extent possible. Target for this project is 50% diversion from landfill. Reuse, recycle, compost, anaerobic digest or sell material for reuse except where indicated otherwise. On site sales are not permitted.
- .2 Source separate waste and maintain waste audits in accordance with the Environmental Protection Act, Ontario Regulation 102/94 and Ontario Regulation 103/94.
 - .1 Provide facilities for collection, handling and storage of source separated wastes.
 - .2 Source separate the following waste:
 - .1 Brick and portland cement concrete.
 - .2 Corrugated cardboard.
 - .3 Wood, not including painted or treated wood or laminated wood.
 - .4 Gypsum board, unpainted.
 - .5 Steel.
- .3 Submit a waste reduction workplan indicating the materials and quantities of material that will be recycled and diverted from landfill.
 - .1 Indicate how material being removed from the site will be reused, recycled, composted or anaerobically digested using Section 02 42 93, Deconstruction and Waste Products Workplan Summary.
- .4 Submit proof that all waste is being disposed of at a licensed land fill site or waste transfer site. A copy of the disposal/waste transfer site's license and a letter verifying that said landfill site will accept the waste must be supplied to Departmental Representative prior to removal of waste from the demolition site.

1.2 WASTE PROCESSING SITES

- .1 Province of: Ontario.
 - .1 Ministry of Environment and Energy, 135 St. Clair Avenue West, Toronto, ON, M4V 1P5.
 - .2 Telephone: 800-565-4923 or 416-323-4321.
 - .3 Fax: 416-323-4682.
 - .2 Recycling Council of Ontario: 215 Spadina Avenue, #225, Toronto, ON, M5T 2C7.
 - .1 Telephone: 416-657-2797
 - .2 Fax: 416-960-8053
 - .3 Email: rco@rco.on.ca.
 - .4 Internet: <http://www.rco.on.ca/>.
-

Part 2 PRODUCTS

2.1 NOT USED

.1 Not Used.

Part 3 EXECUTION

3.1 CANADIAN GOVERNMENTAL DEPARTMENTS CHIEF RESPONSIBILITY FOR THE ENVIRONMENT

.1 Government Chief Responsibility for the Environment.

Province	Address	General	Fax <u>Inquiries</u>
Ontario	Ministry of Environment and Energy 135 St Clair Avenue West Toronto, ON M4V 1P5 Environment Canada Toronto, ON	(416) 323-4321 (800) 565-4923 (416) 734-4494	(416) 323-4682

END OF SECTION

Part 1 GENERAL

1.1 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.
- .2 Departmental Representative's Inspection: Departmental Representative and Contractor will perform inspection of Work to identify obvious defects or deficiencies. Contractor to correct Work accordingly.
- .3 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 Boiler Inspection Branch, Fire Commissioner and Utility companies have been submitted.
 - .5 Operation of systems have been demonstrated to Owner's personnel.
 - .6 Work is complete and ready for final inspection.
- .4 Final Inspection: when items noted above are completed, request final inspection of Work by Departmental Representative and Contractor. If Work is deemed incomplete by Departmental Representative, complete outstanding items and request reinspection.

1.2 CLEANING

- .1 In accordance with Section 01 74 11.
- .2 Remove waste and surplus materials, rubbish and construction facilities from the site in accordance with Section 01 74 20.

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 SECTION INCLUDES

- .1 As-built, samples, and specifications.
- .2 Equipment and systems.
- .3 Product data, materials and finishes, and related information.
- .4 Operation and maintenance data.
- .5 Spare parts, special tools and maintenance materials.
- .6 Warranties and bonds.
- .7 Final site survey.

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 Substantial Performance of the Work, submit to the Departmental Representative, four final copies of maintenance manuals and commissioning documentation in English.
- .5 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.
- .6 If requested, furnish evidence as to type, source and quality of products provided.
- .7 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.
- .8 Pay costs of transportation.

1.3 FORMAT

- .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 systems under Section numbers and sequence of Table of Contents.
 - .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
-

- .7 Text: Manufacturer's printed data, or typewritten data.
- .8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- .9 Provide 1:1 scaled CAD files in dwg format. Forward pdf, MS Word, MS Excel and AutoCAD dwg files on USB compatible with PWGSC encryption requirements, or through email or alternate electronic file sharing service such as ftp, as directed by Departmental Representative.

1.4 CONTENTS - EACH VOLUME

- .1 Table of Contents: provide title of project;
 - .1 date of submission; names,
 - .2 addresses, and telephone numbers of Contractor with name of responsible parties;
 - .3 schedule of products and systems, indexed to content of volume.
- .2 For each product or system:
 - .1 list names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product Data: mark each sheet to 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.
- .6 Training: Refer to Sections 01 79 00 and 01 91 13.

1.5 AS-BUILTS AND SAMPLES

- .1 In addition to requirements in General Conditions, maintain at the site for Departmental Representative, one record copy of:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Amendments and 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 Turn one set, paper copy and electronic copy, of AS-BUILT drawings and specifications over to Departmental Representative on completion of work.
- .7 If project is completed without significant deviations from Contract drawings and specifications submit to Departmental Representative one set of drawings and specifications marked "AS-BUILT".

1.6 RECORDING ACTUAL SITE CONDITIONS

- .1 Record information on set of black line opaque drawings, and in copy of Project Manual, 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 Amendments and change orders.
- .6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.

1.7 FINAL SURVEY

- .1 Submit final site survey certificate in accordance with Section 01 73 00, certifying that elevations and locations of completed Work are in conformance with Contract Documents.

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 and 01 91 13.
- .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 site 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.

1.12 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 Certificate 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.

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 SECTION INCLUDES

- .1 Procedures for demonstration and instruction of equipment and systems to Owner's O&M personnel.
- .2 O&M personnel includes property facility manager, building operators, maintenance staff, security staff and technical specialists, as applicable.

1.2 DESCRIPTION

- .1 Demonstrate scheduled operation and maintenance of equipment and systems to Departmental Representative's personnel two weeks prior to date of final inspection substantial performance.
- .2 Departmental Representative will provide list of personnel to receive instructions, and will coordinate their attendance at agreed-upon times.

1.3 QUALITY CONTROL

- .1 When specified in individual Sections, require manufacturer to provide authorized representative to demonstrate operation of equipment and systems, instruct Owner's personnel, and provide written report that demonstration and instructions have been completed.
- .2 Submit training schedule of time and date for demonstration and training of each item of equipment and each system in accordance with the training plan four 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 Report shall give time and date of each demonstration and training, with list of persons present.

1.4 CONDITIONS FOR DEMONSTRATIONS

- .1 Equipment has been inspected and put into operation in accordance with Section 01 91 13.
- .2 Testing, adjusting, and balancing has been performed in accordance with Section 01 91 13 and equipment and systems are fully operational.
- .3 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

1.5 PREPARATION

- .1 Verify that conditions for demonstration and instructions comply with requirements.
- .2 Verify that designated O&M personnel are present.

1.6 DEMONSTRATION AND INSTRUCTIONS

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

- .2 Review contents of manual in detail to explain all aspects of operation and maintenance.
- .3 Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instructions.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 General requirements relating to commissioning of project's components and systems, specifying general requirements to PV of components, equipment, sub-systems, systems, and integrated systems.
- .2 Acronyms:
 - .1 AFD - Alternate Forms of Delivery, service provider.
 - .2 BMM - Building Management Manual.
 - .3 Cx - Commissioning.
 - .4 EMCS - Energy Monitoring and Control Systems.
 - .5 O&M - Operation and Maintenance.
 - .6 PI - Product Information.
 - .7 PV - Performance Verification.
 - .8 TAB - Testing, Adjusting and Balancing.

1.2 GENERAL

- .1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved. Objectives:
 - .1 Verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent.
 - .2 Ensure appropriate documentation is compiled into the BMM.
 - .3 Effectively train O&M staff.
- .2 Contractor assists in Cx process, operating equipment and systems, troubleshooting and making adjustments as required.
 - .1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be interactively with each other as intended in accordance with Contract Documents and design criteria.
 - .2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.
- .3 Design Criteria: as per client's requirements or determined by designer. To meet Project functional and operational requirements.
- .4 AFD managed projects the term Departmental Representative in Cx specifications to be interpreted as AFD Service Provider.

1.3 COMMISSIONING OVERVIEW

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

- .2 Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .3 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the built facility is constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.
- .4 Departmental Representative will issue Certificate of Substantial Performance when:
 - .1 Completed Cx documentation has been received, reviewed for suitability and approved by Departmental Representative.
 - .2 Equipment, components and systems have been commissioned.
 - .3 O&M training has been completed.

1.4 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

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

1.5 PRE-CX REVIEW

- .1 Before Construction:
 - .1 Review contract documents, confirm by writing to Departmental Representative.
 - .1 Adequacy of provisions for Cx.
 - .2 Aspects of design and installation pertinent to success of Cx.
- .2 During Construction:
 - .1 Co-ordinate provision, location and installation of provisions for Cx.
- .3 Before start of Cx:
 - .1 Have completed Cx Plan up-to-date.
 - .2 Ensure installation of related components, equipment, sub-systems, systems is complete.
 - .3 Fully understand Cx requirements and procedures.
 - .4 Have Cx documentation shelf-ready.
 - .5 Understand completely design criteria and intent and special features.
 - .6 Submit complete start-up documentation to Departmental Representative.
 - .7 Have Cx schedules up-to-date.
 - .8 Ensure systems have been cleaned thoroughly.

- .9 Complete TAB procedures on systems, submit TAB reports to Departmental Representative for review and approval.
- .10 Ensure "As-Built" system schematics are available.
- .4 Inform Departmental Representative in writing of discrepancies and deficiencies on finished works.

1.6 CONFLICTS

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

1.7 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00.
 - .1 Submit no later than 4 weeks after award of Contract:
 - .1 Name of Contractor's Cx agent.
 - .2 Draft Cx documentation.
 - .3 Preliminary Cx schedule.
 - .2 Request in writing to Departmental Representative for changes to submittals and obtain written approval at least 8 weeks prior to start of Cx.
 - .3 Submit proposed Cx procedures to Departmental Representative where not specified and obtain written approval at least 8 weeks prior to start of Cx.
 - .4 Provide additional documentation relating to Cx process required by Departmental Representative.

1.8 COMMISSIONING DOCUMENTATION

- .1 Departmental Representative to review and approve Cx documentation.
- .2 Provide completed and approved Cx documentation to Departmental Representative.

1.9 COMMISSIONING SCHEDULE

- .1 Provide detailed Cx schedule as part of construction schedule in accordance with Section 01 32 16.
- .2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
 - .1 Approval of Cx reports.
 - .2 Verification of reported results.
 - .3 Repairs, retesting, re-commissioning, re-verification.
 - .4 Training.

1.10 COMMISSIONING MEETINGS

- .1 Convene Cx meetings following project meetings: Section 01 31 19 and as specified herein.
-

Part 1 GENERAL

1.1 REFERENCES

- .1 CSA International
 - .1 CSA S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.
- .2 U.S. Environmental Protection Agency (EPA)/Office of Water
 - .1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 and 01 74 20.
- .2 Submit demolition drawings:
 - .1 Submit for review and approval by Departmental Representative shoring and underpinning drawings stamped and signed by professional engineer registered or licensed in the Province of Ontario Canada, showing proposed method.

1.3 SITE CONDITIONS

- .1 Review "Designated Substance Report" and take precautions to protect environment.
- .2 If material resembling spray or trowel-applied asbestos or other designated substance or listed as hazardous be encountered, stop work, take preventative measures, and notify Departmental Representative immediately.
 - .1 Proceed only after receipt of written instructions have been received from Departmental Representative.
- .3 Notify Departmental Representative before disrupting building access or services.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not used.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Inspect building with Departmental Representative and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.
 - .2 Locate and protect utilities. Preserve active utilities traversing site in operating condition.
 - .3 Notify and obtain approval of utility companies before starting demolition.
-

- .4 Disconnect, cap, plug or divert, as required, existing public utilities within the property where they interfere with the execution of the work, in conformity with the requirements of the authorities having jurisdiction. Mark the location of these and previously capped or plugged services on the site and indicate location (horizontal and vertical) on the record drawings. Support, shore up and maintain pipes and conduits encountered.
 - .1 Immediately notify Departmental Representative and utility company concerned in case of damage to any utility or service, designated to remain in place.
 - .2 Immediately notify the Departmental Representative should uncharted utility or service be encountered, and await instruction in writing regarding remedial action.

3.2 PROTECTION

- .1 Prevent movement, settlement, or damage to adjacent structures, utilities, and parts of building to remain in place. Provide bracing and shoring required.
- .2 Keep noise, dust, and inconvenience to occupants to minimum.
- .3 Protect building systems, services and equipment.
- .4 Provide temporary dust screens, covers, railings, supports and other protection as required.

3.3 PREPARATION

- .1 Protection of In-Place Conditions:
 - .1 Prevent movement, settlement, or damage to adjacent structures, utilities, and parts of building to remain in place. Provide bracing and shoring required.
 - .2 Keep noise, dust, and inconvenience to occupants to minimum.
 - .3 Protect building systems, services and equipment.
 - .4 Provide temporary dust screens, covers, railings, supports and other protection as required.
 - .5 Do Work in accordance with Section 01 35 29.
- .2 Demolition/Removal/Restore:
 - .1 Remove items as indicated for relocation and refurbishing.
 - .2 Removal of Curbs:
 - .1 Square up adjacent surfaces to remain in place by saw cutting or other method approved by Departmental Representative.
 - .2 Protect adjacent joints and load transfer devices.
 - .3 Remove parts of existing building to permit new construction.
 - .4 Trim edges of partially demolished building elements to tolerances as defined by Departmental Representative to suit future use.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .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.
 - .3 Refer to demolition drawings and specifications for items to be salvaged for reuse.
-

- .4 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

DECONSTRUCTION AND WASTE PRODUCTS WORKPLAN SUMMARY

Number R.069651.001

Section 02 42 93

Page 1

General Contractor / Waste Management Coordinator	Contact Person(s)	Tel & Fax Nos. Phone - - Fax - -
Project Site:	Type & Work Location: Deconstruction and Renovation	

Material Division #	Material Category	Quantity	Unit of Measure	Material Receiving Body & Hauler	% of total Weight	Disposal Option - % Breakdown			
						Reuse	Recycle	Landfill	

Division 01 - General Requirements									
	Pallets		each						
	Wood		kg.						
	Cardboard Packaging		cu. m.						
	Plastic Packaging		cu. m.						
	Styrene Packaging		cu. m.						
	PS Polyethylene Sheet		sq. m.						
	FRPS Fiber Reinf. Polyethylene Sheet		sq. m.						
				Subtotal	%	%	%	%	%

Division 02 - Existing Conditions									
	Deconstruction		tonnes						
	Mould Remediation		cu. m.						
	Asbestos Abatement Intermediate Precautions		cu. m.						
	Asbestos Abatement Glove Bag		cu. m.						
	PCB Remediation Liquid and Solid		litres						
	Asphalt Paving		sq. m.						
	Contaminated Soil		cu. m.						
				Subtotal	%	%	%	%	%

DECONSTRUCTION AND WASTE PRODUCTS WORKPLAN SUMMARY

Number R.069651.001

Section 02 42 93

Page 2

General Contractor / Waste Management Coordinator	Contact Person(s)	Tel & Fax Nos. Phone - - Fax - -
Project Site:	Type & Work Location: Deconstruction and Renovation	

Material Division #	Material Category	Quantity	Unit of Measure	Material Receiving Body & Hauler	% of total Weight	Disposal Option - % Breakdown			
						Reuse	Recycle	Landfill	

Division 03 - Concrete									
	Poured Concrete		tonnes						
	Concrete Cisterns		tonnes						
	Crushed Concrete Rubble		cu. m.						
	Concrete Reinforcing Steel, Rebars, Mesh		tonnes						
			Subtotal		%	%	%	%	%

Division 04 - Masonry									
	Concrete Blocks		each						
	Metal reinforcing ties and accessories		tonnes						
	Masonry Foundations		cu. m.						
			Subtotal		%	%	%	%	%

Division 05 - Metals									
	Reinforcing steel		tonnes						
	Miscellaneous Metals		tonnes						
			Subtotal		%	%	%	%	%

Division 06 - Wood, Plastics and Composites									
	Regular Wood Framing		cu. m.						
	Wood Decking		cu. m.						
	Laminated Beams		lin. m.						
	Wood Joists		lin. m.						
	Plywood: Pressure Treated-Preservative		sq. m.						
	Plywood: Pressure		sq. m.						

DECONSTRUCTION AND WASTE PRODUCTS WORKPLAN SUMMARY

Number R.069651.001

Section 02 42 93

Page 3

General Contractor / Waste Management Coordinator	Contact Person(s)	Tel & Fax Nos. Phone - - Fax - -
Project Site:	Type & Work Location: Deconstruction and Renovation	

Material Division #	Material Category	Quantity	Unit of Measure	Material Receiving Body & Hauler	% of total Weight	Disposal Option - % Breakdown			
						Reuse	Recycle	Landfill	

	Treated-Fire Retardant									
	Pressure Treated Wood		cu. m .							
	Plywood: Douglas Fir		sq. m.							
	Plywood: Sheathing		sq. m.							
	Hardwood Plywood		sq. m.							
	OSB		sq. m.							
	Hardwood Trim		lin. m .							
	Softwood Trim		lin. m.							
	Subtotal				%	%	%	%	%	

Division 07 - Thermal & Moisture Protection

	Asphalt Roof Shingles		cu. m.							
	Sheet Steel Roofing		sq. m.							
	Prefinished Aluminum Flashing		m.							
	Semi-Rigid Insulation: Mineral Fibre		cu. m.							
	Semi-Rigid Insulation: Glass fibre		cu. m.							
	Rigid Insulation: Mineral Fibre		cu. m.							
	Rigid Insulation: Glass Fibre		cu. m.							
	Rigid Insulation: Isocyanurate		cu. m.							
	Rigid Insulation: Polystyrene Extruded		cu. m.							
	Rigid Insulation: Polystyrene Expanded		cu. m.							

DECONSTRUCTION AND WASTE PRODUCTS WORKPLAN SUMMARY

Number R.069651.001

Section 02 42 93

Page 4

General Contractor / Waste Management Coordinator	Contact Person(s)	Tel & Fax Nos. Phone - - Fax - -
Project Site:	Type & Work Location: Deconstruction and Renovation	

Material Division #	Material Category	Quantity	Unit of Measure	Material Receiving Body & Hauler	% of total Weight	Disposal Option - % Breakdown			
						Reuse	Recycle	Landfill	

	Loose Insulation: Mineral Fibre		cu. m.						
	Loose Insulation: Cellulose		cu. m.						
	Sprayed Insulation: Mineral Fibre		cu. m.						
	Steel Soffit, Fascia & Eavestroughs		lin. m.						
	Steel Downspouts		lin. m.						
	Poly Vapour Barrier		sq. m.						
	Air Barrier – list types		sq. m.						
	Subtotal				%	%	%	%	%

Division 08 - Openings									
	Single Doors (steel)		each						
	Single Doors (wood)		each						
	Double Doors (wood)		each						
	Overhead Roll-up Door		each						
	Bi-Fold Wood Doors		each						
	Pre-fin. Steel Windows		each						
	Steel Sash Windows		each						
	Aluminum Windows		each						
	Fiberglass Windows		each						
	Insulating Glazing Units		each						
	Glass		sq. m.						
	Steel Store Fronts		each						
	Hardware		each						
	Subtotal				%	%	%	%	%

DECONSTRUCTION AND WASTE PRODUCTS WORKPLAN SUMMARY

Number R.069651.001

Section 02 42 93

Page 5

General Contractor / Waste Management Coordinator	Contact Person(s)	Tel & Fax Nos. Phone - - Fax - -
Project Site:	Type & Work Location: Deconstruction and Renovation	

Material Division #	Material Category	Quantity	Unit of Measure	Material Receiving Body & Hauler	% of total Weight	Disposal Option - % Breakdown			
						Reuse	Recycle	Landfill	

Division 09 - Finishes									
	Flooring: Carpet		sq. m.						
	Flooring: Vinyl Composition Tile		sq. m.						
	Flooring: Sheet Vinyl		sq. m.						
	Flooring: Ceramic Tile		sq. m.						
	Base: Wood		m.						
	Base: Vinyl		m.						
	Gypsum Board Wall and Ceiling		sq. m.						
	Wall: Plaster / Lath		sq. m.						
	Wall: Wood Paneling		sq. m.						
	Acoustic Tile		sq. m.						
	Acoustical Suspension System/T Bar Grid		sq. m.						
	Specialty Wood Finish		sq. m.						
	Acoustic Batt Insulation		cu. m.						
	Vinyl Wall Covering		sq. m.						
	Subtotal				%	%	%	%	%

Division 11 - Equipment									
11 31 00 – Residential Appliances									
	Appliances - list types		each						
	Refrigerator		each						
	Range		each						
	Dishwasher – light duty		each						
	Microwave		each						

DECONSTRUCTION AND WASTE PRODUCTS WORKPLAN SUMMARY

Number R.069651.001

Section 02 42 93

Page 6

General Contractor / Waste Management Coordinator	Contact Person(s)	Tel & Fax Nos. Phone - - Fax - -
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Material Division #	Material Category	Quantity	Unit of Measure	Material Receiving Body & Hauler	% of total Weight	Disposal Option - % Breakdown			
						Reuse	Recycle	Landfill	

				Subtotal	%	%	%	%	%
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Division 12 - Furnishings

	Metal File Cabinets		each						
	Desks: Metal		each						
	Desks: Wood		each						
	Built-in furniture		each						
	Horizontal Louvre Blind		each						
	Vertical Louvre Blind		each						
	Roller Blind		each						
	Steel Lab Casework		each						
	Wood Lab Casework		each						
	Interlocking Acoustical Screens & Workstation Components – list items		each						
	Interior Planters & Artificial Plants by type		each						
				Subtotal	%	%	%	%	%

Division 21 - Fire Suppression

	Fire Extinguishers		each						
				Subtotal	%	%	%	%	%

Division 22 - Plumbing

22 07 00 Plumbing Insulation

	Piping Insulation		lin. m.						
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DECONSTRUCTION AND WASTE PRODUCTS WORKPLAN SUMMARY

Number R.069651.001

Section 02 42 93

Page 7

General Contractor / Waste Management Coordinator	Contact Person(s)	Tel & Fax Nos. Phone - - Fax - -
Project Site:	Type & Work Location: Deconstruction and Renovation	

Material Division #	Material Category	Quantity	Unit of Measure	Material Receiving Body & Hauler	% of total Weight	Disposal Option - % Breakdown			
						Reuse	Recycle	Landfill	

22 10 00 Facility Water Distribution									
	Cast Iron Pipe by dia.		lin. m.						
	Galv Steel Pipe by dia.		lin. m.						
	ABS Pipe by dia.		lin. m.						
	Copper Tube by dia.		lin. m.						
	Wrought Copper Pipe by dia.		lin. m.						
	PVC Pipe by dia.		lin. m.						
	HDPE Pipe by dia.		lin. m.						
	Valves		each						
22 13 00 Facility Sanitary Sewerage Piping									
	Facility Sanitary Sewer		lin. m.						
	Sanitary Waste and Vent Piping		lin. m.						
22 44 00 Plumbing Fixtures									
	Water Closet -Tank		each						
	China Lavatory		each						
	Hot Water Tankless gas		each						
	Hot Water Tank		each						
	Floor Drain: cast iron		each						
	Water Hammer Arrestors		each						
	Recirculating Pump		each						
	Vent Pipe & Flashing		each						
				Subtotal	%	%	%	%	%

Part 1 GENERAL

1.1 SUMMARY

- .1 Comply with requirements of this Section when performing following Work:
 - .1 Removing all or part of a false ceiling to obtain access to a work area, if asbestos containing material is likely lying on the surface of the false ceiling.
 - .2 Removing more than 7.5 square metres of asbestos containing suspended ceiling tiles and mastic, as indicated.
 - .3 Removal of asbestos containing material from locations as indicated on drawings.
 - .4 Removal or disturbance of one square metre or less of friable asbestos containing material during the demolition of all or part of machinery or equipment, or of a building.
 - .5 Application of tape or sealant or other covering to pipe and boiler insulation containing asbestos.
 - .6 Removal all or part of a false ceiling to obtain access to a work area, if asbestos containing is likely to be lying on the surface of the false ceiling.
 - .7 Removing non-friable asbestos containing materials by breaking, cutting, drilling, abrading, grinding, sanding or vibrating at locations directed by Departmental Representative if:
 - .1 The material is not wetted to control the spread of dust or fibres, and,
 - .2 The work is done only by means of non-powered hand-held tools.
 - .8 Removing non-friable asbestos containing materials by breaking, cutting, drilling, abrading, grinding, sanding or vibrating at locations directed by Departmental Representative if the work is done by means of power tools that are attached to dust-collecting devices equipped with HEPA filters.
 - .9 Removing more than one square metre of drywall in which joint-filling compounds that are asbestos containing materials have been used.
 - .10 Removing of asbestos containing material from a pipe, duct or similar structure using a glove bag.
 - .11 Removing filters used in an air handling unit in a building that has sprayed-on asbestos containing fireproofing.

1.2 SECTION INCLUDES

- .1 Requirements and procedures for asbestos abatement of asbestos containing materials of the type described within.

1.3 REFERENCES

- .1 O.Reg. 278/05, Designated Substance - Asbestos on Construction Projects and in Buildings and Repair Operations.
- .2 A Guide to the Regulations respecting Asbestos on Construction Projects and in Buildings and Repair Operations released in November 2007,
<http://www.labour.gov.on.ca/english/hs/asbestos/index.html>.

- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.205-94, Sealer for Application of Asbestos Fibre Releasing Materials.
- .4 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act, 1999 (CEPA).
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .6 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992 (TDGA).
- .7 Underwriters' Laboratories of Canada (ULC).

1.4 DEFINITIONS

- .1 Amended Water: water with non-ionic surfactant wetting agent added to reduce water tension to allow wetting of fibres.
 - .2 Asbestos Containing Materials (ACMs): materials that contain provincial regulated amount per cent or more asbestos by dry weight and are identified under Existing Conditions including fallen materials and settled dust.
 - .3 Asbestos Work Area: area where work takes place which will, or may disturb ACMs.
 - .4 Authorized Visitors: Engineers, or designated representatives, and representatives of regulatory agencies.
 - .5 Competent worker person: in relation to specific work, means a worker who:
 - .1 Is qualified because of knowledge, training and experience to perform the work.
 - .2 Is familiar with the provincial and federal laws and with the provisions of the regulations that apply to the work.
 - .3 Has knowledge of all potential or actual danger to health or safety in the work.
 - .6 Friable Materials: material that when dry can be crumbled, pulverized or powdered by hand pressure and includes such material that is crumbled, pulverized or powdered.
 - .7 Glove Bag: prefabricated glove bag as follows:
 - .1 Minimum thickness 0.25 mm (10 mil) polyvinyl-chloride bag.
 - .2 Integral 0.25 mm (10 mil) thick polyvinyl-chloride gloves and elastic ports.
 - .3 Equipped with reversible double pull double throw zipper on top and at approximately mid-section of the bag.
 - .4 Straps for sealing ends around pipe.
 - .8 HEPA vacuum: High Efficiency Particulate Air filtered vacuum equipment with filter system capable of collecting and retaining fibres greater than 0.3 microns in any dimension at 99.97% efficiency.
 - .9 Non-Friable Material: material that when dry cannot be crumbled, pulverized or powdered by hand pressure.
 - .10 Occupied Area: any area of building or work site that is outside Asbestos Work Area.
-

- .11 Polyethylene: polyethylene sheeting or rip-proof polyethylene sheeting with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide protection and isolation.
- .12 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must have appropriate capacity for scope of work.

1.5 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00.
- .2 Submit proof satisfactory to Departmental Representative that suitable arrangements have been made to dispose of asbestos containing waste in accordance with requirements of authority having jurisdiction.
- .3 Submit Provincial/Territorial and/or local requirements for Notice of Project Form.
- .4 Submit proof of Contractor's Asbestos Liability Insurance.
- .5 Submit to Departmental Representative necessary permits for transportation and disposal of asbestos containing waste and proof that asbestos containing waste has been received and properly disposed.
- .6 Submit proof satisfactory to Departmental Representative that all asbestos workers have received appropriate training and education by a competent person in the hazards of asbestos exposure, good personal hygiene, entry and exit from Asbestos Work Area, aspects of work procedures and protective measures while working in Asbestos Work Areas, and the use, cleaning and disposal of respirators and protective clothing.
- .7 Submit proof that supervisory personnel have attended asbestos abatement course, of not less than two days duration, approved by Departmental Representative. Minimum of one supervisor for every ten workers.
- .8 Submit Worker's Compensation Board status and transcription of insurance.
- .9 Submit documentation including test results, fire and flammability data, and Material Safety Data Sheets (MSDS) for chemicals or materials including:
 - .1 Encapsulants;
 - .2 Amended water;
 - .3 Slow drying sealer.
- .10 Submit proof satisfactory to Departmental Representative that employees have respirator fitting and testing. Workers must be fit tested (irritant smoke test) with respirator that is personally issued.

1.6 QUALITY ASSURANCE

- .1 Regulatory Requirements: comply with Federal, Provincial/Territorial and local requirements pertaining to asbestos, provided that in case of conflict among these requirements or with these specifications more stringent requirement applies. Comply with regulations in effect at the time work is performed.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.

- .2 Safety Requirements: worker and visitor protection.
 - .1 Protective equipment and clothing to be worn by workers while in Asbestos Work Area include:
 - .1 Air purifying half-mask respirator with N-100, R-100 or P-100 particulate filter, personally issued to worker and marked as to efficiency and purpose, suitable for protection against asbestos and acceptable to Provincial Authority having jurisdiction. The respirator to be fitted so that there is an effective seal between the respirator and the worker's face, unless the respirator is equipped with a hood or helmet. The respirator to be cleaned, disinfected and inspected after use on each shift, or more often if necessary, when issued for the exclusive use of one worker, or after each use when used by more than one worker. The respirator to have damaged or deteriorated parts replaced prior to being used by a worker; and, when not in use, to be stored in a convenient, clean and sanitary location. The employer to establish written procedures regarding the selection, use and care of respirators, and a copy of the procedures to be provided to and reviewed with each worker who is required to wear a respirator. A worker not to be assigned to an operation requiring the use of a respirator unless he or she is physically able to perform the operation while using the respirator.
 - .2 Disposable type protective clothing that does not readily retain or permit penetration of asbestos fibres. Protective clothing to be provided by the employer and worn by every worker who enters the work area, and the protective clothing to consist of a head covering and full body covering that fits snugly at the ankles, wrists and neck, in order to prevent asbestos fibres from reaching the garments and skin under the protective clothing. It includes suitable footwear, and it to be repaired or replaced if torn.
 - .3 Eating, drinking, chewing, and smoking are not permitted in Asbestos Work Area.
 - .4 Before leaving Asbestos Work Area, the worker can decontaminate his or her protective clothing by using a vacuum equipped with a HEPA filter, or by damp wiping, before removing the protective clothing, or, if the protective clothing will not be reused, place it in a container for dust and waste. The container to be dust tight, suitable for asbestos waste, impervious to asbestos, identified as asbestos waste, cleaned with a damp cloth or a vacuum equipped with a HEPA filter immediately before removal from the work area, and removed from the work area frequently and at regular intervals.
 - .5 Ensure workers wash hands and face when leaving Asbestos Work Area. Facilities for washing are located as indicated on drawings or directed by Departmental Representative.
 - .6 Ensure that no person required to enter an Asbestos Work Area has facial hair that affects seal between respirator and face.
 - .7 Visitor Protection:
 - .1 Provide protective clothing and approved respirators to Authorized Visitors to work areas.

- .2 Instruct Authorized Visitors in the use of protective clothing, respirators and procedures.
- .3 Instruct Authorized Visitors in proper procedures to be followed in entering into and exiting from Asbestos Work Area.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.
- .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 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 the CEPA, TDGA, Regional and Municipal regulations.
- .7 Fold up metal banding, flatten and place in designated area for recycling.
- .8 Disposal of asbestos waste generated by removal activities must comply with Federal, Provincial/Territorial and Municipal regulations. Dispose of asbestos waste in sealed double thickness 0.15 mm thick (6 mil) bags or leak proof drums. Label containers with appropriate warning labels.
- .9 Provide manifests describing and listing waste created. Transport containers by approved means to licensed landfill for burial.

1.8 EXISTING CONDITIONS

- .1 Reports and information pertaining to ACMS to be handled, removed, or otherwise disturbed and disposed of during this Project are titled "Designated Substances and Hazardous Materials Survey" and bound as appendix to this project manual.
- .2 Notify Departmental Representative of friable material discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material until instructed by Departmental Representative.

1.9 OWNER'S INSTRUCTIONS

- .1 Before beginning Work, provide Departmental Representative satisfactory proof that every worker has had instruction and training in hazards of asbestos exposure, in personal hygiene and work practices, in use of glove bag procedures, and in use, cleaning, and disposal of respirators and protective clothing.
- .2 Instruction and training related to respirators includes, at minimum:
 - .1 Fitting of equipment.
 - .2 Inspection and maintenance of equipment.
 - .3 Disinfecting of equipment.
 - .4 Limitations of equipment.

- .3 Instruction and training must be provided by competent, qualified person.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Drop and Enclosure Sheets:
 - .1 Polyethylene: 0.15 mm thick.
 - .2 FR polyethylene: 0.15 mm thick woven fibre reinforced fabric bonded both sides with polyethylene.
 - .2 Wetting Agent: 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with water in concentration to provide thorough wetting of asbestos containing material.
 - .3 Waste Containers: contain waste in two separate containers.
 - .1 Inner container: 0.15 mm thick sealable polyethylene bag.
 - .2 Outer container: sealable metal or fibre type where there are sharp objects included in waste material; otherwise outer container may be sealable metal or fibre type or second 0.15 mm thick sealable polyethylene bag.
 - .3 Labelling requirements: affix preprinted cautionary asbestos warning, in both official languages, that is visible when ready for removal to disposal site.
 - .4 Glove bag:
 - .1 Acceptable materials: safe-T-Strip products in configuration suitable for Work, or Alternative material approved by addendum during bid period in accordance with Instructions to Bidders.
 - .2 The glove bag to be equipped with:
 - .1 Sleeves and gloves that are permanently sealed to the body of the bag to allow the worker to access and deal with the insulation and maintain a sealed enclosure throughout the work period.
 - .2 Valves or openings to allow insertion of a vacuum hose and the nozzle of a water sprayer while maintaining the seal to the pipe, duct or similar structure.
 - .3 A tool pouch with a drain.
 - .4 A seamless bottom and a means of sealing off the lower portion of the bag.
 - .5 A high strength double throw zipper and removable straps, if the bag is to be moved during the removal operation.
 - .5 Tape: tape suitable for sealing polyethylene to surfaces under both dry and wet conditions using amended water.
 - .6 Slow - drying sealer: non-staining, clear, water - dispersible type that remains tacky on surface for at least 8 hours and designed for purpose of trapping residual asbestos fibres.
 - .1 Sealer: flame spread and smoke developed rating less than 50.
 - .7 Encapsulant: surface film forming type conforming to CAN/CGSB-1.205.
-

Part 3 EXECUTION

3.1 SUPERVISION

- .1 Minimum of one Supervisor for every ten workers is required.
- .2 Approved Supervisor must remain within Asbestos Work Area during disturbance, removal, or other handling of asbestos-containing materials.

3.2 PROCEDURES

- .1 Do construction occupational health and safety in accordance with Section 01 35 29.
- .2 Before beginning Work, at each access to Asbestos Work Area, install warning signs in both official languages in upper case 'Helvetica Medium' letters reading as follows, where number in parentheses indicates font size to be used: 'CAUTION ASBESTOS HAZARD AREA (25 mm) / NO UNAUTHORIZED ENTRY (19 mm) / WEAR ASSIGNED PROTECTIVE EQUIPMENT (19 mm) / BREATHING ASBESTOS DUST MAY CAUSE SERIOUS BODILY HARM (7 mm)'.
 - .1 Use HEPA vacuum or damp cloths where damp cleaning does not create hazard and is otherwise appropriate.
 - .2 Do not use compressed air to clean up or remove dust from any surface.
- .4 Prevent spread of dust from Asbestos Work Area using measures appropriate to work to be done.
 - .1 Use FR polyethylene drop sheets over flooring such as carpeting that absorbs dust and over flooring in work areas where dust or contamination cannot otherwise be safely contained.
 - .2 When removing suspended ceilings and walls themselves do not enclose work area, and when removing asbestos containing material from piping or equipment and "glove bag" method is not used erect enclosure of polyethylene sheeting around work area, shut off mechanical ventilation system serving work area and seal ventilation ducts to and from work area.
- .5 Remove loose material by HEPA vacuum; thoroughly wet friable material containing asbestos to be removed or disturbed before and during Work unless wetting creates hazard or causes damage.
 - .1 Use garden reservoir type low - velocity sprayer or airless spray equipment capable of producing mist or fine spray.
 - .2 Perform Work in a manner to reduce dust creation to lowest levels practicable.
- .6 Pipe Insulation Removal Using Glove Bag:
 - .1 A glove bag not to be used to remove insulation from a pipe, duct or similar structure if:
 - .1 It may not be possible to maintain a proper seal for any reason including, without limitation:
 - .1 The condition of the insulation.
 - .2 The temperature of the pipe, duct or similar structure.

- .2 The bag could become damaged for any reason including, without limitation.
 - .1 The type of jacketing.
 - .2 The temperature of the pipe, duct or similar structure.
 - .2 Upon installation of the glove bag, inspect bag for any damage or defects. If any damage or defects are found, the glove bag is to be repaired or replaced. The glove bag to be inspected at regular intervals for damage and defects, and repair or replaced, as appropriately. The asbestos containing contents of the damaged or defective glove bag found during removal are to be wetted and the glove bag and its contents are to be removed and disposed of in an appropriate waste disposal container. Any damaged or defective glove bags are not be reused.
 - .3 Place tools necessary to remove insulation in tool pouch. Wrap bag around pipe and close zippers. Seal bag to pipe with cloth straps.
 - .4 Place hands in gloves and use necessary tools to remove insulation. Arrange insulation in bag to obtain full capacity of bag.
 - .5 Insert nozzle of garden reservoir type sprayer into bag through valve and wash down pipe and interior of bag thoroughly. Wet surface of insulation in lower section of bag.
 - .6 To remove bag after completion of stripping, wash top section and tools thoroughly. Remove air from top section through elasticized valve using a HEPA vacuum. Pull polyethylene waste container over glove bag before removing from pipe. Release one strap and remove freshly washed tools. Place tools in water. Remove second strap and zipper. Fold over into waste container and seal.
 - .7 After removal of bag ensure that pipe is free of residue. Remove residue using HEPA vacuum or wet cloths. Ensure that surfaces are free of sludge which after drying could release asbestos dust into atmosphere. Seal exposed surfaces of pipe and ends of insulation with slow drying sealer to seal in any residual fibres.
 - .8 Upon completion of Work shift, cover exposed ends of remaining pipe insulation with polyethylene taped in place.
 - .7 Work is subject to visual inspection and air monitoring. Contamination of surrounding areas indicated by visual inspection or air monitoring will require complete enclosure and clean-up of affected areas.
 - .8 Cleanup:
 - .1 Frequently during Work and immediately after completion of work, clean up dust and asbestos containing waste using HEPA vacuum or by damp mopping.
 - .2 Place dust and asbestos containing waste in sealed dust tight waste bags. Treat drop sheets and disposable protective clothing as asbestos waste and wet and fold to contain dust and then place in waste bags.
 - .3 Immediately before their removal from Asbestos Work Area and disposal, clean each filled waste bag using damp cloths or HEPA vacuum and place in second clean waste bag.
 - .4 Seal and remove double bagged waste from site. Dispose of in accordance with requirements of Provincial/Territorial and Federal authority having jurisdiction. Supervise dumping and ensure that dump operator is fully aware of hazardous nature of material to be dumped and that guidelines and regulations for asbestos disposal are followed.
-

- .5 Perform final thorough clean-up of Asbestos Work Areas and adjacent areas affected by Work using HEPA vacuum.

3.3 AIR MONITORING

- .1 From beginning of Work until completion of cleaning operations, Departmental Representative to take air samples on daily basis outside of Asbestos Work Area enclosures in accordance with Provincial Occupational Health and Safety Regulations and PWGSC requirements.
 - .1 Contractor will be responsible for monitoring inside enclosure in accordance with applicable Provincial/Territorial Occupational Health and Safety Regulations.
- .2 If air monitoring shows that areas outside Asbestos Work Area enclosures are contaminated, enclose, maintain and clean these areas in same manner as that applicable to Asbestos Work Area.
- .3 Ensure that respiratory safety factors are not exceeded.
- .4 During the course of Work, Departmental Representative to measure fibre content of air outside Work areas by means of fibrous aerosol monitors (FAM).
 - .1 When FAM readings exceed 0.25 f/cc, adopt more stringent Work procedures immediately and perform PCM test.
 - .2 Stop Work when PCM measurements exceed 0.01 f/cc and correct procedures.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

- .1 Comply with requirements of this Section when performing following Work: Type 1 Operation.
 - .1 Removal of lead-containing coatings with a chemical gel or paste and fibrous laminated cloth wrap on walls and ceilings.
 - .2 Removal of lead-containing coatings or materials using a power tool with an effective dust collection system equipped with a HEPA filter on walls and ceilings.
 - .3 Removal of lead-containing coatings or materials with non-powered hand tool, other than manual scraping and sanding on walls and ceilings as indicated on drawings.

1.2 REFERENCES

- .1 Ontario Ministry of Labour
 - .1 Occupational Health and Safety Branch, Guideline Lead On Construction Projects, September 2004, and O. Reg. 490/09 respecting Designated Substances - Lead made under the Occupational Health and Safety Act as amended by O. Reg. 148/12 and O. Reg. 149/12.
 - .2 Department of Justice Canada
 - .1 Canadian Environmental Protection Act, 1999 (CEPA).
 - .3 Health Canada
 - .1 Workplace Hazardous Materials Information System (WHMIS), Material Safety Data Sheets (MSDS).
 - .4 Human Resources and Social Development Canada (HRSDC)
 - .1 Canada Labour Code Part II, - SOR 86-304 - Occupational Health and Safety Regulations.
 - .5 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992 (TDGA).
 - .6 U.S. Environmental Protection Agency (EPA)
 - .1 EPA 747-R-95-007-1995, Sampling House Dust for Lead.
 - .7 U.S. Department of Health and Human Services/Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health (NIOSH)
 - .1 NIOSH 94-113 - NIOSH Manual of Analytical Methods (NMAM), 4th Edition (1994).
 - .8 U.S. Department of Labour - Occupational Safety and Health Administration (OSHA) - Toxic and Hazardous Substances
 - .1 Lead in Construction Regulation - 29 CFR 1926.62-1993.
 - .9 Underwriters' Laboratories of Canada (ULC)
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- .10 Report of the Royal Commission on Matters of Health and Safety Arising from the Use of Asbestos in Ontario, 1984.

1.3 DEFINITIONS

- .1 HEPA vacuum: High Efficiency Particulate Air filtered vacuum equipment with a filter system capable of collecting and retaining fibres greater than 0.3 microns in any direction at 99.97% efficiency.
- .2 Authorized Visitors: Departmental Representative or designated representatives.
- .3 Polyethylene: polyethylene sheeting or rip-proof polyethylene sheeting with tape along edges, around penetrating objects over cuts and tears, and elsewhere as required to provide protection and isolation. For protection of underlying surfaces from damage and to prevent lead dust entering in clean area.
- .4 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must be appropriate capacity for scope of work.
- .5 Action level: employee exposure, without regard to use of respirators, to airborne concentration of lead of 50 micrograms per cubic meter of air (50 ug/m^3) calculated as 8-hour time-weighted average (TWA). Minimum precautions for lead abatement are based on airborne lead concentrations less than 0.05 milligrams per cubic meter of air for removal of lead based paint by methods noted in paragraph 1.1.
- .6 Competent person: Departmental Representative capable of identifying existing lead hazards in workplace taking corrective measures to eliminate them.
- .7 Lead dust: wipe sampling on vertical surfaces and/or horizontal surfaces, dust and debris is considered to be lead contaminated if it contains more than 40 micrograms of lead in dust per square foot.

1.4 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Provide proof satisfactory to Departmental Representative that suitable arrangements have been made to dispose of lead based paint waste in accordance with requirements of authority having jurisdiction.
- .3 Provide proof of Contractor's General and Environmental Liability Insurance.
- .4 Quality Control:
- .1 Provide Departmental Representative necessary permits for transportation and disposal of lead based paint waste and proof that lead based paint waste has been received and properly disposed.
- .2 Provide proof satisfactory to Departmental Representative that employees have had instruction on hazards of lead exposure, respirator use, dress, and aspects of work procedures and protective measures.
- .5 QUALITY ASSURANCE
- .1 Regulatory Requirements: comply with Federal, Provincial and local requirements pertaining to lead paint, provided that in case of conflict among those requirements or with these specifications more stringent requirement applies. Comply with regulations in effect at time work is performed.

- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.
 - .2 Safety Requirements: worker and visitor protection.
 - .1 Protective equipment and clothing to be worn by workers and visitors in work Area include:
 - .1 Respirator NIOSH approved and equipped with replaceable HEPA filter cartridges with an assigned protection factor of 10, acceptable to Authority having jurisdiction. Suitable for type of lead and level of lead dust exposure. Provide sufficient amount of filters.
 - .2 Half mask respirator: half-mask particulate respirator with R - series filter, and 99% efficiency could be provided.
 - .2 Eating, drinking, chewing, and smoking are not permitted in work area.
 - .3 Ensure workers wash hands and face when leaving work area. Facilities for washing are located as directed by Departmental Representative.
 - .4 Visitor Protection:
 - .1 Provide approved respirators to Authorized Visitors to work areas.
 - .2 Instruct Authorized Visitors procedures to be followed in entering and exiting work area.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.
- .2 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.
- .3 Disposal of lead waste generated by removal activities must comply with Federal, Provincial, Territorial and Municipal regulations. Dispose of lead waste in sealed double thickness 0.152 mm thick bags or leak proof drums. Label containers with appropriate warning labels.
- .4 Provide manifests describing and listing waste created. Transport containers by approved means to licensed landfill for burial.

1.6 EXISTING CONDITIONS

- .1 Reports and information pertaining to lead based paint to be handled, removed, or otherwise disturbed and disposed of during this Project are titled "Designated Substances and Hazardous Materials Survey" and bound as appendix to this project manual.
 - .2 Notify Departmental Representative of lead based paint discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material until instructed by Departmental Representative.
-

1.7 SCHEDULING

- .1 Not later than two days before beginning Work on this Project notify following in writing:
 - .1 Appropriate Regional or Zone Director of Medical Services Branch, Health Canada.
 - .2 Provincial Ministry of Labour.
 - .3 Disposal Authority.
- .2 Inform sub trades of presence of lead- containing materials identified in Existing Conditions.
- .3 Provide Departmental Representative copy of notifications prior to start of Work.

1.8 OWNER'S INSTRUCTIONS

- .1 Provide Departmental Representative satisfactory proof that every worker has had instruction and training in hazards of lead exposure, in personal hygiene, in aspects of work procedures, and in use, cleaning, and disposal of respirators.
- .2 Instruction and training related to respirators includes, at minimum:
 - .1 Proper fitting of equipment.
 - .2 Inspection and maintenance of equipment.
 - .3 Disinfecting of equipment.
 - .4 Limitations of equipment.
- .3 Instruction and training must be provided by competent, qualified person.
- .4 Supervisory personnel to complete required training.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Polyethylene 0.15 mm thick unless otherwise specified; in sheet size to minimize joints.
- .2 Tape: fibreglass - reinforced duct tape suitable for sealing polyethylene under dry conditions and wet conditions using amended water.
- .3 Slow - drying sealer: non-staining, clear, water - dispersible type that remains tacky on surface for at least 8 hours and designed for purpose of trapping residual lead paint residue.
- .4 Lead waste containers: metal type acceptable to dump operator with tightly fitting covers and 0.15 mm thickness sealable polyethylene liners.
 - .1 Label containers with pre-printed bilingual cautionary Warning Lead clearly visible when ready for removal to disposal site.

Part 3 EXECUTION

3.1 SUPERVISION

- .1 One Supervisor for every ten workers is required.
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- .2 Supervisor must remain within work area during disturbance, removal, or handling of lead based paints.

3.2 PREPARATION

- .1 Remove and store items to be salvaged or reused.
 - .1 Protect and wrap items and transport and store in area specified by Departmental Representative.
- .2 Work Area:
 - .1 Shut off and isolate HVAC system to prevent dust dispersal into other building areas. Conduct smoke tests to ensure duct work is airtight.
 - .2 Pre-clean fixed casework and equipment within work area, using HEPA vacuum and cover and seal with polyethylene sheeting and tape.
 - .3 Clean work area using HEPA vacuum. If not practicable, use wet cleaning method. Do not raise dust.
 - .4 Seal off openings with polyethylene sheeting and seal with tape.
 - .5 Protect floor surfaces covered from wall to wall with polyethylene sheets.
 - .6 Maintain emergency fire exits or establish alternatives satisfactory to Authority having jurisdiction.
 - .7 Where water application is required for wetting lead containing materials, provide temporary water supply appropriately sized for application of water as required.
 - .8 Provide electrical power and shut off for operation of powered tools and equipment. Provide 24 volt safety lighting and ground fault interrupter circuits on power source for electrical tools, in accordance with applicable CSA Standard. Ensure safe installation of electrical cables and equipment.
- .3 Do not start work until:
 - .1 Arrangements have been made for disposal of waste.
 - .2 Tools, equipment, and materials waste containers are on site.
 - .3 Arrangements have been made for building security.
 - .4 Notifications have been completed and preparatory steps have been taken.

3.3 LEAD ABATEMENT

- .1 Removal of lead-containing coatings with a chemical gel or paste and fibrous laminated cloth wrap; or removal equipped with HEPA filters; or removal with using power tools, non-powered hand tool, other than manual scraping and sanding.
 - .2 Remove lead based paint in small sections and pack as it is being removed in sealable 0.15 mm plastic bags and place in labelled containers for transport.
 - .3 Seal filled containers. Clean external surfaces thoroughly by wet sponging. Remove from immediate working area to staging area. Clean external surfaces thoroughly again by wet sponging. Wash containers thoroughly pending removal to outside. Ensure containers are removed by workers who have entered from uncontaminated areas dressed in clean coveralls.
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- .4 After completion of stripping work, wire brush and wet sponge surface from which lead based paint has been removed to remove visible material. During this work keep surfaces wet.
- .5 After wire brushing and wet sponging to remove visible lead based paint, and after encapsulating lead containing material impossible to remove, wet clean entire work area, and equipment used in process. After inspection by Departmental Representative apply continuous coat of slow drying sealer to surfaces of work area. Do not disturb work area for 8 hours no entry, activity, ventilation, or disturbance during this period.

3.4 INSPECTION

- .1 Perform inspection to confirm compliance with specification and governing authority requirements. Deviations from these requirements not approved in writing by Departmental Representative will result in work stoppage, at no cost to Departmental Representative.
- .2 Departmental Representative will inspect work for:
 - .1 Adherence to specific procedures and materials.
 - .2 Final cleanliness and completion.
 - .3 No additional costs will be allowed by Contractor for additional labour or materials required to provide specified performance level.

3.5 LEAD SURFACE SAMPLING - WORK AREAS

- .1 Final lead surface sampling to be conducted as follows:
 - .1 After work area has passed a visual inspection for cleanliness approved and accepted by Departmental Representative. Apply coat of lock-down agent to surfaces within enclosure, and appropriate setting period of 8 hours has passed, Departmental Representative will perform lead wipe sampling.
 - .1 Final lead wipe sampling results from horizontal and vertical surfaces must show lead levels of less than 40 micrograms of lead in dust per square foot. Samples collected and analyzed in accordance with EPA 747-R-95-007.
 - .2 If wipe sampling results show levels of lead in excess of 40 micrograms per square foot, re-clean work area at contractor's expense and apply another acceptable coat of lock-down agent to surfaces.
 - .3 Repeat as necessary until fibre levels are less than 40 micrograms per square foot.

3.6 FINAL CLEANUP

- .1 Following cleaning and when lead wipe surfaces sampling are below acceptable concentrations, proceed with final cleanup.
 - .2 Remove polyethylene sheet by rolling it away from walls to centre of work area. Vacuum visible lead containing particles observed during cleanup, immediately, using HEPA vacuum.
 - .3 Place polyethylene sheets, tape, cleaning material, clothing, and contaminated waste in plastic bags and sealed labelled waste containers for transport.
-

- .4 Conduct final check to ensure no dust or debris remains on surfaces as result of dismantling operations.

3.7 RE-ESTABLISHMENT OF OBJECTS AND SYSTEMS

- .1 Repair or replace objects damaged in course of work to their original state or better, as directed by Departmental Representative.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA A23.1-14, Concrete materials and methods of concrete construction/Test methods and standard practices for concrete.
 - .2 CSA A179-14, Mortar and Grout for Unit Masonry.
 - .3 CSA A371-14, Masonry Construction for Buildings.
 - .4 CAN/CSA-A3000-13, Cementitious Materials Compendium;
CAN/CSA-A3002-13, Masonry and Mortar Cement.
- .2 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD)
 - .1 SCAQMD Rule 1168-05, Adhesive and Sealant Applications.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Provide submittals in accordance with Section 01 33 00.
 - .2 Provide manufacturer's printed product literature, specifications and datasheets. Include product characteristics, performance criteria, and limitations.
 - .3 Provide two copies of Workplace Hazardous Materials Information System (WHMIS) - Material Safety Data Sheets (MSDS) in accordance with Section 01 35 43. Indicate VOC's mortar, grout, parging, colour additives and admixtures. Expressed as grams per litre (g/L).
- .2 Samples:
 - .1 Samples: provide unit samples as follows:
 - .1 Provide two size samples of coloured mortar.
 - .2 Provide confirmation of source or product data sheet, prior to mixing or preparation of mortars, to Departmental Representative of:
 - .1 Aggregate: course aggregate as required and sand.
 - .2 Cement.
 - .3 Lime.
- .3 Manufacturer's Instructions:
 - .1 Provide manufacturer's installation instructions.

1.3 QUALITY ASSURANCE

- .1 Test Reports: certified test reports including sand gradation tests in accordance with CSA A179 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 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handles masonry mortar and grout materials in accordance with Section 01 61 00, supplemented as follows:
 - .1 Deliver prepackaged, dry-blended mortar mix to project site in labelled plastic-lined bags each bearing name and address of manufacturer, production codes or batch numbers, and colour or formula numbers.
 - .2 Maintain mortar, grout and packaged materials clean, dry, and protected against dampness, freezing, traffic and contamination by foreign materials.
- .2 Packaging Waste Management: remove for reuse and return of pallets and packaging materials in accordance with Section 01 74 20.

1.5 SITE CONDITIONS

- .1 Ambient Conditions: maintain materials and surrounding air temperature to:
 - .1 Minimum 5°C prior to, during, and 48 hours after completion of masonry work.
 - .2 Maximum 32°C prior to, during, and 48 hours after completion of masonry work.
- .2 Weather Requirements: CSA A371 International Masonry Industry All-Weather Council (IMIAC) - Recommended Practices and Guide Specifications for Hot and Cold Weather Masonry Construction.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Use same brands of materials and source of aggregate for entire project.
- .2 Cement:
 - .1 Portland Cement: to CAN/CSA-A3000, Type GU - General use hydraulic cement (formerly Type 10).
 - .1 Use low VOC products in compliance with SCAQMD Rule 1168.
 - .2 Masonry Cement: to CAN/CSA-A3002 and CSA A179, Type N.
 - .3 Mortar Cement: to CAN/CSA-A3002 and CSA A179, Type N.
 - .1 Use low VOC products in compliance with SCAQMD Rule 1168.
 - .4 Packaged Dry Combined Materials for mortar: to CSA A179, Type N.
- .3 Aggregate: supplied by one supplier.
 - .1 Fine Aggregate: to CSA A179, natural sand.
 - .2 Course Aggregate: to CSA A179.
- .4 Water: clean and potable.
- .5 Lime:
 - .1 Quick Lime: to CSA A179, Type N.
 - .2 Hydrated Lime: to CSA A179, Type S.

- .6 Polymer Latex: organic polymer latex admixture of butadiene-styrene type non-emulsifiable bonding admixture.

2.2 MORTAR MIXES

- .1 Mortar for interior and exterior masonry: as indicated on the drawings.
- .2 Pointing Mortar: CSA A179, Type S using property specification with maximum 2 percent ammonium stearate or calcium stearate of cement by weight.
- .3 Mortar for foundation walls, manholes, sewers, pavements, walks, patios and other exterior masonry at or below grade: type M based on property specifications, CSA A179 Tables A.2 and A.3.

2.3 MORTAR MIXING

- .1 Use pre-blended, pre-coloured mortar prepackaged under controlled factory conditions. Ingredients batching limitations to be within 1% accuracy.
- .2 Mix mortar ingredients in accordance with CSA A179 in quantities needed for immediate use.
- .3 Maintain sand uniformly damp immediately before mixing process.
- .4 Add mortar colour and admixtures in accordance with manufacturer's instructions. Provide uniformity of mix and colouration.
- .5 Do not use anti-freeze compounds including calcium chloride or chloride based compounds.
- .6 Do not add air entraining admixture to mortar mix.
- .7 Use a batch type mixer in accordance with CSA A179.
- .8 Pointing mortar: prehydrate pointing mortar by mixing ingredients dry, then mix again adding just enough water to produce damp unworkable mix that will retain its form when pressed into ball. Allow to stand for not less than 1 hour no more than 2 hours then remix with sufficient water to produce mortar of proper consistency for pointing.
- .9 Re-temper mortar only within two hours of mixing, when water is lost by evaporation.
- .10 Use mortar within 2 hours after mixing at temperatures of 32°C, or 2-1/2 hours at temperatures under 5°C.

2.4 GROUT MIXES

- .1 Bond Beams and Hollow Core Infill: grout mix 10 to 12.5 MPa strength at 28 days; 200-250 mm slump; mixed in accordance with CSA A179 fine grout
- .2 Lintels: grout mix 10 to 12.5 MPa strength at 28 days; 200-250 mm slump; mixed in accordance with CSA A179 fine
- .3 Grout: Minimum compressive strength of 12.5 MPa at 28 days. Maximum aggregate size and grout slump: CSA A179.

2.5 GROUT MIXING

- .1 Mix batched and delivered grout in accordance with CSA A23.1-14 transit mixed.

- .2 Mix grout ingredients in quantities needed for immediate use in accordance with CSA A179 fine grout.
- .3 Add admixtures in accordance with manufacturer's instructions; mix uniformly.
- .4 Do not use calcium chloride or chloride based admixtures.

2.6 MIX TESTS

- .1 Testing Mortar Mix:
 - .1 Test mortar to requirements of Section 01 45 00, and in accordance with CSA A179, for mortar based on property specification. Test prior to construction and during construction for:
 - .1 Compressive strength.
 - .2 Consistency.
 - .3 Mortar aggregate ratio.
 - .4 Sand/cement ratio.
 - .5 Water content and water/cement ratio.
 - .6 Air content.
 - .7 Splitting tensile strength.
- .2 Testing Grout Mix:
 - .1 Test grout to requirements of Section 01 45 00, and in accordance with CSA A179, for grout based on property specification. Test prior to construction and during construction for:
 - .1 Compressive strength.
 - .2 Sand/cement ratio.
 - .3 Water content and water/cement ratio.
 - .4 Slump.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Request inspection of spaces to be grouted.

3.2 PREPARATION

- .1 Apply bonding agent to existing concrete surfaces.
- .2 Plug clean-out holes with block masonry units. Brace masonry for wet grout pressure.

3.3 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.
-

3.4 CONSTRUCTION

- .1 Do masonry mortar and grout work in accordance with CSA A179 except where specified otherwise.
- .2 Apply parging in uniform coating not less than total 10 mm thick, where indicated

3.5 MIXING

- .1 All pointing mortar can be mixed using a regular paddle mixer. Only electric motor mixers are permissible. Mixers run on hydrocarbons are not permitted, due to fumes. Mixing by hand must be pre-approved by the Departmental Representative.
- .2 Clean all mixing boards and mechanical mixing machine between batches.
- .3 Mortar must be weaker than the units it is binding.
- .4 Contractor to appoint one individual to mix mortar, for duration of project. In the event that this individual must be changed, mortar mixing must cease until the new individual is trained, and mortar mix is tested.

3.6 MORTAR PLACEMENT

- .1 Install mortar to manufacturer's instructions.
- .2 Install mortar to requirements of CSA A179.
- .3 Remove excess mortar from grout spaces.

3.7 GROUT PLACEMENT

- .1 Install grout in accordance with manufacturer's instructions.
- .2 Install grout in accordance with CSA A179.
- .3 Work grout into masonry cores and cavities to eliminate voids.
- .4 Do not install grout in lifts greater than 400 mm, without consolidating grout by rodding.
- .5 Do not displace reinforcement while placing grout.

3.8 FIELD QUALITY CONTROL

- .1 Site Tests, Inspection:
 - .1 Test and evaluate mortar prior to construction and during construction in accordance with CSA A179.
 - .2 Test and evaluate grout prior to construction and during construction to CSA A179; test in conjunction with masonry unit sections specified.
- .2 Manufacturer's Field Services: in accordance with Section 01 45 00.

3.9 CLEANING

- .1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.
- .2 Remove droppings and splashings using clean sponge and water.
- .3 Clean masonry with low pressure clean water and soft natural bristle brush.

- .4 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

3.10 PROTECTION OF COMPLETED WORK

- .1 Cover completed and partially completed work not enclosed or sheltered with waterproof covering at end of each work day. Anchor securely in position.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 ASTM International Inc.
 - .1 ASTM A36/A36M-14, Standard Specification for Carbon Structural Steel.
 - .2 ASTM A1060/A1060M-14, Standard Specification for Zinc-Coated (Galvanized) Steel Welded Wire Reinforcement, Plan and Deformed, for Concrete.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA-A179-14, Mortar and Grout for Unit Masonry.
 - .3 CAN/CSA-A370-14, Connectors for Masonry.
 - .4 CAN/CSA-A371-14, Masonry Construction for Buildings.
 - .5 CSA G30.18(R2014), Carbon Steel Bars for Concrete Reinforcement.
 - .6 CSA S304.1-14, Design of Masonry Structures.
 - .7 CSA W186-M1990(R2012), Welding of Reinforcing Bars in Reinforced Concrete Construction.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheets illustrating products to be incorporated into project for specified products.
 - .2 Provide two copies of Workplace Hazardous Materials Information System (WHMIS) - Material Safety Data Sheets (MSDS).
- .3 Shop Drawings:
 - .1 Provide shop drawings in accordance with Section 01 33 00.
 - .1 Provide drawings stamped and signed by professional engineer registered or licensed in the Province of Ontario, Canada.
 - .2 Provide shop drawings detailing bar bending details, anchorage details lists and placing drawings.
 - .3 On placing drawings, indicate sizes, spacing, location and quantities of reinforcement and connectors.

1.3 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 FIELD MEASUREMENTS

- .1 Make field measurements necessary to ensure proper fit of members.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle masonry anchorage and reinforcing materials in accordance with Section 01 61 00, supplemented as follows:
 - .1 Deliver reinforcement and connectors, identified in shop and placement drawings.
- .2 Packaging Waste Management:
 - .1 Separate and recycle waste materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Bar reinforcement: Steel to CAN/CSA-A371 and CSA G30.18, Grade 400.
- .2 Connectors: to CAN/CSA-A370 and CSA S304.1.
- .3 Corrosion protection: to CSA S304.1, galvanized to CSA S304.1 and CAN/CSA-A370.
- .4 Fasteners: installed post-construction:
 - .1 Screw Shields and Plugs: plastic, chemical-resistant, install in mortar joints.
 - .2 Bolts and Screws: size and type to suit application, locate where indicated.
 - .3 Nails: case-hardened cut or spiral nails, size and type to suit fastening application.
 - .4 Powder-Driven Fasteners: pin styles and lengths to suit fastening application in accordance with manufacturers use, load and hold recommendations.
 - .5 Adhesives: epoxies, mastics and contact cements for fastening applications, use in accordance with manufacturers' recommendations.
- .5 Ties: uncoated steel finish.
 - .1 Corrugated to CAN/CSA-A370.
 - .2 Unit ties, to CAN/CSA-A370: rectangular fabricated form cold-drawn steel wire
Adjustable Unit Ties: to CAN/CSA-A370: proprietary type ties, type, style and size to suit application in accordance with manufacturer's recommendations.
 - .3 Joint Reinforcement Ties: to CAN/CSA-A370:
 - .1 Single Wythe Joint Reinforcement: ladder type:
 - .1 Cold drawn steel wire conforming to ASTM A1060/A1060M.
 - .2 Provide joint reinforcement as indicated on Drawings.
 - .2 Multiple Wythe Joint Reinforcement: ladder type: without moisture drip; adjustable:
 - .1 Cold drawn steel wire conforming to ASTM A1060/A1060M.
 - .2 Provide joint reinforcement as indicated on Drawings.
- .6 Anchors: to CAN/CSA-A370:
 - .1 Conventional Anchors: type steel bolts with bent bar anchors, plate anchors, through bolts sized to suit application.
 - .2 Wedge Anchors: expansion anchors type wedge and bolt sized to suit application.

- .3 Self-Contained Anchors: type with epoxy resin and hardener.
- .4 Dovetail Anchors: bent steel strap, 25 mm size x 6 mm thick, galvanized to CAN/CSA-A370 Table 5.2 uncoated finish.
- .5 Spiral Anchors: 8 mm stainless steel spiral anchors to Grade 304.
- .7 Conventional Bolts:
 - .1 Bolts: to ASTM A36/A36M, bar stock.
- .8 Adhesive Anchors: proprietary systems, pre-mixed, self-contained system with double glass vial system to contain epoxy, consisting of resin, hardener and aggregate measure and mix system where epoxy materials are hand-measured and mixed in accordance with manufacturers' written instructions.

2.2 FABRICATION

- .1 Fabricate reinforcing in accordance with CSA A23.1/A23.2 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
- .2 Fabricate connectors in accordance with CAN/CSA-A370.
- .3 Obtain Departmental Representative's approval for locations of reinforcement splices other than shown on placing drawings.
- .4 Upon approval of Departmental Representative, weld reinforcement in accordance with CSA W186.
- .5 Ship reinforcement and connectors, clearly identified in accordance with drawings.

2.3 SOURCE QUALITY CONTROL

- .1 Upon request, provide Departmental Representative with certified copy of mill test report of reinforcement steel and connectors, showing physical and chemical analysis, minimum 5 weeks prior to commencing reinforcement work.
- .2 Upon request inform Departmental Representative of proposed source of material to be supplied.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 PREPARATION

- .1 Direct and coordinate placement of metal anchors for masonry supplied to other Sections.

3.3 INSTALLATION

- .1 Install masonry connectors and reinforcement in accordance with CAN/CSA-A370, CAN/CSA-A371, CSA-A23.1/A23.2 and CSA S304.1 unless indicated otherwise.
 - .2 Prior to placing concrete, mortar and grout, obtain Departmental Representative's approval of placement of reinforcement and connectors.
-

- .3 Install additional reinforcement to masonry as indicated.

3.4 BONDING AND TYING

- .1 Bond walls of two or more wythes using metal connectors in accordance with CSA S304.1, CAN/CSA-A371 and as indicated.
- .2 Tie masonry veneer to backing in accordance with NBC 2010, CSA S304.1, CAN/CSA-A371 and as indicated.
- .3 Install unit, adjustable, single wythe and multiple wythe joint reinforcement where indicated and in accordance with CAN/CSA-A370 and CAN/CSA-A371.
 - .1 Bond walls of two or more wythes using metal connectors in accordance with CAN/CSA-A371 and as indicated.
 - .2 Install horizontal joint reinforcement 400 mm on centre.
 - .3 Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 400 mm each side of opening.
 - .4 Place joint reinforcement continuous in first and second joint below top of walls.
 - .5 Lap joint reinforcement ends minimum 150 mm.
 - .6 Connect stack bonded units, joint corners and intersections with strap anchors 400 mm on centre.

3.5 REINFORCED LINTELS AND BOND BEAMS

- .1 Reinforce masonry beams, masonry lintels and bond beams as indicated.
- .2 Place and grout reinforcement in accordance with CSA S304.1, CAN/CSA-A371, and CAN/CSA-A179.
- .3 Support and position reinforcing bars in accordance with CAN/CSA-A371.

3.6 GROUTING

- .1 Grout masonry in accordance with CSA S304.1, CAN/CSA-A371 and CAN/CSA-A179 and as indicated.

3.7 ANCHORS

- .1 Install metal anchors in accordance with CAN/CSA-A370 and CAN/CSA-A371 as indicated.

3.8 LATERAL SUPPORT AND ANCHORAGE

- .1 Install lateral support and anchorage in accordance with CSA S304.1 and as indicated.

3.9 MOVEMENT JOINTS

- .1 Reinforcement will not be continuous across movement joints unless otherwise indicated.

3.10 FIELD BENDING

- .1 Do not field bend reinforcement and connectors except where indicated or authorized by Departmental Representative.
- .2 When field bending is authorized, bend without heat, applying a slow and steady pressure.

- .3 Replace bars and connectors which develop cracks or splits.

3.11 FIELD QUALITY CONTROL

- .1 Conduct site inspections to verify compliance with specified requirements.
- .2 Obtain Departmental Representative approval of placement of reinforcement and connectors, prior to placing mortar and grout.

3.12 FIELD TOUCH-UP

- .1 Touch up damaged and cut ends of epoxy coated or galvanized reinforcement steel and connectors with compatible finish to provide continuous coating.

3.13 CLEANING

- .1 Clean in accordance with Section 01 74 11.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 ASTM International Inc.
 - .1 ASTM D2240-05(2010), Standard Test Method for Rubber Property - Durometer Hardness.
- .2 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-A371-14, Masonry Construction for Buildings.
- .3 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD)
 - .1 SCAQMD Rule 1168-05, Adhesives and Sealants Applications.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheets. Include product characteristics, performance criteria, and limitations.
- .3 Shop Drawings:
 - .1 Provide shop drawings in accordance with Section 01 33 00.
 - .1 Provide drawings stamped and signed by professional engineer registered or licensed in the Province of Ontario, Canada.
 - .2 Shop drawings consist of flashing and installation details. Indicate sizes, spacing, location and quantities of fasteners.
- .4 Samples:
 - .1 Provide masonry accessory samples in accordance with Section 01 33 00, supplemented as follows:
 - .1 Materials: two, cured, and coloured samples, illustrating colour and colour range. Include:
 - .1 Movement joint filler.
 - .2 Lap adhesive.
 - .3 Mechanical fasteners.
 - .4 Reglets.
 - .2 Two moisture control material samples, illustrating colour and colour range, size, and shape. Include:
 - .1 Weep hole vents.
 - .2 Mortar diverters.
 - .3 Grout screens.
 - .3 Two flashing material samples, illustrating colour and colour range, size, shape, and profile. Include as specified:
 - .1 Sheet metal flashings.

- .2 Composite flashings.
- .5 Quality Assurance Submittals:
 - .1 Test reports: submit certified test reports in accordance with Section 01 45 00.
 - .2 Certificates: submit in accordance with Section 01 45 00.
 - .3 Pre-installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.
 - .4 Manufacturer's Instructions: submit as specified, supplemented as follows:
 - .1 Submit installation instructions for fillers, adhesives, reglets, brick vents, weeps, vents, diverters, screens, and flashings.
 - .6 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
 - .7 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
 - .8 Pre-installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

1.3 FIELD MEASUREMENTS

- .1 Make field measurements necessary to ensure proper fit of members.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle masonry accessories in accordance with, Section 01 61 00 supplemented as follows:
 - .1 Keep fillers and adhesives dry, protected against dampness, and freezing.
 - .2 Store packaged materials off ground and in accordance with manufacturer's written instructions.
- .2 Packaging Waste Management:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Movement joint filler: purpose-made elastomer durometer hardness to ASTM D2240 of size and shape indicated.
 - .1 Use low VOC products in compliance with the SCAQMD Rule 1168.
 - .2 Material type: fibre board.
 - .2 Lap adhesive: recommended by masonry flashing manufacturer. Use low VOC products in compliance with the SCAQMD Rule 1168.
 - .3 Weep hole vents: purpose-made PVC.
 - .4 Mechanical fasteners: recommended by flashing manufacturer to suit project requirements.
-

2.2 MOISTURE CONTROL

- .1 Weep Hole Vents: PVC.
- .2 Cell vents: polypropylene plastic, honeycomb design.
 - .1 Size: 9.5 mm x 63.5 mm x 85.7 mm.
- .3 Colour: gray.
- .4 Mortar diverters: shaped and sized to suit cavity spaces.
 - .1 Cavity space size: 25 mm.
 - .2 Manufactures from recycled material.
- .5 Grout Screens: 6 mm square monofilament screen is fabricated form high-strength, non-corrosive polypropylene polymers to isolate flow of grout in designated areas.
 - .1 Size: 100 mm wide x 30 m.

2.3 FLASHINGS

- .1 Sheet metal: aluminum.
 - .1 Thickness: Minimum 1.0 mm.
 - .2 Finish: Prefinished, as selected by Departmental Representative.
 - .3 Surface Texture: Smooth.
- .2 Composite Flashings:
 - .1 Aluminum flashings: aluminum foil, 0.004 mm thick, asphalt laminated between two sheets of creped kraft paper with one exposed paper surface coated with asphalt-wax treatment.

Part 3 EXECUTION

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION: MATERIALS

- .1 Install continuous movement joint fillers in movement joints at 7,000 mm intervals or at locations indicated on drawings.
- .2 Lap adhesive: apply adhesive to flashing lap joints.
- .3 Mechanical fasteners: install fasteners to suit application and in accordance with manufacturer's written installation instructions.
- .4 Reglets: install reglets at locations indicated on drawings.
- .5 Brick vents: install brick vents at locations indicated on drawings.

3.3 INSTALLATION: MOISTURE CONTROL

- .1 Install weep hole vents in vertical joints immediately over flashings, in exterior wythes of cavity wall and masonry veneer wall construction, at maximum horizontal spacing of 600 mm on centre.
- .2 Mortar diverters: install purpose made diverters in cavities where indicated and as directed, size and shape to suit purpose and function.
- .3 Grout screens: install purpose made diverters in cavities where indicated and as directed, size and shape to suit purpose and function.

3.4 INSTALLATION: FLASHINGS

- .1 Build in flashings in masonry in accordance with CAN/CSA-A371.
 - .1 Install flashings under exterior masonry bearing on foundation walls, slabs, shelf angles, and steel angles over openings, and at base of cavity wall and where cavity is interrupted by horizontal members or supports and as shown on drawings. Install flashings under weep hole courses and as indicated.
 - .2 In cavity walls and veneered walls, carry flashings from front edge of exterior masonry, under outer wythe, then up backing not less than 150 mm, and as follows:
 - .1 For masonry backing embed or bond flashing 25 mm in joint.
 - .2 For concrete backing, insert or bond flashing into reglets.
 - .3 For wood frame backing, staple flashing to walls behind water resistive paper, and lap joints.
 - .4 For gypsum board and glass fibre faced sheathing backing, bond to wall using manufacturer's recommended adhesive.
 - .3 Lap joints 150 mm and seal with adhesive.
- .2 Form flashing (end dams) at lintels, sills and wall ends to prevent water from travelling horizontally past flashing ends.
- .3 Install vertical flashing where outer veneer returns at window or door jambs, to prevent contact of veneer with inner wall.

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 11.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 ASTM International Inc.
 - .1 ASTM E336-14, Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA A165 Series-14, CSA Standards on Concrete Masonry Units (covers: A165.1, A165.2, A165.3).
 - .2 CSA A371-04-14, Masonry Construction for Buildings.
 - .3 CSA S304.1-14, Design of Masonry Structures.
- .3 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD)
 - .1 SCAQMD Rule 1168-05, Adhesives and Sealants Applications.
- .4 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S101-14, Standard Methods of Fire Endurance Tests of Building Construction and Materials.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Product Data: provide product data, including manufacturer's printed data sheets and catalog pages illustrating products to be incorporated into project for specified products.
- .3 Samples:
 - .1 Provide unit samples in accordance with Section 01 33 00.
- .4 Manufacturer's Written Instructions.

1.3 QUALITY ASSURANCE SUBMITTALS

- .1 Certificates: provide in accordance with Section 01 33 00.
- .2 Test and Evaluation Reports: provide certified test reports.
- .3 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle concrete unit masonry in according to manufacturer' instructions.
- .2 Packaging Waste Management:
 - .1 Separate and recycle waste materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Standard concrete block units to CSA A165 Series (CSA A165.1).
 - .1 Classification: H/15/D/M.
 - .2 Dimensions - Nominal: 150, 200, 240 mm wide x 200 mm high x 400 mm long.

2.2 REINFORCEMENT

- .1 Reinforcement in accordance with Section 04 05 19.

2.3 CONNECTORS

- .1 Connectors in accordance with Section 04 05 19.

2.4 FLASHING

- .1 Flashing: in accordance with Section 04 05 23.

2.5 MORTAR MIXES

- .1 Mortar and mortar mixes in accordance with Section 04 05 12.

2.6 GROUT MIXES

- .1 Grout and grout mixes in accordance with Section 04 05 12.

2.7 CLEANING COMPOUNDS

- .1 Use low VOC products in compliance with SCAQMD Rule 1168.
- .2 Compatible with substrate and acceptable to masonry manufacturer for use on products.
- .3 Cleaning compounds compatible with concrete unit masonry and in accordance with manufacturer's written recommendations and instructions.

2.8 TOLERANCES

- .1 Tolerances for standard concrete unit masonry tolerances in accordance with CSA A165.1, supplemented as follows:
 - .1 Maximum variation between units within specific job lot not to exceed 2 mm.
 - .2 No parallel edge length, width or height dimension for individual unit to differ by more than 2 mm.
 - .3 Out of square tolerance not to exceed 2 mm.
- .2 Tolerances for architectural concrete masonry units in accordance with CSA A165.1, supplemented as follows:
 - .1 Maximum variation in length or height between units within specific job lot for specified dimension not to exceed 2 mm.
 - .2 No parallel edge length, width or height dimension for individual unit to differ by more than 2 mm.
 - .3 Out of square tolerance not to exceed 2 mm.

- .4 Maximum variation in width between units within specific job lot for specified dimension not to exceed 2 mm.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verify surfaces and conditions are ready to accept work of this Section.
- .2 Commencing installation means acceptance of existing substrates.

3.2 PREPARATION

- .1 Protect adjacent finished materials from damage due to masonry work.

3.3 INSTALLATION

- .1 Concrete block units:
 - .1 Bond: running.
 - .2 Coursing height: 200 mm for one block and one joint.
 - .3 Jointing: concave where exposed or where paint or other finish coating is specified.
- .2 Architectural concrete unit masonry:
 - .1 Bond: running.
 - .2 Coursing height: 200 mm for one block and one joint.
 - .3 Jointing: concave where exposed or where paint or finish coating is specified.
- .3 Special Shapes:
 - .1 Install special units to form corners, returns, offsets, reveals and indents without cut ends being exposed and without losing bond or module.
 - .2 Install reinforced concrete block lintels over openings in masonry where steel or reinforced concrete lintels are not indicated.
 - .3 End bearing: not less than 200 mm.

3.4 REINFORCEMENT

- .1 Install reinforcing in accordance with Section 04 05 19.

3.5 CONNECTORS

- .1 Install connectors in accordance with Section 04 05 19.

3.6 FLASHING

- .1 Install flashings: in accordance with Section 04 05 23.

3.7 MORTAR PLACEMENT

- .1 Place mortar in accordance with Section 04 05 12.

3.8 GROUT PLACEMENT

- .1 Place grout in accordance with Section 04 05 12.

3.9 CONSTRUCTION

- .1 Cull out masonry units, in accordance with CSA A165 and reviewed range of colour samples, with chips, cracks, broken corners, excessive colour and texture variation.
- .2 Build in miscellaneous items such as bearing plates, steel angles, bolts, anchors, inserts, sleeves and conduits.
- .3 Construct masonry walls using running bond unless otherwise noted.
- .4 Build around frames previously set and braced. Fill behind hollow frames within masonry walls with mortar or grout and embed anchors.
- .5 Fit masonry closely against electrical and plumbing outlets so collars, plates and covers overlap and conceal cuts.
- .6 Install movement joints and keep free of mortar where indicated.
- .7 Solid Units: apply mortar over entire vertical and horizontal surfaces. Avoid bridging of airspace between brick veneer and backup wall with mortar.
- .8 Ensure compacted head joints. Use full or face-shell joint as indicated.
- .9 Tamp units firmly into place.
- .10 Do not adjust masonry units after mortar has set. Where resetting of masonry is required, remove, clean and reset units in new mortar.
- .11 Tool exposed joints concave, strike concealed joints flush.
- .12 After mortar has achieved initial set up, tool joints.
- .13 Do not interrupt bond below or above openings.

3.10 REPAIR/RESTORATION

- .1 Upon completion of masonry, fill holes and cracks, remove loose mortar and repair defective work.

3.11 FIELD QUALITY CONTROL

- .1 Site Tests, Inspection: in accordance with Section 01 45 00 supplemented as follows:
 - .1 Concrete masonry units will be sampled and tested by independent testing agency appointed and paid by Departmental Representative in accordance with CSA S304.1.
 - .2 Noise reduction between two rooms will be tested by independent testing agency appointed and paid by Departmental Representative in accordance with ASTM E336.
 - .3 Notify inspection agency minimum of 24 hours in advance of requirement for tests.
- .2 Manufacturer's Field Services: in accordance with Section 01 45 00.

3.12 CLEANING

- .1 Clean in accordance with Section 01 74 11, supplemented as follows.
 - .1 Progress Cleaning:
 - .1 Standard Concrete Unit Masonry:
 - .1 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block. Clean wall surface with suitable brush or burlap.
 - .2 Architectural Concrete Unit Masonry:
 - .1 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block. Clean wall surface with suitable brush or burlap.
 - .3 Prefaced Concrete Unit Masonry:
 - .1 Clean masonry as work progresses using soft, clean cloths, within few minutes after laying. Upon completion, when mortar has set so that it will not be damaged by cleaning, clean with soft sponge or clean cloths, brush, and clean water. Polish with soft, clean cloths.
 - .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

3.13 PROTECTION

- .1 Brace and protect concrete unit masonry in accordance with Section 01 45 00.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This section does not include incidental fastening that may be required for supporting, attaching or suspending non-structural steel related materials that are described in other specification sections and can include items such as architectural accessories; healthcare accessories; mechanical and electrical equipment; communications equipment; wood framing and blocking; doors, windows and louvers; and similar attached materials.

1.2 RELATED REQUIREMENTS

- .1 Section 05 12 23 – Structural Steel Framing

1.3 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A193/A193M-15, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
 - .2 ASTM A307-14, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod
- .2 Canadian Standards Association (CSA):
 - .1 CSA S16-14, Design of Steel Structures, with Updates
 - .2 CSA G30.18-09 (R2014), Carbon Steel Bars for Concrete Reinforcement

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Provide fastenings attached to other construction without delaying the Work; provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 SUBMITTALS

- .1 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit product data for each type of fastener, accessory and installation tool required for the project including the following:
 - .1 Manufacturer's written installation requirements and setting out diagrams.
 - .2 Type, size, and length of anchors and fastenings required for project.
 - .2 Informational Submittals: Provide the following submittals during the course of the work:
 - .1 Training Certificates: Provide training certificates or letter from manufacturer indicating that installers have been tested for the anchor and fastening requirements for the project.
-

1.6 QUALITY ASSURANCE

- .1 Qualifications: Provide proof of qualifications during the course of the work of this Section:
 - .1 Manufacturer: Use a manufacturer that provides site personnel, technical assistance and training to installers; and on-site support during installation of post-installed anchors and fastenings.
 - .2 Installer: Use installers that are trained by manufacturer's site engineer for project specific methods and limitations of anchor installation.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Storage and Handling Requirements: Store materials to permit easy access for inspection and identification; store fasteners in a protected place; clean and relubricate nuts that become dry or rusty before use.

1.8 SITE CONDITIONS

- .1 Ambient Conditions: Install adhesive anchors only when temperature of surfaces and surrounding air temperatures are within temperature range recommended in writing by fastener manufacturer.

Part 2 Products

2.1 ADHESIVE FASTENERS

- .1 Anchor Rod System: Adhesive anchor system consisting of all-thread anchor rod having 45° chisel point; nut and washer matching anchor rod materials, and adhesive capsule; and as follows:
 - .1 Anchor Rod Material: Carbon steel meeting requirements of ASTM A307
 - .2 Minimum Ultimate Tensile Strength: Nominal 460 MPa
 - .3 Nominal Diameter: As indicated on drawings and details and not less than 13 mm diameter
 - .4 Nominal Length: As Indicated or to meet manufacturer's recommended embedment depths
 - .5 Adhesive Capsule: Two component vinyl urethane methacrylate contained within a dual chamber foil capsule
 - .2 Threaded Insert System: Adhesive anchor system consisting of internally threaded insert and adhesive capsule, and as follows:
 - .1 Threaded Insert Material: Carbon steel meeting requirements of ASTM A307
 - .2 Minimum Ultimate Tensile Strength: Nominal 460 MPa
 - .3 Nominal Diameter: As indicated on drawings and details and not less than 13 mm diameter
 - .4 Nominal Length: As Indicated or to meet manufacturer's recommended embedment depths
 - .5 Adhesive Capsule: Two component vinyl urethane methacrylate contained within a dual chamber foil capsule
-

- .3 Rapid Setting Adhesive Anchor Rod System: Rapid setting adhesive anchoring system consisting of all-thread anchor rod having 45° chisel point, bond enhancing threaded rod; nut and washer matching anchor rod materials, and as follows:
 - .1 Anchor Rod Material: Carbon steel meeting requirements of ASTM A307.
 - .2 Minimum Ultimate Tensile Strength: Nominal 460 MPa
 - .3 Nominal Diameter: As indicated on drawings and details and not less than 13 mm diameter
 - .4 Nominal Length: As Indicated
 - .5 Adhesive: Two component, injection type vinyl urethane methacrylate low temperature application epoxy acrylate and cement with zinc coated steel and with stainless steel mesh screen tube for hollow substrates.
- .4 Rapid Setting Adhesive Threaded Insert System: Adhesive anchor system consisting of internally threaded insert and adhesive, and as follows:
 - .1 Threaded Insert Material: Carbon steel meeting requirements of ASTM A307
 - .2 Minimum Ultimate Tensile Strength: Nominal 460 MPa
 - .3 Nominal Diameter: As indicated on drawings and details and not less than 13 mm diameter
 - .4 Nominal Length: As Indicated
 - .5 Adhesive: Two component, injection type vinyl urethane methacrylate, low temperature application epoxy acrylate and cement with zinc coated steel and with stainless steel mesh screen tube for hollow substrates

Part 3 Execution

3.1 INSTALLATION

- .1 Prepare drilled holes, clean and dry holes, and install anchors and fastenings in accordance with manufacturer's written instructions as modified by directions from manufacturer's site engineer to suit project conditions.
- .2 Setting Structural Anchors and Fastenings: Set structural anchors and fastenings accurately in locations and to elevations indicated on Drawings; survey measure critical areas and components that align with other construction in accordance with Section 01 70 00 – Execution Requirements.

3.2 SITE QUALITY CONTROL

- .1 Post Installed Fastening Testing and Inspections: Observation requirements of structural fastenings in accordance with CSA S16.
- .2 Non-Conforming Work: Remove and replace non-conforming work at no additional expense to the Work using methods and materials acceptable to the Consultant.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 03 30 00.01 Cast-in-Place Concrete

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM A36/A36M-12, Standard Specification for Carbon Structural Steel.
 - .2 ASTM A325-14, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - .3 ASTM A325M-14, Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength (Metric).
- .2 Canadian Standards Association (CSA)
 - .1 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CSA S16-14, Design of Steel Structures.
 - .3 CSA W47.1-09(R2014), Certification of Companies for Fusion Welding of Steel.
 - .4 CSA W55.3-08(R2013), Certification of Companies for Resistance Welding of Steel and Aluminum
 - .5 CSA W59-13, Welded Steel Construction (Metal Arc Welding) Metric.

1.3 DESIGN REQUIREMENTS

- .1 Design details and connections in accordance with requirements of CSA S16 to resist forces, moments, shears and allow for movements indicated.
- .2 Design Criteria: Fabricator is required to design and submit details for connections not otherwise detailed on the Drawings using loads and forces indicated on the Drawings and as follows:
 - .1 Loads and forces shown on Drawings are not factored, unless specifically indicated otherwise.
 - .2 Request from Departmental Representative any loads and forces not shown on Drawings, but that may be required to detail connections.
- .3 Submit sketches and design calculations stamped and signed by qualified professional engineer licensed in Province of Ontario, Canada for non standard connections.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings including fabrication and erection documents and materials list in accordance with Section 01 33 00.
- .2 Erection drawings: indicate details and information necessary for assembly and erection purposes including:
 - .1 Description of methods.
 - .2 Sequence of erection.

- .3 Type of equipment used in erection.
- .4 Temporary bracings.
- .3 Ensure Fabricator drawings showing designed assemblies, components and connections are stamped and signed by qualified professional engineer licensed in the province of Ontario, Canada.

1.5 QUALITY ASSURANCE

- .1 Submit 3 copies of mill test reports 4 weeks prior to fabrication of structural steel.
 - .1 Mill test reports to show chemical and physical properties and other details of steel to be incorporated in project.
 - .2 Provide mill test reports certified by metallurgists qualified to practice in province of Ontario, Canada.
- .2 Provide structural steel Fabricator's affidavit stating that materials and products used in fabrication conform to applicable material and products standards specified and indicated.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
- .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 for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.
- .5 Divert unused paint material from landfill to official hazardous material collections site approved by Departmental Representative.
- .6 Do not dispose of unused paint materials into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Structural steel to:
 - .1 Rolled W-Sections: In accordance with CSA G40.20/G40.21, Grade 350W
 - .2 Other Rolled Sections and Plates: In accordance with CSA G40.20/G40.21, Grade 300W
- .2 Bolts, nuts and washers: to ASTM A325M minimum 30% recycled content.
- .3 Welding materials: to CSA W59 and certified by Canadian Welding Bureau.
- .4 Shop paint primer: to CISC/CPMA 1, Ecologo certified.

2.2 FABRICATION

- .1 Fabricate structural steel in accordance with CSA S16 and in accordance with reviewed shop drawings.
- .2 Provide holes in top flanges.

2.3 SHOP PAINTING

- .1 Clean, prepare surfaces and shop prime structural steel in accordance with CSA S16.
- .2 Clean members, remove loose mill scale, rust, oil, dirt and other foreign matter. Prepare surface according to SSPC-SP-6.
- .3 Apply one coat of primer in shop to steel surfaces, except:
 - .1 Surfaces to be encased in concrete.
 - .2 Surfaces to receive field installed stud shear connections.
 - .3 Surfaces and edges to be field welded.
 - .4 Faying surfaces of friction-type connections.
- .4 Apply paint under cover, on dry surfaces when surface and air temperatures are above 5 degrees C.
- .5 Maintain dry condition and 5 degrees C minimum temperature until paint is thoroughly dry.
- .6 Strip paint from bolts, nuts, sharp edges and corners before prime coat is dry.

Part 3 EXECUTION

3.1 GENERAL

- .1 Structural steel work: in accordance with CSA S16.
- .2 Welding: in accordance with CSA W59.
- .3 Companies to be certified under Division 01 or 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding of structural components.

3.2 CONNECTION TO EXISTING WORK

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

3.3 MARKING

- .1 Mark materials in accordance with CSA G40.20/G40.21. Do not use die stamping. If steel is to be left in unpainted condition, place marking at locations not visible from exterior after erection.
 - .2 Match marking: shop mark bearing assemblies and splices for fit and match.
-

3.4 ERECTION

- .1 Erect structural steel, as indicated and in accordance with CSA S16 and in accordance with reviewed erection drawings.
- .2 Field cutting or altering structural members: to approval of Departmental Representative.
- .3 Clean with mechanical brush and touch up shop primer to bolts, rivets, welds and burned or scratched surfaces at completion of erection.
- .4 Continuously seal members by continuous welds where indicated. Grind smooth.

3.5 FIELD QUALITY CONTROL

- .1 Inspection and testing of materials and workmanship will be carried out by testing laboratory designated by Departmental Representative.
- .2 Provide safe access and working areas for testing on site, as required by testing agency and as authorized by Departmental Representative.
- .3 Submit test reports to Departmental Representative within 2 weeks of completion of inspection.
- .4 Test shear studs in accordance with CSA W59.

END OF SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 09 21 16 – Gypsum Board Assemblies.

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - .2 ASTM A123/A123M-13, Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
 - .3 ASTM A307-14, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
- .2 CSA International
 - .1 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CSA S16-14, Design of Steel Structures.
 - .3 CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).
 - .4 CSA W59-13, Welded Steel Construction (Metal Arc Welding) Metric.
- .3 Environmental Choice Program
 - .1 CCD-047-98(R2005), Architectural Surface Coatings.
- .4 Green Seal Environmental Standards (GS)
 - .1 GS-11-2008, 2nd Edition, Paints and Coatings.
- .5 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .6 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - current edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
 - .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 MSDS.
 - .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 Ontario, Canada.
 - .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 AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Steel sections and plates: to CSA G40.20/ G40.21, Grade 350W and 300W respectively, minimum 30% recycled content.
- .2 Steel pipe: to ASTM A53/A53M double extra strong, black finish, minimum 30% recycled content.
- .3 Steel sheet: to CSA G40.20/G40.21, Grade 300W.
- .4 Welding materials: to CSA W59.
- .5 Welding electrodes: to CSA W48 Series.
- .6 Bolts and anchor bolts: to ASTM A307.
- .7 Grout: non-shrink, non-metallic, flowable, 15 MPa at 24 hours.

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 round 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 600 g/m², Coating Grade 85, to ASTM A123/A123M.
- .2 Shop coat primer: in accordance with chemical component limits and restrictions requirements and VOC limits of CCD-047a.
- .3 Zinc primer: zinc rich, ready mix in accordance with chemical component limits and restrictions requirements and VOC limits of CCD-047a.

2.4 SHOP PAINTING

- .1 Primer: VOC limit 250 g/L maximum to GS-11.
- .2 Apply one shop coat of primer to metal items, with exception of 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.

2.5 STEEL SHEET

- .1 Shop fabricate steel sheets to fit around existing room perimeter, door and frames, and power/communications openings.
- .2 Anchor to existing wall construction using screws.
- .3 Screw steel sheet 300 mm on centre, 600 mm on centre in field with a minimum of 16 screws per sheet. Screws to be flush with surface.

2.6 ANGLE LINTELS

- .1 Steel angles: galvanized or prime painted, sizes indicated for openings. Provide 200 mm minimum bearing at ends.
- .2 Weld or bolt back-to-back angles to profiles as indicated.
- .3 Finish: shop painted.
 - .1 Primer: VOC limit 250 g/L maximum to GS-11 when applied onsite.

Part 3 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.

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 Make field connections with bolts to CSA S16 or 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 GS-11.
- .9 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.
 - .1 Primer: maximum VOC limit 250 g/L to GS-11.

3.3 LATERAL SUPPORT ANGLES FOR MASONRY PARTITIONS

- .1 Supply masonry section with steel angles to provide lateral support of masonry partitions where they abutt the underside of deck.
- .2 Apply alkyd primer.

3.4 CORNER GUARDS

- .1 Install corner guards in locations as indicated.

3.5 CHANNEL FRAMES

- .1 Install steel channel frames to openings as indicated.

3.6 CLEANING

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

- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.7 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by metal fabrications installation.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
 - .2 CSA O141-05(R2014), Softwood Lumber.
 - .3 CAN/CSA-Z809-08 (R2013), Sustainable Forest Management.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 National Lumber Grades Authority (NLGA)
 - .1 Standard Grading Rules for Canadian Lumber December 2010.

1.2 SUBMITTALS

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

1.3 QUALITY ASSURANCE

- .1 Lumber identification: by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.
- .2 Plywood identification: by grade mark in accordance with applicable CSA standards.
- .3 Plywood, OSB and wood based composite panel construction sheathing identification: by grademark in accordance with applicable CSA standards.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 LUMBER MATERIAL

- .1 Lumber: unless specified otherwise, softwood, S4S, S-DRY Lumber graded and stamped in accordance with following standards:
 - .1 CSA-O141.
 - .2 NLGA Standard Grading Rules for Canadian Lumber.
 - .3 CAN/CSA-Z809.
 - .2 Furring, blocking, nailing strips, grounds, rough bucks, cants, curbs, fascia backing and sleepers: to NLGA 113d. and 121c., S4S.
 - .1 S2S is acceptable for all.
 - .2 Board sizes: "Standard" or better grade.
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- .3 Dimension sizes: "Standard" light framing or better grade.
- .4 Post and timbers sizes: "Standard" or better grade.

2.2 ACCESSORIES

- .1 Nails, spikes and staples: to CSA B111.
- .2 Bolts: 12.5 mm diameter unless indicated otherwise, complete with nuts and washers.
- .3 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, explosive actuated fastening devices, recommended for purpose by manufacturer.

2.3 FINISHES

- .1 Hot-dip galvanized connectors and fasteners to CAN/CSA-G164 minimum 610g/m² coating for:
 - .1 Exterior work (outside of building vapour barrier).
 - .2 Interior highly humid (55% RH or higher) areas.
 - .3 Pressure-preservative treated wood.
- .2 Stainless Steel: use Type 304 stainless steel fasteners for Fire-retardant treated wood.

Part 3 EXECUTION

3.1 PREPARATION

- .1 Treat surfaces of material with wood preservative, before installation.
- .2 Apply preservative by dipping, or by brush to completely saturate and maintain wet film on surface for minimum 3 minute soak on lumber and one minute soak on plywood.
- .3 Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of preservative before installation.
- .4 Treat material as follows:
 - .1 Wood cants, fascia backing, curbs, nailers, sleepers on roof deck.

3.2 INSTALLATION

- .1 Comply with requirements of NBC, Division B, supplemented by the following paragraphs.
- .2 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, facings, fascia, soffit, siding and other work as required.
- .3 Align and plumb faces of furring and blocking to tolerance of 1:600.
- .4 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.
- .5 Install wood cants, fascia backing, nailers, curbs and other wood supports as required and secure using galvanized steel fasteners.
- .6 Install wood backing, dressed, tapered and recessed slightly below top surface of roof insulation for roof hopper.

- .7 Install sleepers as indicated.
- .8 Use caution when working with particle board. Use dust collectors and high quality respirator masks.

3.3 ERECTION

- .1 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.
- .2 Countersink bolts where necessary to provide clearance for other work.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section includes requirements for incidental roofing repairs required as a part of creating new roof openings and installing new roof mounted equipment.
- .2 Drawings contain details that suggest directions for general configuration of roofing and flashing components; these details can be developed further by the Roofing Subcontractor provided that the final installation provides a weather tight installation and maintains relationships with other building elements.
- .3 Existing fully adhered roofing system is comprised of the following:
 - .1 Membrane Protection or Ballast
 - .2 Membrane Underlay or Secondary Insulation
 - .3 Primary Insulation
 - .4 Air and Vapour Membrane
 - .5 Structural Roof Deck

1.2 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A653/A653M-13, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ASTM C1396/C1396M - 14a - Standard Specification for Gypsum Board
- .2 Canadian Standards Association (CSA):
 - .1 CSA A231.1-14/A231.2-14 - Precast concrete paving slabs/Precast concrete pavers
 - .2 CSA O141-05 (2014) – Softwood Lumber
 - .3 CSA-O325-07 (R2012) – Construction Sheathing
 - .4 CSA B35.3-1962 - Tapping and Drive Screws (Slotted and Recessed Head, Thread Forming and Thread Cutting Screws, and Metallic Drive Screws)

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Construction Meetings: Meet on site at the location of required penetrations and repairs in accordance with Section 01 31 19 – Project Meetings before ordering materials to review existing conditions affecting work of this Section, determine membrane and flashing types, patching and repair procedures and protection of interior components from water infiltration and weather, attended by the following:
 - .1 Departmental Representative.
 - .2 Contractor.
 - .3 Roofing Subcontractor.
 - .4 Owner’s Representative.
- .2 Sequencing: Install roofing repair materials to coincide with removal of existing roofing system; remove existing roofing in size and quantity that can be completely repaired in the same day including installation of base flashings.

- .3 Scheduling: Schedule roofing repairs when installation of rooftop mechanical equipment and other construction requiring roof penetrations is substantially complete.

1.4 SITE CONDITIONS

- .1 Existing Conditions: Protect openings using tarps, dams and diversion materials to prevent water or snow from entering interior of building.
- .2 Ambient Conditions: Install materials during dry weather and temperatures are within manufacturer's written minimum and maximum application range.

Part 2 Products

2.1 MATERIALS

- .1 Carpentry Materials:
 - .1 Lumber: Light Framing Grade in accordance with CAN/CSA O141 and NLGA Rules; sizes as indicated on drawings and meeting the following requirements:
 - .1 Maximum Moisture Content at Time of Installation; 8%.
 - .2 Consisting of Species Group D (SPF): Construction Grade or better.
 - .2 Sheathing: Plywood or OSB panels in accordance with CSA O325, Sheathing Grade; thickness as indicated on drawings.
- .2 Auxiliary Levelling Surface: Treated gypsum core, moisture resistant paper faced roof sheathing material, suitable for normal humidity buildings, and as follows:
 - .1 Applicable Standard: ASTM C1396/C1396M for manufacturing.
 - .2 Thickness: To match existing.
 - .3 Long Edges: Square.
 - .4 Location: Roof substrates over steel decks only.
- .3 Screw Fasteners: #14 Phillips pre-assembled mechanical fasteners fabricated from case hardened carbon steel with a rust preventive coating; 50 mm diameter, barbed stress plates that meet requirements of CSA B35.3 and as follows:
 - .1 Fasteners will not be permitted in areas where acoustic steel deck is exposed in final interior construction; use insulation adhesive to prevent damage to finished surfaces.
 - .2 Space screws and stress plates one per 0.25 m², penetrating a minimum of 38 mm into top of flutes for corrosion and wind lift factors.
- .4 Roofing Nails: Spiral nails having 25 mm Ø steel round top cap 25 mm Ø and 3 mm Ø shank in accordance with membrane manufacturer's recommendations, length to penetrate solid wood supports by a minimum of 38 mm and plywood substrates by a minimum of 19 mm.
- .5 Primer: Primer comprised of elastomeric bitumen and solvents, and adhesive enhancing resins as recommended by membrane roofing manufacturer to suit substrates and installation conditions.
- .6 Membrane Vapour Retarder: Premanufactured self adhering air/vapour barrier membrane composed of bitumen modified with thermoplastic polymers and high density polyethylene film; 1140 mm width to allow membrane to span top flute of structural steel deck.

- .7 Insulation:
 - .1 Primary Flat Insulation: Rigid board roof insulation to match existing materials; thickness to match existing.
 - .2 Sloped Insulation: Moulded expanded polystyrene (MEPS) rigid board roof insulation consisting of largest panels practical, having square edges, sloped to a minimum 2% perpendicular from edge of new curbs; size as required to redirect water around new roof openings or equipment curbs.
- .8 Roofing Membrane: Compatible with existing membrane system.
- .9 Flashings: Zinc galvanized sheet steel; tension levelled, Commercial Steel (CS) designation, Type A, Grade 230 in accordance with ASTM A653/A653M and as follows:
 - .1 Thickness: Minimum 0.45 mm base metal thickness.
 - .2 Galvanizing Designation: Z275 applied evenly to both sides.
 - .3 Surface Texture: Smooth.
 - .4 Finish: Prefinished colour selected from manufacturer's standard range using Silicone Modified Polyester.
- .10 Premanufactured Pipe Supports: Premanufactured pipe supports fabricated from 100% recycled rubber, with 2.7 mm thickness galvanized steel frame, 150 mm wide x 100 mm tall x length to suit installation; including fasteners, bridge components, and angled supports as required for a complete installation and having the following accessories:
 - .1 Pipe and Conduit Support: Galvanized pipe clamp sized to suit gas pipe in accordance with manufacturers instruction's.
 - .2 Multi-Pipe and Conduit Support: Galvanized pipe support system size and number to suit pipes being supported in accordance with manufacturer's instructions.
 - .3 Extendable Height Support: Galvanized steel pipe extensions to suit installation in accordance with manufacturer's instructions.

2.2 ACCESSORIES

- .1 Provide materials required for a complete installation including; but not limited to, accessories listed in this Section, and as required to provide a weather tight, leak proof repair.
- .2 Waterproofing Mastic: Mastic comprised of synthetic rubbers, plasticized with bitumen and solvents, and aluminum pigments to provide greater resistance to ultraviolet light degradation.
- .3 Pitch Pocket Filler: Aluminum coloured solvent based mastic containing bitumen modified with SBS synthetic rubber and fibres, specifically intended for pitch pocket fill.
- .4 Equipment Skid: Non-penetrating equipment mount nominal 1200 mm x 1200 mm, prefabricated galvanized steel frame finished with polyester powder coating; minimum 3 mm thick neoprene pad to protect roof membrane; ready for installation of standard concrete paving blocks.
- .5 Concrete Paving Blocks: High density hydraulic pressed pavers, 600 mm x 600 mm with weight not exceeding 45 kg per unit, meeting requirements of CSA A231.1.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify that substrates and conditions are in accordance with manufacturer's written recommendations and installation guidelines before starting work of this Section.
- .2 Start of roofing work will be interpreted as meaning roofing conditions are in accordance with manufacturer's requirements.

3.2 PREPARATION

- .1 Building Protection: Provide tarps and hoarding as required to protect existing building finishes and assemblies from work of this Section; clean any spills and repair any damaged materials resulting from work of this Section.
- .2 Penetration Protection: Provide suitable protection during preparation and installation of new roofing penetrations to prevent water or weather from entering interior spaces:
 - .1 Lap protective coverings over existing roofing to prevent water ingress.
 - .2 Secure protective coverings against wind blow-off.
 - .3 Leave protective covering in place for duration of the work.

3.3 ROOFING REPAIRS

- .1 Remove existing roofing and flashing systems to accommodate new roofing penetrations, accessories and flashing systems:
 - .1 Remove existing systems to expose substrates.
 - .2 Clean and prepare surfaces ready for new materials.
- .2 Provide new materials as required to form a complete and continuous roof assembly:
 - .1 Include additional sloped insulation as required to form new crickets around new construction to prevent ponding around new curbed roof openings.
 - .2 Complete work of this Section in accordance with original design intent of existing roofing assembly.
- .3 Restore existing roofing to original condition, remove construction debris and leave area of work in a condition acceptable to the Consultant; remove all traces of splashed or spilled materials.
- .4 Restore existing roofing flashings to original condition, matching colour and profile where repairs are observable from grade or from other parts of the building.

3.4 SITE QUALITY CONTROL

- .1 Inspection and testing of roofing application may be carried out by testing laboratory designated by Owner in cooperation with the Consultant.
- .2 Inspection fees will be paid by the Owner directly in accordance with Section 01 45 00 – Quality Control.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 04 22 00 - Concrete Unit Masonry.
- .2 Section 07 26 00 - Vapor Retarders.

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM C591-13, Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
- .2 Canadian Standards Association (CSA).
 - .1 CAN/CSA B149.1-15, Natural Gas and Propane Installation Code.
 - .2 CAN/CSA B149.2-15 - Propane Storage and Handling Code
- .3 Underwriters Laboratories of Canada (ULC).
 - .1 CAN/ULC-S604-2012, Standard for Factory-Built Type A Chimneys.
 - .2 CAN/ULC S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00.
 - .2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets. Indicate VOC's insulation products and adhesives.
- .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 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements. Comply with Section 01 31 19.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
 - .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 for recycling in accordance with Waste Management Plan.

Part 2 PRODUCTS

2.1 INSULATION

- .1 Rigid Cellular Polyisocyanurate:
 - .1 Unfaced: to ASTM C591.
 - .1 Type: 1 to match existing.
 - .2 Thickness: as indicated on Drawings and to achieve required R-value.
 - .3 Size: Manufacturers standard sizes.
 - .2 Sloped Insulation: Moulded expanded polystyrene (MEPS) rigid board roof insulation consisting of largest panels practical, having square edges minimum LTTR RSI 0.73/25 mm, total thickness as indicated on Drawings, sloped to a minimum 2% perpendicular from edge of roof to a minimum thickness of 25 mm; conforming to ULC S701, Type II, to a tolerance not exceeding 3 mm from nominal size in any dimension:

2.2 ACCESSORIES

- .1 Insulation clips: 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.

Part 3 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 WORKMANSHIP

- .1 Install insulation after building substrate materials are dry.
 - .2 Install insulation to maintain continuity of thermal protection to building elements and spaces.
 - .3 Fit insulation tight around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows and other protrusions.
 - .4 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures, and minimum 50 mm from sidewalls of CAN/ULC-S604 and CAN/CSA B149.1 and CAN/CSA B149.2 type B and L vents.
 - .5 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.
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- .6 Offset both vertical and horizontal joints in multiple layer applications.
- .7 Do not enclose insulation until it has been inspected and approved by Departmental Representative.

3.3 EXAMINATION

- .1 Examine substrates and immediately inform Departmental Representative in writing of defects.
- .2 Prior to commencement of work ensure:
 - .1 Substrates are firm, straight, smooth, dry, free of snow, ice or frost, and clean of dust and debris.

3.4 RIGID INSULATION INSTALLATION

- .1 Apply specified adhesive to polystyrene insulation board and substrate in accordance with manufacturer's recommendations.
- .2 Imbed insulation boards into vapour barrier type adhesive, applied as specified, prior to skinning of adhesive.
- .3 Leave insulation board joints unbonded over line of expansion and control joints. Bond a continuous 150 mm wide strip of modified bituminous membrane over expansion and control joints using compatible adhesive and primer before application of insulation.

3.5 CLEANING

- .1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet, for Use in Building Construction.
- .2 Canadian Standards Association (CSA)
 - .1 CAN/CSA-ISO 9001:08(R2014), Quality management systems -- Requirements.
 - .2 CAN/CSA-ISO 14001-04(R2014), Environmental management systems - Requirements with guidance for use.

1.2 SUBMITTALS

- .1 Submit proof of manufacturer's CCMC Listing and listing number to Departmental Representative.
- .2 Submit proof of manufacturer's ISO 9002 registration and compliance to Departmental Representative.
- .3 Submit proof of manufacturer's ISO 14001 registration and compliance to Departmental Representative.
- .4 Submit proof of manufacturer's participation certificate for Environmental Choice Program to Departmental Representative.
- .5 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence, cleaning procedures.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00.
- .2 Submit WHMIS MSDS - Material Safety Data Sheets.
- .3 Submit product data sheets for sheet vapour retarders. Include:
 - .1 Product characteristics.
 - .2 Performance criteria.
 - .3 Limitations.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20, and with the Waste Reduction Workplan.
 - .2 Use the least toxic sealants and adhesives necessary to comply with requirements of this section.
 - .3 Close and seal, tightly, all partly used sealant and adhesive containers and store protected in well ventilated, fire-safe area at moderate temperature.
 - .4 Place used hazardous sealant tubes and adhesive containers in areas designated for hazardous materials.
-

- .5 Collect, package and store polyethylene cut offs and waste material for recycling in accordance with Waste Management Plan.

Part 2 PRODUCTS

2.1 SHEET VAPOUR BARRIER

- .1 Polyethylene film: to CAN/CGSB-51.34, 0.15 mm thick EcoLogo certified containing minimum 50% recycled content.

2.2 ACCESSORIES

- .1 Joint sealing tape: air resistant pressure sensitive adhesive tape, type recommended by vapour barrier manufacturer, 50 mm wide for lap joints and perimeter seals, 25 mm wide elsewhere.
- .2 Sealant: EcoLogo certified, containing a minimum of 25% recycled content, not to contain total of volatile organic compounds in excess of 5% by weight, asbestos-free sealant, compatible with vapour retarder materials, recommended by vapour retarder manufacturer.
- .3 Staples: minimum 6 mm leg.
- .4 Moulded box vapour barrier: factory-moulded polyethylene box for use with recessed electric switch and outlet device boxes.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Ensure services are installed and inspected prior to installation of retarder.
- .2 Install sheet vapour retarder on warm side of exterior wall assemblies prior to installation of gypsum board to form continuous retarder.
- .3 Use sheets of largest practical size to minimize joints.
- .4 Inspect for continuity. Repair punctures and tears with sealing tape before work is concealed.

3.2 EXTERIOR SURFACE OPENINGS

- .1 Cut sheet vapour retarder to form openings and ensure material is lapped and sealed to frame.

3.3 PERIMETER SEALS

- .1 Seal perimeter of sheet vapour barrier as follows:
 - .1 Apply continuous bead of sealant to substrate at perimeter of sheets.
 - .2 Lap sheet over sealant and press into sealant bead.
 - .3 Install staples through lapped sheets at sealant bead into wood substrate.
 - .4 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

3.4 LAP JOINT SEALS

- .1 Seal lap joints of sheet vapour barrier as follows:
 - .1 Attach first sheet to substrate.
 - .2 Apply continuous bead of sealant over solid backing at joint.
 - .3 Lap adjoining sheet minimum 150 mm and press into sealant bead.
 - .4 Install staples through lapped sheets at sealant bead into wood substrate.
 - .5 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 The Aluminum Association Inc. (AAI)
 - .1 AAI-Aluminum Sheet Metal Work in Building Construction-2002.
 - .2 AAI DAF 45-03(R2009), Designation System for Aluminum Finishes.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A653/A653M-13, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ASTM A792/A792M-10, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 - .3 ASTM B32-08(2014), Standard Specification for Solder Metal.
 - .4 ASTM D523-14, Standard Test Method for Specular Gloss.
 - .5 ASTM D822/D822M-13, Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
- .3 Canadian Roofing Contractors Association (CRCA)
 - .1 Roofing Specifications Manual 2012.
- .4 Canadian Standards Association (CSA International)
 - .1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .6 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule #1168-05, Adhesives and Sealants.

1.2 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .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 MSDS - Material Safety Data Sheets.
- .3 Shop Drawings:
 - .1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .4 Samples:
 - .1 Submit duplicate 50 x 50 mm samples of each type of sheet metal material, finishes and colours.

- .5 Quality assurance submittals: submit following in accordance with Section 01 45 00.
 - .1 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.
 - .2 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.

1.3 QUALITY ASSURANCE

- .1 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section and on-site installation, with contractor's representative and Departmental Representative in accordance with Section 01 32 16 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 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 SHEET METAL MATERIALS

- .1 Zinc coated steel sheet: minimum 0.45 mm thickness, commercial quality to ASTM A653/A653M, with Z275 designation zinc coating.

2.2 PREFINISHED STEEL SHEET

- .1 Prefinished steel with factory applied silicone modified polyester.
 - .1 Class F1S.
 - .2 Colour selected by Departmental Representative from manufacturer's standard range.
 - .3 Specular gloss: 30 units +/-5 to ASTM D523.
 - .4 Coating thickness: not less than 25 micrometres.
 - .5 Resistance to accelerated weathering for chalk rating of 8, colour fade 5 units or less and erosion rate less than 20% to ASTM D822/D822M as follows:
 - .1 Outdoor exposure period 1000 hours.
 - .2 Humidity resistance exposure period 1000 hours.

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: as specified in Section 07 92 00.
- .5 Cleats: of same material, and temper as sheet metal, minimum 50 mm wide. Thickness same as sheet metal being secured.
- .6 Fasteners: of same material as sheet metal, to CSA B111, flat head roofing nails of length and thickness suitable for metal flashing application.
- .7 Washers: of same material as sheet metal, 1 mm thick with rubber packings.
- .8 Solder: to ASTM B32, alloy composition.
- .9 Flux: rosin, cut hydrochloric acid, or commercial preparation suitable for materials to be soldered.
- .10 Touch-up paint: as recommended by prefinished material manufacturer.

2.4 FABRICATION

- .1 Fabricate metal flashings and other sheet metal work as indicated.
- .2 Form pieces in 2400 mm maximum lengths.
 - .1 Make allowance for expansion at joints.
- .3 Hem exposed edges on underside 12 mm.
 - .1 Mitre and seal corners with sealant.
- .4 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .5 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

2.5 METAL FLASHINGS

- .1 Form flashings, copings and fascias to profiles indicated of 0.45 mm thick galvanized prefinished steel.

2.6 REGLETS AND CAP FLASHINGS

- .1 Form surface mounted metal cap flashing of 0.60 mm thick sheet metal for base flashings as detailed in accordance with CRCA FL series details, FL series details.
 - .1 Provide slotted fixing holes and steel/plastic washer fasteners.

2.7 EAVES TROUGHS AND DOWNPIPES

- .1 Form eaves troughs and downpipes from 0.55 mm thick, galvanized prefinished steel sheet metal.
- .2 Sizes and profiles as indicated.
- .3 Provide goosenecks, outlets, strainer baskets and necessary fastenings.
- .4 Form 600 x 600 mm splash pans from 0.55 mm thick galvanized prefinished sheet metal.

- .5 Form scuppers for down pipes.

2.8 SCUPPERS

- .1 Form scuppers from 0.55 mm thick galvanized prefinished sheet metal.
- .2 Sizes and profiles as indicated on Drawings.
- .3 Provide necessary fastenings.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install sheet metal work in accordance with CRCA FL series details, AAI-Aluminum Sheet Metal Work in Building Construction and as detailed.
- .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 standing seams forming tight fit over hook strips, as detailed.
- .5 Lock end joints and caulk with sealant.
- .6 Turn top edge of flashing into recessed reglet or mortar joint minimum of 25 mm. Lead wedge flashing securely into joint.
- .7 Caulk flashing at cap flashing with sealant.

3.3 EAVES TROUGHS AND DOWNPIPES

- .1 Install eaves troughs and secure to building at 750 mm on centre with eaves trough spikes through spacer ferrules.
 - .1 Slope eaves troughs to downpipes as recommended by manufacturer.
 - .2 Solder and Seal joints watertight.
- .2 Install downpipes and provide goosenecks back to wall.
 - .1 Secure downpipes to wall with straps at 1800 mm on centre; minimum two straps per downpipe.
 - .2 Connect downpipes to drainage system and seal joint with plastic cement.
- .3 Install splash pans as indicated.

3.4 SCUPPERS

- .1 Install scuppers as indicated.

3.5 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.

3.6 CLEANING

- .1 Proceed in accordance with Section 01 74 11.
- .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, finger marks and stains.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC-S101-14, Standard Methods of for Fire Endurance Tests of Building Construction and Materials.
 - .2 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
 - .3 CAN/ULC-S115-11, Standard Method of Fire Tests of Firestop Systems.

1.2 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 Continuity of Fire Separations: NBC 2010, Division B, Parts 3.1.8 and 3.1.9.1, 9.10.9:
 - .1 Wall, partition or floor assemblies required to be a fire separation shall be: constructed as a continuous element; have a fire resistance rating; have openings protected by a closure; and have penetrations sealed by a firestop.

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .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 MSDS - Material Safety Data Sheets.
- .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 Samples:
 - .1 Submit duplicate 300 x 300 mm samples showing actual fire stop material proposed for project.
- .5 Quality assurance submittals: submit following in accordance with Section 01 45 00.
 - .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.

1.4 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: company specializing in fire stopping installations with 5 years documented experience and approved by manufacturer.
 - .2 All fire stopping material shall be from one manufacturer.
 - .3 All fire stopping installation work for entire project shall be by a single contractor experienced in firestopping. Individual disciplines shall NOT fire stop their own work.
- .2 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section, with contractor's representative and Departmental Representative in accordance with Section 01 32 16 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.
- .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.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with Section 01 61 00.

- .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 indoors, 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 reuse and recycling in accordance with Section 01 74 20.

Part 2 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: F.
- .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.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 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 Metal deck bonding: fire stopping to precede spray applied fireproofing to ensure required bonding.
- .4 Mechanical pipe insulation: certified fire stop system component.
 - .1 Ensure pipe insulation installation precedes fire stopping.

3.5 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.

3.6 CLEANING

- .1 Proceed in accordance with Section 01 74 11.
- .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.

3.7 SCHEDULE

- .1 Fire stop and smoke seal at:
 - .1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.
 - .2 Top of fire-resistance rated masonry and gypsum board partitions.
 - .3 Intersection of fire-resistance rated masonry and gypsum board partitions.
 - .4 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.
 - .5 Penetrations through fire-resistance rated floor slabs, ceilings and roofs.
 - .6 Openings and sleeves installed for future use through fire separations.
 - .7 Around mechanical and electrical assemblies penetrating fire separations.
 - .8 Rigid ducts: greater than 129 cm²: 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

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 Materials, preparation and application for caulking and sealants.

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM C834-14, Standard Specification for Latex Sealants
 - .2 ASTM C919-12, Standard Practice for Use of Sealants in Acoustical Applications.
 - .3 ASTM C920-14a, Standard Specification for Elastomeric Joint Sealants.
- .2 Canadian General Standards Board (CGSB)
 - .1 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 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .5 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.
- .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.
- .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.
 - .1 Instructions to include installation instructions for each product used.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, handle, store and protect materials in accordance with Section 01 61 00.
- .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.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.
- .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 Place materials defined as hazardous or toxic in designated containers.
- .5 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.
- .6 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.
- .7 Divert unused joint sealing material from landfill to official hazardous material collections site approved by Departmental Representative.
- .8 Empty plastic joint sealer containers are not recyclable. Do not dispose of empty containers with plastic materials destined for recycling.
- .9 Fold up metal banding, flatten, and place in designated area for recycling.

1.6 PROJECT 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°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.

1.7 ENVIRONMENTAL REQUIREMENTS

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of Material Safety Data Sheets (MSDS) acceptable to Labour Canada.
- .2 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.
- .3 Ventilate area of work as directed by Departmental Representative by use of approved portable supply and exhaust fans.

Part 2 PRODUCTS

2.1 SEALANT MATERIALS

- .1 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.
 - .1 When low toxicity caulks are not available for an application, confine usage to areas which offgas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize offgas time.
 - .2 Where sealants are qualified with primers use only these primers.

2.2 SEALANT MATERIAL DESIGNATIONS

- .1 Urethanes Two Part.
 - .1 Self-Leveling to ASTM C920, Type M, Grade P, Class 5.
- .2 Urethanes Two Part.
 - .1 Non-Sag to ASTM C920, Type S, Grade NS, Class 25 CAN/CGSB-19.24, Type 2, Class B.
- .3 Urethanes One Part.
 - .1 Non-Sag to ASTM C920, Type S, Grade NS, Class 25.
- .4 Silicones One Part.
 - .1 Silicone based, Shore A Hardness 15-25, conforming to ASTM C920, Type S, Grade NS, Class 25, SWRI validated.
 - .2 Mildew resistant.
- .5 Acrylic Latex One Part.
 - .1 To ASTM C834.
- .6 Acoustical Sealant: one part silicone.
 - .1 To ASTM C919, primerless, Type S, Grade NS, Class 25, SWRI validated.
- .7 Preformed Compressible and Non-Compressible back-up materials.
 - .1 Polyethylene, Urethane, Neoprene or Vinyl Foam.
 - .1 Extruded open or closed cell foam backer rod.
 - .2 Size: oversize 30 to 50%.
 - .2 Neoprene or Butyl Rubber.
 - .1 Round solid rod, Shore A hardness 70.
 - .3 High Density Foam.
 - .1 Extruded closed cell polyvinyl chloride (PVC), extruded polyethylene, closed cell, Shore A hardness 20, tensile strength 140 to 200 kPa, extruded polyolefin foam, 32 kg/m³ density, or neoprene foam backer, size as recommended by manufacturer.
 - .4 Bond Breaker Tape.
 - .1 Polyethylene bond breaker tape which will not bond to sealant.

2.3 SEALANT SELECTION

- .1 Perimeters of exterior openings where frames meet exterior facade of building (i.e. brick, block, siding): Sealant Type: 2.1, as described in Paragraph 2.2.4 above.
- .2 Expansion and control joints in exterior surfaces of poured-in-place concrete walls: Sealant Type: 7.1, as described in Paragraph 2.2.4 above.
- .3 Seal interior perimeters of exterior openings as detailed on drawings: Sealant Type: 6.1, as described in Paragraph 2.2.4 above.
- .4 Control and expansion joints on the interior of exterior surfaces of unit masonry walls: Sealant Type: 4.1, as described in Paragraph 2.2.4.1 above.
- .5 Perimeters of interior frames, as detailed and itemized: Sealant Type: 4.1, as described in Paragraph 2.2.4.1 above.
- .6 Interior masonry vertical control joints (block-to-block, block-to-concrete, and intersecting masonry walls): Sealant type: 2.1, as described in Paragraph 2.2.4 above.
- .7 Perimeter of bath fixtures (e.g. sinks, tubs, urinals, stools, water closets, basins, vanities): Sealant Type: 4.2, as described in Paragraph 2.2.4 above.
- .8 Interior control and expansion joints in floor surfaces: Sealant Type: 1.1, as described in Paragraph 2.2.1.1 above.
- .9 Exposed interior control joints in drywall: Sealant Type: 3.1, 6.1, as described in Paragraphs 2.2.4 above.
- .10 Other interior surfaces where little or no movement can occur: Sealant Type: 5.1, as described in Paragraph 2.2.4 above.

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.

Part 3 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.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A653/A653M-13, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ASTM E330/E330M-14, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
- .2 Canadian General Standards Board (CGSB):
 - .1 CGSB 41-GP-19MA, Rigid Vinyl Extrusions for Windows and Doors.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CSA W59-13, Welded Steel Construction (Metal Arc Welding).
- .4 Canadian Steel Door Manufacturers' Association (CSDMA)
 - .1 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames, 2006.
 - .2 CSDMA, Selection and Usage Guide for Commercial Steel Door and Frame Products, 2009.
- .5 National Fire Protection Association (NFPA)
 - .1 NFPA 80-13, Standard for Fire Doors and Other Opening Protectives.
- .6 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.
- .7 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S104-10, Standard Method for Fire Tests of Door Assemblies.
 - .2 CAN/ULC-S105-09, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN/ULC-S104.
 - .3 CAN/ULC-S702-14, Thermal Insulation, Mineral Fibre, for Buildings.
 - .4 CAN/ULC-S704-11, Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

1.2 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 Design exterior frame assembly to accommodate to expansion and contraction when subjected to minimum and maximum surface temperature of -35°C to 35°C.

- .2 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN/ULC-S104 for ratings specified or indicated.
- .3 Provide fire labelled frames for openings requiring fire protection ratings. Test products in conformance with CAN/ULC-S104 and listed by nationally recognized agency having factory inspection services.

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Provide product data: in accordance with Section 01 33 00.
- .3 Provide shop drawings: in accordance with Section 01 33 00.
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, glazing, louvres, arrangement of hardware, fire rating and finishes.
 - .3 Indicate each type frame material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings and reinforcing, fire rating and finishes.
 - .4 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.
- .4 Provide samples in accordance with Section 01 33 00.
- .5 Submit one 300 x 300 mm corner sample of each type of frame.
 - .1 Show butt cutout, glazing stops, 300 mm long removable mullion connection, snap-on trim with clips.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Hot dipped galvanized steel sheet: to ASTM A653/A653M, ZF75, minimum base steel thickness in accordance with CSDMA Table 1 - Thickness for Component Parts, minimum 30% recycled content.
 - .2 Reinforcement channel: to CSA G40.20/G40.21, Type 44W, coating designation to ASTM A653/A653M, ZF75, minimum 30% recycled content.
-

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: face sheets welded, honeycomb, uninsulated and insulated core.
 - .1 Mineral Fibre: to CAN/ULC-S702, semi-rigid Type 1, density 24 kg/m³.
 - .2 Polyurethane: to CAN/ULC-S704 rigid, modified poly/isocyanurate, closed cell board. Density 32 kg/m³.
- .3 Fire rated doors: Core to be tested as part of a complete door assembly, in accordance with CAN/ULC-S104 covering Standard Method of Tests of Door Assemblies and listed by nationally recognized testing agency having factory inspection service.

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 Polystyrene and polyurethane cores: heat resistant, epoxy resin based, low viscosity, contact cement.
- .3 Lock-seam doors: fire resistant, resin reinforced polychloroprene, high viscosity, sealant/adhesive.

2.4 PRIMER

- .1 Touch-up primer: as recommended by paint manufacturer for metal door and frame.
 - .1 Maximum VOC limit 50 g/L.

2.5 PAINT

- .1 Field paint steel doors and frames in accordance with Section 09 91 99. Protect weatherstrips from paint. Provide final finish free of scratches or other blemishes.
 - .1 Maximum VOC emission level 50 g/L to SCAQMD Rule 1113.

2.6 ACCESSORIES

- .1 Door silencers: single stud rubber/neoprene type.
- .2 Exterior and 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 Door bottom seal: As specified in Section 08 71 00.
- .5 Metallic paste filler: to manufacturer's standard.
- .6 Fire labels: metal rivited.
- .7 Sealant: as specified in Section 07 92 00.
 - .1 Maximum VOC limit 250 g/L to SCAQMD Rule 1168.

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 Exterior frames: 1.2 mm welded thermally broken type construction.
- .4 Interior frames: 1.2 mm welded type construction.
- .5 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.
- .6 Protect mortised cutouts with steel guard boxes.
- .7 Prepare frame for door silencers, 3 for single door, 2 at head for double door.
- .8 Manufacturer's nameplates on frames and screens are not permitted.
- .9 Conceal fastenings except where exposed fastenings are indicated.
- .10 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.
- .11 Insulate exterior frame components with polyurethane insulation.

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.
- .4 Locate anchors for frames in existing openings not more than 150 mm from top and bottom of each jambs and intermediate at 660 mm on centre maximum.

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 Exterior doors: hollow steel construction. Interior doors: honeycomb construction.

- .3 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.
- .4 Doors: manufacturers' proprietary construction, tested and/or engineered as part of a fully operable assembly, including door, frame, gasketing and hardware in accordance with ASTM E330/E330M.
- .5 Blank, reinforce, drill doors and tap for mortised, templated hardware and electronic hardware.
- .6 Factory prepare holes 12.7 mm diameter and larger except mounting and through-bolt holes, on site, at time of hardware installation.
- .7 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.
- .8 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.
- .9 Provide fire labelled doors for those openings requiring fire protection ratings, as scheduled. Test such products in conformance with CAN/ULC-S104 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.

2.11 DOORS: CORE CONSTRUCTION

- .1 Form face sheets for exterior doors from 2.0 mm sheet steel with polyurethane core laminated under pressure to face sheets.
- .2 Form face sheets for interior doors from 1.6 mm sheet steel with honeycomb core (for non-rated doors).

2.12 HOLLOW STEEL CONSTRUCTION

- .1 Form face sheets for exterior doors from 2.0 mm sheet steel.
- .2 Form face sheets for interior doors from 1.6 sheet steel.
- .3 Reinforce doors with vertical stiffeners, securely welded to face sheets at 150 mm on centre maximum.
- .4 Fill voids between stiffeners of exterior doors with polyurethane core.
- .5 Fill voids between stiffeners of interior doors with honeycomb core (for non-rated doors) and temperature rise rated core (for temperature rise rated doors).

2.13 THERMALLY BROKEN DOORS AND FRAMES

- .1 Fabricate thermally broken doors by using insulated core and separating exterior parts from interior parts with continuous interlocking thermal break.
 - .2 Thermal break: rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19Ma.
 - .3 Fabricate thermally broken frames separating exterior parts from interior parts with continuous interlocking thermal break.
 - .4 Apply 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 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. Remove metal spreader.
- .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 and Section 08 71 00 and drawing detail A.03/3.
- .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, top of carpet, noncombustible sill and thresholds: 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

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 08 11 00 – Metal Doors and Frames.
- .2 Section 11 19 12 – Detention Hardware.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA)
 - .1 ANSI/BHMA A156.1-2013, Butts and Hinges.
 - .2 ANSI/BHMA A156.3-2014, Exit Devices.
 - .3 ANSI/BHMA A156.4-2013, Door Controls - Closers.
 - .4 ANSI/BHMA A156.6-2010, Architectural Door Trim.
 - .5 ANSI/BHMA A156.8-2010, Door Controls - Overhead Stops and Holders.
 - .6 ANSI/BHMA A156.10-2011, Power Operated Pedestrian Doors.
 - .7 ANSI/BHMA A156.12-2013, Interconnected Locks.
 - .8 ANSI/BHMA A156.13-2012, Mortise Locks & Latches Series 1000.
 - .9 ANSI/BHMA A156.15-2011, Release Devices - Closer Holder, Electromagnetic and Electromechanical.
 - .10 ANSI/BHMA A156.16-2013, Auxiliary Hardware.
 - .11 ANSI/BHMA A156.17-2014, Self-closing Hinges & Pivots.
 - .12 ANSI/BHMA A156.19-2013, Power Assist and Low Energy Power Operated Doors.
 - .13 ANSI/BHMA A156.20-2012, Strap and Tee Hinges, and Hasps.
- .2 Canadian Steel Door Manufacturers' Association (CSDMA)
 - .1 CSDMA Recommended Dimensional Standards for Commercial Steel Doors and Frames - 2009.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00.
- .2 Operation and Maintenance Data: submit operation and maintenance data for door hardware for incorporation into manual.

1.5 MAINTENANCE MATERIALS SUBMITTALS

- .1 Extra Stock Materials:
 - .1 Supply maintenance materials in accordance with Section 01 78 00.
 - .2 Tools:
 - .1 Supply 2 sets of wrenches for door closers, locksets and fire exit hardware.

1.6 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.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 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.
 - .4 Replace defective or damaged materials with new.
- .5 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 35 20.

- .6 Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 HARDWARE ITEMS

- .1 Use one manufacturer's products only for similar items.

2.2 DOOR HARDWARE

- .1 Locks and latches:
 - .1 Interconnected locks and latches: to ANSI/BHMA A156.12, series 5000 interconnected lock, grade 1, designed for function and keyed as stated in Hardware Schedule.
 - .2 Mortise locks and latches: to ANSI/BHMA A156.13, series 1000 mortise lock, grade 1, designed for function and keyed as directed by Departmental Representative.
 - .3 Lever handles: plain design.
 - .4 Escutcheons: round.
 - .5 Normal strikes: box type, lip projection not beyond jamb.
 - .6 Cylinders: key into keying system as directed.
 - .7 Finished to C26D.
 - .2 Butts and hinges:
 - .1 Butts and hinges: to ANSI/BHMA A156.1.
 - .2 Self-closing hinges and pivots: to ANSI/BHMA A156.17, for used on fire doors.
 - .3 Strap and tee hinges and hasps: to ANSI/BHMA A156.20, finished to 602 (cadmium plated).
 - .3 Exit devices: to ANSI/BHMA A156.3, type 1, grade 1, modern design, finished to C26D.
 - .4 Door Closers and Accessories:
 - .1 Door controls (closers): to ANSI/BHMA A156.4, designated by letter C and numeral identifiers listed in Hardware Schedule, in accordance with ANSI/BHMA A156.4, table A1, finished to C26D.
 - .2 Door controls - overhead holders: to ANSI/BHMA A156.8, designated by letter C and numeral identifiers listed in Hardware Schedule, finished to C26D.
 - .3 Closer/holder release devices: to ANSI/BHMA A156.15, designated by letter C and numeral identifiers listed in hardware schedule, finished to C26D.
 - .5 Door Operators:
 - .1 Power-operated pedestrian doors: to ANSI/BHMA A156.10.
 - .2 Power assist and low energy power operated doors: to ANSI/BHMA A156.19.
 - .3 Provide power-assisted and power-operated fire doors with releasing device that automatically disconnects power operator at time of fire, allowing a self-closing or automatic device to latch door regardless of power failure or manual operation.
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- .6 Architectural door trim: to ANSI/BHMA A156.6, as listed in Hardware Schedule, finish: C26D.
 - .1 Push/Pull units: stainless steel, finish: C26D.
- .7 Door bottom seal: heavy duty, door seal of extruded aluminum frame and solid closed cell neoprene weather seal, recessed in door bottom clear anodized finish.
- .8 Thresholds: to ANSI/BHMA A156.21, full width of door opening, extruded aluminum mill finish, serrated surface, with thermal break of rigid.
- .9 Weatherstripping:
 - .1 Head and jamb seal:
 - .1 Extruded aluminum frame and solid closed cell neoprene insert, clear anodized finish.
 - .2 Adhesive backed neoprene material.
 - .2 Door bottom seal:
 - .1 Extruded aluminum frame and closed cell neoprene sweep, clear anodized finish.
- .10 Astragal: overlapping, extruded aluminum frame with pile insert, finished to match doors.
- .11 Barrier Free Pneumatic Door Operator:
 - .1 Heavy duty pneumatically assisted door closer, capable of multi-door operation, complete with actuators, control boxes, pneumatic tubing and compressed air source.
 - .2 Self contained control box/compressor combination for independent operation of two door leaves.
 - .3 Control boxes: complete with electric strike relay.
 - .4 Mount operators on either push or pull sides of doors as required to place them inside rooms.
 - .5 Electrical box and actuator: Hardwired low voltage actuator with stainless steel 114 mm round plate, engraved blue filled with handicap symbol. Box 51 mm wide x 102 mm high x 50 mm deep single gang electrical box, flush mounted in wall, locations indicated.
 - .6 Supply switched line voltage to control box. Locate switch adjacent to box.
 - .7 Supply low voltage wiring to each actuator and 6 mm diameter air tubing to each operator.
 - .8 Mount control box in location as directed by Departmental Representative.
- .12 Wall type door stop: to ANSI/BHMA-A156.16, type L02011, finish 628, overall projection 89 mm, attached by surface screws.
- .13 Floor door stop: to ANSI/BHMA-A156.16, dome type, cushion secured by concealed fasteners, anti-rotation stud, type L22141 finish 626 for doors without threshold and type L22161, finish 626 for doors with threshold.

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 to be great great grand master keyed as directed, to tie into existing keying system. Prepare detailed keying schedule in conjunction with Departmental Representative.
- .2 Supply keys in duplicate for every lock in this Contract.
- .3 Supply 3 master keys for each master key or grand master key group.
- .4 Stamp keying code numbers on keys and cylinders.
- .5 Supply construction cores.
- .6 Hand over permanent cores and keys to Departmental Representative.

Part 3 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 CSDMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction).
- .5 Where door stop contacts door pulls, mount stop to strike bottom of pull.
- .6 Install key control cabinet.
- .7 Use only manufacturer's supplied fasteners.
 - .1 Use of "quick" type fasteners, unless specifically supplied by manufacturer, is unacceptable.
- .8 Remove construction cores when directed by Departmental Representative.
 - .1 Install permanent cores and ensure locks operate correctly.

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.
 - .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.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 DEMONSTRATION

- .1 Keying System Setup and Cabinet:
 - .1 Set up key control system with file key tags, duplicate key tags, numerical index, alphabetical index and key change index, label shields, control book and key receipt cards.
 - .2 Place file keys and duplicate keys in key cabinet on their respective hooks.
 - .3 Lock key cabinet and turn over key to Departmental Representative.
- .2 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.
- .3 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 SCHEDULE

- .1 Hardware groups as scheduled on Drawings

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM C475/C475M-15, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
 - .2 ASTM C514-04(2014), Standard Specification for Nails for the Application of Gypsum Board
 - .3 ASTM C840-13, Standard Specification for Application and Finishing of Gypsum Board.
 - .4 ASTM C1002-14, 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.
 - .5 ASTM C1047-14a, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
 - .6 ASTM C1396/C1396M-14a, Standard Specification for Gypsum Board.
 - .7 ASTM E90-09, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - .8 ASTM E2638-10, Standard Test Method for Objective Measurement of the Speech Privacy Provided by a Closed Room.
- .2 Association of the Wall and Ceilings Industries International (AWCI)
 - .1 AWCI Levels of Gypsum Board Finish 101a-97.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.34-M86(R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
 - .2 CAN/CGSB-71.25-M88, Adhesive, for Bonding Drywall to Wood Framing and Metal Studs.
- .4 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1113-A2007, Architectural Coatings.
 - .2 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 DESIGN REQUIREMENTS

- .1 Minimum sound transmission rating of installed panel partition to be STC 30, tested to ASTM E90.
- .2 Minimum speech privacy category SPC Standard Speech Privacy 60-65, tested to ASTM E2638.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store gypsum board assemblies materials level, off ground, indoors, 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.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials.

1.5 AMBIENT CONDITIONS

- .1 Maintain temperature 10°C minimum, 21°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.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Standard board: to ASTM C1396/C1396M, minimum 40% recycled content, regular, 15.9 mm thick and fire-rated, 15.9 mm thick, 1200 mm wide x maximum practical length, ends square cut, edges bevelled.
 - .2 Metal furring runners, hangers, tie wires, inserts, anchors, as recommended by gypsum board manufacturer to suit board.
 - .3 Drywall furring channels: 0.5 mm core thickness galvanized steel channels for screw attachment of gypsum board.
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- .4 Resilient drywall furring: 0.5 mm base steel thickness galvanized steel for resilient attachment of gypsum board.
- .5 Nails: to ASTM C514.
- .6 Steel drill screws: to ASTM C1002.
- .7 Stud adhesive: to CAN/CGSB-71.25.
- .8 Steel sheet adhesive: industrial, water based, synthetic rubber based adhesive with the following properties:
 - .1 VOC Content: less than 50g/L
 - .2 Formaldehyde free
- .9 Laminating compound: as recommended by manufacturer, asbestos-free.
- .10 Casing beads, corner beads, control joints and edge trim: to ASTM C1047, aluminum coated, 0.5 mm base thickness, perforated flanges, one piece length per location.
- .11 Sealants: in accordance with Section 07 92 00.
 - .1 VOC limit 250 g/L maximum to SCAQMD Rule 1168.
 - .2 Acoustic sealant: in accordance with Section 07 92 00.
- .12 Polyethylene: to CAN/CGSB-51.34, Type 2.
- .13 Insulating strip: rubberized, moisture resistant, 3 mm thick closed cell neoprene strip, 12 mm wide, with self sticking permanent adhesive on one face, lengths as required.
- .14 Joint compound: to ASTM C475/C475M, asbestos-free.
- .15 Joint tape: to ASTM C475/C475M.
 - .1 Paper tape for standard gypsum board.
 - .2 Glass mesh tape for cement board.

2.2 FINISHES

- .1 Texture finish: asbestos-free standard white texture coating and primer-sealer, recommended by gypsum board manufacturer.
 - .1 Primer: VOC limit 50 g/L maximum to SCAQMD Rule 1113.

Part 3 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 Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.
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3.2 ERECTION

- .1 Do application and finishing of gypsum board to ASTM C840 except where specified otherwise.
- .2 Do application of gypsum sheathing to ASTM C1280.
- .3 Erect hangers and runner channels for suspended gypsum board ceilings to ASTM C840 except where specified otherwise.
- .4 Support light fixtures by providing additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.
- .5 Install work level to tolerance of 1:1200.
- .6 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, grilles.
- .7 Install 19 x 64 mm furring channels parallel to, and at exact locations of steel stud partition header track.
- .8 Furr for gypsum board faced vertical bulkheads within and at termination of ceilings.
- .9 Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.
- .10 Install wall furring for gypsum board wall finishes to ASTM C840, except where specified otherwise.
- .11 Furr openings and around built-in equipment, cabinets, access panels, on four sides. Extend furring into reveals. Check clearances with equipment suppliers.
- .12 Furr duct shafts, beams, columns, pipes and exposed services where indicated.
- .13 Erect drywall resilient furring transversely across studs, spaced maximum 600 mm on centre and not more than 150 mm from ceiling/wall juncture. Secure to each support with 25 mm drywall screw.
- .14 Install 150 mm continuous strip of 12.7 mm gypsum board along base of partitions where resilient furring installed.

3.3 APPLICATION

- .1 Apply gypsum board after bucks, anchors, blocking, sound attenuation, electrical and mechanical work have been approved.
 - .2 Apply single layer gypsum board to wood furring or framing using screw fasteners. Maximum spacing of screws 300 mm on centre.
 - .1 Single-Layer Application:
 - .1 Apply gypsum board on ceilings prior to application of walls to ASTM C840.
 - .2 Apply gypsum board vertically or horizontally, providing sheet lengths that will minimize end joints.
 - .3 Apply single layer gypsum board to concrete block surfaces, where indicated, using laminating adhesive.
 - .1 Comply with gypsum board manufacturer's recommendations.
 - .2 Brace or fasten gypsum board until fastening adhesive has set.
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- .3 Mechanically fasten gypsum board at top and bottom of each sheet.
- .4 Apply single layer gypsum board to steel sheet surfaces, where indicated, using laminating adhesive.
 - .1 Comply with adhesive manufacturer's recommendations.
 - .2 Cover the entire back of the face ply with laminating adhesive using a notched spreader, box spreader, or other suitable tool.
 - .3 Attach gypsum board using moderate pressure and promptly remove any adhesive squeezed out at the joints.
- .5 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, ducts, in partitions where perimeter sealed with acoustic sealant.
- .6 Apply board using stud adhesive on furring or framing.
- .7 Install ceiling boards in direction that will minimize number of end-butt joints. Stagger end joints at least 250 mm.
- .8 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.
- .9 Install gypsum board with face side out.
- .10 Do not install damaged or damp boards.
- .11 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 Provide continuous polyethylene dust barrier behind and across control joints.
 - .7 Locate control joints where indicated; 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.
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- .10 Install expansion joint straight and true.
 - .11 Install cornice cap where gypsum board partitions do not extend to ceiling.
 - .12 Fit cornice cap over partition, secure to partition track with two rows of sheet metal screws staggered at 300 mm on centre.
 - .13 Splice corners and intersections together and secure to each member with 3 screws.
 - .14 Install access doors to electrical and mechanical fixtures specified in respective sections.
 - .1 Rigidly secure frames to furring or framing systems.
 - .15 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.
 - .16 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 Level 1: embed tape for joints and interior angles in joint compound. Surfaces to be free of excess joint compound; tool marks and ridges are acceptable.
 - .2 Level 2: embed tape for joints and interior angles in joint compound and apply one separate coat of joint compound over joints, angles, fastener heads and accessories; surfaces free of excess joint compound; tool marks and ridges are acceptable.
 - .3 Level 4: embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; surfaces smooth and free of tool marks and ridges.
 - .4 Level 5: embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; apply a thin skim coat of joint compound to entire surface; surfaces smooth and free of tool marks and ridges.
 - .17 Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.
 - .18 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.
 - .19 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.
 - .20 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.
 - .21 Apply one coat of white primer sealer over surface to be textured. When dry apply textured finish in accordance with manufacturer's instructions.
 - .22 Mix joint compound slightly thinner than for joint taping.
 - .23 Apply thin coat to entire surface using trowel or drywall broad knife to fill surface texture differences, variations or tool marks.
 - .24 Allow skim coat to dry completely.
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- .25 Remove ridges by light sanding or wiping with damp cloth.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .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.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 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

Part 1 GENERAL

1.1 REFERENCES

- .1 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1113-A2013, Architectural Coatings.
 - .2 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for base, adhesive and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit 2 copies of WHMIS MSDS.
- .3 Samples:
 - .1 Submit for review and acceptance of each unit.
 - .2 Samples will be returned for inclusion into work.
 - .3 Submit 300 mm long base.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00.
- .2 Operation and Maintenance Data: submit operation and maintenance data for base for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect base from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials as specified in Waste Reduction Workplan in accordance with Section 01 74 20.

1.5 SITE CONDITIONS

- .1 Ensure high ventilation rate, with maximum outside air, during installation.
 - .1 Vent directly to outside.
 - .2 Do not let contaminated air recirculate through a district or whole building air distribution system.
 - .3 Maintain extra ventilation for 1 month minimum after building occupation.

Part 2 PRODUCTS

2.1 ACCESSORIES

- .1 Resilient base: continuous, top set, complete with premoulded end stops and external corners:
 - .1 Type: rubber, 3.0 mm thick.
 - .2 Style: straight.
 - .3 Height: 101.6 mm.
 - .4 Lengths: cut lengths minimum 2400 mm.
 - .5 Colour: as indicated.
- .2 Primers and adhesives: of types recommended by resilient flooring manufacturer for specific material on applicable substrate, above, on or below grade.
 - .1 Adhesives: VOC limit 50 g/L maximum to SCAQMD Rule 1168.
 - .2 Primer: in accordance with manufacturer's recommendations for surface conditions:
 - .1 VOC limit: 100 g/L maximum to SCAQMD Rule 1113.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Examine conditions, substrates and work to receive work of this Section, co-ordinate with Section 01 71 00.
- .2 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.
- .3 Ensure concrete floors are clean and dry by using test methods recommended by flooring manufacturer.

3.2 PREPARATION

- .1 Prepare for installation in accordance with manufacturer's written recommendations.
- .2 Ensure existing vinyl flooring is removed by trained personnel.
- .3 Remove or treat existing adhesives to prevent residual bleeding through to new base or interfering with bonding of new adhesives.

3.3 APPLICATION: BASE

- .1 Lay out base to keep number of joints at minimum.
- .2 Clean substrate and prime with one coat of adhesive.
- .3 Apply adhesive to back of base.
- .4 Set base against wall and floor surfaces tightly by using 3 kg hand roller.
- .5 Install straight and level to variation of 1:1000.
- .6 Scribe and fit to door frames and other obstructions. Use premoulded end pieces at flush door frames.
- .7 Cope internal corners using premoulded corner units for right angle external corners and formed straight base material for external corners of other angles.
- .8 Use toeless type base where floor finish will be carpet, coved type elsewhere.
- .9 Install toeless type base before installation of carpet on floors.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .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.
 - .1 Remove excess adhesive from floor, base and wall surfaces without damage.
 - .2 Clean, seal and wax floor and base surface to flooring manufacturer's printed instructions.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Protect new floors in accordance with manufacturer's printed instructions.
- .3 Repair damage to adjacent materials caused by resilient flooring installation.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Green Seal Environmental Standards (GS)
 - .1 GS-11-2008, 2nd Edition, Paints and Coatings.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - current edition.
 - .2 Maintenance Repainting Manual - current edition.
- .4 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1113-A2011, Architectural Coatings.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for paint and coating products and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit 2 copies of WHMIS MSDS.
- .3 Samples:
 - .1 Submit for review and acceptance of each unit.
 - .2 Samples will be returned for inclusion into work.
 - .3 Submit 200 x 300 mm sample panels of each paint, stain, clear coating and special finish with specified paint or coating in colours, gloss/sheen and textures required to MPI Painting Specification Manual standards.
- .4 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Provide and maintain dry, temperature controlled, secure storage.
 - .2 Store painting materials and supplies away from heat generating devices.

- .3 Store materials and equipment in well ventilated area within temperature as recommended by manufacturer.
- .4 Fire Safety Requirements:
 - .1 Supply 1 9 kg 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 National Fire Code of Canada requirements.
- .5 Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 20.

1.4 SITE CONDITIONS

- .1 Heating, Ventilation and Lighting:
 - .1 Ventilate enclosed spaces in accordance with Section 01 51 00.
 - .2 Co-ordinate use of existing ventilation system with Departmental Representative and ensure its operation during and after application of paint as required.
 - .3 Provide minimum lighting level of 323 Lux on surfaces to be painted.
- .2 Temperature, Humidity and Substrate Moisture Content Levels:
 - .1 Apply paint finishes when ambient air and substrate temperatures at location of installation can be satisfactorily maintained during application and drying process, within MPI and paint manufacturer's prescribed limits.
 - .2 Test concrete, masonry and plaster surfaces for alkalinity as required.
 - .3 Apply paint to adequately prepared surfaces, when moisture content is below paint manufacturer's prescribed limits.
- .3 Additional application requirements:
 - .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 in occupied facilities during silent hours only. Schedule operations to approval of Departmental Representative such that painted surfaces will have dried and cured sufficiently before occupants are affected.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Supply paint materials for paint systems from single manufacturer.
- .2 Conform to latest MPI requirements for painting work including preparation and priming.
- .3 Materials in accordance with MPI - Architectural Painting Specification Manual and MPI - Maintenance Repainting Manual "Approved Product" listing.
 - .1 Use MPI listed materials having E3 rating where indoor air quality requirements exist.

- .2 Primer: VOC limit 100 g/L maximum to GS-11 or SCAQMD Rule 1113.
- .3 Paint: VOC limit 100 g/L maximum to GS-11 or SCAQMD Rule 1113.
- .4 Colours:
 - .1 Submit proposed Colour Schedule to Departmental Representative for review.
 - .2 Base colour schedule on selection of 5 base colours and 3 accent colours.
- .5 Mixing and tinting:
 - .1 Perform colour tinting operations prior to delivery of paint to site, in accordance with manufacturer's written recommendations. Obtain written approval from Departmental Representative for tinting of painting materials.
 - .2 Use and add thinner in accordance with paint manufacturer's recommendations.
 - .1 Do not use kerosene or similar organic solvents to thin water-based paints.
 - .3 Thin paint for spraying in accordance with paint manufacturer's written recommendations.
 - .4 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.
- .6 Gloss/sheen ratings:
 - .1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

Gloss Level-Category	Gloss @ 60 degrees	Sheen @ 85 degrees
Gloss Level 1 - Matte Finish	Max. 5	Max. 10
Gloss Level 2 - Velvet	Max.10	10 to 35
Gloss Level 3 - Eggshell	10 to 25	10 to 35
Gloss Level 4 - Satin	20 to 35	min. 35
Gloss Level 5 - Semi-Gloss	35 to 70	
Gloss Level 6 - Gloss	70 to 85	
Gloss Level 7 - High Gloss	More than 85	
 - .2 Gloss level ratings of painted surfaces as indicated.
 - .1 Confirm Gloss Level, irrespective of whether it is indicated or not, with Departmental Representative before ordering materials.
- .7 Exterior painting:
 - .1 Structural Steel and Metal Fabrications: columns, beams, joists and miscellaneous metal.
 - .1 EXT 5.1D - Alkyd, Gloss Level 3 finish.

- .2 Galvanized Metal: high contact/high traffic areas (doors, frames, railings and handrails, etc.).
 - .1 EXT 5.3G - Water based light industrial coating, Gloss Level 3 finish.
- .8 Interior painting:
 - .1 Concrete Vertical Surfaces (including horizontal soffits):
 - .1 INT 3.1A – Latex, Gloss Level 5 finish.
 - .2 Concrete Masonry Units: smooth and split face block:
 - .1 INT 4.2A - Latex, Gloss Level 5 finish.
 - .3 Structural Steel and Metal Fabrications: columns, beams, joists and miscellaneous metal.
 - .1 INT 5.1E Alkyd, Gloss Level 3 finish.
 - .4 Galvanized Metal: doors, frames, railings and handrails, etc.
 - .1 INT 5.3B - Water based light industrial coating, Gloss Level 5 finish.
 - .5 Plaster and gypsum board: gypsum wallboard, drywall, "sheet rock" type material, etc.
 - .1 INT 9.2M - Institutional low odour/low VOC finish.
 - .1 Gloss Level 5 finish: Washrooms, Kitchen, Washer – Dryer, Service Room, Mechanical Room, Electrical Room.
 - .2 Gloss Level 3: Other rooms.

Part 3 EXECUTION

3.1 GENERAL

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheets.
- .2 Perform preparation and operations for interior painting in accordance with MPI - Architectural Painting Specifications Manual and MPI - Maintenance Repainting Manual except where specified otherwise.

3.2 EXAMINATION

- .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 unfavourable conditions before proceeding with work.
 - .2 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test". Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.
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3.3 PREPARATION

- .1 Protection of in-place conditions:
 - .1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore surfaces as directed by Departmental Representative.
 - .2 Protect items that are permanently attached such as Fire Labels on doors and frames.
 - .3 Protect factory finished products and equipment.
- .2 Surface Preparation:
 - .1 Remove electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Identify and store items in secure location and re-installed after painting is completed.
 - .2 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.
 - .3 Place "WET PAINT" signs in occupied areas as painting operations progress. Signs to approval of Departmental Representative.
 - .4 Clean and prepare surfaces in accordance with MPI - Architectural Painting Specification Manual and MPI - Maintenance Repainting Manual specific requirements and coating manufacturer's recommendations.
 - .5 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.
 - .6 Where possible, prime non-exposed surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.
 - .1 Apply vinyl sealer to MPI #36 over knots, pitch, sap and resinous areas.
 - .2 Apply wood filler to nail holes and cracks.
 - .3 Tint filler to match stains for stained woodwork.
 - .7 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.
 - .8 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements.
 - .9 Touch up of shop primers with primer as specified.

3.4 APPLICATION

- .1 Paint only after prepared surfaces have been accepted by Departmental Representative.
- .2 Use method of application approved by Departmental Representative.
 - .1 Conform to manufacturer's application recommendations.
- .3 Apply coats of paint in continuous film of uniform thickness.
 - .1 Repaint thin spots or bare areas before next coat of paint is applied.

- .4 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
- .5 Sand and dust between coats to remove visible defects.
- .6 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as tops of interior cupboards and cabinets and projecting ledges.
- .7 Finish inside of cupboards and cabinets as specified for outside surfaces.
- .8 Finish closets and alcoves as specified for adjoining rooms.
- .9 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.
- .10 Mechanical/Electrical Equipment:
 - .1 Paint conduits, piping, hangers, ductwork and other mechanical and electrical equipment exposed in finished areas, to match adjacent surfaces, except as indicated.
 - .2 Do not paint over nameplates.
 - .3 Keep sprinkler heads free of paint.
 - .4 Paint fire protection piping red.
 - .5 Paint disconnect switches for fire alarm system and exit light systems in red enamel.
 - .6 Paint natural gas piping yellow.
 - .7 Paint both sides and edges of backboards for telephone and electrical equipment before installation.
 - .1 Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .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.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
- .4 Place paint, stain and primer defined as hazardous or toxic waste, including tubes and containers, in containers or areas designated for hazardous waste.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section includes requirements for surface preparation, and supply and site application of high performance coating systems.

1.2 RELATED REQUIREMENTS

- .1 Section 09 91 00 – Painting: General site painting.

1.3 DEFINITIONS

- .1 Terminology: Standard coating terms defined in ASTM D16 apply to this Section.
- .2 Gloss Range: Standard gloss range shall be as follows:
 - .1 Semi-Gloss: Medium sheen finish with a gloss range between 30 and 65 when measured at a 60 degree meter.
 - .2 High Gloss: High sheen finish with a gloss range more than 65 when measured at a 60 degree meter.

1.4 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM D16-14, Standard Terminology for Paint, Related Coatings, Materials and Applications

1.5 SUBMITTALS

- .1 Provide required information in accordance with Section 01 33 00.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Product Data: Submit product data for each coating system indicated including block fillers and primers required for the system including; not limited to, the following:
 - .1 An inclusive list of required coating materials indicating each material cross referenced to specific coating, finish system, and application; with manufacturer's catalogue number and general classification.
 - .2 Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each material specified.
 - .2 Samples: Submit samples of each colour and material being applied, with texture to simulate actual conditions, on representative samples of the actual substrate and as follows for Departmental Representative's verification:
 - .1 Provide stepped samples defining each separate coat, including block fillers and primers.
 - .2 Use representative colours when preparing samples for review; resubmit until required sheen, colour, and texture are achieved.
 - .3 List of material and application for each coat of each sample; label each sample for location and application.

- .4 Submit samples on the following substrates for Departmental Representative 's review of colour and texture:
 - .1 Concrete: Provide two (2) - 100 mm square samples for each colour and finish.
- .3 Informational Submittals: Provide the following submittals when requested by the Departmental Representative:
 - .1 Certificates: Submit written certification prepared by manufacturer that products supplied are in accordance with requirements indicated for amounts of VOC's in coating products.

1.6 PROJECT CLOSEOUT SUBMISSIONS

- .1 Operation and Maintenance Data: Submit copies of paint manufacturer's written maintenance information for inclusion in the operations manual in accordance with Section 01 78 00 including specific warning of any maintenance practice or materials that may damage or disfigure the finished Work.
- .2 Maintenance Materials: Deliver maintenance materials to Departmental Representative in quantities indicated and in accordance with Section 01 78 00 that match products installed; packaged with protective covering for storage, and identified with labels describing contents and building location and as follows:
 - .1 Paints and Coatings: Minimum of 4-4 L containers of field colours and 4-1 L containers of each accent colour, and all remnants.

1.7 QUALITY ASSURANCE

- .1 Qualifications: Provide proof of qualifications when requested by Departmental Representative:
 - .1 Manufacturers: Obtain primers and undercoat materials for each coating system from the same manufacturer as the finish coats.
 - .2 Applicators: Use experienced applicators having a record of successful in-service high performance coating system applications similar in material and extent to those indicated and as follows:
 - .1 Applicators must have completed coating manufacturer's training program for materials specified.
 - .2 Applicators must be licensed or certified by the coating manufacturer for the materials specified.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements: Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label with the following information:
 - .1 Name or title of material
 - .2 Product description (generic classification or binder type)
 - .3 Manufacturer's stock number and date of manufacture
 - .4 Contents by volume, for pigment and vehicle constituents
 - .5 Thinning instructions
 - .6 Application instructions

- .7 Colour name and number
- .8 Handling instructions and precautions
- .2 Storage and Handling Requirements: Store materials not in use in tightly covered containers in a well ventilated area at a minimum ambient temperature of 7°C and as follows:
 - .1 Maintain containers used in storage in a clean condition, free of foreign materials and residue, and as follows:
 - .1 Protect materials from freezing.
 - .2 Keep storage area neat and orderly.
 - .3 Remove oily rags and waste daily.
 - .4 Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and applying coatings.

1.9 SITE CONDITIONS

- .1 Ambient Conditions: Apply coatings only when temperature of surfaces being coated and surrounding air temperatures are within temperature range recommended in writing by coating manufacturer and as follows:
 - .1 Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85%; at temperatures less than 3°C above dew point; or to damp or wet surfaces:
 - .1 Allow wet surfaces to dry thoroughly and attain temperature and conditions specified before proceeding with or continuing coating operation.
 - .2 Work may continue during inclement weather only if areas and surfaces being coated are enclosed and temperature within the area can be maintained within limits specified by manufacturer during application and drying periods.

Part 2 Products

2.1 COATINGS MATERIALS

- .1 Provide primers, undercoats, and finish coat materials that are compatible with one another and substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and site experience.
- .2 Provide manufacturer's highest grade of the various high performance coatings specified; materials not displaying manufacturer's product identification are not acceptable.

2.2 INTERIOR DECORATIVE COATINGS

- .1 Decorative Waterproof Flooring: Decorative, trowel or liquid applied, 2 component, epoxy coating system with integral flexible epoxy, reinforced waterproofing membrane and cove base; consisting of primer, flexible coloured membrane, decorative quartz chip layer and clear wear course approximately 3 mm total DFT.

- .2 Decorative Waterproof Wall and Ceiling Coating: Seamless, reinforced, high performance wall and ceiling coating system with waterproofing membrane; consisting of primer, flexible membrane, reinforced finish coating approximately 1.0 mm total DFT.

2.3 COLOURS

- .1 Colours: As selected by Departmental Representative from manufacturer's full range.

Part 3 Execution

3.1 EXAMINATION

- .1 Examine substrates and conditions under which high performance coatings will be applied for acceptability in accordance with coating manufacturer's application requirements, and as follows:
 - .1 Apply coatings only after unsatisfactory conditions have been corrected and surfaces to receive coatings are thoroughly dry.
 - .2 Start of application is construed as Applicator's acceptance of surfaces within that particular area.
- .2 Coordinate requirements of substrates to which primers or other coatings are being applied to ensure compatibility of total systems; provide information on characteristics of specified finish materials to indicate compatibility when requested:
 - .1 Obtain the following primer information before proceeding if a potential incompatibility exists:
 - .1 Confirmation of primer's suitability for expected service conditions.
 - .2 Confirmation of primer's ability being top coated with materials specified.
 - .2 Notify Departmental Representative about anticipated problems before using the coatings specified over substrates primed by others.

3.2 PREPARATION

- .1 Remove plates, machined surfaces, and similar items already in place that are not being coated. If removal is impractical or impossible because of size or weight of item, provide surface applied protection before surface preparation and coating.
- .2 After completing coating operations, reinstall items that were removed; use workers skilled in the trades involved.
- .3 Clean substrates of substances that could impair bond of coatings before applying high performance coatings; remove oil and grease before cleaning.
- .4 Schedule cleaning and coating application so dust and other contaminants from cleaning process will not fall on wet, newly coated surfaces.
- .5 Clean and prepare surfaces being coated in accordance with manufacturer's written instructions for each substrate condition and as specified and as follows:
 - .1 Provide barrier coats over incompatible primers or remove primers and re-prime substrate.

- .2 Prepare concrete being coated; remove efflorescence, chalk, dust, dirt, grease, oils, and release agents; roughen as required to remove glaze; use mechanical methods to prepare surfaces if hardeners or sealers have been used to improve curing, and as follows:
 - .1 Use abrasive blast cleaning methods if recommended by coating manufacturer.
 - .2 Determine alkalinity and moisture content of surfaces by performing appropriate tests; correct this condition before application if surfaces are sufficiently alkaline to cause the finish paint to blister and burn; do not coat surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
- .6 Carefully mix and prepare coating materials in accordance with manufacturer's written instructions, and as follows:
 - .1 Maintain containers used in mixing and applying coatings in a clean condition, free of foreign materials and residue.
 - .2 Stir materials before applying to produce a mixture of uniform density; stir as required during application; do not stir surface film into the material; remove film and strain coating material before using.
 - .3 Use only the type of thinners approved by manufacturer and only within recommended limits.
- .7 Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are being applied; tint undercoats to match colour of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

- .1 Apply high performance coatings in accordance with manufacturer's written instructions, and as follows:
 - .1 Use applicators and techniques best suited for the material being applied.
 - .2 Do not apply high performance coatings over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to forming a durable coating film.
 - .3 Coating colours, surface treatments, and finishes are indicated in the coating system descriptions.
 - .4 Provide finish coats compatible with primers used.
 - .5 The term "exposed surfaces" includes areas visible when permanent or built in fixtures, convactor covers, grilles, covers for finned tube radiation, and similar components are in place; extend coatings in these areas to maintain system integrity and provide desired protection, and as follows:
 - .1 Coat surfaces behind movable equipment and furniture the same as similar exposed surfaces; coat surfaces behind permanently fixed equipment or furniture with prime coat only before final installation.
 - .2 Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

- .2 Apply first coat to surfaces that have been cleaned, pre-treated, or otherwise prepared for coating as soon as practicable after preparation and before subsequent surface deterioration, and as follows:
 - .1 The number of coats and film thickness required is the same regardless of application method:
 - .1 Omit primer on metal surfaces that have been shop primed and touch-up painted.
 - .2 Do not apply succeeding coats until previous coat has cured as recommended by manufacturer.
 - .3 Sand between applications to produce a smooth, even surface where manufacturer's written instructions require sanding.
 - .4 Allow sufficient time between successive coats to permit proper drying.
 - .5 Do not recoat surfaces until coating has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and application of another coat does not cause undercoat to lift or lose adhesion.
 - .2 Apply additional coats until cured film has a uniform coating finish, colour, and appearance if undercoats or other conditions show through final coat; give special attention to edges, corners, crevices, welds, exposed fasteners, and similar surfaces to ensure that they receive a dry film thickness equivalent to that of flat surfaces.
- .3 Apply coatings by brush, roller, spray, or other applicators in accordance with manufacturer's written instructions, and as follows:
 - .1 Brush Application: Use brushes best suited for material applied and of appropriate size for the surface or item being coated:
 - .1 Apply primers and first coats by brush unless manufacturer's written instructions permit using roller or mechanical applicators.
 - .2 Brush out and work brush coats into surfaces in an even film.
 - .3 Eliminate cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections.
 - .4 Neatly draw glass lines and colour breaks.
 - .2 Rollers: Use rollers of carpet, velvet back, or high pile sheep's wool as recommended by manufacturer for the material and texture required.
 - .3 Spray Equipment: Use mechanical methods to apply coating if permitted by manufacturer's written instructions and governing regulations:
 - .1 Use spray equipment with orifice size recommended by manufacturer for material and texture required.
 - .2 Apply each coat to provide the equivalent hiding of brush applied coats.
 - .3 Do not double back with spray equipment building up film thickness of two coats in one pass, unless recommended by manufacturer.
- .4 Apply each material no thinner than manufacturer recommended spreading rate; provide total dry film thickness of the entire system as recommended by manufacturer.
- .5 Apply block fillers to concrete masonry block at a rate that provides complete coverage with pores filled.

- .6 Apply prime coat as recommended by manufacturer to material being coated or finished that has not been prime coated by others before applying finish coats:
 - .1 Recoat primed and sealed substrates if there is evidence of suction spots or unsealed areas in first coat, to ensure a finish coat with no burn through or other defects caused by insufficient sealing.
- .7 Remove, refinish, or recoat work that does not are in accordance with specified requirements.

3.4 CLEANING

- .1 At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- .2 Clean spattered surfaces after completing coating application.
- .3 Remove spattered coatings by washing, scraping, or other methods.
- .4 Do not scratch or damage adjacent finished surfaces.

3.5 PROTECTION

- .1 Protect work of other trades, whether being coated or not, against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Departmental Representative, and leave in an undamaged condition.
- .2 Provide "Wet Paint" signs to protect newly coated finishes. After completing coating operations, remove temporary protective wrappings provided by others to protect their work.
- .3 At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 08 71 00: Door Hardware.
- .2 Installation only of detention hardware for:
 - .1 Section 11 19 13: Hollow metal detention doors.

1.2 REQUIREMENTS OF REGULATORY AGENCIES

- .1 Use only ULC listed and labelled hardware for fire doors.

1.3 HARDWARE LIST

- .1 Submit hardware schedule in accordance with Section 01 33 00.
- .2 Clearly indicate hardware proposed including make, model, material, function, finish and all other pertinent information.

1.4 SAMPLES AND MODELS

- .1 Submit one full size sample of each type hardware specified, in accordance with Section 01 33 00.
- .2 Identify each sample by label indicating applicable specification paragraph number and type, brand name and number, finish and building location installation.
- .3 Submit one full scale working model of cell door locking device complete with cell door and frame, to fully demonstrate every detail of its operation.
- .4 Pay all costs relative to submitting and removing samples and models.

1.5 SHOP DRAWINGS, PRODUCT DATA AND INSTALLATION INSTRUCTIONS

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 and 01 78 00.
- .2 Clearly indicate all information required for proper preparation and application of hardware.
- .3 Submit shop drawings for each type locking device to show fabrication, layout, setting and erection details.
- .4 Submit wiring diagrams and service requirements for electrically operated hardware and equipment.
- .5 Furnish door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.

1.6 MAINTENANCE DATA AND INSTRUCTIONS

- .1 Provide maintenance data, parts list and manufacturer's instructions for each type of lock, cremone bolt set, door closer, door holder, electric deadbolt, and locking device for incorporation into maintenance manual specified in Section 01 78 00.
 - .2 Brief maintenance staff regarding proper care of hardware and locking devices, such as lubrication, adjustments cleaning, and general instructions.
-

1.7 MAINTENANCE MATERIALS

- .1 Supply two spanner tools for each size spanner screw on job.
- .2 Supply two sets of wrenches for each type of do or closer.

1.8 DELIVERY AND STORAGE

- .1 Store all hardware and locking devices in locked, clean and dry area.
- .2 Package each item of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.

1.9 ENGINEERING AND TECHNICAL SUPERVISION

- .1 Provide qualified engineering and technical supervision commencing at date contract is awarded and continuing until Final Certificate of Completion is issued.
- .2 Qualified supervisor will have been actively engaged in prison security hardware business for not less than five years.
- .3 Upon completion of work, and prior to issuance of Final Certificate of Completion, qualified supervisor to examine each lock, locking device, and all other detention hardware items, to ensure their proper installation and operation.

Part 2 PRODUCTS

2.1 HARDWARE ITEMS

- .1 Use one manufacturer's products only for all similar items.
- .2 Hardware for additions or alterations to existing institutions to match existing hardware for make, material, finish, and to be keyed into the existing system at the manufacturer's plant.

2.2 FASTENING DEVICES

- .1 Provide security screws, security nuts, rivets, spanner screws or other equally secure approved devices for affixing various hardware items.
 - .2 Use only rivets, security screws, or security nuts at locations where maximum security against removal is required.
 - .3 Use spanner screws only at locations where security against removal is not as important, and where it is necessary to remove and repair items from time to time.
 - .4 Security screws and nuts to have an extra head which twists off when screw or nut is fully secured, leaving main head without holes or slots for insertion of tool for removal.
 - .5 Spanner screws to have slots or holes that require a special spanner tool to remove screws.
 - .6 Round head screws not acceptable except at locations approved where material is not thick enough to permit counter-sinking.
 - .7 Standard screws not acceptable.
 - .8 Use fasteners compatible with material through which they pass.
 - .9 Exposed fastening devices to match finish of hardware.
-

2.3 KEYING

- .1 Prepare keying schedule in consultation with Departmental Representative. Keying system to include keying alike in groups, and keying differently. Submit schedule for approval.
- .2 Master keying not allowed.
- .3 Construction keying not allowed.
- .4 Provide keys in triplicate for each key-code.
- .5 Stamp key-code numbers on keys, prison lock cases, and institutional lock cylinders. Stamp year of issue on prison keys.
- .6 Deliver keys via bonded courier or registered mail to person and place designated by Departmental Representative.
- .7 Certify that lock manufacturer maintains a register listing all key-codes issued to this project to ensure that replacement keys may be ordered by key-code number only in future, and that locks added in future will not accidentally duplicate existing codes.
- .8 Assign key-code numbers which identify the institution, plus the particular key-code within the institution.
- .9 Key-code numbers which directly relate to the actual physical cuts on the keys, not allowed.

2.4 HINGES

- .1 Type 1B3:
 - .1 Style, full mortise or half mortise, three-knuckle type (cast stainless steel).
 - .2 Size, 114 mm high x 114 mm wide.
 - .3 Hinge leaves, 5 mm thick cast stainless steel.
 - .4 Ball bearings, 10 mm diameter stainless steel.
 - .5 Ball races, hardened tool steel.
 - .6 Hinge pins, 14 mm diameter stainless steel (non-removable).
 - .7 Fasteners, eight 1/4-20 or No.12 flat head spanner machine screws.
 - .8 Finish, C32D.

2.5 KEY OPERATED LOCKS

- .1 Following features are common to all locks Type 3A:
 - .1 All have five lever tumblers of "spring temper" hard brass, each tumbler 3 mm thick and actuated by phosphor bronze spring.
 - .2 All have key cylinders of polished alloy bronze having hardness and tensile strength equal to mild steel. Each cylinder grooved to match and guide similar grooves in key.
 - .3 All operate by key type 14A1.
- .2 Type 3A9 (deadlock):
 - .1 Case and cover drop forged steel, size 95 mm x 140 mm wide x 38 mm thick.
 - .2 Lockbolt solid steel 51 mm x 19 mm in size with three hardened steel inserts 6 mm diameter inserted into blind holes from inside of lock.

- .3 Bolt throw 19 mm.
- .4 Finish CP.
- .5 Keyed one side or two sides.
- .6 Fasteners, four 10 mm diameter flat head spanner security machine screws.

2.6 ESCUTCHEONS, CYLINDER SHIELDS, PULL HANDLES, FOOT BOLT RECEPTACLES

- .1 Escutcheon type 11A1:
 - .1 Material, 3 mm thick stainless steel, C32D finish.
 - .2 Outside diameter 76 mm.
 - .3 Fasteners, two 6 mm diameter oval or truss head spanner screws.
 - .4 Single or double wing.
- .2 Door pull type 11A5:
 - .1 Material, manganese bronze.
 - .2 Overall length 219 mm.
 - .3 Hand hold 133 mm long.
 - .4 Clearance between grip and door, 38 mm.
 - .5 Fasteners, two 10 mm oval head spanner screws.
 - .6 Finish C26D.

2.7 KEYS

- .1 Type 14A1:
 - .1 Paracentric type not less than 114 mm in length. Blade to be 22 mm wide x 4 mm thick, with overlapping paracentric grooves to match similar grooves in lock cylinders.
 - .2 Handle to be oval shape, to properly fit hand, 57 mm x 35 mm in size, separated from blade by 13 mm x 38 mm shank to provide clearance for hand.
 - .3 Material, alloy bronze having tensile strength not less than Brinnell 150.
 - .4 Factory stamp assigned key-code number on each key.

Part 3 EXECUTION

3.1 LEGEND OF ABBREVIATIONS USED IN HARDWARE SCHEDULE

- .1 Legend:
 - .1 C26D - satin chromium plated
 - .2 C32D - satin stainless steel
 - .3 CP - prime painted
 - .4 K1S - keyed one side
 - .5 K2S - keyed two sides

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 07 92 00: Caulking of joints between frames and other building components.
- .2 Section 08 11 00: Metal Doors and Frames.
- .3 Section 09 91 99: Painting.
- .4 Section 11 19 12: Detention Hardware.

1.2 REQUIREMENTS OF REGULATORY AGENCIES

- .1 Fabricate and install fire doors and frames to NFPA 80-2010 except where specified otherwise.
- .2 Fire doors and frames to be ULC or ULI listed and labelled for fire protection ratings as indicated.

1.3 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00.
- .2 Submit one 300 x 300 mm corner sample of each type door, and of each type door frame, showing corner detail, butt cutout.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 and 01 78 00.
- .2 Clearly indicate each type material, core thickness, reinforcements, integral and removable stops, location of anchors exposed fastenings, finishes, and arrangement of hardware.
- .3 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and in door schedule.
- .4 Submit drawings for each type of door, panel, frame, component.

1.5 TESTS

- .1 Perform tests under the supervision of Departmental Representative and submit test reports certifying following minimum performance of typical flush detention door, 910 x 2130 x 50 mm in size:
 - .1 Static load: Centrally apply load of 4309 Kg (.22 kg per square centimeter) at quarter points on door. Maximum deflection must not exceed 0.38 mm after release of load.
 - .2 Rack test: Concentrate load of 1905 Kg on one unsupported corner of door. Door must not fail. Deflection must not exceed 37 mm.
- .2 Notify Departmental Representative sufficiently in advance of tests to allow for assignment of supervisory personnel.

1.6 ALTERNATIVES

- .1 Alternative designs for the specified method internal reinforcement for doors and panels may be acceptable.
- .2 Submit for approval complete drawings, description, and test reports certifying performance for doors or panels of proposed alternative design.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Sheet steel: commercial quality cold-rolled to ASTM A1008/A1008M-09, Class 1 finish.
- .2 Steel plate, shapes and bars: to CAN/CSA- G40.20-04(R2009)/G40.21-04(R2009), type 230G or 260W.
- .3 Shop paint primer: to MPI# 79.
- .4 Fastening Devices:
 - .1 Provide security screws, security nuts, rivets, spanner screws or other equally secure approved devices for affixing various components.
 - .2 Use only rivets, security screws, or security nuts at locations where maximum security against removal is required.
 - .3 Use spanner screws only at locations where security against removal is not as important and where it is necessary to remove and repair items from time to time.
 - .4 Security screws and nuts to have an extra head which twists off when screw or nut is fully secured, leaving main head without holes or slots for insertion of tool for removal.
 - .5 Spanner screws to have slots or holes that require a special spanner tool to remove screws.
 - .6 Round head screws not acceptable except at locations approved where material is not thick enough to permit counter-sinking.
 - .7 Standard screws not acceptable.

2.2 HOLLOW METAL DETENTION DOORS

- .1 Fabricate hollow metal detention doors as detailed.
 - .2 Doors to have 3 mm side clearance with bevelled edges where necessary to permit operating without binding.
 - .3 Construct doors with 2 mm thick cold-rolled sheet steel face sheets both sides, each sheet one piece, formed to corner and meet at middle of door thickness. Provide continuous weld at meeting edges. Welds to be ground smooth and filled.
 - .4 Provide internal 3.5 mm thick steel channel banding around entire outside perimeter edge of door, spot welded to face sheets at 76 mm oc. Banding to be continuous, full height and width.
 - .5 Inner reinforcement to be continuous full height true truss design with triangular form, of shape which cannot be altered without changing length of sides. Flat apexes to be resistance spot welded at 70 mm oc horizontally and 76 mm oc vertically.
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- .6 Fill void between each flute of reinforcement with minimum 24 kg/m³ density rock wool, or rigid fibreglass for sound-deadening and fire insulation.
- .7 Provide additional backup reinforcement of 5 mm plate welded in place at hinge reinforcing channel, factory drilled and tapped to receive hinge screws.
- .8 Pull reinforcement to be 10 mm thick x 35 x 254 mm.
- .9 Closer reinforcement to be 2.5 mm thick x 89 mm x 356 mm.
- .10 Build special pocket into door where prison lock is to be installed. Detention side of door to be finished flush and have a 3 mm internal back-up plate to protect lock. Design pocket so that removal of lock bolt is extended.
- .11 Build special 3.5 mm thick lock case support brackets internally in door where mortised institutional lock is to be installed. Brackets to firmly support case of lock on both faces to prevent it from moving in event of impact attack on door.
- .12 Provide all boxes and conduits required to accommodate wiring in doors and panels where electric locks or limit switches are to be installed.
- .13 Provide drilled and tapped holes for all hardware according to templates furnished by hardware supplier.

2.3 HOLLOW METAL PANELS

- .1 Fabricate hollow metal panels to be fixed in place at frame openings as detailed.
- .2 Construct panels using same materials, design and fabrication procedures as specified for hollow metal detention doors.

2.4 PRESSED STEEL FRAMES

- .1 Fabricate pressed steel frames for detention doors, hollow metal fixed panels as detailed.
 - .2 Construct frames with minimum 2.5 mm thick cold-rolled sheet steel.
 - .3 Corners to be fully mitered, Continuously welded and ground smooth.
 - .4 Stops on detention side to be formed integrally in frames, minimum 16 x 32 mm size.
 - .5 Removable stops on opposite side to detention side to be held in place with 6 mm diameter flat head security screws at 203 mm centre to centre. Form stops with minimum 2.5 mm thick cold-rolled sheet steel minimum 16 x 25 mm size.
 - .6 For each mortise hinge, provide 5 mm thick reinforcement full depth of jamb spot welded to frame and completely drilled and tapped.
 - .7 For each surface hinge provide 10 mm thick x 35 x 254 mm long reinforcement welded to frame and completely drilled and tapped.
 - .8 Provide drilled and tapped reinforcement for all hardware mountings, including door closers. Protect all mortises with steel cover boxes.
 - .9 For each jamb mounted electric lock, provide special 2.5 mm thick perimeter housing with 5 mm thick back-up plate for field attachment of lock.
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- .10 For each sliding door, provide continuous full height vertical receiving channel for door to close against. Minimum 2.5 mm thick formed steel. Provide two adjustable rubber bumpers on each (unless the bumpers are provided as part of Type 16A Locking Device package).
- .11 Provide all boxes and conduits required to accommodate wiring in frames and screens where electric locks or limit switches are specified.
- .12 Provide 1.6 mm thick steel masonry anchors at each jamb, at approximately 533 mm centre to centre. Each anchor 76 mm wide x 305 mm long.
- .13 Provide 2.5 mm thick x 76 mm steel angle jamb floor anchors.
- .14 Provide two steel channel or angle removable temporary spreaders welded to jambs at bottom of door opening to maintain proper alignment.

2.5 SHOP PAINTING

- .1 Apply one coat of paint primer to steel and ferrous metal with exception of stainless steel, and those zinc-coated or galvanized.
- .2 Clean, prepare surfaces and apply primer in accordance with manufacturer's instructions.
- .3 Remove blemishes and foreign matter by automatic pressure sanding both faces of each hollow metal door and panel. Spot glaze imperfections with metallic filler and sand smooth.

Part 3 EXECUTION

3.1 FRAME INSTALLATION

- .1 Set frames plumb, square, level at correct elevation.
- .2 Secure anchorages and connections to adjacent construction.
- .3 Brace frames rigidly in position while building-in. Install temporary horizontal and vertical wood spreaders as necessary to maintain frame alignment. Remove temporary steel and wood spreaders after frames are built-in.

3.2 DOOR AND PANEL INSTALLATION

- .1 Install doors panels, and hardware in accordance with templates and manufacturer's instructions.
- .2 Adjust operable parts for correct function.
- .3 Co-operate with engineering supervisor provided by Detention Hardware Supplier to ensure proper installation, adjustment, and operation of hardware.
- .4 The Detention Door Manufacturer shall be employed as subcontractor to hang and adjust all doors equipped with type 16A locking devices including mechanical installation of the following type 16A locking device components:
 - .1 Mechanism housings at each door complete.
 - .2 Vertical locking columns complete.
 - .3 Bottom door guide assemblies complete.

- .4 Mechanism housings connecting rows of cell doors to mechanical control cabinets.
- .5 Mechanical control cabinets.
- .6 Rubber bumpers in sliding door receiving channels.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section includes requirements for cabinet mounted laboratory fume hoods in the following configurations:
 - .1 Constant volume fume hood.
 - .2 Laboratory fittings and fixtures specified in Section 11 53 43, and required by this Section shall be supplied and installed integrally fume hoods; connection to services will be completed by Division 22 and Division 23 and Division 26.

1.2 RELATED REQUIREMENTS

- .1 Section 12 35 53 – Laboratory Casework
- .2 Division 22 – Plumbing: Plumbing rough-in and connection.
- .3 Division 23 – Heating, Ventilating and Air Conditioning: Duct work rough-in and connection.
- .4 Division 26 – Electrical: Wire ways and devices, rough-in and connection.

1.3 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE):
 - .1 Standard 110-1995, Method of Testing Performance of Laboratory Fume Hoods (ANSI approved).
 - .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM A167-99(2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - .2 ASTM A240/A240M-13b, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - .3 ASTM A1008/A1008M-13, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
 - .3 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB 12.1-M90, Glass, Safety, Tempered or Laminated.
 - .4 Canadian Standards Association (CSA):
 - .1 CSA C22.2 NO. 151-M1986(R2004), Laboratory Equipment.
 - .2 CSA O121-M1978(R2003), Douglas Fir Plywood.
 - .3 CAN3 O188.1-M78, Interior Mat-Formed Wood Particleboard.
 - .4 CSA Z316.5-04, Fume Hoods and Associated Exhaust Systems.
 - .5 National Fire Protection Association (NFPA):
 - .1 NFPA 30 2000, Flammable and Combustible Liquids Code
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- .2 NFPA 45 2000, Standard on Fire Protection for Laboratories Using Chemicals
- .3 NFPA 91 2015, Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Particulate Solids
- .6 Scientific Equipment and Furniture Association (SEFA):
 - .1 SEFA 1.2-2002, Laboratory Fume Hoods.
 - .2 SEFA 3-1996, Work Surfaces.

1.4 COORDINATION

- .1 Coordinate with Division 22, Division 23 and Division 26 for proper and correct installation of plumbing, ducting and electrical rough-in and other affected Sections for rough opening dimensions required for installation of specified fume hood and equipment.

1.5 SYSTEM REQUIREMENTS

- .1 Provide fully tested and functional fume hood as described in this section with specific operational characteristics as listed below.
- .2 Automatic Air Bypass:
 - .1 Automatic air bypass system shall incorporate an automatic compensating opening or make-up air unit, as applicable, that functions as the sash is lowered or raised.
 - .2 Air drawn through the bypass shall pass through the hood interior to dilute generated fumes.
 - .3 The bypass shall limit the face velocity and maintain a relatively constant exhaust volume.
- .3 Face Velocity: Face velocity shall be designed to meet Class A fume hood requirements with an average of 38 to 45 m/min with a sash opening of 305 mm, with a corresponding minimum reading of 30 to 38 m/min with the sash in the full open position.
- .4 Static Pressure Loss: Static pressure loss and exhaust volume shall be relatively constant regardless of sash position.
- .5 Safety:
 - .1 Install label indicating sash opening height.
 - .2 Install label indicating proper pressure gauge reading required for safe operation.
 - .3 Install pressure alarm and differential pressure gauge, providing an alarm to operators for unsafe operating conditions with a manual shut-off for maintenance or false alarm conditions.

1.6 QUALITY ASSURANCE

- .1 Where governed by code requirements in their final installed locations, items of this Section shall conform to the Building Code and all other standards as noted.
 - .2 Electrical and operating items shall be CSA or ULC approved and carry the appropriate CSA or ULC label in accordance with Section 01 61 00: Fire Rated Separations, Assemblies and Materials.
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- .3 Fume hoods shall be manufactured by a fabricator having a minimum of 10 years experience in the design, fabrication and installation of highest quality research scientific laboratory fume hoods, manufactured to highest laboratory standards and accuracy:
 - .1 Provide evidence of experience and list of similar projects with Bid Submission.

1.7 MANUFACTURER QUALIFICATIONS

- .1 Manufacturer shall have an established organization; experienced engineering department and production facilities specializing in fume hood fabrication.
- .2 Manufacturer shall have demonstrated ability to produce equipment of the required quality, and the proven capacity to complete an installation of this size and type within the required time limits.
- .3 Fume hood evaluation of the manufacturer's product shall take place in the manufacturer's test facility with samples, apparatus, instruments, and test materials to be supplied by the manufacturer at no cost to the Departmental Representative. At his option, the Departmental Representative may verify data with his own instruments, providing instrument suitability and calibration are mutually acceptable.
- .4 Perform factory testing in accordance with the requirements of CSA Z316.5, CSA C22.2, No. 151, ASHRAE 110 and SEFA 1.2 Standards listed in 1.3 above.
- .5 CSA Approval:
 - .1 Fume hoods and components used to construct fume hoods shall be certified and approved by CSA.
 - .2 Provide CSA identification in a visible identification on the front of hood exterior.

1.8 SUBMITTALS

- .1 Provide required submittals in accordance with Section 01 33 00.
- .2 Submit information on the type of fume hood and exhaust system; and any specific limitations on use.
- .3 Submit detailed shop drawings of each piece of equipment listed in this Section showing size, installation, preparation, services required and rough-in requirements, operation, construction materials, finishes, joints installed on site, wiring and piping diagrams, controls, and similar items.
- .4 Submit test results of manufacturers testing indicating performance levels prior to delivery of specified items; manufacturer's testing will form the baseline result for assessing performance of site testing requirements.
- .5 Manufacturer's publications are acceptable for standard non-custom specialties if the specific model or type fully shown along with all available accessories, features.
- .6 Submit two (2) samples, minimum size 50 mm x 100 mm, of material or finish when requested by Departmental Representative.

1.9 MAINTENANCE DATA

- .1 Provide required data in accordance with Section 01 78 00.
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- .2 Submit two (2) copies of complete operating and maintenance data for each specified item in this Section including the following:
 - .1 Operating and maintenance instructions.
 - .2 As-built drawings showing the complete installation.
 - .3 Name, address and telephone number of nearest representative for parts supply and servicing.
 - .4 Identification of construction materials.
 - .5 Make, model, and serial number of installed units.
 - .6 Results of site testing and commissioning.

1.10 DELIVERY, STORAGE AND HANDLING

- .1 Do not deliver items or materials to the site until that area or part of the project in which the item is to be installed is ready to receive the Work.
- .2 Finished items, components, assemblies shall be wrapped and crated in a manner to protect materials and finishes from damage during shipping and handling.
- .3 Store items carefully protected from moisture and damage, in original wrappings with manufacturer's labels, seals intact.
- .4 Tie or secure all moving parts so that no damage will occur during shipping, handling.

1.11 SITE CONDITIONS

- .1 Protect surfaces, materials, and finishes of other Work from damage during Work of this Section.
- .2 Where connections to mechanical, electrical or other trades required, provide all data, dimensions, drawings in time for proper roughing-in and preparation required to receive the Work.

Part 2 Products

2.1 MATERIALS

- .1 Materials used to construct fume hoods shall meet or exceed the requirements of CSA Z316.5, suitable for the specific end use that each item or assembly is intended for the Project, and as follows:
 - .1 Sheet steel: Stretcher levelled furniture grade to ASTM A1008/A1008M, galvanized, thickness as indicated.
 - .2 Stainless steel: To ASTM A167 and ASTM A240/A240M, Type 316 with #4 finish.
 - .3 Particleboard: To CAN3 O188.1, Type II Industrial grade, sanded, density.
 - .4 Plywood: CSA O121, Douglas Fir Plywood.

2.2 FUME HOOD FH-1

- .1 Fume Hood Type:
 - .1 Constant Volume Type.
- .2 Hood Size:
 - .1 Nominal Interior: 675 mm.

- .2 Width: 1530 mm.
 - .3 Height: 1400 mm.
 - .4 Depth: 835 mm.
 - .3 Hood Configuration and Classification:
 - .1 Single Sided, Access.
 - .2 Cabinet Mounted Type.
 - .3 Acid and Solvent Usage Classification.
 - .4 Explosion Proof.
 - .4 Liner and Baffle Material:
 - .1 Stainless Steel: Stainless steel (SS) Type 316, welded, minimum 1.519 mm thickness with a directional #4 satin finish, corners coved to 38 mm Ø.
 - .2 Removable interior side panels for access to service fittings.
 - .5 Work Surface:
 - .1 Stainless Steel: Stainless steel (SS) Type 316, minimum 1.519 mm thickness with a directional #4 satin finish, dished to 13 mm to retain spillage and having a 19 mm plywood backing; waterproof sealed and bonded to underside of stainless steel.
 - .6 Equipment Struts: Stainless steel channel to each side of inner liner at attachment locations; stiffen liner panel as required from behind to permit positive attachment.
 - .7 Exterior Panels: Front and side panels, furring panels to conceal duct work finished same as front panel, galvanized steel rear panel, and as follows:
 - .1 Galvanized Steel Panels: Sheet steel galvanized to Z275, minimum 1.214 mm core metal thickness; manufacture's standard grey finish.
 - .2 Access Opening: Provide access opening at the rear of fume hood, concealed between the walls on both sides, to facilitate connection of fume hood service fittings to piping located in service chase at top of laboratory casework.
 - .8 Sash:
 - .1 Type: Vertical Rising.
 - .2 Glass: 6 mm thick tempered safety glass in accordance with CGSB 12.1.
 - .3 Frame: Epoxy coated cold rolled steel frame assembly; adjustable to stop at any position and be easily movable, and as follows:
 - .1 Provide positive seal to sash for correct air bypass operation.
 - .2 Sash guides, internal sash surfaces and counterbalance mechanism shall be fabricated from fire rated and corrosion resistant materials; sash cords shall be stainless steel.
 - .4 Stop: Manufacturer's standard sash limit stop.
 - .5 Sash Air Foil: Minimum 1.897 mm epoxy coated cold rolled steel, and as follows:
 - .1 Mounted on bottom front of hood, to direct air across working surface and seep air back to lower baffle exhaust slot.
 - .2 Provide minimum 70 mm space back-set between airfoil and front edge of the working top to provide a continuous flow of air.
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- .9 Air Handling Requirements:
 - .1 Sound Level: 67 dBA or less when measured in accordance to NSF 49.
 - .2 Exhaust Connection: Type 316 stainless steel, quantity as required for efficient operation and proper air flow.
 - .3 Pressure Gauge: Manufacturer's standard magnahelic pressure gauge to monitor air flow; mounted in visible location on rear wall of interior, connected to a positive pressure duct.
 - .4 Internal Ductwork: Stainless Steel.
 - .5 External Air Balancing System: Controlled orifice type.
 - .10 Service Fittings: All components pre-plumbed up to top of hood ready for connection by Division 22, and as follows:
 - .1 Sink: 460 mm x 410 mm oval self-rimming sink, to match countertop material, sealed into work surface; with tail piece, located at back right corner to align over casework services space.
 - .2 Service Fixtures: Quarter-turn, on/off Type, remote operation as scheduled in Section 11 53 43, and as follows:
 - .1 Air Fitting: One (1), Schedule Mark.
 - .2 Cold Water Fitting: One (1), located at back right corner to align over self-rimming sinks, with rigid gooseneck and a vacuum breaker, Schedule Mark.
 - .11 Electrical Components: All components pre-wired ready for connection by Division 26, and as follows:
 - .1 Wiring:
 - .1 Explosion Proof Units: Single switch for light and blower; internal wiring to circuit junction boxes.
 - .2 Lighting:
 - .1 Explosion Proof Lighting: Manufacturer's standard explosion proof system, serviceable from outside fume hood cavity with tempered glass safety shield on top of the hood liner, and providing 5200 Lumens across working surfaces using one of the following lamp solutions or a combination of both lamp solutions:
 - .1 4100K low mercury, long life 25 to 28 Watt T8 or T5 fluorescent lamps.
 - .2 4100K LED lamp with a minimum 50,000 hour system life based on LM-79 and LM-80 Standards.
 - .3 Receptacles: Two (2), 120 Volt x 15 Amp, GFI receptacles as listed in Section 11 53 43.
 - .12 Accessories:
 - .1 Face velocity alarm to continuously monitor hood performance, having site calibration feature, manufacturer's basic audible and visual alarm activating when airflow falls below a pre-set velocity.
 - .2 Data Card Holder: 0.912 mm thickness stainless steel frame secured to exterior of fume hood, including acrylic glazing and removable data card describing characteristics, operation and site test data, for each fume hood.
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- .3 Paper tissue screen located behind baffle to prevent paper towels and other debris from blocking exhaust system.

2.3 FABRICATION

- .1 Shop fabricate, assemble and finish fume hoods with fastenings concealed or countersunk flush; joints in exposed surfaces to hairline profile with complete internal piping, wiring, ducting, shop installed and tested, having mechanical and electrical fittings and fixtures installed in accordance with CSA Z316.5.
- .2 Assemble equipment accurately, free from distortion or defects detrimental to appearance and operation.
- .3 Provide equipment ready for site hook up to building services; connections to suit adjacent casework service strip.

Part 3 Execution

3.1 INSPECTION/PREPARATION

- .1 Inspect the work of other Sections upon which the work of this Section depends; proceed only after deficiencies, if any, in the Work of other Sections have been corrected.
- .2 Verify dimensions affecting the Work of this Section on the site.
- .3 Coordinate anchors, frames or other items required by this Section and installed by other Sections, or supplied to other Sections by this Section for building into their Work are properly located and securely mounted.
- .4 Verify that services required by this Section are roughed-in and of the required capacity.

3.2 EXAMINATION

- .1 Verify equipment rough-in before proceeding with work.

3.3 INSTALLATION

- .1 Install according to manufacturer's instructions.
 - .2 Install according to standards required by authority having jurisdiction.
 - .3 Install equipment plumb, square and straight with no distortion and securely anchor as required.
 - .4 Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner:
 - .1 Connect power operated equipment to power source in accordance with requirements of Division 26; motors, controls and switches shall be supplied under this Section as part of specified equipment.
 - .2 Connect mechanical services to building sources in accordance with requirements of Division 22; sinks, faucets, gas fittings, drains and other items shall be supplied under this Section as part of specified equipment.
 - .3 Connect ductwork to building sources in accordance with requirements of Division 23.
 - .5 Touch up minor damaged surfaces caused by installation; replace damaged components as directed by Consultant.
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3.4 SITE QUALITY CONTROL

- .1 Conduct site tests in accordance with CSA Z316.5, ASHRAE 110, SEFA 1.2 and CSA C22.2 to verify equipment performance, using factory testing results as baseline for performance.
- .2 Correct equipment not passing test results as directed by authorities having jurisdiction and the Consultant.
- .3 Tests shall include, but not be limited to, the following:
 - .1 Confirmation of As Manufactured Condition.
 - .2 Face Velocity.
 - .3 Flow Containment.
 - .4 Sash Operation.
 - .5 Baffle Operation.
 - .6 Alarm Function.
 - .7 Exhaust Operation.
- .4 Commission installation in accordance with Section 01 91 13 and as follows:
 - .1 Verify and witness electrical safety.
 - .2 Measure, verify and witness lighting levels within fume hoods.
 - .3 Measure, verify and witness noise levels with the room.
 - .4 Verify and witness functioning of components and services.
 - .5 Verify and witness site test results listed in Item 3.4.3 above.

3.5 ADJUSTING

- .1 Adjust operating equipment, with exception of air moving equipment installed by Division 23, to efficient operation for its intended use, and verify that equipment will function correctly within manufacturer's tested performance criteria; make any adjustment or realignment necessary for smooth, trouble-free operation.
- .2 If smooth and correct operation cannot be fully verified by site work and adjustment, ship the affected assembly to the factory for reworking and reinstalled in place at no additional cost or delay to the Departmental Representative.

3.6 CLEANING

- .1 Clean equipment, casework, countertops and all other surfaces as recommended by the manufacturer, rendering all work in a new and unused appearance.
- .2 Clean adjacent construction and surfaces, which may have been soiled in the course of installation of work in this section.

3.7 PROTECTION OF FINISHED WORK

- .1 Provide protective measures to prevent exposure of equipment and surfaces from exposure to other construction activity.
 - .2 Advise contractor of procedures and precautions for protection of material and installed equipment and casework from damage by work of other trades.
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3.8 DEMONSTRATION

- .1 Provide systems demonstration and demonstrate all equipment operations and functions in accordance with CSA Z316.5.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

- .1 It is the responsibility of the Constructor to make requirements for affected related specification sections, and any requirements for alternates and sub situations available to Subcontractors:
 - .1 Subcontractors to receive a complete set of Documents for preparation of their Bids, and to provide a clear understanding of the complete scope-of-work for the Project.
 - .2 Failure to provide required information to Subcontractors during the bid and Construction Phases of the Work will not relieve the Constructor of their responsibility for coordination of the affected Work.
 - .3 Constructor is responsible for any additional costs to the Contractor arising from Subcontractors not receiving a complete package of Documents.
 - .4 Provide complete coordination between Mechanical Divisions to attain a complete and functional building system; Mechanical Divisions include, but are not limited to, the following:
 - .1 Division 21 – Mechanical Common Requirements
 - .2 Division 21 – Fire Suppression
 - .3 Division 22 – Plumbing
 - .4 Division 23 – Heating, Ventilation, and Air Conditioning
 - .5 Division 25 – Integrated Automation
 - .5 Provide complete, fully tested and operational mechanical systems to meet requirements described herein and in complete accord with applicable codes and ordinances:
 - .1 Comply with the National Building Code
 - .6 Include costs to obtain permits and to pay for fees and charges, including inspection charges, by Authorities Having Jurisdiction that issue permits; coordinate related inspections; permits, fees, and inspections include, but are not limited to the following:
 - .1 Plumbing and Gas
 - .2 HVAC
 - .3 Sprinklers and Fire Protection
 - .4 Boilers
 - .7 Documents for the Project, including Specifications and Drawings, are generally diagrammatic and approximately to scale unless specifically detailed otherwise; the establish scope, material, and installation quality, and are not considered as detailed installation instructions.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Cooperate and coordinate with other trades and verify order of installation of overlapping or interconnecting services or equipment before starting Work:
 - .1 Drawings and Specifications: Drawings and specifications are complementary to each other; and what is called for by one is binding as if called for by both and as follows:
 - .1 Examine Contract Documents including drawings and specifications, and work of other trades before starting Work and verify that Work can be satisfactorily completed without changes to the building.
 - .2 Departmental Representative will provide a clarification to identified discrepancies between drawings and specifications that leave the Contractor in doubt as to the true intent and meaning of the documents as follows:
 - .1 During Bid Period: A written Addendum will be issued to address a written request for clarification
 - .2 During Construction: A Construction Communication will be issued to address a written request for information
 - .3 Departmental Representative will respond to Requests for Interpretation and determine the requirements for clarification based only on variances contained in the documents as follows:
 - .1 Clarification based on information and not contained in the documents or in manufacturers written literature will be regarded as a change to the Work
 - .2 Clarification will include effects or influence of other specified products, adjacent construction, adjacent finishes, and methods of construction.
 - .3 Clarification issued during Construction Phase that affects the cost of the Work will be regarded as a Change to the Work.
 - .4 Coordinate installation of the Work with manufacturer's recommended installation details and procedures, supplemented by requirements of Contract Documents; provide adequate access space for maintenance and service of equipment and systems.
 - .5 Coordinate installation of Work with adjacent work by others in accordance with requirements listed in Section 01 73 00 and as follows:
 - .1 Install material and equipment generally in locations and routes shown, close to building structure with minimum interference with other services or free space; remove and replace improperly installed equipment as determined by Departmental Representative
 - .2 Refer to electrical, mechanical, structural and architectural drawings when setting out work and coordinate with other applicable components of the Work when setting out locations for ductwork, equipment, and piping so that conflicts are avoided and symmetrical even spacing is maintained.

- .3 Provide coordination drawings showing the work of other trades and contractors involved in areas of potential conflict or congestion at no additional cost to the Contract.
- .4 Coordinate dimensional details with applicable architectural and structural drawings.
- .5 Full size and detailed drawings will take precedence over scale measurements from drawings when laying out the Work.
- .6 Coordinate requirements of, and connect to, equipment specified in other Sections, and to equipment supplied and installed by other contractors or by Departmental Representative; uncrate equipment, assemble, move in place, and install complete, start-up and test; refer to Division 01 for pre-purchased equipment and equipment furnished by other Divisions.
- .6 Declarations: Coordinate declaration of Substantial Performance and Total Performance with requirements of the General Conditions and Supplementary Conditions of Contract and with Section 01 77 00.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for mechanical equipment and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop drawings:
 - .1 Where stated in respective specification sections, submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Drawings to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
 - .3 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 33 00: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00.

- .2 Operation and Maintenance Data: submit operation and maintenance data of mechanical equipment for incorporation into manual.
 - .1 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
 - .2 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 Colour coding chart.
 - .3 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
 - .4 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93.
 - .5 Approvals:
 - .1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
 - .2 Make changes as required and re-submit as directed by Departmental Representative.
 - .6 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
 - .7 Site records:
 - .1 Departmental Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.

- .8 As-Built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to Departmental Representative for approval and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00.
- .2 Furnish spare parts as follows:
 - .1 One set of packing for each pump.
 - .2 One casing joint gasket for each size pump.
 - .3 One head gasket set for each heat exchanger.
 - .4 One glass for each gauge glass.
 - .5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.6 WARRANTY

- .1 Provide a written warranty stating that Work executed in this Contract will be free from defective workmanship and materials for a period of one (1) year starting from the date of substantial performance of work in accordance with the requirements specified in Section 01 78 00.
- .2 Warranty makes provision for repair or replacement of any Work that fails or becomes defective during the term of the warranty, providing the operating and maintenance instructions have been complied with by the Departmental Representative.
- .3 Duration of the warranty specified does not, in any way, supplant any other guaranties or warranties provided under the Contract for individual pieces of equipment or systems having a longer period provided by Manufacturers or as called for in the project documents.

- .4 Unless specified otherwise, Departmental Representative will be responsible for routine maintenance requirements as required in the manufacturer's instructions, and will be responsible for supplying filters, grease and belts and other consumables required for routine maintenance.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors, off ground, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 .Not used

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Examination of Existing Conditions
 - .1 Visit and examine the site and note characteristics and features affecting the Work before submitting Bid.
 - .2 Report discrepancies in writing to Departmental Representative prior to Bid closing.
 - .3 No allowances will be made for difficulties encountered or expenses incurred arising from conditions of the site or existing items that are readily visible or known to exist at the time of Bid.
 - .4 Unforeseen conditions or discrepancies that could not be readily ascertained at the time of Bid will be administered as a change to the Contract.

3.2 CUTTING AND PATCHING

- .1 Coordinate requirements of the Work with other Divisions.

- .2 Coordinate locations of mechanical penetrations and sleeves through concrete floor structure including slabs, beams, purlins and girders; coordinate sleeving locations with other trades and conditions noted on site.
 - .1 Contractor will prepare coordination drawings for each floor level of the building indicating requirements of all trades penetrating concrete floor construction.
 - .2 Contractor to obtain sign-off from affected mechanical subtrades having penetrations and sleeves before submitting shop drawings to Departmental Representative for review
- .3 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .4 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.
- .5 Provide inserts, holes and sleeves, cutting and fitting required for mechanical work; relocate improperly located holes and sleeves.
- .6 Provide inserts or drill for expansion bolts, hanger rods, brackets, and supports.
- .7 Obtain written approval from Departmental Representative before drilling, coring, cutting or burning structural members; verify that post tensioned or pre-stressed strands are located accurately and avoid cutting or damaging these elements with an adequate margin of safety.
- .8 The Contractor is responsible to patch and make good building where damaged from equipment installation, improperly located holes and similar criteria.

3.3 EXCAVATION AND BACKFILL

- .1 Refer to other Divisions for requirements affecting this Work.
- .2 Confirm service invert elevations and locations prior to starting work, set grades to suit inverts.
- .3 Provide excavating to facilitate installation of mechanical work, including shoring, pumping, placement of 150 mm compacted sand bedding under and first 300 mm of compacted sand over piping and ducting

3.4 USE OF PERMANENT SYSTEMS FOR TEMPORARY HEAT

- .1 Coordinate requirements for use of permanent heating systems for temporary heat in accordance with Section 01 51 00; do not use permanent system for temporary heating purposes without written permission from Departmental Representative; protect and restore permanent systems as specified in Section 01 51 00.
 - .2 Provide a proposed temporary heat agreement for Departmental Representative to review prior to use of permanent building systems for temporary heat; agreement includes payment schedules for utilities, spare parts listings, and confirmation of warranty.
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- .3 The terms of warranty are not modified by the use of permanent systems for temporary heat; equipment manufacturers certify that equipment is in "new" condition at start of warranty period, and as follows:
 - .1 Block-off system components not required for temporary heat in accordance with manufacturer's requirement to maintain warranty.
 - .2 Thoroughly clean and overhaul permanent equipment used during construction period, replace worn or damaged parts before final inspection.
 - .3 Operate heating systems under conditions that allow no temporary or permanent damage.
 - .4 Operate with proper safety devices and controls installed and fully operational.
 - .5 Operate systems only with treated water as specified.
 - .6 Air systems may not be used for temporary heating.
 - .7 Provide alarm indicating system failure; connect alarm to independent alarm company system.
 - .8 Replace mechanical seals, regardless of condition, with new mechanical seals where pumps are used for temporary heating prior to Total Performance of the Work.
 - .9 Avoid thermal shock to heating system during planning, construction and operation of temporary heating system.
- .4 Review temporary heating procedures with Departmental Representative as follows:
 - .1 Obtain acceptance by Departmental Representative for thermal insulation work and automatic control equipment associated with use of permanent heating system for temporary heat.
 - .2 Obtain approval from Departmental Representative and authority having jurisdiction before use of permanent heating system for temporary heat.

3.5 EXISTING SERVICES

- .1 Maintain liaison with Departmental Representative to interrupt, re-route, or connect to water, sewer, heating, or gas systems, with minimum interruption of services.
 - .2 Do not shut down or make connections to any existing service without written permission from the Departmental Representative.
 - .3 Confirm elevations and locations of existing services prior to and during excavation.
 - .4 Route pipes, ducts, conduits and other services to avoid interference with existing installation.
 - .5 Cut back and cap existing services not being used to the source, so that finished Work presents a neat and clean appearance.
 - .6 Contractor shall be responsible for any damage to existing systems, including insulation and coverings, when making connections.
 - .7 Existing facility to be in operation throughout the duration of Construction, with minimum length of system shut-down periods.
 - .8 Include overtime work for tie-in piping, ductwork, or wiring at night or on weekends.
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- .9 Provide Departmental Representative with as-built drawings of site services in accordance with Section 01 78 00; dimensioned to grid lines, building exterior walls or other permanent building component.

3.6 EQUIPMENT PROTECTION AND CLEAN-UP

- .1 Protect equipment and materials in storage on site during and after installation until final acceptance; leave factory covers in place; take special precautions to prevent entry of foreign material into working parts of piping and duct systems.
- .2 Protect equipment with polyethylene covers and crates.
- .3 Operate, drain and flush out bearings and refill with new change of oil, before final acceptance.
- .4 Clean piping, ducts and equipment of dirt, cuttings and other foreign substances in accordance with Section 01 74 11.
- .5 Protect bearings and shafts during installation: Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.
- .6 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling unit.

3.7 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Section 09 91 99.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

3.8 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.9 DEMONSTRATION

- .1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Trial usage to apply to following equipment and systems:
 - .1 Make Up Air Unit
 - .2 Air Conditioning Units
 - .3 Terminal Boxes

- .3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .4 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .5 Instruction duration time requirements as specified in appropriate sections.
- .6 Contractor will record these demonstrations on video tape for future reference.

3.10 PROTECTION

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

END OF SECTION

Part 1 GENERAL

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for equipment specified in Division 21 and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate on drawings:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
 - .2 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable codes.
 - .3 In addition to transmittal letter referred to in Section 01 33 00: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

1.2 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00.
- .2 Operation and Maintenance Data: submit operation and maintenance data for sprinkler heads and fire hose cabinet for incorporation into manual.
 - .1 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
 - .2 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 Colour coding chart.
 - .3 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.

- .4 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93.
- .5 Approvals:
 - .1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
 - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .6 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 Site records:
 - .1 Departmental Representative will provide 1 set of reproducible mechanical drawings. Provide sets of prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
- .8 As-Built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to Departmental Representative for approval and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00.
- .2 Furnish spare parts as follows:

- .1 One set of packing for each pump.
- .2 One casing joint gasket for each size pump.
- .3 One glass for each gauge glass.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00.
- .4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect fire suppression equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Refer to related sections

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that site conditions of are acceptable for installation of fire suppression systems in accordance with manufacturer's written instructions.
 - .1 Visually inspect site conditions where fire suppression systems are to be installed.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Section 09 91 99.
 - .2 Prime and touch up marred finished paintwork to match original.
 - .3 Restore to new condition, finishes which have been damaged.
-

3.3 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.4 DEMONSTRATION

- .1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.
- .5 Departmental Representative will record these demonstrations on video tape for future reference.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .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.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

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

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 National Fire Prevention Association (NFPA)
 - .1 NFPA 13-2010, Standard for the Installation of Sprinkler Systems.
 - .2 NFPA 25-2008, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.
- .2 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC-S543-09, Standard for Internal Lug Quick Connect Coupling for Fire Hose.
 - .2 CAN/ULC-S543-09-AM1, Amendment 1 to Standard for Internal Lug Quick Connect Coupling for Fire Hose.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
 - .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
 - .3 Shop Drawings:
 - .1 Indicate:
 - .1 Materials.
 - .2 Finishes.
 - .3 Temperature Rating.
 - .4 Assembly details.
 - .5 Accessories.
 - .4 Samples:
 - .1 Submit samples of following:
 - .1 Each type of sprinkler head.
 - .2 Graphic sample of signs.
 - .5 Test reports:
 - .1 Submit certified test reports for wet pipe fire protection sprinkler systems from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
 - .6 Certificates:
 - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .7 Manufacturers' Instructions:
 - .1 Provide manufacturer's installation instructions.
-

- .8 Field Quality Control Submittals:
 - .1 Manufacturer's Field Reports: manufacturer's field reports specified.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide operation, maintenance and engineering data for incorporation into manual specified in Section 01 78 00.
- .2 Manufacturer's Catalog Data, including specific model, type, and size for:
 - .1 Pipe and fittings.
 - .2 Sprinkler heads.
 - .3 Mechanical couplings.
- .3 Drawings:
 - .1 Sprinkler heads and piping system layout.
 - .1 Prepare 760 mm by 1050 mm detailed working drawings of system layout in accordance with NFPA 13, "Working Drawings (Plans)".
 - .2 Show data essential for proper installation of each system.
 - .3 Show details, plan view, elevations, and sections of systems supply and piping.
- .4 Field Test Reports:
 - .1 Preliminary tests on piping system.
- .5 Records:
 - .1 As-built drawings of each system.
 - .1 After completion, but before final acceptance, submit complete set of as-built drawings of each system for record purposes.
 - .2 Submit 760 mm by 1050 mm drawings with title block similar to full size contract drawings.
 - .3 Submit as-built drawings in AutoCAD format for recording keeping at completion of project
- .6 Operation and Maintenance Manuals:
 - .1 Provide Contractors Material and Test Certificate for aboveground piping and other documentation for incorporation into manual in accordance with NFPA 13.

1.4 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: company or person specializing in wet sprinkler systems with documented experience.
- .2 Supply grooved joint couplings, fittings, valves, grooving tools and specialties from a single manufacturer. Use date stamped castings for coupling housings, fittings, valve bodies, for quality assurance and traceability.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:

- .1 Provide maintenance materials in accordance with Section 01 78 00.
- .2 Provide spare sprinklers and tools in accordance with NFPA 13.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Storage and Protection:
 - .1 Store materials indoors in dry location.
 - .2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.
- .4 Packaging Waste Management: remove for reuse of pallets, crates, padding, and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

- .1 Locate sprinkler heads in consistent pattern in ceiling. Avoid interference with lights, and air supply diffusers.
- .2 Devices and equipment for fire protection service: ULC approved for use in wet pipe sprinkler systems.
- .3 Location of Sprinkler Heads:
 - .1 Locate heads in relation to ceiling and spacing of sprinkler heads not to exceed that permitted by NFPA 13 for ordinary hazard occupancy.
 - .2 Positioning of sprinkler heads to be similar to existing conditions on site, with new concealed heads located in new drywall ceiling.
- .4 Water Distribution:
 - .1 Make distribution uniform throughout the area in which sprinkler heads will open.
- .5 Delegated Design Requirements: Design sprinkler system required by the Contract Documents meeting requirements of [NFPA 13](#) and Authorities Having Jurisdiction.

2.2 PIPE, FITTINGS AND VALVES

- .1 Pipe:
 - .1 Ferrous: to NFPA 13.
 - .2 Copper tube: to NFPA 13.
- .2 Fittings and joints to NFPA 13:
 - .1 Ferrous: screwed, welded, flanged or roll grooved.

- .1 Grooved joints designed with two ductile iron housing segments, pressure responsive gasket, and zinc-electroplated steel bolts and nuts. Cast with offsetting angle-pattern bolt pads for rigidity and visual pad-to-pad offset contact.
 - .2 Copper tube: screwed, soldered, brazed, grooved.
 - .3 Provide threaded fittings into which sprinkler heads, sprinkler head riser nipples, or drop nipples are threaded.
 - .4 Plain-end fittings with mechanical couplings and fittings which use steel gripping devices to bite into pipe when pressure is applied will not be permitted.
 - .5 Rubber gasketed grooved-end pipe and fittings with mechanical couplings are permitted in pipe sizes 32 mm and larger.
 - .6 Fittings: ULC approved for use in wet pipe sprinkler systems.
 - .7 Ensure fittings, mechanical couplings, and rubber gaskets are supplied by same manufacturer.
 - .8 Side outlet tees using rubber gasketed fittings are not permitted.
 - .9 Sprinkler pipe and fittings: metal.
- .3 Pipe hangers:
- .1 ULC listed for fire protection services in accordance with NFPA.

2.3 SPRINKLER HEADS

- .1 General: to NFPA 13 and ULC listed for fire services.
- .2 Sprinkler Head Type:
 - .1 Upright Heat Fittings: Provide 25 mm diameter nipple and 25 mm x 15 mm reducing fitting for each upright head.
- .3 Provide nominal 1.2 cm orifice sprinkler heads.
 - .1 Release element of each head to be of intermediate temperature rating or higher as suitable for specific application.
 - .2
 - .3 Provide corrosion-resistant sprinkler heads and sprinkler head guards in accordance with NFPA 13.
 - .4 Provide sprinkler heads as indicated on drawings.
 - .5 Deflector: not more than 75 mm below suspended ceilings.
 - .6 Ceiling plates: not more than 25 mm deep.
 - .7 Ceiling cups: not permitted.

2.4 PIPE SLEEVES

- .1 Provide pipe sleeves where piping passes through walls.
- .2 Secure sleeves in position and location during construction.
- .3 Provide sleeves of sufficient length to pass through entire thickness of walls.
- .4 Provide 2.5 cm minimum clearance between exterior of piping and interior of sleeve or core-drilled hole.

- .1 Firmly pack space with mineral wool insulation.
- .2 Seal space at both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to firm but pliable mass.
- .3 In fire walls and fire floors, seal both ends of pipe sleeves or core-drilled holes with ULC listed fill, void, or cavity material.
- .5 Sleeves in Masonry and Concrete Walls, Floors, and Roofs:
 - .1 Provide hot-dip galvanized steel.
 - .2 Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in core-drilled hole are completely grouted smooth.

2.5 ESCUTCHEON PLATES

- .1 Provide split hinge type metal plates for piping passing through walls in exposed spaces.
- .2 Provide polished stainless steel plates in finished spaces.
- .3 Provide paint finish on metal plates in unfinished spaces.

2.6 SIGNS

- .1 Attach properly lettered and approved metal signs to each valve and alarm device to NFPA 13.

2.7 SPARE PARTS CABINET

- .1 Provide metal cabinet with extra sprinkler heads and sprinkler head wrench adjacent to each alarm valve. Number and types of extra sprinkler heads as specified in NFPA 13.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Install, inspect and test to acceptance in accordance with NFPA 13 and NFPA 25.

3.3 PIPE INSTALLATION

- .1 Install piping straight and true to bear evenly on hangers and supports. Do not hang piping from plaster ceilings.
 - .2 Keep interior and ends of new piping and existing piping thoroughly cleaned of water and foreign matter.
 - .3 Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter.
 - .4 Inspect piping before placing into position.
-

3.4 DISINFECTION

- .1 Disinfect new piping and existing piping.
- .2 Fill piping systems with solution containing minimum of 50 parts per million of chlorine and allow solution to stand for minimum of 24 hours.
- .3 Flush solution from systems with clean water until maximum residual chlorine content is not greater than 0.2 part per million or residual chlorine content of domestic water supply.
- .4 Obtain at least two consecutive satisfactory bacteriological samples from piping, analyzed by certified laboratory, and submit results prior to piping being placed into service.

3.5 FIELD QUALITY CONTROL

- .1 Site Test, Inspection:
 - .1 Perform test to determine compliance with specified requirements in presence of Departmental Representative.
 - .2 Test, inspect, and approve piping before covering or concealing.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.6 CLEANING

- .1 Clean in accordance with Section 01 74 11.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for equipment listed in Divisions 21 through 25, 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 Ontario, Canada.
 - .2 Indicate on drawings:
 - .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 33 00: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00.
- .2 Operation and Maintenance Data: submit operation and maintenance data for equipment for incorporation into manual.
 - .1 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
 - .2 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 Colour coding chart.

- .3 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
 - .4 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93.
 - .5 Approvals:
 - .1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
 - .2 Make changes as required and re-submit as directed by Departmental Representative.
 - .6 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
 - .7 Site records:
 - .1 Departmental Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
 - .8 As-built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to Departmental Representative for approval and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
 - .9 Submit copies of as-built drawings for inclusion in final TAB report.
-

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00.
- .2 Furnish spare parts as follows:
 - .1 One set of packing for each pump.
 - .2 One casing joint gasket for each size pump.
 - .3 One glass for each gauge glass.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors, off ground, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not used.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Examination of Existing Conditions
 - .1 Visit and examine the site and note characteristics and features affecting the Work before submitting Bid.
 - .2 Report discrepancies in writing to Consultant prior to Bid closing.
 - .3 No allowances will be made for difficulties encountered or expenses incurred arising from conditions of the site or existing items that are readily visible or known to exist at the time of Bid.
 - .4 Unforeseen conditions or discrepancies that could not be readily ascertained at the time of Bid will be administered as a change to the Contract.

3.2 CUTTING AND PATCHING

- .1 Coordinate requirements of the Work with Section 01 73 29 – Cutting and Patching.
- .2 Coordinate locations of mechanical penetrations and sleeves through concrete floor structure including slabs, beams, purlins and girders; coordinate sleeving locations with other Divisions
 - .1 Contractor will prepare coordination drawings for each floor level of the building indicating requirements of all trades penetrating concrete floor construction.
 - .2 Contractor to obtain sign-off from affected mechanical subtrades having penetrations and sleeves before submitting shop drawings to Consultant for review
- .3 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .4 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.
- .5 Provide inserts, holes and sleeves, cutting and fitting required for mechanical work; relocate improperly located holes and sleeves.
- .6 Provide inserts or drill for expansion bolts, hanger rods, brackets, and supports.
- .7 Obtain written approval from Consultant before drilling, coring, cutting or burning structural members; verify that post tensioned or pre-stressed strands are located accurately and avoid cutting or damaging these elements with an adequate margin of safety.
- .8 The Contractor is responsible to patch and make good building where damaged from equipment installation, improperly located holes and similar criteria.

3.3 EXCAVATION AND BACKFILL

- .1 Refer to other Divisions for requirements affecting this Work.
- .2 Confirm service invert elevations and locations prior to starting work, set grades to suit inverts.
- .3 Provide excavating to facilitate installation of mechanical work, including shoring, pumping, placement of 150 mm compacted sand bedding under and first 300 mm of compacted sand over piping and ducting

3.4 EXISTING SERVICES

- .1 Maintain liaison with Owner to interrupt, re-route, or connect to water, sewer, heating, or gas systems, with minimum interruption of services.
- .2 Do not shut down or make connections to any existing service without written permission from the Owner.
- .3 Confirm elevations and locations of existing services prior to and during excavation.
- .4 Route pipes, ducts, conduits and other services to avoid interference with existing installation.
- .5 Cut back and cap existing services not being used, so that finished Work presents a neat and clean appearance.

- .6 Contractor shall be responsible for any damage to existing systems, including insulation and coverings, when making connections.
- .7 Existing facility to be in operation throughout the duration of Construction, with minimum length of system shut-down periods.
- .8 Include overtime work for tie-in piping, ductwork, or wiring at night or on weekends.
- .9 Provide Consultant with as-built drawings of site services in accordance with Section 01 78 00; dimensioned to grid lines, building exterior walls or other permanent building component.

3.5 EQUIPMENT PROTECTION AND CLEAN-UP

- .1 Protect equipment and materials in storage on site during and after installation until final acceptance; leave factory covers in place; take special precautions to prevent entry of foreign material into working parts of piping and duct systems.
- .2 Protect equipment with polyethylene covers and crates.
- .3 Operate, drain and flush out bearings and refill with new change of oil, before final acceptance.
- .4 Clean piping, ducts and equipment of dirt, cuttings and other foreign substances in accordance with Section 01 74 11.
- .5 Protect bearings and shafts during installation: Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.
- .6 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling unit.

3.6 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Section 09 91 23.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

3.7 SYSTEM CLEANING

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

3.8 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 and submit report as described in PART 1 -ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
-

3.9 DEMONSTRATION

- .1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Trial usage to apply to following equipment and systems:
 - .1 Domestic systems.
 - .2 Sanitary drainage piping
 - .3 Compressed gas systems
- .3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .4 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .5 Instruction duration time requirements as specified in appropriate sections.
- .6 Contractor will record these demonstrations on video tape for future reference.

3.10 PROTECTION

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

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME).
 - .1 ANSI/ASME B16.24-2001(2006), Cast Copper Alloy Pipe Flanges and Flanged Fittings.
- .2 American Society of Mechanical Engineers International (ASME)
 - .1 ASME B16.15-2013, Cast Copper Alloy Threaded Fittings: Classes 125 and 250.
 - .2 ASME B16.18-2012, Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 ASME B16.22-2001(R2005), Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
- .3 ASTM International Inc. (ASTM)
 - .1 ASTM A307-12, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
 - .2 ASTM B88M-13, Standard Specification for Seamless Copper Water Tube (Metric).
- .4 Canadian Standards Association (CSA International)
 - .1 CSA B242-05(R2011), Groove and Shoulder Type Mechanical Pipe Couplings.
- .5 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).
- .6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .7 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
 - .1 MSS-SP-67-2011, Butterfly Valves.
 - .2 MSS-SP-70-2011, Gray Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS-SP-71-2011, Gray Iron Swing Check Valves, Flanged and Threaded Ends.
 - .4 MSS-SP-80-2013, Bronze Gate, Globe, Angle and Check Valves.
- .8 National Research Council (NRC)/Institute for Research in Construction
 - .1 NRCC 47668, National Plumbing Code of Canada (NPC) - 2010.
- .9 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992, c. 34 (TDGA).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for insulation and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Packaging Waste Management:
 - .1 Separate and recycle waste materials in accordance with Section 01 74 20.
- .2 Place materials defined as hazardous or toxic in designated containers.
- .3 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.

Part 2 PRODUCTS

2.1 PIPING

- .1 Domestic cold systems, within building.
 - .1 Above ground: copper tube, hard drawn, type L: to ASTM B88M.
 - .2 Buried or embedded: copper tube, soft annealed, type K: to ASTM B88M, in long lengths and with no buried joints.

2.2 FITTINGS

- .1 Bronze pipe flanges and flanged fittings, Class 150 and 300: to ANSI/ASME B16.24.
- .2 Cast bronze threaded fittings, Class 125 and 250: to ASME B16.15.
- .3 Cast copper, solder type: to ASME B16.18.
- .4 Wrought copper and copper alloy, solder type: to ASME B16.22.
- .5 NPS 2 and larger: roll grooved to CSA B242.

2.3 JOINTS

- .1 Rubber gaskets, latex-free 1.6 mm thick: to AWWA C111.
 - .2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.
 - .3 Solder: lead free.
 - .4 Teflon tape: for threaded joints.
 - .5 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM flush seal gasket.
 - .6 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.
-

2.4 GATE VALVES

- .1 NPS 2 and under, soldered:
 - .1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc.
- .2 NPS 2 and under, screwed:
 - .1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc.

2.5 SWING CHECK VALVES

- .1 NPS 2 and under, soldered:
 - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat.
- .2 NPS 2 and under, screwed:
 - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat.

2.6 BALL VALVES

- .1 NPS 2 and under, screwed:
 - .1 Class 150.
 - .2 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle.
- .2 NPS 2 and under, soldered:
 - .1 To ANSI/ASME B16.18, Class 150.
 - .2 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle, with NPT to copper adaptors.

Part 3 EXECUTION

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install in accordance with NPC.
 - .2 Install pipe work in accordance with Section 23 05 01, supplemented as specified herein.
 - .3 Assemble piping using fittings manufactured to ANSI standards.
 - .4 Install CWS piping below and away from HWS and HWC and other hot piping so as to maintain temperature of cold water as low as possible.
-

- .5 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.
- .6 Buried tubing:
 - .1 Lay in well compacted washed sand in accordance with AWWA Class B bedding.
 - .2 Bend tubing without crimping or constriction. Minimize use of fittings.

3.3 VALVES

- .1 Isolate equipment, fixtures and branches with ball valves.

3.4 PRESSURE TESTS

- .1 Conform to requirements of Section 22 05 01.
- .2 Test pressure: greater of 1 times maximum system operating pressure or 860 kPa.

3.5 FLUSHING AND CLEANING

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

3.6 PRE-START-UP INSPECTIONS

- .1 Systems to be complete, prior to flushing, testing and start-up.
- .2 Verify that system can be completely drained.
- .3 Ensure that pressure booster systems are operating properly.
- .4 Ensure that air chambers, expansion compensators are installed properly.

3.7 DISINFECTION

- .1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction.
- .2 Upon completion, provide laboratory test reports on water quality for Departmental Representative approval.

3.8 START-UP

- .1 Timing: Start up after:
 - .1 Pressure tests have been completed.
 - .2 Disinfection procedures have been completed.
 - .3 Certificate of static completion has been issued.
 - .4 Water treatment systems operational.
 - .2 Provide continuous supervision during start-up.
 - .3 Start-up procedures:
 - .1 Establish circulation and ensure that air is eliminated.
 - .2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.
-

- .3 Bring domestic hot water storage tank up to design temperature slowly.
- .4 Monitor piping systems for freedom of movement, pipe expansion as designed.
- .5 Check control, limit, safety devices for normal and safe operation.
- .4 Rectify start-up deficiencies.

3.9 PERFORMANCE VERIFICATION

- .1 Scheduling:
 - .1 Verify system performance after pressure and leakage tests and disinfection are completed, and Certificate of Completion has been issued by authority having jurisdiction.
- .2 Procedures:
 - .1 Verify that flow rate and pressure meet Design Criteria.
 - .2 TAB in accordance with Section 23 05 93.
 - .3 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.
 - .4 Sterilize piping systems for Legionella control.
 - .5 Verify performance of temperature controls.
 - .6 Verify compliance with safety and health requirements.
 - .7 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.
 - .8 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.
- .3 Reports:
 - .1 In accordance with Section 01 91 13: Reports, using report forms as specified in Section 01 91 13: Report Forms and Schematics.

3.10 OPERATION REQUIREMENTS

- .1 Co-ordinate operation and maintenance requirements including, cleaning and maintenance of specified materials and products with Section 23 05 01.

3.11 CLEANING

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

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 22 11 16: Domestic Water Piping

1.2 REFERENCES

- .1 ASTM International Inc.
 - .1 ASTM B32-08, Standard Specification for Solder Metal.
 - .2 ASTM B306-13, Standard Specification for Copper Drainage Tube (DWV).
 - .3 ASTM C564-12, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- .2 Canadian Standards Association (CSA International).
 - .1 CSA B67-1972(R1996), Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories. NOT ON CSA WEB SITE use another reference standard.
 - .2 CSA B70-12, Cast Iron Soil Pipe, Fittings and Means of Joining.
 - .3 CSA B125.3-12, Plumbing Fittings.
- .3 Green Seal Environmental Standards (GSES)
 - .1 Standard GS-36-00, Commercial Adhesives.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- .1 Above ground sanitary, storm, and vent: Type DWV to: ASTM B306.
 - .1 Fittings.
 - .1 Cast brass: to CSA B125.3.
-

- .2 Wrought copper: to CSA B125.3.
- .2 Solder: lead free, to ASTM B32.

2.2 CAST IRON PIPING AND FITTINGS

- .1 Buried sanitary, storm, and vent minimum NPS 3, to: CSA B70.
 - .1 Joints:
 - .1 Mechanical joints:
 - .1 Neoprene or butyl rubber compression gaskets: to CSA B70. ASTM C564 or
 - .2 Stainless steel clamps.
 - .2 Hub and spigot:
 - .1 Caulking lead: to CSA B67.
 - .2 Cold caulking compounds.
 - .2 Above ground sanitary, storm and vent: to CSA B70.
 - .1 Joints:
 - .1 Hub and spigot:
 - .1 Caulking lead: to CSA B67.
 - .2 Mechanical joints:
 - .1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

Part 3 EXECUTION

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 In accordance with Section 22 05 00.
- .2 Install in accordance with National Plumbing Code and local authority having jurisdiction.

3.3 TESTING

- .1 Pressure test buried systems before backfilling.
- .2 Hydraulically test to verify grades and freedom from obstructions.

3.4 PERFORMANCE VERIFICATION

- .1 Cleanouts:
 - .1 Ensure accessible and that access doors are correctly located.
 - .2 Open, cover with linseed oil and re-seal.
 - .3 Verify that cleanout rods can probe as far as the next cleanout, at least.

- .2 Test to ensure traps are fully and permanently primed.
- .3 Storm water drainage:
 - .1 Verify domes are secure.
 - .2 Ensure weirs are correctly sized and installed correctly.
 - .3 Verify provisions for movement of roof system.
- .4 Ensure that fixtures are properly anchored, connected to system and effectively vented.
- .5 Affix applicable label (storm, sanitary, vent, pump discharge etc.) c/w directional arrows every floor or 4.5 m (whichever is less).

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 11
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation for piping, fittings, equipment used in compressed air systems.

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME Boiler and Pressure Vessel Code Section VIII Pressure Vessels.
 - .1 BPVC-VIII B - 2010, BPVC Section VIII - Rules for Construction of Pressure Vessels Division 1.
 - .2 BPVC-VIII-2 B - 2100, BPVC Section VIII - Rules for Construction of Pressure Vessels Division 2 - Alternative Rules.
 - .3 BPVC-VIII-3 B - 2010, BPVC Section VIII - Rules for Construction of Pressure Vessels Division 3 - Alternative Rules High Press Vessels.
 - .2 ASME B16.5-2009, Pipe Flanges and Flanged Fittings.
 - .3 ASME B16.11-2009, Forged Fittings, Socket-Welding and Threaded.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A53-12/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A181-13/A181M-13, Standard Specification for Carbon Steel Forgings for General Purpose Piping.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.
 - .2 Submit WHMIS MSDS. Indicate VOC's for adhesive and solvents during application and curing.
 - .3 Included accepted product data in Operations and Maintenance Manual in accordance with Section 01 78 00.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.
-

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .3 Separate for reuse and recycling and place in designated containers in accordance with Waste Management Plan (WMP).
Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal, regulations.

Part 2 PRODUCTS

2.1 PIPING

- .1 Piping: to ASTM A53/A53M, schedule 80 seamless black steel.
- .2 Fittings:
 - .1 NPS2 and smaller: to ASME B16.11, schedule 80 steel, socket welded.
 - .2 NPS2 1/2 and larger: to ASME B16.11, schedule 80 steel, butt or socket welded.
- .3 Couplings: to ASME B16.11, socket welded or threaded half coupling type.
- .4 Unions: 1000 kPa malleable iron with brass-to-iron ground seat.
- .5 Dissimilar metal junctions: use dielectric unions.
- .6 Flanges:
 - .1 NPS2 and smaller: to ASME B16.5, forged steel, raised face and socket welded.
 - .2 NPS2 1/2 and larger: to ASME B16.5, forged steel, raised face and slip-on or weld neck.
- .7 Joints:
 - .1 NPS2 and smaller: socket welded.
 - .2 NPS2 1/2 and larger: butt welded.

2.2 BALL VALVES

- .1 Three piece design or top entry for ease of in-line maintenance.
 - .1 To ASTM A181/A181M, Class 70, carbon steel body screwed ends, carbon steel ball and associated trim suitable for compressed air application.
 - .2 To withstand 1034 kPa maximum pressure.

2.3 COUPLERS/CONNECTORS

- .1 Industrial interchange series, full-bore.
- .2 Maximum inlet pressure: 1700 kPa.
- .3 Valve seat: moulded nylon.

- .4 Body: zinc plated steel.
- .5 Threads: NPT.

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 COMPRESSED AIR PIPING CONNECTIONS AND INSTALLATION

- .1 Install flexible connection in accordance with Section 23 05 16.
- .2 Install shut-off valves at outlets, major branch lines and in locations as indicated.
- .3 Install quick-coupler chucks and pressure gauges on drop pipes.
- .4 Install unions to permit removal or replacement of equipment.
- .5 Install tees in lieu of elbows at changes in direction of piping. Install plug in open ends of tees.
- .6 Grade piping at 1% slope minimum.
- .7 Install compressed air trap and pressure equalizing pipe at moisture collecting points. Drain pipe to nearest floor drain.
- .8 Make branch connections from top of main.
- .9 Install compressed air trap at bottom of risers and at low points in mains, piped to nearest drain. Distance between drain points to be 30 m maximum.
- .10 Weld steel piping in accordance with Section 23 05 17 and;
 - .1 To ASME code and requirements of authority having jurisdiction.
 - .2 Weld concealed and inaccessible piping regardless of size.

3.3 FIELD QUALITY CONTROL

- .1 Site Tests/Inspection:
 - .1 Testing: pressure test in accordance with requirements of Section 22 05 01, for 4 h minimum, to 1100 kPa, with outlets closed and with compressor isolated from system. Pressure drop not to exceed 10 kPa.
- .2 Obtain reports within 3 days of review and submit immediately to Departmental Representative.

3.4 CLEANING

- .1 Refer to Section 22 05 01.
 - .2 Cleaning: blow out piping to clean interior thoroughly of oil and foreign matter.
 - .3 Check entire installation is approved by authority having jurisdiction.
-

Part 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 51 00 - Temporary Utilities.

1.2 USE OF SYSTEMS

- .1 Use of new and existing permanent heating and ventilating systems for supplying temporary heat or ventilation is permitted only under the following conditions:
 - .1 Active portion of system is complete, pressure tested, cleaned, flushed out.
 - .2 Specified water treatment system has been commissioned, water treatment is being continuously monitored.
 - .3 Areas of the building under construction have been closed in, and 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 60% 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.
- .3 Exhaust systems are not included in any approvals for temporary heating ventilation.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 CONNECTIONS TO EQUIPMENT

- .1 In accordance with manufacturer's instructions unless otherwise indicated.
- .2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.
- .3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.3 CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.
-

- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, components.

3.4 DRAINS

- .1 Install piping with grade in direction of flow except as indicated.
- .2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.
- .3 Pipe each drain valve discharge separately to above floor drain. Discharge to be visible.
- .4 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.5 AIR VENTS

- .1 Install automatic air vents at high points in piping systems.
- .2 Install isolating valve at each automatic air valve.
- .3 Install drain piping to approved location and terminate where discharge is visible.

3.6 DIELECTRIC COUPLINGS

- .1 General: compatible with system, to suit pressure rating of system.
- .2 Locations: where dissimilar metals are joined.
- .3 NPS 2 and under: isolating unions or bronze valves.
- .4 Over NPS 2: isolating flanges.

3.7 PIPEWORK INSTALLATION

- .1 Screwed fittings jointed with Teflon tape.
 - .2 Protect openings against entry of foreign material.
 - .3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
 - .4 Assemble piping using fittings manufactured to ANSI standards.
 - .5 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.
 - .1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.
 - .6 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
 - .7 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
 - .8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
 - .9 Install, except where indicated, to permit separate thermal insulation of each pipe.
-

- .10 Group piping wherever possible.
- .11 Ream pipes, remove scale and other foreign material before assembly.
- .12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .13 Provide for thermal expansion as indicated.
- .14 Valves:
 - .1 Install in accessible locations.
 - .2 Remove interior parts before soldering.
 - .3 Install with stems above horizontal position unless otherwise indicated.
 - .4 Valves accessible for maintenance without removing adjacent piping.
 - .5 Install globe valves in bypass around control valves.
 - .6 Use ball valves at branch take-offs for isolating purposes except where otherwise specified.
 - .7 Install butterfly valves on chilled water and related condenser water systems only.
 - .8 Install butterfly valves between weld neck flanges to ensure full compression of liner.
 - .9 Install ball valves for glycol service.
 - .10 Use chain operators on valves NPS 2 1/2 and larger where installed more than 2400mm above floor in Mechanical Rooms.
- .15 Check Valves:
 - .1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and elsewhere as indicated.
 - .2 Install swing check valves in horizontal lines on discharge of pumps and elsewhere as indicated.

3.8 SLEEVES

- .1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.
- .2 Material: schedule 40 black steel pipe.
- .3 Construction: foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.
- .4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 Installation:
 - .1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.
 - .2 Other floors: terminate 25 mm above finished floor.
 - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.

- .6 Sealing:
 - .1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.
 - .2 Elsewhere: Provide space for firestopping. Maintain fire rating integrity.
 - .3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.
 - .4 Ensure no contact between copper pipe or tube and sleeve.

3.9 ESCUTCHEONS

- .1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.
- .2 Construction: one piece type with set screws. Chrome or nickel plated brass or type 302 stainless steel.
- .3 Sizes: outside diameter to cover opening or sleeve. Inside diameter to fit around pipe or outside of insulation if so provided.

3.10 PREPARATION FOR FIRE STOPPING

- .1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to Section 07 84 00.
- .2 Uninsulated unheated pipes not subject to movement: No special preparation.
- .3 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe movement without damaging fires topping material or installation.
- .4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

3.11 FLUSHING OUT OF PIPING SYSTEMS

- .1 Flush system in accordance with Section 23 08 02.
- .2 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 11 supplemented as specified in relevant mechanical sections.
- .3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.12 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

- .1 Advise Departmental Representative 48 hours minimum prior to performance of pressure tests.
 - .2 Piping: test as specified in relevant sections of heating, ventilating and air conditioning work.
 - .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.
 - .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
 - .5 Conduct tests in presence of Departmental Representative.
-

- .6 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests by Departmental Representative.

3.13 EXISTING SYSTEMS

- .1 Connect into existing piping systems at times approved by Departmental Representative.
- .2 Request written approval 7 days minimum, prior to commencement of work.
- .3 Be responsible for damage to existing plant by this work.
- .4 Ensure daily clean-up of existing areas.

3.14 CLEANING

- .1 Clean in accordance with Section 01 74 11.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE 90.1-2010, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings (ANSI/ASHRAE/IES).
- .2 Electrical Equipment Manufacturers' Advisory Council (EEMAC)

1.2 SECTIONS INCLUDES

- .1 Electrical work to conform to Electrical Divisions 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.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 33 00.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
- .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 utility company standards and the requirements of ASHRAE 90.1.

2.2 MOTORS

- .1 Provide motors for mechanical equipment as specified.
-

- .2 If delivery of specified motor will delay delivery or installation of equipment, install motor approved by Departmental Representative for temporary use. Final acceptance of equipment will not occur until specified motor is installed.
- .3 Motors under 373 W (1/2 HP): speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.
- .4 Motors 373 W (1/2 HP) and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 °C, 3 phase, 575 V, unless otherwise specified or indicated.

2.3 TEMPORARY MOTORS

- .1 If delivery of specified motor will delay completion or commissioning work, install motor approved by Departmental Representative for temporary use. Work will only be accepted when specified motor is installed.

2.4 BELT DRIVES

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise 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.
- .8 Supply one set of spare belts for each set installed in accordance with Section 01 78 00.

2.5 DRIVE GUARDS

- .1 Provide guards for unprotected drives.
- .2 Guards for belt drives;
 - .1 Expanded metal screen welded to steel frame.
 - .2 Minimum 1.2 mm thick sheet metal tops and bottoms.
 - .3 38 mm dia holes on both shaft centres for insertion of tachometer.
 - .4 Removable for servicing.
- .3 Provide means to permit lubrication and use of test instruments with guards in place.
- .4 Install belt guards to allow movement of motors for adjusting belt tension.
- .5 Guard for flexible coupling:
 - .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.

- .2 Securely fasten in place.
- .3 Removable for servicing.
- .6 Unprotected fan inlets or outlets:
 - .1 Wire or expanded metal screen, galvanized, 19 mm mesh.
 - .2 Net free area of guard: not less than 80% of fan openings.
 - .3 Securely fasten in place.
 - .4 Removable for servicing.

Part 3 EXECUTION

3.1 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 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B31.1-2010, Power Piping.
- .2 ASTM International
 - .1 ASTM A125-96(2007), Standard Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A307-10, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A563-07a, Standard Specification for Carbon and Alloy Steel Nuts.
- .3 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP 58-2009, Pipe Hangers and Supports - Materials, Design and Manufacture.
 - .2 MSS SP 69-2003, Pipe Hangers and Supports - Selection and Application.
 - .3 MSS SP 89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit shop drawings for:
 - .1 Bases, hangers and supports.
 - .2 Connections to equipment and structure.
 - .3 Structural assemblies.
- .4 Certificates:
 - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Manufacturers' Instructions:
 - .1 Provide manufacturer's installation instructions.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
 - .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP 58.
 - .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 SP 58.

2.2 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with MSS SP 58 and ASME B31.1.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.3 PIPE HANGERS

- .1 Finishes:
 - .1 Pipe hangers and supports: galvanized after manufacture.
 - .2 Use hot dipped galvanizing process.
 - .3 Ensure steel hangers in contact with copper piping are epoxy coated.
- .2 Upper attachment structural: suspension from lower flange of I-Beam:
 - .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
 - .1 Rod: 9 mm UL listed.

- .3 Upper attachment structural: suspension from upper flange of I-Beam:
 - .1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed.
 - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed.
- .4 Upper attachment to concrete:
 - .1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
 - .2 Concrete inserts: wedge shaped body with knockout protector plate UL listed to MSS SP 69.
- .5 Shop and field-fabricated assemblies:
 - .1 Trapeze hanger assemblies: As indicated on drawings.
 - .2 Steel brackets: As indicated on drawings.
- .6 Hanger rods: threaded rod material to MSS SP 58:
 - .1 Ensure that hanger rods are subject to tensile loading only.
 - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
 - .3 Do not use 22 mm or 28 mm rod.
- .7 Pipe attachments: material to MSS SP 58:
 - .1 Attachments for steel piping: carbon steel galvanized.
 - .2 Attachments for copper piping: copper plated black steel.
 - .3 Use insulation shields for hot pipework.
 - .4 Oversize pipe hangers and supports.
- .8 Adjustable clevis: material to MSS SP 69 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
 - .1 Ensure "U" has hole in bottom for rivetting to insulation shields.
- .9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP 69.
- .10 U-bolts: carbon steel to MSS SP 69 with 2 nuts at each end to ASTM A563.
 - .1 Finishes for steel pipework: galvanized.
 - .2 Finishes for copper, glass, brass or aluminum pipework: galvanized, with formed epoxy coated.
- .11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP 69.

2.4 INSULATION PROTECTION SHIELDS

- .1 Insulated cold piping:
 - .1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP 69, galvanized sheet carbon steel. Length designed for maximum 3 m span.

- .2 Insulated hot piping:
 - .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP 69.

2.5 CONSTANT SUPPORT SPRING HANGERS

- .1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR).
- .2 Load adjustability: 10% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.
- .3 Provide upper and lower factory set travel stops.
- .4 Provide load adjustment scale for field adjustments.
- .5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.
- .6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.6 VARIABLE SUPPORT SPRING HANGERS

- .1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.
- .2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.
- .3 Variable spring hanger complete with factory calibrated travel stops..
- .4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.7 EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 12 23. Submit calculations with shop drawings.

2.8 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

- .1 Provide templates to ensure accurate location of anchor bolts.

2.9 OTHER EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports from structural grade steel meeting requirements of Section 05 12 23.
 - .2 Submit structural calculations with shop drawings.
-

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Install in accordance with:
 - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
 - .1 Install on piping systems at pumps, boilers, chillers, cooling towers, and as indicated.
- .3 Clamps on riser piping:
 - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
 - .2 Bolt-tightening torques to industry standards.
 - .3 Steel pipes: install below coupling or shear lugs welded to pipe.
 - .4 Cast iron pipes: install below joint.
- .4 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .6 Use approved constant support type hangers where:
 - .1 Vertical movement of pipework is 13 mm or more,
 - .2 Transfer of load to adjacent hangers or connected equipment is not permitted.
- .7 Use variable support spring hangers where:
 - .1 Transfer of load to adjacent piping or to connected equipment is not critical.
 - .2 Variation in supporting effect does not exceed 25 % of total load.

3.3 HANGER SPACING

- .1 Plumbing piping: to National Plumbing Code.
- .2 Fire protection: to National Fire Code and requirements of authority having jurisdiction.
- .3 Gas piping: up to NPS 1/2: every 1.8 m.
- .4 Copper piping: up to NPS 1/2: every 1.5 m.
- .5 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.

- .6 Within 300 mm of each elbow.

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.4 m	1.8 m
1-1/2	3.0 m	2.4 m
2	3.0 m	2.4 m
2-1/2	3.7 m	3.0 m
3	3.7 m	3.0 m
3-1/2	3.7 m	3.3 m
4	3.7 m	3.6 m
5	4.3 m	
6	4.3 m	
8	4.3 m	
10	4.9 m	
12	4.9 m	

- .7 Pipework greater than NPS 12: to MSS SP 69.

3.4 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.5 HORIZONTAL MOVEMENT

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
- .2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 FINAL ADJUSTMENT

- .1 Adjust hangers and supports:
- .1 Ensure that rod is vertical under operating conditions.
- .2 Equalize loads.
- .2 Adjustable clevis:
- .1 Tighten hanger load nut securely to ensure proper hanger performance.
- .2 Tighten upper nut after adjustment.
- .3 C-clamps:
- .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
- .1 Hammer jaw firmly against underside of beam.

3.7 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.8 CLEANING

- .1 Clean in accordance with Section 01 74 11.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 National Fire Protection Association (NFPA)
 - .1 NFPA 13-2009, Installation of Sprinkler Systems.
- .2 National Building Code of Canada (NBC) 2010.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Provide system shop drawings complete with performance and product data.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
- .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 corrugated cardboard, polystyrene, plastic packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

Part 2 PRODUCTS

2.1 GENERAL

- .1 Size and shape of bases type and performance of vibration isolation to be as indicated.

2.2 ELASTOMERIC PADS

- .1 Type EP1 - neoprene waffle or ribbed; 9mm minimum thick; 50 durometer; maximum loading 350 kPa.
- .2 Type EP2 - rubber waffle or ribbed; 9 mm minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.
- .3 Type EP3 - neoprene-steel-neoprene; 9 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.
- .4 Type EP4 - rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.

2.3 ELASTOMERIC MOUNTS

- .1 Type M1 - colour coded; neoprene in shear; maximum durometer of 60; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.
-

2.4 SPRINGS

- .1 Design stable springs so that ratio of lateral to axial stiffness is equal to or greater than 1.2 times the ratio of static deflection to working height. Select for 50% travel beyond rated load. Units to be complete with levelling devices.
- .2 Ratio of height when loaded to diameter of spring to be between 0.8 to 1.0.
- .3 Cadmium plate for outdoor 100% relative humidity installations.
- .4 Colour code springs.

2.5 SPRING MOUNT

- .1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.
- .2 Type M2 - stable open spring; support on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad.
- .3 Type M3 - stable open spring; 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.
- .4 Type M4 - restrained stable open spring; supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.
- .5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg maximum.

2.6 HANGERS

- .1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30° arc without metal to metal contact.
- .2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.
- .3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.
- .4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.
- .5 Type H4 - stable spring, elastomeric element with precompression washer and nut with deflection indicator.

2.7 ROOF CURB ISOLATION RAILS

- .1 General: complete factory assembled without need for sub-base.
 - .2 Lower member: continuous rectangular steel tube.
 - .3 Upper member: continuous rectangular steel tube to provide continuous support for equipment, complete with all-directional neoprene snubber bushings 6 mm thick to resist wind forces.
 - .4 Springs: steel, adjustable, removable, selected for 25 mm maximum static deflection plus 50% additional travel to solid, cadmium plated, sized and positioned to ensure uniform deflection.
-

- .5 High frequency isolation: 6mm minimum thick continuous gasket on top and bottom of complete assembly or pads on top and bottom of each spring. Material: closed cell neoprene.
- .6 Weatherproofing: continuous flexible counterflashing to curb and providing access to springs. Material: aluminum.
- .7 Hardware: cadmium plated or galvanized.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Install vibration isolation equipment in accordance with manufacturer's instructions and adjust mountings to level equipment.
- .2 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.
- .3 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:
 - .1 Up to NPS4: first 3 points of support. NPS5 to NPS8: first 4 points of support. NPS10 and Over: first 6 points of support.
 - .2 First point of support shall have a static deflection of twice deflection of isolated equipment, but not more than 50 mm.
- .4 Where isolation is bolted to floor use vibration isolation rubber washers.
- .5 Block and shim level bases so that ductwork and piping connections can be made to a rigid system at the operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.2 TESTING

- .1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC systems after start up and TAB of systems to Section 23 05 93.
- .2 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations (including sound curves).
- .3 Submit complete report of test results including sound curves.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA-B149.1-10, Natural Gas and Propane Installation Code.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
 - .2 CAN/CGSB-24.3-92, Identification of Piping Systems.
- .3 National Fire Protection Association (NFPA)
 - .1 NFPA 13-2010, Standard for the Installation of Sprinkler Systems.
 - .2 NFPA 14-2010, Standard for the Installation of Standpipe and Hose Systems.

1.2 SUBMITTALS

- .1 Product Data: submit product data for each item specified.
- .2 Submittals: in accordance with Section 01 33 00.
- .3 Product data to include paint colour chips, other products specified in this section.
- .4 Samples:
 - .1 Submit samples in accordance with Section 01 33 00.
 - .2 Samples to include nameplates, labels, tags, lists of proposed legends.

1.3 QUALITY ASSURANCE

- .1 Quality assurance submittals: submit following in accordance with Section 01 33 00.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00.
 - .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 74 20.
 - .2 Dispose of unused paint material at official hazardous material collections site.
 - .3 Do not dispose of unused paint material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

Part 2 PRODUCTS

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers raised or recessed.
- .3 Information to include, as appropriate:
 - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
 - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

- .1 Colours:
 - .1 Hazardous: red letters, white background.
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
 - .1 3 mm thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
 - .1 Conform to following table:

Size #	mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1		10 x 50	1	3
2		13 x 75	1	5
3		13 x 75	2	3
4		20 x 100	1	8
5		20 x 100	2	5
6		20 x 200	1	8
7		25 x 125	1	12
8		25 x 125	2	8
9		35 x 200	1	20
 - .2 Use maximum of 25 letters/numbers per line.
- .4 Locations:
 - .1 Terminal cabinets, control panels: use size #5.
 - .2 Equipment in Mechanical Rooms: use size #9.
- .5 Identification for PWGSC Preventive Maintenance Support System (PMSS):
 - .1 Use arrangement of Main identifier, Source identifier, Destination identifier.
 - .2 Equipment in Mechanical Room:
 - .1 Main identifier: size #9.
 - .2 Source and Destination identifiers: size #6.

- .3 Terminal cabinets, control panels: size #5.
- .3 Equipment elsewhere: sizes as appropriate.

2.3 EXISTING IDENTIFICATION SYSTEMS

- .1 Apply existing identification system to new work.
- .2 Where existing identification system does not cover for new work, use identification system specified this section.
- .3 Before starting work, obtain written approval of identification system from Departmental Representative.

2.4 PIPING SYSTEMS GOVERNED BY CODES

- .1 Identification:
 - .1 Natural gas: to CAN/CSA-B149.1
 - .2 Sprinklers: to NFPA 13.
 - .3 Standpipe and hose systems: to NFPA 14.

2.5 IDENTIFICATION OF PIPING SYSTEMS

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB-24.3 except where specified otherwise.
- .2 Pictograms:
 - .1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.
- .3 Legend:
 - .1 Block capitals to sizes and colours listed in CAN/CGSB-24.3.
- .4 Arrows showing direction of flow:
 - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
 - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
 - .3 Use double-headed arrows where flow is reversible.
- .5 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
 - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
 - .2 Other pipes: pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150°C and intermittent temperature of 200°C.

.7 Colours and Legends:

.1 Where not listed, obtain direction from Departmental Representative.

.2 Colours for legends, arrows: to following table:

<u>Background colour:</u>	<u>Legend, arrows:</u>
Yellow	BLACK
Green	WHITE
Red	WHITE

.3 Background colour marking and legends for piping systems:

<u>Contents</u>	<u>Background colour marking</u>	<u>Legend</u>
Chilled water supply	Green	CH. WTR. SUPPLY
Chilled water return	Green	CH. WTR. RETURN
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
High temp HW Htg. Supply	Yellow	HTHW HTG. SUPPLY++
High temp HW Htg. Return	Yellow	HTHW HTG. RETURN++
Make-up water	Yellow	MAKE-UP WTR
Boiler feed water	Yellow	BLR. FEED WTR
Steam	Yellow	STEAM
Steam condensate (gravity)	Yellow	ST.COND.RET (GRAVITY)
Steam condensate (pumped)	Yellow	ST.COND.RET (PUMPED)
Safety valve vent	Yellow	STEAM VENT
Intermittent blow-off	Yellow	INT. BLOW-OFF
Continuous blow-off	Yellow	CONT. BLOW-OFF
Domestic hot water supply	Green	DOM. HW SUPPLY
Dom. HWS recirculation	Green	DOM. HW CIRC
Domestic cold water supply	Green	DOM. CWS
Acid waste	Yellow	ACID WASTE (add source)
Storm water	Green	STORM
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Refrigeration suction	Yellow	REF. SUCTION
Refrigeration liquid	Yellow	REF. LIQUID
Refrigeration hot gas	Yellow	REF. HOT GAS
Natural gas	to Codes	
Gas regulator vents	to Codes	
Distilled water	Green	DISTILL. WTR
Demineralized water	Green	DEMIN. WATER
Compressed air (<700kPa)	Green	COMP. AIR LP kPa
Compressed air (>700kPa)	Yellow	COMP. AIR HP kPa
Vacuum	Green	VACUUM
Fire protection water	Red	FIRE PROT. WTR
Sprinklers	Red	SPRINKLERS

Instrument air

Green

INSTRUMENT AIR

2.6 IDENTIFICATION DUCTWORK SYSTEMS

- .1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.
- .2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

2.7 VALVES, CONTROLLERS

- .1 Brass tags with 12 mm stamped identification data filled with black paint.
- .2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.8 CONTROLS COMPONENTS IDENTIFICATION

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.
- .2 Inscriptions to include function and (where appropriate) fail-safe position.

2.9 LANGUAGE

- .1 Identification in English.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 TIMING

- .1 Provide identification only after painting specified Section 09 91 23 has been completed.

3.3 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC and CSA registration plates as required by respective agency.
- .3 Identify systems, equipment to conform to PWGSC PMSS.

3.4 NAMEPLATES

- .1 Locations:
 - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs:
 - .1 Provide for nameplates on hot and/or insulated surfaces.

- .3 Protection:
 - .1 Do not paint, insulate or cover.

3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification easily and accurately readable from usual operating areas and from access points.
 - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.6 VALVES, CONTROLLERS

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Departmental Representative. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively.

3.7 CLEANING

- .1 Proceed in accordance with Section 01 74 11.
- .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 RELATED REQUIREMENTS

- .1 Section 23 05 93.13 Testing, Adjusting, and Balancing of Fume Hoods

1.3 QUALIFICATIONS OF TAB PERSONNEL

- .1 Names of personnel it is proposed to perform TAB to be submitted to and approved by Departmental Representative within 60 days of award of contract.
- .2 Personnel to be member in good standing of AABC.
- .3 Provide documentation confirming qualifications, successful experience.

1.4 PURPOSE OF TAB

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads
- .2 Adjust and regulate equipment and systems 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 equipment to regulate flow rates to match load requirements over full operating ranges.

1.5 EXCEPTIONS

- .1 TAB of systems and equipment regulated by codes, standards to be to satisfaction of authority having jurisdiction.

1.6 CO-ORDINATION

- .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.

1.7 PRE-TAB REVIEW

- .1 Review contract documents before project construction is started and confirm in writing to Departmental Representative adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
 - .2 Review specified standards and report to Departmental Representative in writing all proposed procedures which vary from standard.
-

- .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.8 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.

1.9 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.

1.10 START OF TAB

- .1 Notify Departmental Representative 7 days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:
 - .3 Installation of ceilings, doors, windows, other construction affecting TAB.
 - .4 Application of weatherstripping, sealing, caulking.
 - .5 All pressure, leakage, other tests specified elsewhere in Division 23.
 - .6 All provisions for TAB installed and operational.
 - .7 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
 - .1 Proper thermal overload protection in place for electrical equipment.
 - .2 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.

1.11 APPLICATION TOLERANCES

- .1 Do TAB to following tolerances of design values:
 - .1 Laboratory HVAC systems: plus 10%, minus 0%.
 - .2 Office and support space HVAC systems: plus 5%, minus 5 %.
 - .3 Hydronic systems: plus or minus 10%.

1.12 ACCURACY TOLERANCES

- .1 Measured values to be accurate to within plus or minus 2% of actual values.

1.13 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.

1.14 SUBMITTALS

- .1 Submit, prior to commencement of TAB:
- .2 Proposed methodology and procedures for performing TAB if different from referenced standard.
- .3 Submit preliminary TAB Report and final TAB Report as indicated below.

1.15 PRELIMINARY TAB REPORT

- .1 Submit for checking and approval of Departmental Representative, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
 - .1 Date testing work is performed.
 - .2 Details of instruments used.
 - .3 Details of TAB procedures employed.
 - .4 Calculations procedures.
 - .5 Summaries.

1.16 TAB REPORT

- .1 Format to be in accordance with AABC guidelines.
- .2 TAB report to show results in SI units and to include:
 - .1 Project record drawings.
 - .2 System schematics.
- .3 Submit 6 copies of TAB Report to Departmental Representative for verification and approval, in English in D-ring binders, complete with index tabs.
- .4 Submit electronic copy of TAB Report in PDF format.

1.17 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 Bear costs to repeat TAB as required to satisfaction of Departmental Representative.

1.18 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.

1.19 COMPLETION OF TAB

- .1 TAB to be considered complete when final TAB Report received and approved by Departmental Representative.

1.20 AIR SYSTEMS

- .1 Standard: TAB to be to most stringent of this section or TAB standards of AABC.
 - .2 Do TAB of the following systems, equipment, components, controls:
 - .1 MAU-1
 - .2 EF-1
 - .3 Terminal Boxes
 - .4 Air Conditioning Units
 - .3 Qualifications: personnel performing TAB to be current member in good standing of AABC.
 - .4 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
 - .5 Locations of equipment measurements: To include, but not be limited to, following as appropriate:
 - .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
 - .2 At controllers, controlled device.
 - .6 Locations of systems measurements to include, but not be limited to, following as appropriate: Traverse readings at main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).
-

- .7 Make Up Air Units
 - .1 Measure and report the following values as a minimum, as applicable:
 - .1 Design Data
 - .1 Supply air flow rate
 - .2 Supply air fan current draw
 - .3 Outdoor air flow rate
 - .4 Outdoor air temperature
 - .5 Supply air temperature
 - .2 Installation Data
 - .1 Fan motor manufacturer, model number, and horsepower rating
 - .3 Recorded Data
 - .1 Supply air flow rate
 - .2 Supply air fan voltage, amps, and frequency
 - .3 Return air flow rate
 - .4 Return air fan voltage, amps, and frequency
 - .5 Exhaust air flow rate
 - .6 Exhaust air fan voltage, amps, and frequency
- .8 Exhaust Fan
 - .1 Measure and report the following values as a minimum, as applicable:
 - .1 Design Data
 - .1 Exhaust air flow rate
 - .2 Exhaust air fan current draw
 - .3 Exhaust air temperature
 - .2 Installation Data
 - .1 Fan motor manufacturer, model number, and horsepower rating
 - .3 Recorded Data
 - .1 Exhaust air flow rate
 - .2 Exhaust air fan voltage, amps, and frequency
- .9 Air Conditioning Units (indoor)
 - .1 Measure and report the following values as a minimum, as applicable:
 - .1 Design Data
 - .1 Supply air flow rate
 - .2 Supply air temperature
 - .2 Installation Data
 - .1 Fan motor manufacturer, model number, and horsepower rating
 - .3 Recorded Data
 - .1 Supply air flow rate
 - .2 Supply air fan voltage, amps, and frequency

- .10 Air inlets and outlets
 - .1 Measure and report the following values as a minimum, as applicable:
 - .1 Design Data
 - .1 Supply air outlet size and flow rate
 - .2 Exhaust air inlet size and flow rate
 - .2 Installation Data
 - .1 Supply air outlet manufacturer's name, model and size
 - .2 Exhaust air inlet manufacturer's name, model and size
 - .3 Recorded Data
 - .1 Supply air outlet flow rate and velocity
 - .2 Exhaust air inlet flow rate and velocity

1.21 FUME HOODS

- .1 Test the following performances:
 - .1 Face velocity test
 - .1 Face velocity shall be determined in accordance with the containment test specified in [Clause 5.3](#). The test results shall be compared with the values provided by the manufacturer, documented, and provided to the user.
 - .2 The face velocity test should be performed with a hot wire anemometer or equivalent.
 - .2 Containment test
 - .1 The test specified in ASHRAE 110 shall be performed. The test results shall be documented and provided to the user.

Note: This tracer gas test is required because face velocity alone is not a valid indication of containment.

- .3 Sash operation
 - .1 Sash operation shall be smooth and easy throughout the sash's travel.
 - .2 Sash(es) shall be operable from either end with one hand.
 - .3 Sash counterbalances should operate without interference or restriction.
 - .4 Vertical rising sashes shall hold at any set height without creeping up or down.
- .4 Baffle operation
 - .1 All adjustable baffles shall operate freely, without binding or restriction. All baffles shall be easily removed for repair, cleaning, and inspection.
- .5 Alarm
 - .1 The alarm shall function properly and indicate unsafe conditions when the air face velocity falls below safe levels. The alarm shall be audible and visual, with a battery backup in case of power failure.
- .6 Exhaust ducts
 - .1 Exhaust ducts shall be under negative pressure.
 - .2 Terminal portions of exhaust systems beyond the exhaust fan (positively pressurized) shall be inspected for leaks every 12 months. The results shall be documented.

1.22 OTHER TAB REQUIREMENTS

- .1 General requirements applicable to work specified this paragraph:
 - .1 Qualifications of TAB personnel: as for air systems specified this section.
 - .2 Quality assurance: as for air systems specified this section.
- .2 Smoke management systems:
 - .1 Test for proper operation of all smoke and fire dampers, sensors, and detectors, installed as component parts of air systems specified or modified within the scope of work.

1.23 POST- OCCUPANCY TAB

- .1 Measure DBT, WBT (or %RH), air velocity and NC levels, in occupied zone of following areas:
 - .1 Laboratory H158, Laboratory L527, Laboratory L530
 - .2 Calibration Laboratory
 - .3 Wildlife Evidence Room
- .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 PROCEDURE

- .1 Permanently mark, by stick-on labels and/or fluorescent paint, settings on valves, splitters, dampers, and other adjustment devices
- .2 Subsequent to correctional work, take measurements to verify balance has not been disrupted or that any such disruption has been rectified.
- .3 Where vane anemometer is used to measure supply, return or exhaust air grilles, AK factors shall be determined as follows:
 - .1 Determine and tabulate similar sized grilles being balanced for AK schedule.
 - .2 Traverse all ducts serving grilles (outlined in AK schedule) to verify AK factors.
 - .3 AK factor from schedule, must be approved by Departmental Representative during initial review with balancer on site. (Balancer shall include written procedure for determination of AK factors).
 - .4 No flow hoods are to be used for measurement of exhaust or return air grilles.
- .4 Balancing contractor shall advise mechanical contractor of required revised pulleys, sheaves and impellor shavings to allow proper balancing of systems

- .5 Where axial fans require blade pitch changes, this shall be the responsibility of the balancing contractor
- .6 Where pump impellers require shaving, this shall be the responsibility of the mechanical contractor. All adjustments shall be by qualified millwright. All changes shall be documented and included as part of the balancing report

3.2 AIR SYSTEM PROCEDURE

- .1 Perform balancing, adjusting, and testing with building doors and windows in their normal operation position.
 - .2 The following procedure shall be adopted for central systems:
 - .1 Ensure dampers or volume control devices are in fully open position
 - .2 Balance central apparatus to $\pm 5\%$ air flow
 - .3 Balance branches and mains as stated previously
 - .4 Recheck central apparatus
 - .5 Balance all terminal air outlets as stated previously
 - .6 Re-balance central apparatus to $\pm 5\%$
 - .7 Recheck all air outlets.
 - .8 Perform acoustical measurements.
 - .3 When balancing air outlets:
 - .1 Rough balance furthest outlets and then balance sequentially back to source.
 - .2 Fine balance furthest outlet back to source.
 - .4 Take static pressure readings and air supply temperature readings at 10 points on each system.
 - .5 Make air quantity measurements in ducts by "Pitot Tube" traverse of entire cross sectional area. Take minimum of 4 for rectangular ducts, and 2 on each vertical and horizontal axis for round ducts, traverse readings. If readings are inconsistent across duct, try to obtain straight run of six (6) diameters widths upstream and re-do traverse. Measure air quantities on each system.
 - .6 Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control only by duct internal devices such as dampers and splitters
 - .7 Vary total system air quantities by adjustment of fan speeds. Vary branch air quantities by damper regulation.
 - .8 Verify all terminal unit factory settings for maximum air flow (and minimum if applicable). Adjust terminal unit controller if required. Record adjusted units.
 - .9 The final balanced condition of each area shall include testing and adjusting of pressure conditions. Test and record building pressurization levels in variable volume systems throughout full range of fan delivery rates, under both heating and cooling conditions. For laboratories, test pressure conditions inside lab and outside in corridor. Front doors, exits, elevator shafts, should be checked for air flow so that exterior conditions do not cause excessive or abnormal pressure conditions. Document abnormal building leakage conditions noted.
-

- .10 Complete balancing to achieve positive building pressure unless otherwise instructed. A positive pressure relative to outside of 10 Pa minimum and 20 Pa maximum shall be achieved, measured with negligible outside wind velocity

3.3 FIRE DAMPER VERIFICATION

- .1 Visually inspect all fire dampers
 - .1 Installation is straight
 - .2 Wall angles properly installed
 - .3 Duct has break away connection
 - .4 Fire stopping material where used is properly installed
 - .5 Adequate access
 - .6 Clearance between sleeve and wall
- .2 Inspect all fire damper blades and tracks prior to test firing. Sheet metal trade to clean all dirty dampers and tracks to satisfaction of balancer.
- .3 Manually remove each fusible link to ensure damper blade drops properly, then reset damper. Mark dropped fire damper with black felt marker.
- .4 If fire damper does not close properly, sheet metal trade to repair installation and balancing agency to retest.
- .5 All fire damper tests shall be witnessed by two parties, certified by Contractor and endorsed by the testing personnel.

3.4 ACOUSTICAL MEASUREMENTS

- .1 Provide full spectrum acoustical measurements for each major area as follows:
 - .1 Laboratories
 - .2 Offices
- .2 Provide additional or repeat acoustical measurements as necessitated by final balancing of each space, system, or piece of equipment.
- .3 Take measurements at maximum air volume conditions.
- .4 Note room reflective conditions at time of readings. (i.e. furnishings, window coverings, etc).

3.5 BALANCING REPORT

- .1 Submit draft copies of rough balancing reports prior to final acceptance of project.
 - .2 Include types, serial number and dates of calibration of instruments.
 - .3 Record test data on a sepiamade from the latest available revised set of mechanical drawings and submit three (3) copies upon completion of the balancing contract for inclusion in equipment and maintenance manuals.
 - .4 Submit with report, fan and pump curves with operating conditions plotted. Submit grille and diffuser shop drawings and diffusion factors.
-

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 93 – Testing, Adjusting and Balancing for HVAC Systems.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI/ASHRAE 110-1995, Method of Testing Performance of Laboratory Fume Hoods.
 - .2 ANSI/AIHA/ASSE Z9.5-2012, Laboratory Ventilation.
- .2 Public Works and Government Services Canada (PWGSC)
 - .1 PWGSC MD15128 2008, Laboratory Fume Hoods.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Contract Conditions and Section 01 33 00.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00.
- .2 Record Documentation:
 - .1 Submit list of materials used in fume hood work.

1.5 QUALITY ASSURANCE

- .1 Test Agency: fume hood tests to be performed by qualified independent testing agency with proven experience in Work of this Section and in accordance with PWGSC MD15128.
- .2 Test Agency Qualification: submit proof of qualifications to Departmental Representative to demonstrate:
 - .1 Minimum 3 years experience in testing of fume hoods.
 - .2 Attendance at ASHRAE 110 Testing Workshop.

Part 2 PRODUCTS

2.1 TESTING EQUIPMENT

- .1 Test equipment to ANSI/AIHA/ASSE Z9.5 and PWGSC MD 15128.
 - .2 Data logger:
 - .1 Speed: 10 Hz or better.
 - .2 Memory: sufficient to allow data collection for duration of test.
-

- .3 In-duct flow sensor to measure flow response:
 - .1 Speed: 10 Hz.
 - .2 Range: 95 L/s to 950 L/s.
 - .3 Accuracy: $\pm 5\%$.
- .4 Thermal anemometer:
 - .1 Mounting: on stand with probe fixed at each traverse grid location.
 - .2 Include: output recorded for 20 seconds minimum at a rate of one reading/second on data logger.
 - .3 Accuracy:
 - .1 Below 0.50 m/s: ± 0.025 m/s.
 - .2 0.50 m/s and over: $\pm 5\%$.
- .5 Detector for tracer gas containment:
 - .1 Type: continuous reading.
 - .2 Minimum Detectable Level (MDL): 0.01 ppm.
 - .3 Accuracy: concentrations below 0.1 ppm: $\pm 25\%$; concentrations above 0.1 ppm: $\pm 10\%$.
- .6 Smoke generator:
 - .1 Use smoke generator and diffuser complying with PWGSC MD15128.

Part 3 EXECUTION

3.1 AS INSTALLED (AI) AND INTEGRATED SYSTEMS TESTS

- .1 Perform AI and integrated systems tests as follows:
 - .1 After entire laboratory HVAC and exhaust systems have been tested and balanced (TAB), and TAB and Performance Verification (PV) reports have been submitted and accepted.
 - .2 HVAC and exhaust systems are in full operation.
 - .3 Room temperatures are maintained between 22 degrees C and 24.5 degrees C., recorded and submitted with fume hood test documentation.
 - .4 At specified laboratory space pressurization.
 - .5 Under deviation of space pressurization due to laboratory door opening and closing, change of laboratory operating modes, upset conditions, and other causes of change in laboratory air pressure.
 - .6 As part of commissioning of integrated HVAC and exhaust systems and laboratory space pressurization tests included in commissioning process.
- .2 After installation, test each fume hood to ANSI/ASHRAE 110 and PWGSC MD15128 at design sash position to ensure compliance with design criteria in PWGSC MD15128.

3.2 "AI" TESTS FOR AND CAV FUME HOODS

- .1 Cross draft tests:
 - .1 Test air currents external to fume hood to PWGSC MD15128.
 - .2 Ensure velocity of cross draft does not exceed 50% of average face velocity.
 - .3 Record measurements as follows:
 - .1 Using thermal anemometer take readings 1.5 m above floor, 500 mm from sash, at centre, and left and right posts of fume hood.
 - .2 Take readings at 1 reading/second, recorded to obtain average, and maximum and minimum values over a duration of 20 seconds at each location.
 - .3 Ensure that [project authority] reduces excessive values to less than 50% of average face velocity before proceeding with further fume hood testing.
- .2 Visualization (smoke) tests:
 - .1 Extent of tests and performance criteria: to PWGSC MD15128.
- .3 Face velocity and flow response test pass ratings: to PWGSC MD15128 and ANSI/ASHRAE 110.
 - .1 Average face velocity for CAV fume hoods: 0.5 m/s
 - .2 Average face velocity for high performance fume hoods: 0.35 m/s, with no reading less than 0.25 m/s.
- .4 Tracer Gas tests:
 - .1 Performance criteria: to PWGSC MD15128.
 - .2 Conduct tests at target average face velocity.
 - .3 Use approved tracer gas.
 - .4 Perform tests with probe at height of 560 mm above work surface.
 - .5 Leakage with sash at normal operating position:
 - .1 Average leakage: 0.05 ppm maximum.
 - .2 Peak reading: 0.25 ppm.
 - .6 Leakage with sash in fully open position:
 - .1 Average leakage: 0.05 ppm maximum.
 - .2 Peak reading: 0.25 ppm.
 - .7 Peripheral scan:
 - .1 Record significant peak readings and their locations.
 - .2 Record 30 second rolling averages.
 - .3 Maximum 0.25 ppm for any 30 second rolling average.
 - .4 Include readings in test report.
 - .8 Sash Movement Effect (SME), to determine potential for escape after movement of sash to ANSI/ASHRAE 110 procedures:
 - .1 Maximum 45 second rolling average: 0.05 ppm.

3.3 AS USED (AU) TESTS WITH LAB APPARATUS IN PLACE

- .1 Repeat tracer gas tests.

3.4 FUME HOOD MONITOR AND ALARM TESTS

- .1 Fume Hood Monitor:
 - .1 Provide 3 point calibration.
 - .2 Ensure each monitor initiates alarms (audible, visual, and BMS) when unsafe velocity conditions occur.
 - .3 Ensure monitor readings are displayed in metres per second, to 2 decimal places.
- .2 Fume Hood Monitor/Alarm testing:
 - .1 Monitor accuracy test: ensure monitor is accurate within 5% of average face velocity.
 - .2 Alarm enunciation test: ensure alarm occurs beyond $\pm 20\%$ of design flow set point.
 - .3 Alarm response enunciation test: ensure alarm delay is 10 seconds maximum.

3.5 FUME HOOD STATIC PRESSURE TEST

- .1 With sash at design position and face velocity at target setting, fume hood static pressure: less than 62 Pa.

3.6 NOISE LEVEL TEST

- .1 With sash at design position and face velocity at target setting, noise level at working position in front of fume hood: less than 70 dBA.

3.7 VERIFICATION LABELS

- .1 Affix label to front of fume hood indicating verification, name of testing agency, and date.

3.8 COMMISSIONING - INTEGRATED SYSTEMS TESTS

- .1 Do commissioning tests in accordance with Section 01 91 13.
- .2 Fume hood testing to commence only after laboratory HVAC systems are fully commissioned, including calibration of airflow controls, calibration of automatic temperature controls, balance of air supply, completion of duct traverse on each fume hood exhaust duct, and completion of an air balance of the total exhaust flow.
- .3 Test fume hoods in conjunction with complete laboratory integrated HVAC and exhaust systems commissioning testing including, room air flow patterns, temperature, humidity, pressurization, noise, and vibration.

3.9 REPORTS

- .1 Ensure test reports are signed by testing agency before submitting to Departmental Representative.
-

3.10 CLEANING

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

3.11 PROTECTION

- .1 Protect adjacent materials from work associated with testing and maintenance of fume hoods.

END OF SECTION

Part 1 GENERAL

1.1 GENERAL

- .1 Ducts over 5 m in length, forming part of a supply, return or exhaust ductwork system directly or indirectly connected to air handling equipment or fans to be pressure tested for leaks.

1.2 TIMING

- .1 Ducts to be tested before installation of insulation or any other form of concealments.
- .2 Test after seals have cured.
- .3 Test when ambient temperature will not affect effectiveness of seals, gaskets, etc.

1.3 EXCLUSIONS

- .1 Flexible connections to VAV boxes.

1.4 REFERENCES

- .1 SMACNA HVAC Air Duct Leakage Test Manual, 2012.

1.5 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.

1.6 TESTING AGENCY

- .1 Installing Contractor.

1.7 VERIFICATION

- .1 To be verified by project Commissioning Authority in accordance with specification section 01 91 13.

1.8 TEST INSTRUMENTS

- .1 Testing agency to provide instruments for tests.
 - .2 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.
- .3 Test apparatus to be accurate to within +/- 3 % of flow rate and pressure.
- .4 Submit details of test instruments to be used to Departmental Representative at least one month before anticipated start date.
- .5 Test instruments to be calibrated and certificate of calibration deposited with Departmental Representative no more than 28 days before start of tests.
- .6 Instruments to be re-calibrated every six months thereafter.

1.9 SYSTEM LEAKAGE TOLERANCES

- .1 System leakage tolerances specified herein are stated as a percentage of total flow rate handled by the system. Therefore, when testing sections of ductwork this acceptable leakage shall be pro-rated to entire system. Leakage for sections of duct systems shall not exceed the 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 Terminal box and duct on downstream side of terminal 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.

1.10 EQUIPMENT LEAKAGE TOLERANCES

- .1 Equipment and system components such as VAV boxes, duct heating Leakage: 5%.

1.11 REPORT FORMS

- .1 Submit proposed report form and test report format to Departmental Representative for approval at least one months before proposed date of first series of tests. Do not start tests until approval received in writing from Departmental Representative.

1.12 PRESSURE TEST REPORTS

- .1 Prepare report of results and submit to Departmental Representative within 24 hours of completion of tests. Include:
 - .1 Schematic of entire system.
 - .2 Schematic of section under test showing test site.
 - .3 Required and achieved static pressures.

- .4 Orifice differential pressure at test sites.
- .5 Permissible and actual leakage flow rate (L/s) for test sites.
- .6 Witnessed certification of results.
- .2 Include test reports in final TAB report.

Part 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

Part 3 EXECUTION

3.1 NOT USED

- .1 Contractor to bear the cost of remedial repair measures and additional testing if results do not meet tolerances stated in the specifications.
- .2 Testing results to be included in Operations and Maintenance manual in accordance with section 01 78 00.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Definitions:
 - .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - means "not concealed" as previously defined.
 - .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.
 - .2 TIAC Codes:
 - .1 CRD: Code Round Ductwork,
 - .2 CRF: Code Rectangular Finish.
- .2 Reference Standards:
 - .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE/IES 90.1-2010, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - .2 ASTM International Inc.
 - .1 ASTM B209M-10, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
 - .2 ASTM C335-10e1, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
 - .3 ASTM C411-11, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C449-07, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C547-11, Standard Specification for Mineral Fiber Pipe Insulation.
 - .6 ASTM C553-11, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .7 ASTM C612-10, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .8 ASTM C795-08, Standard Specification for Thermal Insulation for Use in Contact 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-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .4 Green Seal Environmental Standards (GSES)
 - .1 Standard GS-36-00, Commercial Adhesives.

- .5 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.
- .6 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).
- .7 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations.
 - .1 Description of equipment giving manufacturer's name, type, model, year and capacity.
 - .2 Details of operation, servicing and maintenance.
 - .3 Recommended spare parts list.
- .3 Samples:
 - .1 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed.
 - .2 Mount sample on 12 mm plywood board.
 - .3 Affix typewritten label beneath sample indicating service.
- .4 Manufacturers' Instructions:
 - .1 Provide manufacture's written duct insulation jointing recommendations, special handling criteria, installation instructions, and cleaning procedures.

1.3 QUALITY ASSURANCE

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00.
 - .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, and ULC markings.
 - .3 Packaging Waste Management: remove for reuse in accordance with Section 01 74 20.
-

Part 2 PRODUCTS

2.1 FIRE AND SMOKE RATING

- .1 To CAN/ULC-S102:
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.2 INSULATION

- .1 Mineral fibre: as specified 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 C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in Part 3 of this Section).
- .4 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in Part 3 of this section).
 - .1 Mineral fibre: to ASTM C553.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to ASTM C553.

2.3 JACKETS

- .1 Canvas:
 - .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .2 Lagging adhesive: compatible with insulation.
 - .1 Maximum VOC limit to GSES GS-36.
- .3 Aluminum:
 - .1 To ASTM B209M with moisture barrier as scheduled in Part 3 of this section.
 - .2 Thickness: 0.50 mm sheet.
 - .3 Finish: Smooth.
 - .4 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel.
 - .1 Stainless steel:
 - .5 Type: 316.
 - .6 Thickness: 0.25 mm sheet.
 - .7 Finish: Smooth.
 - .8 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel.

2.4 ACCESSORIES

- .1 Vapour retarder lap adhesive:
 - .1 Water based, fire retardant type, compatible with insulation.
 - .1 Maximum VOC limit to GSES GS-36.

- .2 Indoor Vapour Retarder Finish:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.
- .4 ULC Listed Canvas Jacket:
 - .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .5 Outdoor Vapour Retarder Mastic:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
 - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m².
- .6 Tape: self-adhesive, aluminum, 50 mm wide minimum.
- .7 Contact adhesive: quick-setting
 - .1 Maximum VOC limit to GSES GS-36.
- .8 Canvas adhesive: washable.
 - .1 Maximum VOC limit to GSES GS-36.
- .9 Tie wire: 1.5 mm stainless steel.
- .10 Banding: 12 mm wide, 0.5 mm thick stainless steel.
- .11 Facing: 25 mm stainless steel hexagonal wire mesh stitched on both faces of insulation.
- .12 Fasteners: 2 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

Part 3 EXECUTION

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 PRE-INSTALLATION REQUIREMENTS

- .1 Pressure test ductwork systems complete, witness and certify.
- .2 Ensure surfaces are clean, dry, free from foreign material.

3.3 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturer's instructions and as indicated.
- .3 Use 2 layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Ensure hangers, and supports are outside vapour retarder jacket.

- .5 Hangers and supports in accordance with Section 23 05 29.
- .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .6 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum 2 rows each side.

3.4 DUCTWORK INSULATION SCHEDULE

- .1 Insulation types and thicknesses: conform to following table:

	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular cold and dual temperature supply air ducts	C-1	yes	50
Round cold and dual temperature supply air ducts	C-2	yes	50
Rectangular warm air ducts	C-1	no	25
Round warm air ducts	C-1	no	25
Supply, return and exhaust ducts exposed in space being served			none
Outside air ducts to mixing plenum	C-1	yes	25
Mixing plenums	C-1	yes	25
Exhaust duct between dampers and louvres	C-1	no	25
Rectangular ducts outside	C-1	special	50
Round ducts outside	C-1	special	50
Acoustically lined ducts	none		

- .2 Exposed round ducts 600 mm and larger, smaller sizes where subject to abuse:
 - .1 Use TIAC code C-1 insulation, scored to suit diameter of duct.
 - .1 Finishes: conform to following table:

	TIAC Code	
	Rectangular	Round
Indoor, concealed	none	none
Indoor, exposed within mechanical room	CRF/1	CRD/2

Indoor, exposed elsewhere	CRF/2	CRD/3
Outdoor, exposed to precipitation	CRF/3	CRD/4
Outdoor, elsewhere	CRF/4	CRD/5

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 11.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 ASME
 - .1 ASME B16.22-12, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
 - .2 ASME B16.24-11, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 600, 900, 1500 and 2500.
 - .3 ASME B16.26-11, Cast Copper Alloy Fittings for Flared Copper Tubes.
 - .4 ASME B31.5-10, Refrigeration Piping and Heat Transfer Components.
- .2 ASTM International
 - .1 ASTM A307-12, Standard Specification for Carbon Steel Bolts and Studs, and Threaded Rod 60,000 PSI Tensile Strength.
 - .2 ASTM B280-13, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- .3 CSA Group
 - .1 CSA B52-13, Mechanical Refrigeration Code.
- .4 Environment Canada (EC)
 - .1 EPS 1/RA/1-96, Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for refrigerant piping, fittings and equipment and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit 1 copy of WHMIS MSDS. Indicate VOC's for adhesive and solvents during application and curing.
- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00.
 - .2 Operation and Maintenance Data: submit operation and maintenance data for refrigerant piping for incorporation into manual.
-

- .3 Submit copies of operation and maintenance information for inclusion in manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect refrigerant piping, fittings and equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
 - .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials as specified in Section 01 74 20.

Part 2 PRODUCTS

2.1 TUBING

- .1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.
 - .1 Hard copper: to ASTM B280, type ACR.
 - .2 Annealed copper: to ASTM B280, with minimum wall thickness as per CSA B52 and ASME B31.5.

2.2 FITTINGS

- .1 Service: design pressure 2070 kPa and temperature 121 degrees C.
- .2 Brazed:
 - .1 Fittings: wrought copper to ASME B16.22.
 - .2 Joints: silver solder, 15% Ag-80% Cu-5%P and non-corrosive flux.
- .3 Flanged:
 - .1 Bronze or brass, to ASME B16.24, Class 150 and Class 300.
 - .2 Gaskets: suitable for service.
 - .3 Bolts, nuts and washers: to ASTM A307, heavy series.
- .4 Flared:
 - .1 Bronze or brass, for refrigeration, to ASME B16.26.

2.3 PIPE SLEEVES

- .1 Hard copper or steel, sized to provide 6 mm clearance around between sleeve and uninsulated pipe or between sleeve and insulation.

2.4 VALVES

- .1 22 mm and under: Class 500, 3.5 Mpa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.
- .2 Over 22 mm: Class 375, 2.5 Mpa, globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that site conditions are acceptable for refrigerant piping installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect area of installation.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.3 GENERAL

- .1 Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5 Section 23 05 05.

3.4 BRAZING PROCEDURES

- .1 Bleed inert gas into pipe during brazing.
- .2 Remove valve internal parts, solenoid valve coils, sight glass.
- .3 Do not apply heat near expansion valve and bulb.

3.5 PIPING INSTALLATION

- .1 General:
 - .1 Hard drawn copper tubing: do not bend. Minimize use of fittings.
- .2 Hot gas lines:
 - .1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.
 - .2 Provide trap at base of risers greater than 2400 mm high and at each 7600 mm thereafter.
 - .3 Provide inverted deep trap at top of risers.

- .4 Provide double risers for compressors having capacity modulation.
 - .1 Large riser: install traps as specified.
 - .2 Small riser: size for 5.1 m³/s at minimum load. Connect upstream of traps on large riser.

3.6 PRESSURE AND LEAK TESTING

- .1 Close valves on factory charged equipment and other equipment not designed for test pressures.
- .2 Leak test to CSA B52 before evacuation to 2 MPa and 1 MPa on high and low sides respectively.
- .3 Test procedure: build pressure up to 35 kPa with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.

3.7 FIELD QUALITY CONTROL

- .1 Site Tests/Inspection:
 - .1 Close service valves on factory charged equipment.
- .2 Ambient temperatures to be at least 13 degrees C for at least 12 hours before and during dehydration.
- .3 Use copper lines of largest practical size to reduce evacuation time.
- .4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5 Pa absolute and filled with dehydrated oil.
- .5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.
- .6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:
 - .1 Twice to 14 Pa absolute and hold for 4 hours.
 - .2 Break vacuum with refrigerant to 14 kPa.
 - .3 Final to 5 Pa absolute and hold for at least 12 hours.
 - .4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
 - .5 Submit test results to Departmental Representative.
- .7 Charging:
 - .1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.
 - .2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.
 - .3 Re-purge charging line if refrigerant container is changed during charging process.

- .8 Checks:
 - .1 Make checks and measurements as per manufacturer's operation and maintenance instructions.
 - .2 Record and report measurements to Departmental Representative.
- .9 Manufacturer's Field Services:
 - .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .1 Upon completion of the Work, after cleaning is carried out.
 - .3 Obtain reports, within 3 days of review, and submit, immediately, to Departmental Representative.

3.8 DEMONSTRATION

- .1 Instructions:
 - .1 Post instructions in frame with glass cover in accordance with Section 01 78 00 and CSA B52.

3.9 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .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.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- .2 ASTM International
 - .1 ASTM A480/A480M-13b, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - .2 ASTM A635/A635M-13, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.
 - .3 ASTM A653/A653M-13, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 Green Seal Environmental Standards (GS)
 - .1 GS-36-11, Standard for Adhesives for Commercial Use.
- .4 National Fire Protection Association (NFPA)
 - .1 NFPA 90A-15, Standard for the Installation of Air-Conditioning and Ventilating Systems.
- .5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005.
 - .2 SMACNA HVAC Air Duct Leakage Test Manual, 2012.
 - .3 IAQ Guideline for Occupied Buildings Under Construction 2007.
- .6 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for metal ducts and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Test and Evaluation Reports:
 - .1 Certification of Ratings:
 - .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect metal ducts from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials as specified Section 01 35 21.

Part 2 PRODUCTS

2.1 SEAL CLASSIFICATION

- .1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
500	B
- .2 Seal classification:
 - .1 Class B: longitudinal seams, transverse joints and connections made airtight with sealant.

2.2 SEALANT

- .1 Low VOC Characteristics:
 - .1 Adhesives and sealants: in accordance with Section 07 92 00.
 - .2 Adhesives and sealants: VOC limit to GS-36.
- .2 Sealant: synthetic latex emulsion water based type with a service temperature of -17°C to 105°C.

2.3 DUCT LEAKAGE

- .1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

2.4 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows:
 - .1 Rectangular: standard radius with centreline radius: 1.5 times width of duct.
 - .2 Round: smooth radius with, centreline radius: 1.5 times diameter of duct.

- .3 Mitred elbows, rectangular:
 - .1 To 400 mm: with single thickness turning vanes.
 - .2 Over 400 mm: with double thickness turning vanes.
- .4 Branches:
 - .1 Rectangular main and branch: with radius on branch 1.5 times width of duct.
 - .2 Round main and branch: enter main duct at 45 degrees [with conical connection].
 - .3 Provide volume control damper in branch duct near connection to main duct.
 - .4 Main duct branches: with splitter damper.
- .5 Transitions:
 - .1 Diverging: 20 degrees maximum included angle.
 - .2 Converging: 30 degrees maximum included angle.
- .6 Offsets:
 - .1 Short radiused elbows, or as indicated on drawings.
- .7 Obstruction deflectors: maintain full cross-sectional area.
 - .1 Maximum included angles: as for transitions.

2.5 FIRE STOPPING

- .1 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00.
- .2 Fire stopping material and installation must not distort duct.

2.6 GALVANIZED STEEL

- .1 Lock forming quality: to ASTM A653/A653M, Z275 zinc coating.
- .2 Thickness, fabrication and reinforcement: to SMACNA.
- .3 Joints: to SMACNA.

2.7 STAINLESS STEEL

- .1 To ASTM A480/A480M, Type 316.
- .2 Finish: mill.
- .3 Thickness, fabrication and reinforcement: to SMACNA.
- .4 Joints: to SMACNA, be continuous inert gas welded.

2.8 HANGERS AND SUPPORTS

- .1 Hangers and Supports: in accordance with Section 23 05 29.
 - .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
 - .1 Maximum size duct supported by strap hanger: 500.
 - .2 Hanger configuration: to SMACNA.

- .3 Hangers: galvanized steel angle with galvanized steel rods to the following table:

<u>Duct Size</u> (mm)	<u>Angle Size</u> (mm)	<u>Rod Size</u> (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
<u>2401 and over</u>	<u>50 x 50 x 6</u>	<u>10</u>

- .4 Upper hanger attachments:
- .1 For concrete: manufactured concrete inserts.
 - .2 For steel joist: manufactured joist clamp.
 - .3 For steel beams: manufactured beam clamps:

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions are acceptable for metal duct installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect elements to which ductwork hangers will be attached.
 - .2 Visually inspect elements which will be penetrated by ductwork.
 - .3 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .4 Proceed with installation only after unacceptable conditions have been remedied.

3.2 GENERAL

- .1 Do work in accordance with NFPA 90A, SMACNA, and drawings as indicated.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
 - .1 Insulate strap hangers 100 mm beyond insulated duct.
- .3 Support risers in accordance with SMACNA as indicated.
- .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 Where acoustic duct lining is noted, ductwork sizing stated on drawings represents clear inside dimensions.

3.3 HANGERS

- .1 Strap hangers: install in accordance with SMACNA.
 - .2 Angle hangers: complete with locking nuts and washers.
-

- .3 Hanger spacing: in accordance with SMACNA, or as follows, whichever is more stringent:

<u>Duct Size</u> (mm)	<u>Spacing</u> (mm)
to 1500	3000
1501 and over	2500

3.4 WATERTIGHT DUCT

- .1 Provide watertight duct for:
- .1 Fresh air intake.
 - .2 Minimum 3000 mm from duct mounted humidifier in all directions.
 - .3 As indicated.
- .2 Form bottom of horizontal duct without longitudinal seams.
- .1 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.
- .4 Fit base of riser with drain pan and 32 mm drain connected, with deep seal trap discharging to open funnel drain or as indicated on drawings.

3.5 SEALING AND TAPING

- .1 Apply sealant in accordance with SMACNA, or the requirements below, whichever is more stringent:
- .1 Slip Joints: Apply heavy brush-on high pressure duct sealant. Apply second application after the first application has completely dried out. Where metal clearance exceeds 1.519 mm use heavy mastic type sealant.
 - .2 Flanged Joints: Soft elastomer butyl or extruded form of sealant between flanges followed by an application of heavy brush-on high pressure duct sealant.
 - .3 Other Joints: Heavy mastic type sealant
 - .4 Bed tape in sealant and recoat with minimum of 1 coat of sealant to manufacturers recommendations.
- .2 Duct tapes as sealing method are not permitted.
- .3 Surfaces to receive sealant should be free from oil, dust, dirt, moisture, rust and other substances that inhibit or prevent bonding.
- .4 Prior to sealing all ductwork, demonstrate sealing of a section of each type of duct and obtain approval from the Departmental Representative.

3.6 LEAKAGE TESTS

- .1 Refer to Section 23 05 94.
 - .2 In accordance with SMACNA HVAC Duct Leakage Test Manual.
 - .3 Do leakage tests in sections.
-

- .4 Make trial leakage tests as instructed to demonstrate workmanship.
- .5 Do not install additional ductwork until trial test has been passed.
- .6 Test section minimum of 30 m long with not less than three branch takeoffs and two 90 degrees elbows.
- .7 Complete test before performance insulation or concealment Work.

3.7 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .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.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- .2 ASTM International
 - .1 ASTM A653/A653M-13, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process. (Metric).
- .3 Green Seal Environmental Standards (GS)
 - .1 GS-36-11, Standard for Adhesives for Commercial Use.
- .4 Sheet Metal Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible, 2005.
 - .2 SMACNA HVAC Air Duct Leakage Test Manual, 2012.
 - .3 SMACNA IAQ Guideline for Occupied Buildings Under Construction, 2007.
- .5 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for metal ducts and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Test and Evaluation Reports:
 - .1 Certification of Ratings:
 - .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
 - .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
 - .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
-

- .2 Store and protect metal ducts from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 DUCTWORK

- .1 Material:
 - .1 Galvanized steel with Z90 designation zinc coating lock forming quality: to ASTM A653/A653M.
 - .2 Thickness: to SMACNA.
- .2 Construction: round and oval.
 - .1 Ducts: factory fabricated, spiral wound, with matching fittings and specials to SMACNA.
 - .2 Transverse joints up to 900 mm: slip type with tape and sealants.
 - .3 Transverse joints over 900 mm: Vanstone.
 - .4 Fittings:
 - .1 Elbows: smooth radius; 5 piece (for 90 degrees), 3 piece (for 45 degrees). Centreline radius: 1.5 x diameter.
 - .2 Branches: conical transition with conical branch at 45 degrees and 45 degrees elbow.
- .3 Construction: rectangular:
 - .1 Ducts: to SMACNA.
 - .2 Transverse joints: SMACNA seal Class A and B.
 - .3 Fittings:
 - .1 Elbows: smooth radius; centreline radius 1.5 x width of duct. No vanes.
 - .2 Branches: with conical branch at 45 degrees and 45 degrees elbow.
- .4 Fire stopping:
 - .1 50 x 50 x 3 mm retaining angles around duct, on both sides of fire separation.
 - .2 Fire stopping material must not distort duct.

2.2 SEAL CLASSIFICATION

- .1 Classification as follows:

<u>Maximum Pressure Pa</u>	<u>SMACNA Seal Class</u>
2500	A
1500	A
1000	A
750	B

- .2 Seal classification:
 - .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.
 - .2 Class B: longitudinal seams, transverse joints and connections made airtight with gaskets, sealant, tape or combination thereof.

2.3 SEALANT

- .1 Sustainability Characteristics:
 - .1 Adhesives and sealants: in accordance with Section 07 92 00.
 - .2 Adhesives and sealants: VOC limit to GS-36.
- .2 Oil resistant, water-borne polymer type flame resistant high velocity duct sealing compound.
 - .1 Temperature range of minus 30 degrees C to plus 93 degrees C.

2.4 TAPE

- .1 Tape: polyvinyl treated, open weave fibre glass, 50 mm wide.

2.5 HANGERS AND SUPPORTS

- .1 Hangers and supports: in accordance with Section 23 05 29.
 - .1 Band hangers: use on round and oval ducts up to 500 mm diameter, of same material as duct but next sheet metal thickness heavier than duct.
 - .2 Trapeze hangers: ducts over 500 mm diameter or longest side, to SMACNA.
 - .3 Hangers: galvanized steel angle with galvanized steel rods to SMACNA or the following table, whichever is more stringent.

<u>Duct Size</u> (mm)	<u>Angle Size</u> (mm)	<u>Rod Size</u> (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10
- .4 Upper hanger attachments:
 - .1 For concrete: manufactured concrete inserts.
 - .2 For steel joist: manufactured joist clamp or steel plate washer.
 - .3 For steel beams: manufactured beam clamps.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that site conditions are acceptable for metal duct installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate area where ductwork is to be installed.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied

3.2 GENERAL

- .1 Do work in accordance with SMACNA guidelines.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
 - .1 Insulate band hangers 100 mm beyond insulated duct.
 - .2 Ensure diffuser is fully seated.
- .3 Support risers in accordance with SMACNA.
- .4 Install breakaway joints in ductwork on sides of fire separation.

3.3 HANGERS

- .1 Band hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Hanger spacing: SMACNA or as follows, whichever is more stringent:

<u>Duct Size</u>	<u>Spacing</u>
(mm)	(mm)
to 1500	3000
1501 and over	2500

3.4 SEALING AND TAPING

- .1 Apply sealant in accordance with SMACNA guidelines.
- .2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturer's recommendations.

3.5 LEAKAGE TESTS

- .1 Refer to Section 23 05 94.
- .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 quality of work.
- .5 Do not install additional ductwork until trial tests have been achieved.
- .6 Test section minimum of 30 m long with not less than 3 branch takeoffs and two 90 degrees elbows.

- .7 Complete tests before performing insulation or concealment Work.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .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.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Sheet Metal and Air Conditioning National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-2013.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for dampers and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00.
- .2 Operation and Maintenance Data: submit operation and maintenance data for dampers for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect dampers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 GENERAL

- .1 Manufacture to SMACNA standards.

2.2 SPLITTER DAMPERS

- .1 Fabricate from same material as duct but one sheet metal thickness heavier, with appropriate stiffening.
-

- .2 Single thickness construction.
- .3 Control rod with locking device and position indicator.
- .4 Rod configuration to prevent end from entering duct.
- .5 Pivot: piano hinge.
- .6 Folded leading edge.

2.3 SINGLE BLADE DAMPERS

- .1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
- .2 Size and configuration to recommendations of SMACNA, except maximum height as indicated.
- .3 Locking quadrant with shaft extension to accommodate insulation thickness.
- .4 Inside and outside nylon end bearings.
- .5 Channel frame of same material as adjacent duct, complete with angle stop.

2.4 MULTI-BLADED DAMPERS

- .1 Factory manufactured of material compatible with duct.
- .2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.
- .3 Maximum blade height: as indicated.
- .4 Bearings: self-lubricating nylon.
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.
- .7 Maximum leakage: 21 L/s/m² at 250 Pa.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that site conditions are acceptable for damper installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect site conditions in area where dampers are to be installed.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Install where indicated.
 - .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
-

- .3 Locate balancing dampers in each branch duct, for supply, return and exhaust systems.
- .4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.
- .5 Dampers: vibration free.
- .6 Ensure damper operators are observable and accessible.
- .7 Corrections and adjustments conducted by Departmental Representative.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .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.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM A653/A653M-13, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for dampers and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00.
- .2 Operation and Maintenance Data: submit operation and maintenance data for dampers for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect dampers, from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 SPLITTER DAMPERS

- .1 Fabricate splitter dampers of double thickness sheet metal to streamline shape, properly stiffened to avoid vibration.
 - .2 Fabricate galvanized steel, minimum nominal 1.5 mm core metal thickness, and provide with adjustable rod and locking screw.
-

- .3 On externally insulated ductwork, install operating mechanisms on a steel bridge type mounting base to permit continuity of insulation under the mechanism.

2.2 BACK DRAFT DAMPERS

- .1 Construct of minimum 0.635 mm aluminum blades, having stiffeners along trailing edge; fabricate single blade dampers for duct sizes less than or equal to 240 mm, multi-blade dampers for ducts greater than 240 mm.
- .2 Provide full blade-length shafts complete with brass or nylon bearings.
- .3 Provide neoprene anti-clatter blade strips on pivot side of blades.
- .4 Construct blade connecting linkage of minimum 2.00 mm aluminum rod with eyelet, pin bearings, and adjustable counter weight to assist blade opening action.
- .5 Maximum blade length of 750 mm.
- .6 Backdraft damper suitable for 10 m/s face velocity

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that site conditions are acceptable for damper installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect site conditions in area where dampers are to be installed.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.
- .3 Seal multiple damper modules with silicon sealant.
- .4 Install access door adjacent to each damper. See Section 23 33 00.
- .5 Ensure dampers are observable and accessible.

3.3 CLEANING

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

- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 National Fire Protection Association (NFPA)
 - .1 NFPA 90A-12, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .2 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S112-10, Standard Test Method of Fire Test of Fire Damper Assemblies.
 - .2 CAN/ULC-S112.2-07, Standard Method of Fire Test of Ceiling Fire Stop Flap Assemblies.
 - .3 ULC-S505-1974, Standard for Fusible Links for Fire Protection Service.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for fire and smoke dampers and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate the following:
 - .1 Fire dampers.
 - .2 Smoke dampers.
 - .3 Fire stop flaps.
 - .4 Operators.
 - .5 Fusible links.
 - .6 Design details of break-away joints.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00.
- .2 Operation and Maintenance Data: submit operation and maintenance data for fire and smoke dampers for incorporation into manual.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Submit maintenance materials in accordance with Section 01 78 00.
 - .2 Provide:
 - .1 6 fusible links of each type.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect fire and smoke dampers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 1 74 20.

Part 2 PRODUCTS

2.1 FIRE DAMPERS

- .1 Fire dampers: arrangement Type B, and bear label of ULC, meet requirements of NFPA 90A and authorities having jurisdiction. Fire damper assemblies fire tested in accordance with CAN/ULC-S112.
- .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
 - .1 Fire dampers: 1-1/2 hour fire rated unless otherwise indicated.
 - .2 Fire dampers: automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.
- .3 Top hinged: offset single damper, square, guillotine type, sized to maintain full duct cross section, for size of duct as indicated on drawings.
- .4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.
- .5 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.
- .6 Equip fire dampers with steel sleeve or frame installed disruption ductwork or impair damper operation.
- .7 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.
- .8 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.
- .9 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness.

- .10 Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed.

2.2 FIRE STOP FLAPS

- .1 Fire smoke flaps: ULC listed and labelled and fire tested in accordance with CAN/ULC-S112.2.
- .2 Construct of minimum 1.5 mm thick sheet steel with 1.6 mm thick non-asbestos ULC listed insulation and corrosion-resistant pins and hinges.
- .3 Flaps held open with fusible link conforming to ULC-S505 and close at 74 degrees C.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that site conditions s are acceptable for fire and smoke damper installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect the area where the fire and smoke dampers are to be installed.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Install in accordance with NFPA 90A and in accordance with conditions of ULC listing.
- .2 Maintain integrity of fire separation.
- .3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
- .4 Install access door adjacent to each damper. See Section 23 33 00.
- .5 Co-ordinate with installer of fire stopping.
- .6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.
- .7 Install break-away joints of approved design on each side of fire separation.

3.3 CLEANING

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

- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE)
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 90A-12, Standard for the Installation of Air-Conditioning and Ventilating Systems.
- .3 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005.
 - .2 SMACNA IAQ Guideline for Occupied Buildings under Construction, 2005.
- .4 Underwriters' Laboratories (UL)
 - .1 UL 181-2005, Standard for Factory-Made Air Ducts and Air Connectors.
- .5 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S110-2007, Standard Methods of Tests for Air Ducts.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for flexible ducts and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate:
 - .1 Thermal properties.
 - .2 Friction loss.
 - .3 Acoustical loss.
 - .4 Leakage.
 - .5 Fire rating.
- .3 Test and Evaluation Reports:
 - .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect flexible ducts from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 GENERAL

- .1 Factory fabricated to CAN/ULC-S110.
- .2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.
- .3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

2.2 NON-METALLIC - UNINSULATED

- .1 Type 3: non-collapsible, aluminum foil/mylar type, mechanically bonded to, and helically supported by, external steel wire, as indicated.
- .2 Performance:
 - .1 Factory tested to 2.5 kPa without leakage.
 - .2 Maximum relative pressure drop coefficient:3.

2.3 NON-METALLIC - INSULATED

- .1 Type 4: non-collapsible, coated aluminum foil/mylar type mechanically bonded to, and helically supported by, external steel wire with factory applied, 37 mm thick flexible mineral fibre thermal insulation with vapour barrier and vinyl reinforced mylar/neoprene laminate jacket, as indicated.
- .2 Performance:
 - .1 Factory tested to 2.5 kPa without leakage.
 - .2 Maximum relative pressure drop coefficient: 3.
 - .3 Thermal loss/gain: 1.6 RSI.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that site conditions are acceptable for flexible ducts installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect area where flexible ducts are to be installed.

- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 DUCT INSTALLATION

- .1 Install in accordance with: CAN/ULC-S110, UL 181, NFPA 90A, and SMACNA.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .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.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM C423-09a, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - .2 ASTM C916-85(2007), Standard Specification for Adhesives for Duct Thermal Insulation.
 - .3 ASTM C1071-12, Standard specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
 - .4 ASTM C1338-14, Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
 - .5 ASTM G21-13, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 90A-12, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .3 North American Insulation Manufacturers Association (NAIMA)
 - .1 NAIMA AH116-2002, Fibrous Glass Duct Construction Standards.
- .4 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
 - .1 SMACNA, HVAC Duct Construction Standards, Metal and Flexible-2005.
 - .2 SMACNA IAQ Guideline for Occupied Buildings Under Construction-2007.
- .5 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for duct liners and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00.
- .2 Operation and Maintenance Data: submit operation and maintenance data for duct liners for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect duct liners from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 DUCT LINER

- .1 General:
 - .1 Mineral Fibre duct liner: air surface coated mat facing.
Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50 when tested in accordance with CAN/ULC-S102 and NFPA 90A.
 - .2 Fungi resistance: to ASTM C1338 and ASTM G21.
- .2 Rigid:
 - .1 Use on flat surfaces where indicated.
 - .2 25 mm thick, to ASTM C1071 Type 2, fibrous glass rigid board duct liner.
 - .3 Density: 48 kg/m³ minimum.
 - .4 Thermal resistance to be minimum 0.76 (m².degrees C)/W for 25 mm thickness when tested in accordance with ASTM C177, at 24 degrees C mean temperature.
 - .5 Maximum velocity on faced air side: 20.3 m/s.
 - .6 Minimum NRC of 0.70 at 25 mm thickness based on Type A mounting to ASTM C 423.
- .3 Flexible:
 - .1 Use on round or oval surfaces.
 - .2 25 mm thick, to ASTM C1071 Type 1, fibrous glass blanket duct liner.
 - .3 Density: 24 kg/m³ minimum.
 - .4 Thermal resistance to be minimum 0.74 (m².degrees C)/W for 25 mm thickness when tested in accordance with ASTM C177, at 24 degrees C mean temperature.
 - .5 Maximum velocity on coated air side: 25.4 m/s.
 - .6 Minimum NRC of 0.65 at 25 mm thickness based on Type A mounting to ASTM C423.

2.2 ADHESIVE

- .1 Adhesive: to NFPA 90A and ASTM C916.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 29 degrees C to plus 93 degrees C.
- .3 Water-based fire retardant type.

2.3 FASTENERS

- .1 Weld pins 2.0 mm diameter, length to suit thickness of insulation. Metal retaining clips, 32 mm square.

2.4 JOINT TAPE

- .1 Poly-Vinyl treated open weave fiberglass membrane 50 mm wide.

2.5 SEALER

- .1 Meet requirements of NFPA 90A.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 68 degrees C to plus 93 degrees C.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that site conditions are acceptable for duct liner installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect area where duct insulation is to be installed.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 GENERAL

- .1 Do work in accordance with SMACNA HVAC Duct Construction Standard except as specified otherwise.
- .2 Line inside of ducts where indicated.
- .3 Duct dimensions, as indicated, are clear inside duct lining.

3.3 DUCT LINER

- .1 Install in accordance with manufacturer's recommendations, and as follows:
 - .1 Fasten to interior sheet metal surface with 100% coverage of adhesive to ASTM C916.
 - .1 Exposed leading edges and transverse joints to be factory coated or coated with adhesive during fabrication.

- .2 In addition to adhesive, impact driven mechanical fasteners to compress duct liner sufficiently to hold it firmly in place.
 - .1 Spacing of mechanical fasteners in accordance with SMAC HVAC Duct Construction Standard.
- .2 In systems, where air velocities exceeds 20.3 m/s, install galvanized sheet metal nosing to leading edges of duct liner.

3.4 JOINTS

- .1 Seal butt joints, exposed edges, weld pin and clip penetrations and damaged areas of liner with joint tape and sealer. Install joint tape in accordance with manufacturer's written recommendations, and as follows:
 - .1 Bed tape in sealer.
 - .2 Apply 2 coats of sealer over tape.
- .2 Replace damaged areas of liner at discretion of Departmental Representative.
- .3 Protect leading and trailing edges of duct sections with sheet metal nosing having 15 mm overlap and fastened to duct.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .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.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)
 - .1 ANSI/AMCA Standard 99-2010, Standards Handbook.
 - .2 ANSI/AMCA Standard 210-2007/(ANSI/ASHRAE 51-07), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
 - .3 ANSI/AMCA Standard 300-2014, Reverberant Room Method for Sound Testing of Fans.
 - .4 ANSI/AMCA Standard 301-2014, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for HVAC fans and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Provide:
 - .1 Fan performance curves showing point of operation, flow rate, kW, static pressure, and efficiency.
 - .2 Sound rating data at point of operation.
 - .2 Indicate:
 - .1 Motors, sheaves, bearings, shaft details.
 - .2 Minimum performance achievable with variable speed controllers, as appropriate.
 - .3 Manufacturer name and model number
 - .4 Electrical voltage, phase, and current draw

1.3 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Submit in accordance with Section 01 78 00.
 - .1 Provide:
 - .1 Matched sets of belts.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:
 - .1 Bearings and seals.
 - .2 Addresses of suppliers.

- .3 List of specialized tools necessary for adjusting, repairing or replacing.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect HVAC fans from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials as specified in Section 01 74 20.

Part 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.
 - .2 Capacity: flow rate, static pressure, W, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.
 - .3 Fans: statically and dynamically balanced, constructed in conformity with ANSI/AMCA Standard 99.
 - .4 Sound ratings: comply with ANSI/AMCA Standard 301, tested to ANSI/AMCA Standard 300. Supply unit with ANSI/AMCA certified sound rating seal.
 - .5 Performance ratings: based on tests performed in accordance with ANSI/AMCA Standard 210. Supply unit with ANSI/AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

2.2 FANS GENERAL

- .1 Motors:
 - .1 In accordance with Section 23 05 13 supplemented as specified herein.
 - .2 For use with variable speed controllers.
 - .3 Sizes as indicated on equipment schedules.
- .2 Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards, coupling guards fan or safety screens as indicated and as specified in Section 23 05 13.

- .3 Factory primed before assembly in colour standard to manufacturer.
- .4 Scroll casing drains: as indicated.
- .5 Finish on fume hood exhaust fans: mill.
- .6 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .7 Statically and dynamically balance fans so no objectionable vibration or noise is transmitted to occupied areas of the building.
- .8 Provide fans capable of accommodating static pressure variations of $\pm 10\%$ with no objectionable operating characteristics.
- .9 Vibration isolation: to Section 23 05 48.
- .10 Flexible connections: to Section 23 33 00.

2.3 FUME HOOD EXHAUST FANS

- .1 Impeller:
 - .1 Fan impeller is non overloading centrifugal backward inclined flat blade. Standard construction is welded aluminum. Aluminum centrifugal impellers are coated with Hi Pro Polyester Resin.
- .2 Fan wheels:
 - .1 Welded aluminum construction.
 - .2 Maximum operating speed of centrifugal fans not more than 50% of first critical speed.
 - .3 Air foil backward inclined blades, as indicated.
- .3 Best Drive Components
 - .1 Bearings selected with L(10) in excess of 100,000 hours (equipment to an average of L (50) life of 500,000 hours.
 - .2 Extended lube lines for fan bearing lubrication
 - .3 Fan bearings and extended lube lines are pre-filled with synthetic grease
 - .4 Shafts are polished and turned steel
 - .5 Fan and motor pulleys are constant speed and size for 200% of motor horse power
 - .6 Motor, belts, pulleys, and bearings are sealed from contaminated airstream
- .4 Isolation and Bypass Dampers
 - .1 Gravity backdraft isolation dampers, aluminum construction.
 - .2 Damper blades and frames are coated with Hi Pro Polyester Resin
 - .3 Isolation and bypass dampers are opposed blade operation.

2.4 IN-LINE CENTRIFUGAL FANS

- .1 Characteristics and construction: as for centrifugal fan wheels, with axial flow construction and direct or belt drive, as indicated on the equipment schedules.

- .2 Provide AMCA arrangements 1 or 9 as indicated with stiffened flanges, smooth rounded inlets, and stationary guide vanes.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions are acceptable for HVAC fan installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect installation area.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 FAN INSTALLATION

- .1 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48, flexible electrical leads and flexible connections in accordance with Section 23 33 00.
- .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 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .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.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 CONTROLS

- .1 Fume hood exhaust fan to be activated by Fume Hood operation.
- .2 Exhaust fan operation to be interlocked with Make Up Air Unit.

END OF SECTION

Part 1 GENERAL

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for diffusers, registers and grilles and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate following:
 - .1 Capacity.
 - .2 Throw and terminal velocity.
 - .3 Noise criteria.
 - .4 Pressure drop.
 - .5 Neck velocity.
 - .6 Dimensions.

1.2 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00.
 - .2 Include:
 - .1 Keys for volume control adjustment.
 - .2 Keys for air flow pattern adjustment.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect diffuser, registers and grilles from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials as in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

2.2 GENERAL

- .1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.
- .2 Frames:
 - .1 Full perimeter gaskets.
 - .2 Frames where set into gypsum board and as indicated on drawings.
 - .3 Concealed fasteners.
- .3 Concealed manual volume control damper operators.
- .4 Colour: as indicated on drawings.

2.3 MANUFACTURED UNITS

- .1 Grilles, registers and diffusers of same generic type, products of one manufacturer.

2.4 SUPPLY GRILLES AND REGISTERS

- .1 As indicated on drawings.

2.5 RETURN AND EXHAUST GRILLES AND REGISTERS

- .1 As indicated on drawings.

2.6 DIFFUSERS

- .1 As indicated on drawings.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that site conditions are acceptable for diffuser, register and grille installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect area where the diffuser, grille, or register is to be installed.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Install in accordance with manufacturers instructions.
- .2 Install with screws in countersunk holes where fastenings are visible.
- .3 Bolt grilles, registers and diffusers, in place, in areas which may be subject to accidental impact.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .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.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM E90-09, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for louvers, intakes and vents and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate following:
 - .1 Pressure drop.
 - .2 Face area and free area.
 - .3 Free area velocity.
 - .4 Required opening size
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Test Reports: submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E 90.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect louvers, intakes and vents from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 20.

Part 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

2.2 GRAVITY ROOF OUTSIDE AIR INTAKES AND RELIEF VENTS

- .1 Factory manufactured galvanized steel hinged at curb line.
 - .1 Complete with integral birdscreen of 2.7 mm diameter aluminum wire.
 - .2 Horizontal backdraft dampers.
 - .3 Maximum throat velocity: 3.3 m/s intake.
 - .4 Maximum loss through unit: 15 Pa static pressure.
 - .5 Maximum velocity through damper area: 1.5 m/s.
 - .6 Dimensions: as indicated.
- .2 Birdscreens:
 - .1 Complete with integral birdscreen of 2.7 mm diameter aluminum wire. Use 19 mm mesh on intake.

2.3 GOOSENECK HOODS

- .1 Thickness: to SMACNA.
- .2 Fabrication: to SMACNA.
- .3 Joints: to SMACNA. Proprietary manufactured flanged duct joint considered class A seal.
- .4 Supports: as indicated.
- .5 Complete with integral birdscreen of 2.7 mm diameter aluminum wire. Use 19 mm mesh on intake].
- .6 Horizontal backdraft dampers.

2.4 FIXED LOUVRES

- .1 General: wind-driven rain resistant stationary louver.
- .2 Frame:
 - .1 127mm deep, 6063T extruded aluminum with 2.1mm nominal wall thickness
- .3 Blades:
 - .1 6063T5 extruded aluminum 1.6mm nominal wall thickness
 - .2 Durable drainable blades to be sightproof and spaced approximately 51mm centre to centre
- .4 Screen
 - .1 16mm x 1mm expanded flattened aluminum bird screen in removable frame

- .5 Finish: prime coated. Colour: to Departmental Representative's approval.
- .6 Accessories
 - .1 To be provided with filter racks where indicated on drawings

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions on site to confirm adequate room to install louvres in existing wall or ceiling without impacting existing equipment, piping, or building services.

3.2 INSTALLATION

- .1 In accordance with manufacturer's and SMACNA recommendations.
- .2 Reinforce and brace as indicated.
- .3 Anchor securely into opening. Seal with caulking to ensure weather tightness.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .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.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 National Fire Prevention Association (NFPA)
 - .1 NFPA 96-2011, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .2 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 52.2-2007, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size. WITHDRAWN
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-115.10-M90, Disposable Air Filters for the Removal of Particulate Matter from Ventilating Systems.
 - .2 CAN/CGSB-115.13-85, Filter Media, Automatic Roll (Reaffirmed April 1985).
 - .3 CAN/CGSB-115.14-M91, High Efficiency Cartridge Type Supported Air Filters for the Removal of Particulate Matter from Ventilating Systems.
 - .4 CAN/CGSB-115.15-M91, High Efficiency Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems.
 - .5 CAN/CGSB-115.16-M82, Activated Carbon for Odor Removal from Ventilating Systems.
 - .6 CAN/CGSB-115.18-M85, Filter, Air, Extended Area Panel Type, Medium Efficiency.
 - .7 CAN/CGSB-115.20-95, Polarized Media Air Filter.
- .4 Underwriters' Laboratories of Canada
 - .1 ULC-S111-07, Standard Method of Fire Tests for Air Filter Units.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawing and product data in accordance with Section 01 33 00.
- .2 Indicate the following:
 - .1 Minimum Efficiency Reporting Value
 - .2 Pressure drop
 - .3 Size

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
- .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.

1.5 MAINTENANCE MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00.
- .2 Furnish list of individual manufacturer's recommended spare parts for equipment such as frames and filters, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing for inclusion in operating manual.

1.6 EXTRA MATERIALS

- .1 Spare filters: in addition to filters to be installed immediately prior to acceptance by Departmental Representative, supply 1 complete set of filters for each filter unit or filter bank in accordance with section 01 78 00.

Part 2 PRODUCTS

2.1 GENERAL

- .1 Media: suitable for air at 100% RH and air temperatures between minus 40 and 50°C.
- .2 Number of units, size and thickness of panels, overall dimensions of filter bank, configuration and capacities: as indicated.
- .3 Pressure drop when clean and dirty, sizes and thickness: as indicated on schedule.

2.2 ACCESSORIES

- .1 Holding frames: permanent channel section construction of same material as casing/hood, 1.6 mm thick, except where specified otherwise.
- .2 Seals: to ensure leakproof operation.
- .3 Blank-off plates: as required, to fit all openings and of same material as holding frames.
- .4 Access and servicing: through doors/panels on each side or as indicated on drawings.

2.3 CARTRIDGE TYPE FILTERS 95 %EFFICIENCY

- .1 Media: disposable, high efficiency, to CAN/CGSB-115.15.
- .2 Holding frame: galvanized steel with bracing.
- .3 Media support: welded wire grid.
- .4 Performance: average atmospheric dust spot efficiency 95% to ASHRAE 52.1.
- .5 Fire rated: to ULC-S111.

2.4 FILTER GAUGES - DIAL TYPE

- .1 Diaphragm actuated, direct reading.
- .2 Range: 0 to 2 times initial pressure (0 to 250 Pa).

2.5 FILTER GAUGES - MANOMETER TYPE

- .1 Inclined acrylic tube.
 - .2 Complete with levelling screws.
-

- .3 Range: 0 to 2 times initial pressure (0 to 250 Pa).

Part 3 EXECUTION

3.1 INSTALLATION GENERAL

- .1 Install in accordance with manufacturer's recommendations and with adequate space for access, maintenance and replacement.

3.2 REPLACEMENT MEDIA

- .1 Replace all media with new upon acceptance.
.2 Filter media to be new and clean, as indicated by pressure gauge, at time of acceptance.

3.3 FILTER GAUGES

- .1 Install type as indicated across each filter bank (pre-filter and final filter) in approved and easy readable location.
.2 Mark each filter gauge with value of pressure drop for clean condition and manufacturer's recommended replacement (dirty) value.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)
 - .1 ANSI/ARI 430-2014, Central-Station Air-Handling Units.
- .2 American Society of Heating, Refrigeration and Air Condition Engineers (ASHRAE)
 - .1 ANSI/ASHRAE 90.1-2013, (I-P) Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - .2 ANSI/ASHRAE 52.2-2007, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .4 Green Seal Environmental Standards (GSES)
 - .1 Standard GS-11-07, Environmental Standard for Paints.
- .5 Master Painters Institute (MPI)
 - .1 MPI-INT 5.3-2007, Galvanized Metal.

1.2 QUALITY ASSURANCE

- .1 Meet the requirements of CSA, Provincial and Municipal Codes, and be CSA listed.
- .2 Test and rate the cooling systems to AHRI Standard 210.
- .3 Units shall be products of manufacturers who provide local service personnel from factory representative, franchised dealer, or certified maintenance service shop.
- .4 Provide start-up service by factory trained representative to make adjustments, perform efficiency tests, start up units, and provide training.
- .5 The unit shall be fully assembled and tested prior to shipment. A detailed pre-shipment test report shall be provided to the Departmental Representative.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
 - .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for insulation, filters, adhesives, and paints, and include product characteristics, performance criteria, physical size, finish and limitations.
 - .3 Shop Drawings:
 - .1 Indicate following:
 - .1 Supply air capacity
 - .2 Heating input and output capacity
 - .3 Heating coil air pressure drop
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- .4 Cooling input and output capacity
- .5 Cooling coil air pressure drop
- .6 Total and external fan static pressure
- .7 Fan BHP
- .8 Fan curves showing point of operation
- .9 Motor drive type
- .10 Bearing life
- .11 Minimum Efficiency Reporting Value for filters
- .12 Damper size and actuator type.
- .13 Electrical characteristics including voltage, phase, current draw
- .14 Provide all available points, point addresses, and point description.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.
- .2 Include following: completed manufacturer's startup checklist from the time of Commissioning, Commissioning Report, copy of final shop drawing.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Provide maintenance materials in accordance with Section 01 78 00.
- .2 Provide one spare set of filters.
- .3 Provide list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.
- .4 Spare filters: in addition to filters installed immediately prior to acceptance by Departmental Representative, supply 1 complete set of filters for each filter unit or filter bank.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer in accordance with Section 01 74 20.

1.7 STARTUP SERVICE AND WARRANTY

- .1 Manufacturer shall furnish a factory trained service technician to perform the unit startup. Manufacturer shall provide instruction to the Departmental Representative on the operation and maintenance of the unit. Factory technician to provide copy of start-up log to Departmental Representative and to demonstrate operation and maintenance to Departmental Representative. The warranty period shall commence at the date of initial startup and shall continue for a period of one (1) year not to exceed eighteen (18) months from shipment. Manufacturer's warranty shall include all parts and labour to install parts.
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- .2 Provide 10 year unconditional parts warranty on heat exchangers.

Part 2 PRODUCTS

2.1 GENERAL

- .1 Factory assembled components to form units supplying air at designed conditions, as indicated.
- .2 Certify ratings: to ANSI/ARI 430 with ARI seal.
- .3 Duct openings as indicated on drawings, having air tight modular components, consisting of casing, fan section with motor and drive, filter section, dampers, bypass section, gas burner, cooling coil, mixing box]
- .4 Unit shall be factory wired and tested, and shall be certified by ETL, with C.S.A. approved components.
- .5 Wiring shall be in accordance with the Canadian Electrical Code, Part 1, and pertinent sections of Part 2 of the Code pertaining to specific equipment type and purpose. All electrical circuits shall undergo a dielectric strength test (CSA C22.2-0), and shall be factory tested and checked as to proper function.
- .6 Automatic controls shall be housed in a control panel mounted in or on the air handling unit, which will meet the C.S.A. standard of the specific installation.

2.2 CASINGS

- .1 Unit casing shall be of minimum 18 (1.8mm) gauge satin coat galvanized sheet metal. Surfaces shall be cleaned with a degreasing solvent to remove oil and metal oxides and primed with a two part acid based etching primer. Finish coat shall be an electrostatically applied enamel, to all exposed surfaces. All unprotected metal and welds shall be factory coated. All walls, roofs and floors shall be of formed construction, with at least two breaks at each joint. Joints shall be secured by sheet metal screws or pop rivets. Wall and floor joints shall be broken in and roof joints broken out (exposed) for rigidity. All joints shall be caulked with a water resistant sealant.
- .2 Air handling units shall be weatherproofed and equipped for installation outdoors. This shall include generally for the prevention of infiltration of rain and snow into the unit, louvers or hoods on air intakes and exhaust openings with 1"(25mm) galvanized inlet screens; rain gutters or diverters over all access doors; all joints caulked with a water resistant sealant; roof joints turned up 2" (51mm) with three break interlocking design; outer wall panels extend a minimum of ¼"(6mm) below the floor panel; drain trap(s) connections for field supply and installation of drain traps.
- .3 Units mounted on roof curbs incorporate welded floor to base construction. Floors are of three break upstanding design with welded corners and free of penetrations. Unit underside joints are caulked.
- .4 Provide a 22 gauge (.85mm) solid galvanized metal liner over all insulated areas in contact with the air stream.
- .5 Casings shall be supported on a structural steel channel supports, designed and welded for low deflections. Integral lifting lugs shall be provided for hoisting.
-

- .6 Unit casing floors shall be of minimum 18 (1.8mm) gauge satin coat galvanized sheet metal. Provide reinforcing channels under floor to minimize deflection and prevent 'oil canning' effect.
- .7 Cooling coil drain pans shall be fabricated of stainless steel and are an integral part of the floor paneling, a minimum of 51mm deep with welded corners. Drain pans shall extend a minimum of 152mm downstream of coil face and be provided with a 38mm drain connections. Drain pans must be sloped and pitched such that there is no standing water.
- .8 Casings shall be supported on formed galvanized steel channel or structural channel supports, designed and welded for low deflections. Integral lifting lugs shall be provided for hoisting.

2.3 ACCESS DOORS

- .1 Units shall be provided with access doors to the following components:
 - 2.3.3.1 Fans, Motors
 - 2.3.3.2 Dampers and Operators
 - 2.3.3.3 Filters
 - 2.3.3.4 Access Panels
 - 2.3.3.5 Burners and Controls
 - 2.3.3.6 Cooling Section
 - 2.3.3.7 Coils
 - 2.3.3.8 Heat Exchanger
- .2 Access Doors shall be minimum 24"X60". Removal of screwed wall panels will not be acceptable. Provide hinged access doors, with stainless steel piano hinges and brass pins, in welded steel frames. Doors shall be fully lined with closed cell, automotive bulb gasket and lever lock roller handle, operable from both sides.
- .3 Hinged access doors to areas of negative pressure shall open out, and to areas of positive pressure shall open in.

2.4 INSULATION

- .1 All units shall be internally insulated with 50mm thick, 24 kg/m³ density thermal insulation, secured to metal panels with a fire retardant adhesive and welded steel pins at 400 mm on centre. All longitudinal insulation joints and butt ends shall be covered by a sheet metal break to prevent erosion of exposed edges. Drain pans and all floor areas shall be insulated on the underside.
- .2 The following areas shall be provided with a 0.85mm (22 gauge) solid galvanized metal liner over insulated areas:
 - 1.1.1.1 Coil Sections
 - 1.1.1.2 Filter Sections
 - 1.1.1.3 Access Sections
 - 1.1.1.4 Underside of unit
- .3 The following areas shall be provided with a 0.70mm (24 gauge) perforated (40% free area) galvanized metal liner over insulated areas:
 - 1.1.1.5 Fan Sections

2.5 FANS

- .1 Centrifugal fans shall be rated in accordance with AMCA and fan manufacturer shall be a member of AMCA.
- .2 Forward curve, double inlet, statically and dynamically balanced Class II centrifugal fan. Heavy-duty shaft and pre-lubricated self-aligning bearings, rubber mounted V-belt drive, adjustable variable pitch motor pulley, rubber isolated hinge mounted motor.
- .3 Fan motor assembly shall be mounted on a free floating angle iron frame and internally isolated from rest of the unit using base isolators and canvas connectors.
- .4 Drives shall be adjustable on fans with motors 5.6 kW or smaller. On fans with larger motors, fixed drives shall be provided. All drives shall be provided with a rust inhibiting coating. The air balancer shall provide drive changes (if required) during the air balance procedure.
- .5 Motor, fan bearings and drive assembly shall be located inside the fan plenum to minimize bearing wear and to allow for internal vibration isolation of the fan-motor assembly. Motor mounting shall be adjustable to allow for variations in belt tension.
- .6 Fan-motor assemblies shall be provided with vibration isolators. Isolators shall be secured to welded steel channel and connected to the structural frame of the unit. The isolators shall be neoprene-in-shear type. Hard mounted fan assemblies are not acceptable.
- .7 Provide single extended grease line from far side to access side bearing.
- .8 Fan motors shall be open drip proof type, premium efficiency type.

2.6 COOLING SECTION

- .1 Unit must conform to regulations set out in the Canadian Energy Efficiency
- .2 Act for large air conditioners (condensing units). Packaged units shall be tested to CSA Standard C746-98 and must bear an EEV (energy efficiency verification) label provided by CSA.
- .3 Coils shall be constructed of copper tube, aluminium fin, copper headers with sweat connections.
- .4 Fins constructed of aluminum shall be rippled for maximum heat transfer and shall be mechanically bonded to the tubes by mechanical expansion of the tubes. The coils shall have a galvanized steel casing. All coils shall be factory tested with air at 300 psig (2070 kPa) while immersed in an illuminated water tank.
- .5 Refrigerant evaporator type coil shall be equipped with minimum 2 distributors connected to the coil by copper tubes. Provide a hot gas bypass valve on lead circuit. Solenoid valves, expansion valves, and related accessories are to be installed in the factory by the unit manufacturer.
- .6 Refrigerant coil shall be designed for minimum two compressors and shall be alternate tube circuited in order to distribute the cooling effect over the entire coil face at reduced load conditions. Maximum face velocity for the Dx cooling coil shall not exceed 500 FPM. Coils exceeding the specified face velocity will not be accepted. Coils shall be CSA certified.
- .7 Refrigerant shall be Type 410A.
- .8 Provide a minimum of 2 hermetic type compressors, 3600 RPM, set on resilient neoprene mounts and complete with line voltage break internal overload protection, internal pressure relief valve and crankcase heater.

- .9 Remote or external condenser shall not be acceptable. The coil shall be copper tube type, mechanically expanded into aluminum fins. Coils shall be factory tested with air at 300 psig (2070 kPa) while immersed in an illuminated water tank. Maximum face velocity for the condenser coil shall not exceed 700 FPM. Coils exceeding the specified face velocity will not be accepted. Coils shall be C.S.A. certified.
- .10 Packaged units shall operate down to 50 F (10 C) as standard. Multiple refrigeration circuits shall be separate from each other. Refrigeration circuits shall be complete with liquid line filter-driers, combination sight glass moisture indicators and service ports fitted with Schraeder fittings. Units with 9, 10 and 12 Ton hermetic compressors shall also incorporate load compensated thermal expansion valves with external equalizers. The complete piping system shall be purged and pressure tested with dry nitrogen, then tested again under vacuum. Each system shall be factory run and adjusted prior to shipment.
- .11 Controls for hermetic compressor units shall include compressor contacts, supply fan contacts and overload protection control circuit transformer, cooling relays, ambient compressor lockout, high pressure controls and automatic reset low pressure controls
 - .1 Provide five minute anti-cycle timers.
 - .2 Provide inter stage time delay timers.

2.7 DAMPERS

- .1 Provide a certified low leak type outdoor air Dampers tested to AMCA standard. Dampers not meeting specifications will not be acceptable. Parallel blades are 6" wide and made of aluminum extrusion low leak air foil type.
- .2 Unit shall be complete with heavy duty, automatic shut-off dampers on exhaust and fresh air side. Damper actuators are to be complete with integral End Switch to prevent main fans from running until the damper has reached a sufficiently open position. Provide shut-off dampers as required to prevent cold air infiltrating building.

2.8 FILTERS

- .1 Filter sections shall be provided with adequately sized access doors to allow easy removal of filters.
- .2 Provide 2" (50 mm) pleated panel disposable filters. Non-woven cotton fabric media with a metal support grid and heavy duty beverage board enclosing frame. Pre filters shall be MERV 8.
- .3 Provide a metal frame with metal grid for filter bank to prevent the collapse of each filter. Provide a differential pressure switch across each filter bank to signal a dirty filter light on the unit panel.

2.9 GAS FIRED HEAT EXCHANGER

- .1 Heating units shall be indirect natural gas fired approved for both sea level and high altitude areas. The entire package, including damper controls, fan controls, and all other miscellaneous controls and accessories shall be approved by an independent testing authority and carry the approval label of that authority as a complete operating package.
- .2 All units must exceed the ASHRAE 90.1 requirement of steady state efficiency at low fire.
- .3 Operating natural gas pressure at unit(s) manifold shall be 7"w.c.(1750 Pa) to 14"w.c.(3500 Pa).

- .4 Gas fired units shall be approved for operation in -40°F(-40°C) locations.
 - .5 Heat exchanger shall be a primary drum and multi-tube secondary assembly constructed of titanium stainless steel with multi-plane metal turbulators and shall be of a floating stress relieved design. Heat exchanger shall be provided with condensate drain connection. The heat exchanger casing shall have 1"(25mm) of insulation between the outer cabinet and inner heat reflective galvanized steel liner. Blower location shall be engineered to improve the required air flow pattern around the heat exchanger. Using duct type furnaces and closed coupled blowers are not acceptable.
 - .6 DJ series heat exchangers shall be tested and certified to ANSI/CSA standards to provide a minimum of 80% efficiency throughout the entire operating range as required by ASHRAE 90.1. The manufacturer shall be routinely engaged in the manufacture of this type of high efficiency equipment.
 - .7 The heat exchanger/burner assembly shall be a blow through positive pressure type. Units incorporating the DJM module shall have an interrupted pilot ignition system to provide increased safety. Units using continuous or intermittent pilots are not acceptable.
 - .8 Flame surveillance shall be from the main flame after ignition not the pilot flame. The burner and gas train shall be in a cabinet enclosure. Atmospheric burners or burners requiring power assisted venting are not acceptable.
 - .9 The heat exchanger/burner assembly shall include 15:1 turndown for all input ranges. The high turn down heat exchanger/burner assembly minimum input shall be capable of controlling 6.7% of its rated input, excluding the pilot assembly, without on/off cycling and include built in electronic linearization of fuel and combustion air. Efficiency shall increase from high to low fire.
 - .10 Tests shall be performed after complete final unit assembly, just prior to shipping to job site. The tests shall be performed in accordance with the equipment standard that the gas heating section is certified: Heat exchanger shall be clocked with a dedicated calibrated gas meter to insure proper set up of the gas manifold; High and Low input flue gas combustion analysis using a calibrated combustion analyzer including O₂ and CO to provide proper air fuel ratio throughout the entire operating range; A copy of the combustion test report shall be provided.
 - .11 All venting materials shall be supplied and installed by the installing contractor.
 - .12 Installation shall be in accordance with the requirements of authorities having jurisdiction and ANSI Z2231/NFPA 54 or CSA B149.1. Heaters must be provided with sufficient combustion air and shall not be located in an area where a negative pressure will be created that will starve the burner of combustion air. Flue outlet pressure must not exceed maximum over fire pressure shown on the nameplate.
 - .13 Electronic module (Modulating Fuel w/ Modulating Combustion Air) complete with proportional and integral control with discharge air sensor to maintain set point temperature and provide rapid response to incremental changes in discharge air temperature. Combustion air motor speed varies proportionally in response to the modulation of gas flow to provide optimum fuel/air mixture and efficiency at all conditions. Combustion blower RPM shall be proved using a hall effect speed sensor. Two speed or step speed combustion blowers are not acceptable.
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- .14 Combustion efficiency of high efficiency heat exchangers shall increase by up to 4% from high fire to low fire while turning down on units incorporating 15:1 turndown. Heat exchangers shall provide a minimum of 80% efficiency throughout the entire operating range.
- .15 Discharge air sensor shall be field mounted in supply ductwork.
- .16 Provide a make up air reverse airflow high limit switch in series with the standard high limit switch mounted in the blower discharge.

2.10 ELECTRICAL

- .1 Each unit shall be wired and tested at the factory before shipment. Wiring shall comply with CSA standards. All wiring shall be number coded per the electrical wiring diagrams. All electrical components shall be labeled according to the electrical diagram and be CSA recognized. Each unit shall have a 115 volt control circuit transformer, system service switch, and control circuit fuse.
- .2 The supply air fan, compressor and condenser fan motor branch circuits shall be individually fused. Contactors and thermal overload protection shall be furnished for each compressor and condenser fan motor. The supply air fan motors shall have contactors and external overload protection.
- .3 A terminal block shall be provided for the main power connection and a terminal board shall be provided for the low voltage control wiring. Knockouts shall be provided in the bottom of the main control panel for field wiring entrance. A separate key locked control panel shall house all controls for the condensing section. Provide a disconnect switch to cut power to the entire unit before the control panel door can be opened.

2.11 CONTROLS FOR APPLIED MAKE UP AIR UNIT

- .1 The unit shall be constructed so that it can function as a stand-alone heating and cooling system controlled by factory-supplied controllers, thermostats and sensors or it can be operated as a heating and cooling system controlled by a Building Management System (BMS). This unit shall be controlled by a factory-installed microprocessor programmable controller (DDC) that is connected to various optional sensors.
- .2 Make Up Air Unit shall be interlock to Fume Hood Exhaust Fan.
- .3 Unit shall incorporate a DDC controller with integral LCD screen that provides text readouts of status. DDC controller shall have a built-in keypad to permit operator to access read-out screens without the use of ancillary equipment, devices or software. DDC controllers that require the use of equipment or software that is not factory-installed in the unit are not acceptable. Alarm readouts consisting of flashing light codes are not acceptable.
- .4 Factory install: Dirty filter sensor, discharge air temperature sensors, airflow monitoring sensors
- .5 Operating protocol: The DDC shall be factory-programmed for Native BACnet over MS/TP and IP.
- .6 Unit mounted digital controller that will provide status, monitoring, command and reset signals. The controller shall have provisions for future BACNET.
- .7 Native BACnet from equipment supplier shall be completely mapped. Provide all available points, point addresses, and point description.

- .8 The following factory read (R) & read/write (R/W) control points shall be read from the unit controller digital display and via BACNET:

Unit Command On/Off (R/W)

Cooling Enabled (R/W)

Damper Minimum Position (R/W)

Discharge Air Setpoint (R/W)

Heating Enabled (R/W)

Heating Status (R)

Cooling Status – Mechanical Cooling On/Off (R)

Ambient Temperature (R)

Blower Status Supply Air (R)

Ambient Sensor Alarm (R)

Cooling Lockout – Low Ambient Temperature (R)

Cooling Status: Stages % On (R)

Discharge Air Low Limit Lockout (R)

Discharge Air Sensor Alarm (R)

Flame Failure Alarm (R)

Heat Failure Lockout (R)

Heating Modulating % Output (R)

Sensor Failure Alarm (R)

Filters status (R)

2.12 ROOF CURB

- .1 Each unit shall be provided with a prefabricated 12-gauge galvanized steel mounting curb designed and manufactured by the unit manufacturer for field assembly on the roof decking prior to unit shipment. The roof curb shall be a perimeter type with complete perimeter support of the air handling section and rail support of the condensing unit section. The curb shall be a minimum of 14 inches high and include a nominal 2 x 4-inch wood strip. Gasketing shall be provided for field mounting between the unit base and roof curb. The roof curb shall be approved by the National Roofing Contractors Association. Provide custom roof curb adaptor to suit existing unit curb size.
- .2 Coordinate roof curb with roofing contractor.

Part 3 EXECUTION

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 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 Install unit on manufacturer's roof curb, for level installation.
- .5 Install unit flat and level on roof curb in accordance with manufacturers' installation literature.
- .6 Install and wire all control accessories and power wiring to the unit.
- .7 Provide two (2) 115 volt electrical power feeds to the unit in addition to the main unit power feed. One shall be rated for a 15 Amp service receptacle located within the control panel. The other shall be rated for 20 Amp service to the electric heater and humidifier in the empty section out of the air stream. Terminate both 115 Volt feeds in the RTU control panel with 15 feet of extra wire on both feeders.
- .8 Provide water and drain piping for the humidifier through the base of the RTU in the humidifier section. Electrically trace these water lines. Patch all holes air and water tight.

3.3 FANS

- .1 Install fan sheaves required for final air balance.
- .2 Install flexible connections at fan inlet and fan outlets.
- .3 Install vibration isolators.

3.4 DRIP PANS

- .1 Install deep seal P-traps on drip lines. Depth of water seal to be 1.5 times static pressure at this point.

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 11.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

3.6 PERFORMANCE VERIFICATION AND TRAINING

- .1 Follow manufacturer's checklist for start-up of equipment, and simulate operation of both heating and cooling operation
- .2 Performance verification of unit to be in accordance with the General requirements listed in section 01 91 13.
- .3 Provide training for Make Up Air Unit for no less than 2 days.

END OF SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Acceptable Materials: Where materials are specified by trade name refer to the General Instructions to Bidders for procedure to be followed in applying for approval: SACC Manual Clause ID R2410T for GI14 Approval of Alternative Materials, or, SACC Manual Clause ID R2710T for GI16 Approval of Alternate Materials.
- .2 Section 23 23 00 – Copper Tubing and Fittings Refrigerant
- .3 Section 23 07 15 – Thermal insulation for Piping
- .4 Section 23 09 33 – Electric and Electronic Control System for HVAC

1.2 REFERENCES

- .1 American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)
 - .1 ANSI/ARI 210/240-2008, Unitary Air Conditioning and Air-Source Heat Pump Equipment.
- .2 CSA International
 - .1 CAN/CSA-C656-05(R2010), Performance Standard for Split-System and Single Package Central Air Conditioners and Heat Pumps.
 - .2 CAN/CSA- B52-05 (R2009), Mechanical Refrigeration Code.
- .3 Environment Canada, (EC) / Environmental Protection Services (EPS)
 - .1 EPS 1/RA/2-1996, Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.
 - .2 Environment Canada-1994, Ozone-Depleting Substances Alternatives and Suppliers List.
- .4 National Fire Protection Association (NFPA)
 - .1 NFPA 90A-12, Standard for Installation of Air Conditioning and Ventilating Systems.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for:
 - .1 Indoor Fan Coil Units
 - .2 Air-Source Outdoor Units
 - .3 Refrigerant Piping Accessories
 - .4 Control Devices and Wiring Diagrams
 - .2 Shop Drawings:
 - .1 Indicate on drawings:
 - .1 Unit Tag Identification
-

- .2 Dimensions and Weights
- .3 Performance Characteristics and Operating Conditions
- .4 Colour and Finish
- .5 Electrical Characteristics
- .6 Required Field Coordination
- .7 Equipment Connections
- .8 Total Refrigerant Charge
- .2 Air-cooled VRF system manufacturer to provide complete piping layout and system schematic for review. Layout to be completed with manufacturer's selection software and drawn on floor plans provided by Department Representative.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
- .3 Manufacturer's limited warranty.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 20.

1.6 WARRANTY

- .1 All equipment shall be provided with a limited manufacturer's warranty for a period of one year after the date of installation or 18 months from date of delivery, whichever is shorter.
- .2 An optional extended warranty including 1 additional year parts and 5 additional years compressor shall be provided upon submission to the manufacturer and acceptance by the manufacturer of proper installation with documentation including:
 - .1 Selection output and layout of the VRF system.
 - .2 60 minutes of operation history upon commissioning from the VRF service tool.
 - .3 Completed commissioning report as per the VRF equipment manufacturer.

Part 2 PRODUCTS

2.1 DESCRIPTION

- .1 System shall be a VRF(Variable Refrigerant Flow) capable of cooling and heating. System shall be air cooled as indicated on mechanical drawings and equipment schedules.
- .2 System shall consist of outdoor units, indoor units, and controls by the equipment manufacturer. Equipment controls shall be capable of operating as a stand alone system.
- .3 System shall be capable of providing heating or cooling. When more than one indoor unit is connected to a single outdoor unit, a single thermostat shall be selected to provide master control for mode of operation (heating/cooling)

2.2 ACCEPTABLE MATERIAL

- .1 Mitsubishi Electric, Mr.Slim P-Series, manufactured by Mitsubishi Electric, 1-(905) 475-7728, fax: 1-(905) 475-6897, www.mitsubishielectric.ca, distributed by Mits Airconditioning Inc., 1-(800)-567-2221, fax: (905) 564-2205, www.mitsair.com
- .2 LG, Multi V, manufactured by LG, 1-(888)-542-2623, fax: 1-(647)-724-0083, www.lgvrf.ca, distributed by O'Dell Associates Inc 1-(519)-772-0386, fax: 1-(519)-772-1029, www.odellassoc.com
- .3 Daikin, Multi-split System, manufactured by Daikin AC (Americas), Inc., 1-(212) 340-7400, fax: 1-(212) 779-5925, www.daikin.com, distributed by HTS Engineering, 1-(519)-748-1860, fax: 1-(519) 784-9466, www.htseng.com

2.3 REFRIGERANTS

- .1 Type of Refrigerant: R-410a.

2.4 AIR-SOURCE HEAT PUMP

- .1 General:
 - .1 Four component VRF unit consisting of outdoor unit, indoor fan coils, manufacturer refrigerant piping and components, and controls.
 - .2 System components shall be from a single manufacturer.
 - .3 Unit control boards shall perform all functions required to effectively and efficiently operate the VRF system and communicate from outdoor unit to indoor units.
 - .4 Outdoor unit shall be completely factory assembled, piped and wired. Each outdoor unit shall be run tested at the factory.
 - .5 Outdoor unit shall have the ability to operate with an elevation difference of up to 50m above or 40m below the indoor units.
 - .6 The outdoor unit shall be capable of operating in heating only mode down to -20°C and up to 16°C ambient wet bulb without additional low ambient controls.
 - .7 The outdoor unit shall be capable of operating in cooling only mode down to -28°C and up to 48°C ambient dry bulb.
 - .8 The outdoor unit shall have an oil separator for the compressor and controls to ensure sufficient oil supply is maintained for the compressor.
 - .9 Field installed refrigerant piping between outdoor and indoor units to be insulated as specified in section 23 07 15 or as per manufacturer recommendations, whichever is more stringent.

- .10 Refrigerant pipe sizes to be as per manufacturers recommendations.
 - .2 Performance data: as indicated in mechanical schedules
 - .3 Frame:
 - .1 Shall be constructed with galvanized steel, bonderized and be finished with powder coat baked enamel paint.
 - .4 Compressor:
 - .1 Welded hermetic digitally controlled inverter driven rotary compressor. Crankcase heater shall be factory mounted on the compressor. Compressor shall be mounted to avoid the transmission of vibration.
 - .2 Compressor shall have an inverter to modulate capacity.
 - .3 Other components to include:
 - .1 Accumulator
 - .2 High pressure safety switch
 - .3 Over-current protection
 - .4 Subcooling heat exchanger
 - .5 Internal thermal overload
 - .5 Fan:
 - .1 Condenser fans shall be direct drive, variable speed.
 - .2 All fan motors shall have inherent protection, have permanently lubricated bearings and be variable speed.
 - .3 All fans shall be provided with a raised guard to limit contact with moving parts.
 - .6 Coil:
 - .1 The outdoor coil shall be of nonferrous construction with louvered fins on copper tubing.
 - .2 The coil fins shall have a factory applied corrosion resistant, hydrophilic coating.
 - .3 The coil shall be protected with an integral metal guard.
 - .4 Refrigerant flow from the outdoor unit shall be controlled by means of a digitally controlled inverter driven rotary compressor.
 - .7 Refrigeration piping:
 - .1 Between outdoor unit, compressor section and indoor coil, complete with refrigerant metering devices and valves.
 - .2 Refrigerant gas and liquid pipe sizes to be as per manufacturer's recommendation.
 - .3 Refer to Section 23 23 00.
 - .8 Electrical:
 - .1 Unit to be capable of operation within voltage limits of +/- 10% rated voltage.
 - .2 Outdoor unit shall be controlled by integral microprocessors.
 - .3 The control circuit between the indoor units and the outdoor unit shall be 24VDC. Communication shall be using 2-conductor, stranded, shield cable for RS485 daisy chain.
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- .9 Controls:
 - .1 Individual indoor units connected to air cooled condensing unit shall be controlled with individual remote mounted thermostats.
 - .2 Thermostats shall be supplied by VRF equipment manufacturer.

2.5 WALL MOUNT INDOOR UNIT

- .1 General:
 - .1 Wall mount indoor unit shall be designed for use with R410a refrigerant.
 - .2 Shall be of the same manufacturer of heating and cooling heat pump VRF systems.
 - .3 Shall communicate with the outdoor unit and heat recovery units using daisy chain communication.
 - .4 Field installed refrigerant piping between outdoor units, and indoor units to be insulated as specified in section 23 07 15 or as per manufacturer recommendations, whichever is more stringent.
- .2 Indoor Unit
 - .1 Shall be factory assembled, wired and run tested.
 - .2 The indoor unit shall be factory wired and piped with its own electronic expansion device, control circuit board, fan and motor.
 - .3 The indoor unit shall have a self-diagnostic function and auto restart function.
 - .4 The indoor unit shall be filled with a dry nitrogen gas charge from the factory.
- .3 Filter:
 - .1 Return air shall be filtered with a factory supplied removable, washable filter.
- .4 Fan:
 - .1 The indoor unit fan shall be no more than one assembly.
 - .2 The indoor fan shall be statically and dynamically balanced.
 - .3 Motor shall have permanently lubricated bearings.
 - .4 Provided fan settings shall be Low, Med, High, Power Cool (Cooling Mode), and Auto.
- .5 Coil:
 - .1 The indoor unit coil shall be nonferrous with louvered fins on copper tubing.
 - .2 The tubing shall have inner grooves.
 - .3 Coils shall be pressure tested at the factory.
 - .4 A condensate drain pan shall be factory installed below the coil.
- .6 Condensate Pump:
 - .1 The unit shall include a factory installed condensate pump that will be able to raise drain water 675mm above the indoor unit.
 - .2 Condensate pump power shall be 120V/1/60.
 - .3 Condensate pump to be concealed in the indoor unit.
- .7 Electrical:
 - .1 The indoor unit electrical power shall be 208-230V, 1-phase, 60 Hz.

- .2 The indoor unit shall be capable of operation within the voltage limits of +/- 10% of the rated voltage.
- .8 Controls:
 - .1 Unit shall use controls provided by the manufacture to perform all functions necessary to operate the system effectively and efficiently and communicate with the outdoor unit over a daisy chain RS485 communication system.
 - .2 Provide a wired thermostat controller for each indoor unit. Where more than one indoor unit is connected to a single outdoor unit, one thermostat shall provide master heating/cooling override control.
 - .3 Wired thermostat shall have the following capabilities and functions:
 - .1 Display operating condition
 - .2 Set Temperature
 - .3 Set Fan Speed
 - .4 On/Off
 - .5 Select Operation Mode
 - .6 7 day programmable heating and cooling schedule
 - .4 Provide fan coil unit with auxiliary heat kit to enable auxiliary hydronic duct mounted heating coil when there is insufficient heat from the air source outdoor unit.
 - .5 Provide IO interface (DDC) for the following points:
 - .1 Control Points
 - .1 ON/OFF
 - .2 Setpoint
 - .3 Mode of Operation
 - .4 Fan Speed
 - .2 Status
 - .1 ON/OFF
 - .2 Error
 - .3 Thermo ON/OFF (Compressor)
 - .4 Mode of Operation (heating/cooling)
 - .6 IO Interface to communicate with existing BMS.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for VRF system installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install where indicated and in accordance with manufacturer's instructions.
- .2 Install air source outdoor units on exterior concrete pad.
- .3 Secure with hold-down bolts in accordance with manufacturer's recommendations.
- .4 Make duct connections through flexible connections.
- .5 Level unit with fans running. Align duct work flexible connections. Misalignment with fan stopped not to strain or damage flexible connection.
- .6 Make piping connections.
- .7 Nothing to obstruct ready access to components or to prevent removal of components for servicing.
- .8 Mount remote wired thermostats. Program thermostats with operational and temperature settings as provided by Departmental Representative.

3.3 DRAIN PANS

- .1 Install so that no water can accumulate. Arrange easy access for cleaning.
- .2 Include internal or external trap for proper draining.

3.4 START-UP AND COMMISSIONING

- .1 Have manufacturer certify installation.
- .2 Have manufacturer present tests and start up units and certify performance.
- .3 Submit written start-up and commissioning reports to Departmental Representative.

3.5 CLOSEOUT ACTIVITIES

- .1 Manufacturer to deliver verbal and written instructions to operating personnel.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .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.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.7 PROTECTION

- .1 Protect installed products and components from damage during construction.
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- .2 Repair damage to adjacent materials caused by VRF system installation.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

- .1 **Provide:** The word provide means to supply, install and make operational.

1.2 GENERAL PROVISIONS

- .1 Provide labour, materials, products, equipment, services and all incidentals required to complete, test and commission all electrical work shown on the drawings or noted in this specification:
- .1 Drawings are diagrammatic except where specific details are given.
 - .2 Obtain accurate dimensions from the architectural and structural drawings, or by on-site measurements.
 - .3 Where directed, relocate outlets and fixtures to within 3050 mm of the indicated location at no extra cost providing that instructions are given before the installation of the outlets and fixtures requiring relocation.
 - .4 All electrical equipment is to be new unless otherwise specified.
- .2 Visit the site to thoroughly examine and become familiar with conditions which may affect the work:
- .1 No claims for extras will be allowed for work or materials necessary for proper execution and completion of the Contract or error, or negligence in this regard.
- .3 Work shall be completed in accordance with the current Canadian Electrical Safety Code, CSA Standards, the local Electrical Inspection Authority's requirements, and with the requirements of all authorities having jurisdiction:
- .1 Submit the necessary plans to the local Electrical Inspection Authority and pay for all permits and fees as required before commencement of work.
- .4 Electrical installation in armoury room 176 and B02 shall conform to CSA C22.1, "Canadian Electrical Code, Part I," for the hazardous locations. The areas are being classified as class 1 division 2.
- .5 The electrical contractor is to be responsible for correcting all work completed contrary to the intent of the drawings. Where the intent is not clear, obtain clarification before proceeding with the work.
- .6 All electrical equipment including light fixtures, transformers, distribution equipment, etc. shall be supported from the building structure with appropriate supports, anchorages, and restraints to meet the requirements of the local Building Code. General Contractor to engage a Seismic engineer to provide Seismic restraint systems meeting requirements of Authorities having jurisdiction. Design for Seismic Effect, in supplement to National Building Code of Canada with regards to seismic forces transmitted to suspended ceiling and interior light gauge steel partitions from building structure during an earthquake at project location. Provide sealed and signed engineering details by seismic engineer licensed in Province of Ontario. Final seismic inspection must be completed prior to substantial completion of the contract.

1.3 SHOP DRAWINGS

- .1 Provide required shop drawings and other submittals information in accordance with Section 01 33 00.
- .2 Submit shop drawings and other relevant submittals for approval by electrical utilities and authorities having jurisdiction before submission to Departmental Representative, and as follows:
 - .1 Include electrical subcontractor's delegated design engineering stamp and electrical utility's approvals where required.
 - .2 Details of construction, dimensions, capacities, weights, starters, light fixtures, exit signs and emergency lighting, floor boxes, receptacles, lighting control hardware, service equipment, panelboards and breakers, and transformers and all electrical data and performance characteristics.
 - .3 Wiring diagrams, control schematics and descriptions of operation
 - .4 Provide additional submittals as requested by the Departmental Representative for products, items, components or systems not listed here but, are required for the performance of the Work.

1.4 TESTING

- .1 Measure phase currents of panel boards with normal loads operating:
 - .1 Adjust branch circuit connections as required to obtain balance of current between phases not exceeding 10% maximum and record changes.
 - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- .2 Perform all necessary tests to confirm the correct operation of the electrical systems.
- .3 Submit letters from manufacturers of all systems indicating that they have checked, tested and verified the respective system and are satisfied with the methods of installation, connection and operation.
- .4 Submit all test results in duplicate to the Departmental Representative for approval.

1.5 UTILITY CHARGES

- .1 Cost of utilities will not be borne by the electrical contractor.

1.6 PERMITS, CERTIFICATES AND FEES

- .1 Permits and Compliance Monitoring:
 - .1 Arrange for the services of an agency authorized by Provincial Labour to issue permits and provide compliance monitoring in non-accredited municipalities.
 - .2 Agency shall not be affiliated with the Contractor in any fashion.
 - .3 Submit name of agency and other relevant information to the Departmental Representative for review and acceptance.
- .2 Compliance monitoring shall consist of a minimum of 3 site inspections: site services, rough-in, and final.
- .3 Submit necessary drawings and specifications to the agency before commencement of the Work.

- .4 Submit certificate of acceptance issued by the agency on completion of the Work.
- .5 Pay associated fees with respect to obtaining permits and certificates.

1.7 WORKMANSHIP AND MATERIAL

- .1 Materials shall be new, carry CSA labelling indicating approval, and conform with NEMA or EEMAC Standards where applicable.
- .2 Only use new materials, except where specifically detailed or indicated that existing materials shall be re-used.
- .3 Workmanship shall be performed in a neat and professional manner; as a minimum, the Departmental Representative will expect that:
 - .1 Exposed conduit and wiring be installed square and plumb to building lines and levels.
 - .2 Damaged or incorrectly installed materials be removed and replaced.
 - .3 Loose bundles of wire or equipment be bound and properly secured to adjacent construction.
 - .4 Damaged finishes are restored to match original finishes.
 - .5 Structural, Architectural or Mechanical items are not damaged, altered, or interfered with by installation of materials by this Section, whether caused directly or indirectly because of their work.
 - .6 Site is left clean and tidy at the end of each workday by removing tools, equipment, ladders, and empty cardboard boxes from site and premises are left broom clean at the end of the workday.

1.8 RENOVATION GUIDELINES

- .1 Work shall be complementary to the base building design and installations.
- .2 Additions or changes to existing systems shall be made using equipment identical to that already used in the base building, unless specifically indicated otherwise.
- .3 Visit the site to thoroughly examine and become familiar with the existing systems and installations and every other condition that may affect the work.
 - .1 Claims for extras will be not be allowed for work or materials necessary for proper execution and completion of the contract or for the Bidder's failure, error, or negligence in this regard.
- .4 Work associated with existing installation shall be carried out as follows:
 - .1 Schedule modifications and additions to existing electrical distribution system as well as communication, security, life safety, and miscellaneous systems so that interruptions to normal operations are kept to an absolute minimum, if at all.
 - .2 Schedule renovations so that areas adjoining the area of work are kept operational and include costs and equipment for temporary measures that become necessary to achieve this to maintain services.
 - .3 Schedule work to the satisfaction and for approval by Departmental Representative, whose convenience will be of the foremost importance.

- .5 Disconnect, remove, recondition (as required) and reinstall existing electrical equipment identified for re-use in new locations as detailed on the Drawings, and as follows:
 - .1 Allow for removal and reinstallation of existing electrical systems where necessary to accommodate the work of other trades, coordinate with architectural, mechanical and structural drawings for full extent of work involved with this project.
 - .2 Completely remove existing electrical installations back to the source, in areas identified for removal, where existing installations have been replaced by new installations and where these have not been specifically indicated for re-use, refer to Drawings.
 - .3 Examine existing materials specifically indicated for re-use before submission of Bid so that any work or materials necessary for cleaning and upgrading are included in the Bid; extras for items that could have been determined during a pre-bid examination will not be considered during construction phase of the work.
 - .4 Render safe the installations at locations where existing equipment has been removed by withdrawing the existing wiring and removing conduits, unless conduits can be re-used for the new installation; where conduit are cast in concrete or are inaccessible, seal and leave in place.
 - .5 Remove and dispose of existing materials that are not scheduled for re-use, unless specifically indicated that materials are turned over to the Departmental Representative, then store materials in location directed by Departmental Representative.
 - .6 Restore any circuits that may be disrupted by the removal of existing equipment, or because of renovation.
- .6 Carry out modifications and additions to the existing electrical distribution system, and communication systems so that interruptions to normal operations are kept to a minimum:
 - .1 Schedule work requiring interruptions to a time that is not disruptive to the Departmental Representative.
 - .2 Review interruption schedule with Departmental Representative, and make adjustments as directed to maintain services to minimize inconvenience.
 - .3 Provide a minimum of 72 hours advance notice to Departmental Representative for scheduled interruptions to services during the course of the work.
- .7 Maintain existing fire alarm, power and communication cables supplying areas outside of area being renovated, but passing through the area, in a functional and operational condition for the entire construction period:
 - .1 No interruptions will be allowed.
 - .2 Be responsible for identifying services that must be maintained.
- .8 Not all existing equipment and devices may be shown on the drawings:
 - .1 Obtain clarification from the Departmental Representative on unidentified equipment before submittal.
 - .2 Be responsible for restoring power to equipment or devices in the area of renovation.

- .9 Update directories in all panel boards where circuits have been modified or new circuits added.

Part 2 Products

2.1 CONDUIT

- .1 Install wiring in EMT conduit, except where specifically stated otherwise or where subject to injury shall be rigid metallic conduit.
- .2 All conduit size shall be minimum 3/4”C.
- .3 Conduit in contact with earth shall be rigid metallic conduit with protective coating or rigid PVC.
- .4 Install conduit parallel or perpendicular to building lines wherever possible and as follows:
 - .1 Conduits shall be concealed in framed walls wherever possible.
 - .2 Run all conduits concealed in finished areas.
 - .3 Conduits in service areas may be surface mounted.
 - .4 Maintain 50 mm between parallel conduits in cast concrete construction, except immediately adjacent to cast in outlet boxes, where conduit run can be adjusted to fit.
 - .5 Install a continuous 25 kg test nylon cord in all empty conduits, with cap at each end of conduit.
- .5 Provide suitable metal brackets, frames, hangers, clamps and related types of support to support conduit and cable runs:
 - .1 Fasten exposed conduits to building construction or support system using one-hole malleable iron straps.
 - .2 Support two or more conduits on U-channels supported by minimum 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
 - .3 Support conduits from U-channels using one-piece pipe clamps.
 - .4 Use EMT conduit with steel set screw-type connectors in dry areas. Utilize rain-tight connectors for panel top connections.
- .6 Use flexible conduit for connection to motors in dry areas and dry type transformers.
- .7 Flexible cable may be used for motorized equipment, fixed appliances, electric heating equipment, in accessible ceiling spaces for final connection to lighting fixtures and for wiring devices in existing wall construction.
- .8 Use liquid-tight flexible metal conduit with compression-type rain-tight couplings and connectors with insulated throat for connection to equipment in damp or wet locations.
- .9 Provide junction and outlet boxes where necessary for proper pulling of wires.

- .10 Provide outlet box for lighting fixtures, each wiring device, communication outlet and as indicated. Use electro-galvanized steel boxes. Provide gang boxes where wiring devices are grouped. Support boxes independently of connection conduits. Do not install outlet boxes back-to-back in walls. Such outlets must be staggered and sealed against noise transmission.
- .11 BX cable may be used up to a maximum length of 2 meters or 6 feet.

2.2 WIRE AND CABLE

- .1 Type T90 (90° C) shall be used for branch circuit conductors.
- .2 Type RW90 (90° C) shall be used for panel and equipment feeders, and where exterior exposure of raceways is encountered.
- .3 All wiring to motors or equipment and cases subject to vibration, shall be stranded.
- .4 Provide separate neutral and separate ground wires for every circuit; neutral wires shall be minimum 12 AWG or to match circuit conductor size if larger; ground wires shall be minimum 12 AWG. Provide a dedicated, insulated ground wire, sized per Code, in each feeder circuit.
- .5 Lighting Circuits Controlled from Dimmer: Provide separate neutral wire for every circuit or dimming channel; neutral wire shall be minimum 12 AWG.
- .6 Size wire for branch circuits to limit voltage drop from the panelboard to the furthest load at 3% with a test current of 80% of branch circuit breaker rating.
- .7 Branch Circuit Wiring Guidelines:
 - .1 Power Conductors smaller than 12 AWG are not permitted unless otherwise stated.
 - .2 Wire for 120 Volt control circuits: minimum 14 AWG
 - .3 Wire for 120 Volt circuits using separate neutrals, minimum wire sizes as follows:
 - .1 12 AWG for runs up to 20 m.
 - .2 10 AWG for runs of 20 m to 35 m.
 - .3 Runs in excess of 35 m shall use a wire size that complies with the requirements of item 2.2.6 above.
 - .4 Homeruns shall not be less than 10 AWG.
 - .4 Wire for 347 Volt lighting circuits, minimum wire sizes as follows:
 - .1 12 AWG for runs up to 90 m.
 - .2 10 AWG for runs of 90 m up to a distance that ensures compliance with the requirements of item 2.2.6 above.
 - .5 Wire for DC emergency lighting circuits, minimum size as follows:
 - .1 10 AWG or larger size where required to comply with requirements of item 2.2.6 above; coordinate with equipment manufacturer's written recommendations.
- .8 Size conductors in accordance with the Ontario Electrical Safety Code where wire sizes are not indicated on the Drawings.

- .9 Wiring for fire alarm, security, paging and similar systems shall match the better of base building wiring and the requirements of the authority having jurisdiction.

2.3 PANEL BOARDS

- .1 Panels shall have bolt-on breakers rated not less than 18KA IC:
- .1 Two and three pole breakers shall have common trip.
 - .2 "Duplex" and "Triplex" breakers and tie handles will not be accepted.
- .2 Provide new circuit breakers with interrupting capacity equal to or greater than that of existing breakers.
- .3 Provide typewritten directories for all panel boards; hand lettered directories will not be acceptable.

2.4 WIRING DEVICES AND COVER PLATES

- .1 Specification grade devices shall be used.
- .2 Receptacles shall be back and side wire type.
- .3 All devices shall be in the colour specified by the Departmental Representative.
- .4 All devices shall be decora style except in utility rooms such as Electrical Rooms, Mechanical Rooms.
- .5 Cover plates shall match device colour, unless noted otherwise.
- .6 Do not install outlet boxes back-to-back in wall:
- .1 Non-Acoustic Walls: Allow minimum 150 mm horizontal clearance between boxes.
 - .2 Acoustically Rated Walls: Offset outlet boxes by 610 mm separated by one stud space or gypsum board baffle; coordinate with Section 09 21 16.
 - .3 Party Walls: Offset outlet boxes by 1000 mm separated by two stud spaces and gypsum board baffles; coordinate with Section 09 21 16.
- .7 Allow for a variation of 3050 mm from locations shown without extra cost; confirm final location before installation.
- .8 Mounting heights from finished floor to centre line of device, **unless indicated otherwise in drawings**, shall be:

Location	Distance
Outlet boxes above counters or splash backs	150 mm above counter
Outlet boxes above base board heaters and radiation cabinets	150 mm above enclosure
General receptacles	400 mm
Receptacles in mechanical and shop areas;	950 mm
Switches, dimmers, push buttons	1200 mm
panic buttons	450 mm
Thermostats	1200 mm

Location	Distance
Fire alarm pull stations	1200 mm
Panel boards, annunciator panels, etcetera	1900 mm to top of panel
Fire alarm bells, speakers, clocks, strobes	2300 mm
Heights as above or in bottom of nearest block or brick course.	

- .9 Use gang plates where two or more outlets are located together:
 - .1 Align all cover plates parallel and perpendicular to building lines.
 - .2 Provide blank cover plates for boxes without wiring devices.
 - .3 Where lighting dimmers are shown, use separate single gang boxes only.

2.5 LIGHTING FIXTURES

- .1 Lighting fixtures, as specified, shall be complete with the appropriate lamps.
- .2 Daisy-chaining of fixtures is not allowed unless otherwise noted.
- .3 Chain hang all fixtures denoted as new or relocated as part of this scope of work.

2.6 FLUORESCENT LAMPS

- .1 Provide fluorescent lamps of types indicated as follows:
 - .1 F32, T8 Fluorescent Lamps: Rapid start, 1219 mm length, having the following minimum requirements:

Initial Wattage	Colour Temperature (K)	Design Lumens	CRI	Average Life (hours)	Comments
32	3500	>2800	>85%	>25,000	Low Mercury <3.5 mg of Mercury, TCLP compliant

2.7 BALLASTS

- .1 Indoor ballasts shall be “A” sound rated.
- .2 Ballasts shall comply with FCC and NEMA limits regarding radio frequency interference (RFI) and electro magnetic interference (EMI) and shall not interfere with operation of other normal electrical equipment.
- .3 Products having the following characteristics are not acceptable for work of this Project:
 - .1 Ballasts containing polychlorinated biphenyls (PCB’s).
 - .2 Master/satellite ballast systems.
 - .3 Magnetic ballast systems.

- .4 Ballasts shall carry a five (5) year manufacturers warranty for replacement of defective materials effective from date of Substantial Performance.
- .5 Supply ballasts of compatible design to lamps specified.

2.8 FLUORESCENT BALLASTS – LINEAR LAMPS

- .1 Rapid Start Electronic Ballasts: Ballasts shall operate one or more lamps using rapid start technology as indicated in lighting fixture schedule:
 - .1 Operating at stated voltage, 60 Hz input frequency and lamps operating above 20,000 Hz, and as follows:
 - .1 Power Factor: >95%
 - .2 Crest Factor: < 1.6
 - .3 Total Harmonic Distortion: < 10%
 - .4 Minimum Ballast Factor: 88%, ±2%
 - .5 Surge Protection: Automatic, withstand line transients as defined in ANSI C62.41, Category A.
 - .6 Sustained Voltage Tolerance: Ballasts shall tolerate sustained voltage variations of ±10% with no damage to ballast and must maintain light output.
 - .2 Ballast shall provide full parallel lamp operation; series wired systems are not acceptable.

2.9 GROUNDING

- .1 Provide all necessary bonding and grounding, in accordance with the drawings and to Ontario Electrical Safety Code requirements.
- .2 Provide separate ground wire in all conduits.

2.10 DISCONNECT SWITCHES

- .1 600V, Type "A", horsepower rated. Quick-make, quick-break with provision for pad locking in the "off" position:
 - .1 Disconnect switches to be product of one manufacturer.
- .2 Fuses: To CSA C22.2 No. 106-M1985, HRCI-J.

2.11 MECHANICAL WIRING

- .1 All wiring for mechanical equipment shall be by this Contractor.
- .2 Coordinate with Division 23 for all requirements.
- .3 Confirm all motor loads with suppliers and provide electrical protection according to the actual requirement in accordance with the Ontario Electrical Safety Code.
- .4 Include motor starters, disconnects, conduits, wire fittings, interlocks, outlet boxes, junction boxes, and all associated equipment required to provide power wiring for mechanical equipment.
- .5 All equipment mounted on the exterior of the building shall be weatherproof.
- .6 Install motor feeders, starter disconnects and associated equipment and make connections to all motors.

- .7 Install wiring to starters furnished with equipment and from remote starters and motors and equipment.
- .8 Install branch circuit wiring for control circuits.
- .9 Wire and connect thermostats for force flows and unit heaters.
- .10 Wire and connect electrical interlocks for starters.

2.12 MISCELLANEOUS APPARATUS AND APPLIANCES

- .1 Make all required electrical connections to devices, equipment, appliances, and other devices furnished by other trades, as indicated, or as required for a complete installation.
- .2 Verify electrical supply characteristics of all equipment.
- .3 Provide all required electrical devices, components, conduits, fittings, wiring, disconnects and miscellaneous equipment to make all connections to equipment.
- .4 Where equipment has line cord and plug, ensure cap is compatible with receptacle, provide cord sets where required.
- .5 Confirm the exact method for final connection of the equipment, and be responsible for providing the required connection devices for each piece of equipment.
- .6 Provide and install miscellaneous electrical components where indicated.

Part 3 Execution

3.1 INSTALLATION

- .1 Obtain Departmental Representative interpretation or clarification on the specifications and drawings before proceeding with the work:
 - .1 Correct completed work installed contrary to the intent of the drawings and specifications at their own expense, where it can be determined that a clarification could have been issued.
 - .2 Notify the Departmental Representative as work progresses where additional clarification or interpretation of the specifications and drawings is required.
- .2 Clean and touch-up surfaces of shop painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Complete coring, cutting and patching using qualified specialists; X-ray and scan locations and submit results to obtain written approval from Departmental Representative before starting coring or cutting work.
- .4 All electrical equipment including light fixtures, transformers, distribution equipment, etc. shall be supported from the building structure with appropriate supports, anchorages, and restraints to meet the requirements of local codes and by-laws.
- .5 Identify electrical equipment with lamacoid nameplates minimum 13 mm height; indicate voltage, usage, and other pertinent information subject to the acceptance of the Departmental Representative.
- .6 Receptacle Identification: provide self-adhesive name tag with 6 mm high white lettering on black background (red background for emergency receptacles) indicating circuit and panel designation and locate on coverplate above receptacle.

- .7 Coordinate and cooperate with other trades on site to avoid interference of systems installed by this section and those installed by other parts of the Work:
 - .1 Protect all finishes and unfinished work of this and other divisions from damage due to carrying out of this work.
 - .2 Keep equipment dry and clean at all times.
 - .3 Cover openings in equipment and materials.
 - .4 Be responsible for and make good any damage caused directly or indirectly to walls, floors, ceilings, woodwork, brickwork, finishes, etcetera
 - .5 Pack space between wiring and sleeve full with mineral wool firestopping and fire rated silicone sealant in accordance with manufacturers written instructions or with a Departmental Representative approved firestop material where cables or conduits pass through floors and fire rated walls.

- .8 Conduct final cleaning upon completion of work including, but not limited to, the following:
 - .1 Clean lighting reflectors, lenses, and other lighting surfaces that have been exposed to construction dust and dirt.
 - .2 Clean and refinish exposed equipment, and replace any broken or malfunctioning components.

- .9 Guarantee materials, equipment, and installations to be free of all defects for a period of twelve months from the date of Substantial Performance in accordance with General Conditions of Contract.

END OF SECTION



EXCELLENCE IN
ENVIRONMENTAL
CONSULTING
SERVICES

XCG File #3-336-128-02

March 30, 2005

**DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS SURVEY
WARKWORTH INSTITUTION
CAMPBELLFORD, ONTARIO**

Prepared for:

**PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
REAL PROPERTY SERVICES, ENVIRONMENTAL SERVICES, ONTARIO REGION
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EXECUTIVE SUMMARY

XCG Consultants Ltd. (XCG) was retained by Public Works and Government Services Canada (PWGSC), acting on behalf of Correctional Service of Canada (CSC), to survey forty-seven (47) buildings for designated substances and hazardous materials (DSHM) at the Warkworth Medium Security Correctional Institution in Campbellford, Ontario.

The designated substances surveyed were those designated under the *Ontario Occupational Health and Safety Act* and included (but were not limited to) asbestos, lead, mercury and silica. The hazardous materials surveyed included polychlorinated biphenyl (PCB)-containing equipment, ozone-depleting substances (ODSs), urea formaldehyde foam insulation (UFFI), fuel, oil, and/or waste oil storage, chemical storage, radioactive materials, and mould.

The findings and recommendations, with Class "D" cost estimates (excluding GST), of the 2005 Survey completed at the Warkworth Institution are as follows:

Asbestos

Asbestos in the form of insulating pipe straights and elbows, and vinyl floor tiles were identified in several buildings. XCG based its recommendations on the Action Matrix outlined in the PWGSC document entitled *DM Directive 057- Asbestos Management* (1997), as adopted by the Treasury Board. The recommended actions are based on the condition and accessibility of the material.

In general, most of asbestos-containing materials (ACMs) were in good condition and had an access classification of "A", which are areas of the building within reach (from floor level) of all building users. Most of the items in this category consisted of vinyl floor tiles. In accordance with DM Directive 057, the recommendation for non-friable ACMs in good condition (i.e. vinyl floor tiles) is Action 7, which is to conduct routine surveillance of the ACMs. Other ACMs in good condition with Access A consist of pipe elbow insulation, but these are minor compared to the area of asbestos-containing vinyl floor tiles. The recommendation for these ACMs is Action 5/7. Action 5 is proactive removal of ACMs. If this is not conducted, then Action 7 is required. The recommendation for ACMs in good condition with Access A is to develop and implement an asbestos management and monitoring plan that conforms to the requirements of Ontario Regulation 838 (amended to 104/04). The buildings that would be applicable to the Action 7 recommendation include: WA01, WA04, WA05, WW03, WW05, WW06, WW07, WW08, WW09, WW10, WW11, WW12, WW13, WW14, WW15, WW16, WW18, WW19, WW22, WW24, WW26, and WW27.

The cost to develop the asbestos management and monitoring plan is approximately \$8,000. The program would likely be implemented internally by a Warkworth

Institution site staff member. Therefore, costs have not been included for the actual implementation of the plan.

There were also a few areas that require mitigative action based on the DM Directive 057 matrix.

The unit cost estimates used to determine approximate total costs are based on typical unit rates for a qualified contractor to perform this work. Allowances for engineering services which include coordination, supervision, and formal reporting are not included.

As shown in the summary table below, 7 buildings have been identified as requiring mitigative measures (Actions 3, 5, or 6) for asbestos for an estimated total cost of \$17,500.

Summary of Asbestos Mitigative Measures and Class D Cost Estimates

Building No. and Name	Room	Elbows (No.)	Runs (m)	Action	Mitigation Type (1,2,3)	Unit Cost	Total Cost
WA01 – Finance and Personnel Building	104	16	20	6/5	2	\$25	\$2,500*
WA04 – General Stores Building	108	4	-	5/6	2	\$35	\$2,500*
WW15 – S.I.S. Building	102	8	-	6	2	\$25	\$2,500*
WW07 – Hospital Building	139	33	-	3	2	\$35	\$2,500*
WW09 – Accommodation Building (Unit 1)	102	5-10	-	6	2	\$25	\$2,500*
WW12 – Inmate Canteen / Hobby Craft Building	209	20-30	-	3	2	\$35	\$2,500*
WW18 – Industrial Shops Building	146	-	6.5	3	2	\$35	\$228
	201	15-30	1.5	6/5	2	\$25	788
Total for Building WW18							\$2,500*
Total Estimated Mitigation Cost							\$17,500

Notes:

* - Minimum contractor charge for small quantity work

Lead

Lead-based paint was detected in several buildings. The condition of these lead-based paints ranged from good to fair. There is no regulatory requirement to remove lead-based paint; however, renovations or demolition, and disposal of materials containing this paint should be conducted according to the applicable regulations. All lead-based paint repair work should be managed in accordance with Regulation 843 (amended to O. Reg. 109/04). Table 50.2 provides a summary of areas containing lead-based paint and Class D cost estimates in the event that renovation or demolition work is conducted.

There are various methods to address the lead-based paint if renovations are to be conducted (e.g. repainting the wall), including scraping, power washing, and sand blasting. XCG assumed that the scraping method would be used and based the estimates on a unit rate of \$65/m². It is assumed that any lead abatement work would be conducted separately for each building (i.e. as required) and a contractor would charge a minimum of \$2,000 for a small quantity project.

Summary of Lead-Based Paint Mitigative Measures and Class D Cost Estimates

Building No. and Name	Room	Location and Description	Condition	Lead Content (ppm)	Estimated Quantity (m ²)	Unit Cost (/ m ²)	Total Cost
WA01 – Finance and Personnel Building	114	Lime green paint on wall	Good	8,203	36	\$65	\$2,340
WA04 – General Stores Building	101	Bright yellow paint on garage door	Good	9,044	40	\$65	\$2,600
WA05 – Central Heating Plant	109	Red door paint	Good	15,792	3	\$65	\$195
	111	Grey-brown wall paint	Poor	10,951	61	\$65	\$3,965
Total for Building WA05							\$4,160
WA07 – Inflammable Stores Building	101	Yellow door trim paint	Fair	6,258	8	\$65	\$2,000*
WA08 – Fire Hall	101	Blue door paint from mock cells	Good	10,926	6	\$65	\$2,000*
WW03 – Administrative Building	102	Green door and wall paint on hall side	Good	9,775	10	\$65	\$650
	130	Orange door paint	Good	55,693	4	\$65	\$260
Total for Building WW03							\$2,000*
WW06 – Segregation Building	101, 116	White wall paint on upper half of corridor	Good	7,006	197	\$65	\$12,805
	116	Yellow door trim	Good	7,354	4	\$65	260
Total for Building WW06							\$13,065
WW08 – Accommodation Building (Unit 4)	A19	Mocha wall paint on interior north wall	Good	13,362	7.5	\$65	\$2,000
WW09 – Accommodation Building (Unit 1)	H109	Purple wall paint	Good	5,128	67	\$65	\$4,355
WW10 – Accommodation Building (Unit 2)	H109	Brown door trim	Good	6,787	16	\$65	\$2,000
WW11 – Accommodation	106 actual	White wall and ceiling	Good	5,055	403	\$65	\$26,195

Summary of Lead-Based Paint Mitigative Measures and Class D Cost Estimates

Building No. and Name	Room	Location and Description	Condition	Lead Content (ppm)	Estimated Quantity (m ²)	Unit Cost (/ m ²)	Total Cost
Building (Unit 3) (104, 105, 106, B, D, F ranges, H103)	sample	paint					
	G106	Dark blue wall paint	Good	5,254	63	\$65	\$4,095
Total for Building WW11							\$30,290
WW13 – Cafeteria Building (118, 101B, 109, 119, 121)	118 actual sample	Sky blue	Good	17,800	65	\$65	\$4,225
	141	Grey	Poor	68,583	28	\$65	\$1,820
Total for Building WW13							\$6,045
WW18 – Industrial Shops Building	106	Cream over rusty red, upper part of wall	Good	8,969	606	\$65	\$39,390
	106	Grey over red, lower part of wall	Good	12,509	225	\$65	\$14,625
	142	Light brown, lower half of wall	Fair	11,399	182	\$65	\$11,830
	144	Green wall	Good	13,060	156	\$65	\$10,140
	146	Mocha over cream on garage door	Fair	9,923	40	\$65	\$2,600
	154	Green trim on wood	Good	25,963	15	\$65	\$975
Total for Building WW18							\$79,560
WW31 – Accommodations Building (80-Man Unit)	M02	Yellow paint on doors, railings, and pipes	Poor	10,052	10	\$65	\$2,000
Total Estimated Mitigation Cost							\$154,415

Notes:

* - Minimum contractor charge for small quantity work

The above unit cost estimates are based on typical unit rates for a qualified contractor to perform this work. Allowances for engineering services which include coordination, supervision, and formal reporting are not included.

Any lead abatement work needs to be conducted in accordance with Ontario Regulation 843, amended to O. Reg. 109/04 and the Ministry of Labour document entitled "Guideline, Lead on Construction Projects," dated September 2004.

Mercury

Small quantities of mercury are present in some of the buildings and include thermostats, thermometers, fluorescent light bulbs, and high intensity discharge (HID) lamps. There is no regulatory requirement to remove mercury. As such, there are no recommendations for mitigative measures. However, if the mercury-containing thermostats, fluorescent lights, and/or HIDs are to be removed, they must be handled and disposed of in accordance with Ontario Regulation 844/90 (amended to O. Reg. 110/04) and Ontario Regulation 347 (amended to O. Reg. 326/03).

Silica

Silica is likely present in concrete, concrete blocks, and bricks in each building. Should renovations or demolition include the cutting or breaking of this material, appropriate precautions should take place to prevent inhalation of silica-containing dust. Any silica disturbance work needs to be conducted in accordance with Ontario Regulation 845 (amended to O. Reg. 111/04) and the Ministry of Labour document entitled "Guideline, Silica on Construction Projects," dated September 2004.

Polychlorinated Biphenyls (PCBs)

CSC site staff indicated that fluorescent light fixtures, for the most part, are considered to be non-PCB containing. CSC staff reported to XCG that most fixtures throughout the facility have been replaced within the last few years, but a few have remained from earlier times when PCBs were used in their ballast. The fixtures that have been removed have been disposed of off-site, as there are no PCB waste storage sites at the Institution. Selected light ballasts that were inspected by XCG did not contain PCBs.

There were numerous fluorescent light fixtures that XCG did not access to verify the PCB content because of the height of the ceilings. If these fixtures are taken out of service in the future, they should be checked to confirm that they in fact do not contain PCBs. If they do contain PCBs, the light ballasts should be managed in accordance with the applicable regulations, including O. Reg. 347 (amended to O. Reg. 326/03), O. Reg. 362/90, SOR91-152, SOR92/502, and the Transportation of Dangerous Goods Act and Regulations.

Ozone-Depleting Substances (ODSs)

There are numerous refrigeration and air conditioning units throughout the facility that contain ODSs. Although there is no current requirement to remove ODSs from active units, any repair, maintenance or decommissioning of equipment containing halocarbons must be performed in accordance with the Federal Halocarbon Regulations and Ontario Regulation 189/04 (amended to O. Reg. 238/01).

Urea Formaldehyde Foam Insulation

No UFFI was identified in any of the buildings during the current survey.

Fuel, Oil and Waste Oil Storage

The facility has four aboveground storage tanks and four underground storage tanks containing gasoline, diesel, and fuel oil. Aboveground storage tanks 460-05 and 460-06 should be equipped with emergency spill kits and fire extinguishers should be provided nearby. This would cost approximately \$500.

Several jerry cans of fuel observed throughout the property should be affixed with a property Workplace Label indicating their contents. In addition, they should be provided with secondary containment when they are stored to contain any potential leaks. This would cost approximately \$500.

Two waste oil containers and some small containers of oil that appeared to be no longer used should be disposed of off-site. This would cost approximately \$500.

Chemical Storage

Various chemicals are storage in numerous buildings (e.g. solvents, paints, floor strippers, etc.). An inventory of hazardous chemicals should be developed and posted at each storage area. This would cost approximately \$7,000. All decanted products should be affixed with an appropriate Workplace Hazard Label as specified by Workplace Hazardous Materials Information System (WHMIS) regulation. This would cost approximately \$500.

Material Safety Data Sheets (MSDS) information shall be placed near or in any storage areas that contain chemicals. This would cost approximately \$1,000.

Various unused chemicals, including two 205-litre drums labelled "Toxic Waste" and "Hazardous Waste" shall be disposed of off-site by a licensed hauler. This would cost approximately \$1,000.

Radioactive Materials

No radioactive materials were observed in this building during the current survey.

Mould

Water damage was observed in three of the four Private Family Duplex Units, with evidence of potential mould growth noted in two of the buildings. This water damage should be corrected and future leaks mitigated. A sampling study to determine if any and where mould growth may be occurring should be conducted. The mould investigation would cost approximately \$8,000.

TABLE OF CONTENTS

1.	INTRODUCTION.....	1-1
1.1	Site Description	1-1
1.2	Scope of Work.....	1-5
1.3	Project Team.....	1-6
1.4	Report Format.....	1-6
1.5	Limitations.....	1-6
2.	SURVEY METHODOLOGY	2-1
2.1	Site Inspections and Sampling	2-1
2.2	Record Keeping	2-2
2.3	Asbestos-Containing Materials	2-3
2.3.1	<i>Assessment of Condition and Accessibility, and Remedial Actions</i>	2-3
2.3.2	<i>Sampling of Suspected Asbestos-Containing Materials</i>	2-7
2.3.3	<i>Analytical Methodology</i>	2-7
2.4	Lead	2-7
2.4.1	<i>XCG Classification System</i>	2-8
2.4.2	<i>Lead Paint Sampling</i>	2-8
2.5	Mercury	2-8
2.6	Silica	2-8
2.7	Other Designated Substances	2-9
2.8	Polychlorinated Biphenyls (PCBs).....	2-9
2.9	Ozone-Depleting Substances (ODSs).....	2-9
2.10	Urea Formaldehyde Foam Insulation (UFFI).....	2-9
2.11	Fuel, Oil, and/or Waste Oil Storage	2-10
2.12	Chemical Storage	2-10
2.13	Radioactive Materials.....	2-10
2.14	Mould	2-10
3.	WA01 – FINANCE AND PERSONNEL BUILDING.....	3-1
3.1	Building Description	3-1
3.2	Survey Findings.....	3-1
3.2.1	<i>Asbestos-Containing Materials (ACMs)</i>	3-1
3.2.2	<i>Lead-Containing Materials</i>	3-4
3.2.3	<i>Mercury</i>	3-4
3.2.4	<i>Silica</i>	3-4
3.2.5	<i>Other Designated Substances</i>	3-4
3.2.6	<i>Polychlorinated Biphenyls (PCBs)</i>	3-6
3.2.7	<i>Ozone-Depleting Substances (ODSs)</i>	3-6
3.2.8	<i>Urea Formaldehyde Foam Insulation (UFFI)</i>	3-6
3.2.9	<i>Fuel, Oil, and/or Waste Oil Storage</i>	3-6
3.2.10	<i>Chemical Storage</i>	3-6
3.2.11	<i>Radioactive Materials</i>	3-7
3.2.12	<i>Mould</i>	3-7
4.	WA04 – GENERAL STORES BUILDING	4-1
4.1	Building Description	4-1
4.2	Survey Findings.....	4-1
4.2.1	<i>Asbestos-Containing Materials (ACMs)</i>	4-1
4.2.2	<i>Lead-Containing Materials</i>	4-4

	4.2.3	Mercury.....	4-4
	4.2.4	Silica	4-4
	4.2.5	Other Designated Substances	4-4
	4.2.6	Polychlorinated Biphenyls (PCBs)	4-6
	4.2.7	Ozone-Depleting Substances (ODSs).....	4-6
	4.2.8	Urea Formaldehyde Foam Insulation (UFFI).....	4-7
	4.2.9	Fuel, Oil, and/or Waste Oil Storage	4-7
	4.2.10	Chemical Storage.....	4-7
	4.2.11	Radioactive Materials	4-7
	4.2.12	Mould	4-7
5.	WA05	– CENTRAL HEATING PLANT	5-1
	5.1	Building Description	5-1
	5.2	Survey Findings.....	5-1
	5.2.1	Asbestos-Containing Materials (ACMs)	5-1
	5.2.2	Lead-Containing Materials.....	5-3
	5.2.3	Mercury.....	5-3
	5.2.4	Silica	5-3
	5.2.5	Other Designated Substances	5-5
	5.2.6	Polychlorinated Biphenyls (PCBs)	5-5
	5.2.7	Ozone-Depleting Substances (ODSs).....	5-5
	5.2.8	Urea Formaldehyde Foam Insulation (UFFI).....	5-5
	5.2.9	Fuel, Oil, and/or Waste Oil Storage	5-5
	5.2.10	Chemical Storage.....	5-5
	5.2.11	Radioactive Materials	5-6
	5.2.12	Mould	5-6
6.	WA06	– MAINTENANCE STORAGE BUILDING	6-1
	6.1	Building Description	6-1
	6.2	Survey Findings.....	6-1
	6.2.1	Asbestos-Containing Materials (ACMs)	6-1
	6.2.2	Lead-Containing Materials.....	6-1
	6.2.3	Mercury.....	6-1
	6.2.4	Silica	6-2
	6.2.5	Other Designated Substances	6-2
	6.2.6	Polychlorinated Biphenyls (PCBs)	6-2
	6.2.7	Ozone-Depleting Substances (ODSs).....	6-2
	6.2.8	Urea Formaldehyde Foam Insulation (UFFI).....	6-2
	6.2.9	Fuel, Oil, and/or Waste Oil Storage	6-2
	6.2.10	Chemical Storage.....	6-2
	6.2.11	Radioactive Materials	6-3
	6.2.12	Mould	6-3
7.	WA07	– INFLAMMABLE STORES BUILDING.....	7-1
	7.1	Building Description	7-1
	7.2	Survey Findings.....	7-1
	7.2.1	Asbestos-Containing Materials (ACMs)	7-1
	7.2.2	Lead-Containing Materials.....	7-1
	7.2.3	Mercury.....	7-1
	7.2.4	Silica	7-1
	7.2.5	Other Designated Substances	7-2
	7.2.6	Polychlorinated Biphenyls (PCBs)	7-2
	7.2.7	Ozone-Depleting Substances (ODSs).....	7-2

	7.2.8	Urea Formaldehyde Foam Insulation (UFFI)	7-2
	7.2.9	Fuel, Oil, and/or Waste Oil Storage	7-2
	7.2.10	Chemical Storage	7-2
	7.2.11	Radioactive Materials	7-2
	7.2.12	Mould	7-2
8.		WA08 – FIRE HALL	8-1
	8.1	Building Description	8-1
	8.2	Survey Findings	8-1
	8.2.1	Asbestos-Containing Materials (ACMs)	8-1
	8.2.2	Lead-Containing Materials	8-1
	8.2.3	Mercury	8-1
	8.2.4	Silica	8-2
	8.2.5	Other Designated Substances	8-2
	8.2.6	Polychlorinated Biphenyls (PCBs)	8-2
	8.2.7	Ozone-Depleting Substances (ODSs)	8-2
	8.2.8	Urea Formaldehyde Foam Insulation (UFFI)	8-2
	8.2.9	Fuel, Oil, and/or Waste Oil Storage	8-2
	8.2.10	Chemical Storage	8-2
	8.2.11	Radioactive Materials	8-2
	8.2.12	Mould	8-3
9.		WA09 – SEWAGE DISPOSAL BUILDING	9-1
	9.1	Building Description	9-1
	9.2	Survey Findings	9-1
	9.2.1	Asbestos-Containing Materials (ACMs)	9-1
	9.2.2	Lead-Containing Materials	9-3
	9.2.3	Mercury	9-3
	9.2.4	Silica	9-3
	9.2.5	Other Designated Substances	9-3
	9.2.6	Polychlorinated Biphenyls (PCBs)	9-5
	9.2.7	Ozone-Depleting Substances (ODSs)	9-5
	9.2.8	Urea Formaldehyde Foam Insulation (UFFI)	9-5
	9.2.9	Fuel, Oil, and/or Waste Oil Storage	9-5
	9.2.10	Chemical Storage	9-5
	9.2.11	Radioactive Materials	9-5
	9.2.12	Mould	9-5
10.		WA16 – CLARIFICATION BUILDING	10-1
	10.1	Building Description	10-1
	10.2	Survey Findings	10-1
	10.2.1	Asbestos-Containing Materials (ACMs)	10-1
	10.2.2	Lead-Containing Materials	10-1
	10.2.3	Mercury	10-1
	10.2.4	Silica	10-1
	10.2.5	Other Designated Substances	10-3
	10.2.6	Polychlorinated Biphenyls (PCBs)	10-3
	10.2.7	Ozone-Depleting Substances (ODSs)	10-3
	10.2.8	Urea Formaldehyde Foam Insulation (UFFI)	10-3
	10.2.9	Fuel, Oil, and/or Waste Oil Storage	10-3
	10.2.10	Chemical Storage	10-3
	10.2.11	Radioactive Materials	10-3
	10.2.12	Mould	10-3

11.	WA18 – RIFLE RANGE	11-4
12.	WA19 – AGGREGATE BUILDING	12-5
	12.1 Building Description	12-5
	12.2 Survey Findings.....	12-5
	12.2.1 Asbestos-Containing Materials (ACMs)	12-5
	12.2.2 Lead-Containing Materials.....	12-5
	12.2.3 Mercury.....	12-5
	12.2.4 Silica	12-5
	12.2.5 Other Designated Substances	12-5
	12.2.6 Polychlorinated Biphenyls (PCBs)	12-5
	12.2.7 Ozone-Depleting Substances (ODSs).....	12-6
	12.2.8 Urea Formaldehyde Foam Insulation (UFFI).....	12-6
	12.2.9 Fuel, Oil, and/or Waste Oil Storage	12-6
	12.2.10 Chemical Storage.....	12-6
	12.2.11 Radioactive Materials.....	12-6
	12.2.12 Mould.....	12-6
13.	WGP12 – GUARD POST	13-1
	13.1 Building Description	13-1
	13.2 Survey Findings.....	13-1
	13.2.1 Asbestos-Containing Materials (ACMs)	13-1
	13.2.2 Lead-Containing Materials.....	13-3
	13.2.3 Mercury.....	13-3
	13.2.4 Silica	13-3
	13.2.5 Other Designated Substances	13-3
	13.2.6 Polychlorinated Biphenyls (PCBs)	13-5
	13.2.7 Ozone-Depleting Substances (ODSs).....	13-5
	13.2.8 Urea Formaldehyde Foam Insulation (UFFI).....	13-5
	13.2.9 Fuel, Oil, and/or Waste Oil Storage	13-5
	13.2.10 Chemical Storage.....	13-5
	13.2.11 Radioactive Materials.....	13-5
	13.2.12 Mould.....	13-5
14.	WGP13 – GUARD POST	14-1
	14.1 Building Description	14-1
	14.2 Survey Findings.....	14-1
	14.2.1 Asbestos-Containing Materials (ACMs)	14-1
	14.2.2 Lead-Containing Materials.....	14-3
	14.2.3 Mercury.....	14-3
	14.2.4 Silica	14-3
	14.2.5 Other Designated Substances	14-3
	14.2.6 Polychlorinated Biphenyls (PCBs)	14-5
	14.2.7 Ozone-Depleting Substances (ODSs).....	14-5
	14.2.8 Urea Formaldehyde Foam Insulation (UFFI).....	14-5
	14.2.9 Fuel, Oil, and/or Waste Oil Storage	14-5
	14.2.10 Chemical Storage.....	14-5
	14.2.11 Radioactive Materials.....	14-5
	14.2.12 Mould.....	14-5
15.	WGP14 – GUARD POST	15-1
	15.1 Building Description	15-1
	15.2 Survey Findings.....	15-1

	15.2.1 Asbestos-Containing Materials (ACMs)	15-1
	15.2.2 Lead-Containing Materials	15-1
	15.2.3 Mercury	15-1
	15.2.4 Silica	15-1
	15.2.5 Other Designated Substances	15-2
	15.2.6 Polychlorinated Biphenyls (PCBs)	15-2
	15.2.7 Ozone-Depleting Substances (ODSs)	15-2
	15.2.8 Urea Formaldehyde Foam Insulation (UFFI)	15-2
	15.2.9 Fuel, Oil, and/or Waste Oil Storage	15-2
	15.2.10 Chemical Storage	15-2
	15.2.11 Radioactive Materials	15-2
	15.2.12 Mould	15-2
16.	WGP15 – GUARD POST	16-1
	16.1 Building Description	16-1
	16.2 Survey Findings	16-1
	16.2.1 Asbestos-Containing Materials (ACMs)	16-1
	16.2.2 Lead-Containing Materials	16-1
	16.2.3 Mercury	16-1
	16.2.4 Silica	16-1
	16.2.5 Other Designated Substances	16-1
	16.2.6 Polychlorinated Biphenyls (PCBs)	16-2
	16.2.7 Ozone-Depleting Substances (ODSs)	16-2
	16.2.8 Urea Formaldehyde Foam Insulation (UFFI)	16-2
	16.2.9 Fuel, Oil, and/or Waste Oil Storage	16-2
	16.2.10 Chemical Storage	16-2
	16.2.11 Radioactive Materials	16-2
	16.2.12 Mould	16-2
17.	WW01 – ENTRANCE GATE	17-1
	17.1 Building Description	17-1
	17.2 Survey Findings	17-1
	17.2.1 Asbestos-Containing Materials (ACMs)	17-1
	17.2.2 Lead-Containing Materials	17-1
	17.2.3 Mercury	17-1
	17.2.4 Silica	17-1
	17.2.5 Other Designated Substances	17-1
	17.2.6 Polychlorinated Biphenyls (PCBs)	17-1
	17.2.7 Ozone-Depleting Substances (ODSs)	17-1
	17.2.8 Urea Formaldehyde Foam Insulation (UFFI)	17-2
	17.2.9 Fuel, Oil, and/or Waste Oil Storage	17-2
	17.2.10 Chemical Storage	17-2
	17.2.11 Radioactive Materials	17-2
	17.2.12 Mould	17-2
18.	WW02 – STAFF AND TRAINING BUILDING	18-1
	18.1 Building Description	18-1
	18.2 Survey Findings	18-1
	18.2.1 Asbestos-Containing Materials (ACMs)	18-1
	18.2.2 Lead-Containing Materials	18-3
	18.2.3 Mercury	18-3
	18.2.4 Silica	18-3
	18.2.5 Other Designated Substances	18-3

	18.2.6 Polychlorinated Biphenyls (PCBs)	18-5
	18.2.7 Ozone-Depleting Substances (ODSs).....	18-5
	18.2.8 Urea Formaldehyde Foam Insulation (UFFI).....	18-5
	18.2.9 Fuel, Oil, and/or Waste Oil Storage	18-5
	18.2.10 Chemical Storage.....	18-5
	18.2.11 Radioactive Materials.....	18-5
	18.2.12 Mould.....	18-6
19.	WW03 – ADMINISTRATION BUILDING.....	19-1
	19.1 Building Description	19-1
	19.2 Survey Findings.....	19-1
	19.2.1 Asbestos-Containing Materials (ACMs).....	19-1
	19.2.2 Lead-Containing Materials.....	19-3
	19.2.3 Mercury.....	19-3
	19.2.4 Silica	19-3
	19.2.5 Other Designated Substances	19-3
	19.2.6 Polychlorinated Biphenyls (PCBs)	19-5
	19.2.7 Ozone-Depleting Substances (ODSs).....	19-5
	19.2.8 Urea Formaldehyde Foam Insulation (UFFI).....	19-5
	19.2.9 Fuel, Oil, and/or Waste Oil Storage	19-5
	19.2.10 Chemical Storage.....	19-5
	19.2.11 Radioactive Materials.....	19-5
	19.2.12 Mould.....	19-6
20.	WW04 – PROGRAMS AND SBC BUILDING.....	20-1
	20.1 Building Description	20-1
	20.2 Survey Findings.....	20-1
	20.2.1 Asbestos-Containing Materials (ACMs).....	20-1
	20.2.2 Lead-Containing Materials.....	20-3
	20.2.3 Mercury.....	20-3
	20.2.4 Silica	20-3
	20.2.5 Other Designated Substances	20-3
	20.2.6 Polychlorinated Biphenyls (PCBs)	20-5
	20.2.7 Ozone-Depleting Substances (ODSs).....	20-5
	20.2.8 Urea Formaldehyde Foam Insulation (UFFI).....	20-5
	20.2.9 Fuel, Oil, and/or Waste Oil Storage	20-5
	20.2.10 Chemical Storage.....	20-5
	20.2.11 Radioactive Materials.....	20-5
	20.2.12 Mould.....	20-6
21.	WW05 – INTENSIVE SUPPORT BUILDING	21-1
	21.1 Building Description	21-1
	21.2 Survey Findings.....	21-1
	21.2.1 Asbestos-Containing Materials (ACMs).....	21-1
	21.2.2 Lead-Containing Materials.....	21-3
	21.2.3 Mercury.....	21-3
	21.2.4 Silica	21-3
	21.2.5 Other Designated Substances	21-3
	21.2.6 Polychlorinated Biphenyls (PCBs)	21-5
	21.2.7 Ozone-Depleting Substances (ODSs).....	21-5
	21.2.8 Urea Formaldehyde Foam Insulation (UFFI).....	21-5
	21.2.9 Fuel, Oil, and/or Waste Oil Storage	21-5
	21.2.10 Chemical Storage.....	21-5

	21.2.11 Radioactive Materials	21-6
	21.2.12 Mould	21-6
22.	WW06 – SEGREGATION BUILDING	22-1
	22.1 Building Description	22-1
	22.2 Survey Findings.....	22-1
	22.2.1 Asbestos-Containing Materials (ACMs)	22-1
	22.2.2 Lead-Containing Materials.....	22-3
	22.2.3 Mercury.....	22-3
	22.2.4 Silica	22-3
	22.2.5 Other Designated Substances	22-3
	22.2.6 Polychlorinated Biphenyls (PCBs)	22-5
	22.2.7 Ozone-Depleting Substances (ODSs).....	22-5
	22.2.8 Urea Formaldehyde Foam Insulation (UFFI).....	22-5
	22.2.9 Fuel, Oil, and/or Waste Oil Storage	22-5
	22.2.10 Chemical Storage.....	22-5
	22.2.11 Radioactive Materials	22-5
	22.2.12 Mould.....	22-5
23.	WW07 – HOSPITAL BUILDING	23-1
	23.1 Building Description	23-1
	23.2 Survey Findings.....	23-1
	23.2.1 Asbestos-Containing Materials (ACMs)	23-1
	23.2.2 Lead-Containing Materials.....	23-4
	23.2.3 Mercury.....	23-4
	23.2.4 Silica	23-4
	23.2.5 Other Designated Substances	23-4
	23.2.6 Polychlorinated Biphenyls (PCBs)	23-6
	23.2.7 Ozone-Depleting Substances (ODSs).....	23-6
	23.2.8 Urea Formaldehyde Foam Insulation (UFFI).....	23-6
	23.2.9 Fuel, Oil, and/or Waste Oil Storage	23-6
	23.2.10 Chemical Storage.....	23-6
	23.2.11 Radioactive Materials	23-7
	23.2.12 Mould.....	23-7
24.	WW08 – ACCOMMODATION BUILDING (UNIT 4)	24-1
	24.1 Building Description	24-1
	24.2 Survey Findings.....	24-1
	24.2.1 Asbestos-Containing Materials (ACMs)	24-1
	24.2.2 Lead-Containing Materials.....	24-3
	24.2.3 Mercury.....	24-3
	24.2.4 Silica	24-3
	24.2.5 Other Designated Substances	24-3
	24.2.6 Polychlorinated Biphenyls (PCBs)	24-5
	24.2.7 Ozone-Depleting Substances (ODSs).....	24-5
	24.2.8 Urea Formaldehyde Foam Insulation (UFFI).....	24-6
	24.2.9 Fuel, Oil, and/or Waste Oil Storage	24-6
	24.2.10 Chemical Storage.....	24-6
	24.2.11 Radioactive Materials	24-6
	24.2.12 Mould.....	24-6
25.	WW09 – ACCOMMODATION BUILDING (UNIT 1)	25-1
	25.1 Building Description	25-1

25.2	Survey Findings.....	25-1
25.2.1	Asbestos-Containing Materials (ACMs).....	25-1
25.2.2	Lead-Containing Materials.....	25-3
25.2.3	Mercury.....	25-3
25.2.4	Silica.....	25-3
25.2.5	Other Designated Substances.....	25-3
25.2.6	Polychlorinated Biphenyls (PCBs).....	25-5
25.2.7	Ozone-Depleting Substances (ODSs).....	25-5
25.2.8	Urea Formaldehyde Foam Insulation (UFFI).....	25-6
25.2.9	Fuel, Oil, and/or Waste Oil Storage.....	25-6
25.2.10	Chemical Storage.....	25-6
25.2.11	Radioactive Materials.....	25-6
25.2.12	Mould.....	25-6
26.	WW10 – ACCOMMODATION BUILDING (UNIT 2)	26-1
26.1	Building Description.....	26-1
26.2	Survey Findings.....	26-1
26.2.1	Asbestos-Containing Materials (ACMs).....	26-1
26.2.2	Lead-Containing Materials.....	26-3
26.2.3	Mercury.....	26-3
26.2.4	Silica.....	26-3
26.2.5	Other Designated Substances.....	26-3
26.2.6	Polychlorinated Biphenyls (PCBs).....	26-5
26.2.7	Ozone-Depleting Substances (ODSs).....	26-5
26.2.8	Urea Formaldehyde Foam Insulation (UFFI).....	26-6
26.2.9	Fuel, Oil, and/or Waste Oil Storage.....	26-6
26.2.10	Chemical Storage.....	26-6
26.2.11	Radioactive Materials.....	26-6
26.2.12	Mould.....	26-6
27.	WW11 – ACCOMMODATION BUILDING (UNIT 3)	27-1
27.1	Building Description.....	27-1
27.2	Survey Findings.....	27-1
27.2.1	Asbestos-Containing Materials (ACMs).....	27-1
27.2.2	Lead-Containing Materials.....	27-3
27.2.3	Mercury.....	27-6
27.2.4	Silica.....	27-6
27.2.5	Other Designated Substances.....	27-6
27.2.6	Polychlorinated Biphenyls (PCBs).....	27-6
27.2.7	Ozone-Depleting Substances (ODSs).....	27-6
27.2.8	Urea Formaldehyde Foam Insulation (UFFI).....	27-7
27.2.9	Fuel, Oil, and/or Waste Oil Storage.....	27-7
27.2.10	Chemical Storage.....	27-7
27.2.11	Radioactive Materials.....	27-7
27.2.12	Mould.....	27-8
28.	WW12 – INMATE CANTEEN/HOBBY CRAFT BUILDING	28-1
28.1	Building Description.....	28-1
28.2	Survey Findings.....	28-1
28.2.1	Asbestos-Containing Materials (ACMs).....	28-1
28.2.2	Lead-Containing Materials.....	28-4
28.2.3	Mercury.....	28-4
28.2.4	Silica.....	28-4

	28.2.5 Other Designated Substances	28-4
	28.2.6 Polychlorinated Biphenyls (PCBs)	28-7
	28.2.7 Ozone-Depleting Substances (ODSs).....	28-7
	28.2.8 Urea Formaldehyde Foam Insulation (UFFI).....	28-8
	28.2.9 Fuel, Oil, and/or Waste Oil Storage	28-8
	28.2.10 Chemical Storage.....	28-8
	28.2.11 Radioactive Materials	28-8
	28.2.12 Mould	28-8
29.	WW13 – CAFETERIA BUILDING.....	29-1
	29.1 Building Description	29-1
	29.2 Survey Findings.....	29-1
	29.2.1 Asbestos-Containing Materials (ACMs).....	29-1
	29.2.2 Lead-Containing Materials.....	29-3
	29.2.3 Mercury.....	29-3
	29.2.4 Silica	29-3
	29.2.5 Other Designated Substances	29-3
	29.2.6 Polychlorinated Biphenyls (PCBs)	29-5
	29.2.7 Ozone-Depleting Substances (ODSs).....	29-5
	29.2.8 Urea Formaldehyde Foam Insulation (UFFI).....	29-5
	29.2.9 Fuel, Oil, and/or Waste Oil Storage	29-6
	29.2.10 Chemical Storage.....	29-6
	29.2.11 Radioactive Materials	29-6
	29.2.12 Mould	29-6
30.	WW14 – CATHOLIC CHAPEL.....	30-1
	30.1 Building Description	30-1
	30.2 Survey Findings.....	30-1
	30.2.1 Asbestos-Containing Materials (ACMs).....	30-1
	30.2.2 Lead-Containing Materials.....	30-3
	30.2.3 Mercury.....	30-3
	30.2.4 Silica	30-3
	30.2.5 Other Designated Substances	30-3
	30.2.6 Polychlorinated Biphenyls (PCBs)	30-3
	30.2.7 Ozone-Depleting Substances (ODSs).....	30-3
	30.2.8 Urea Formaldehyde Foam Insulation (UFFI).....	30-4
	30.2.9 Fuel, Oil, and/or Waste Oil Storage	30-4
	30.2.10 Chemical Storage.....	30-4
	30.2.11 Radioactive Materials	30-4
	30.2.12 Mould	30-4
31.	WW15 – S.I.S. BUILDING.....	31-1
	31.1 Building Description	31-1
	31.2 Survey Findings.....	31-1
	31.2.1 Asbestos-Containing Materials (ACMs).....	31-1
	31.2.2 Lead-Containing Materials.....	31-3
	31.2.3 Mercury.....	31-3
	31.2.4 Silica	31-3
	31.2.5 Other Designated Substances	31-3
	31.2.6 Polychlorinated Biphenyls (PCBs)	31-5
	31.2.7 Ozone-Depleting Substances (ODSs).....	31-5
	31.2.8 Urea Formaldehyde Foam Insulation (UFFI).....	31-5
	31.2.9 Fuel, Oil, and/or Waste Oil Storage	31-5

	31.2.10 Chemical Storage.....	31-5
	31.2.11 Radioactive Materials.....	31-6
	31.2.12 Mould.....	31-6
32.	WW16 – PROTESTANT CHAPEL.....	32-1
	32.1 Building Description.....	32-1
	32.2 Survey Findings.....	32-1
	32.2.1 Asbestos-Containing Materials (ACMs).....	32-1
	32.2.2 Lead-Containing Materials.....	32-3
	32.2.3 Mercury.....	32-3
	32.2.4 Silica.....	32-3
	32.2.5 Other Designated Substances.....	32-3
	32.2.6 Polychlorinated Biphenyls (PCBs).....	32-3
	32.2.7 Ozone-Depleting Substances (ODSs).....	32-3
	32.2.8 Urea Formaldehyde Foam Insulation (UFFI).....	32-3
	32.2.9 Fuel, Oil, and/or Waste Oil Storage.....	32-4
	32.2.10 Chemical Storage.....	32-4
	32.2.11 Radioactive Materials.....	32-4
	32.2.12 Mould.....	32-4
33.	WW17 – EDUCATION AND LIBRARY BUILDING.....	33-1
	33.1 Building Description.....	33-1
	33.2 Survey Findings.....	33-1
	33.2.1 Asbestos-Containing Materials (ACMs).....	33-1
	33.2.2 Lead-Containing Materials.....	33-3
	33.2.3 Mercury.....	33-3
	33.2.4 Silica.....	33-3
	33.2.5 Other Designated Substances.....	33-3
	33.2.6 Polychlorinated Biphenyls (PCBs).....	33-5
	33.2.7 Ozone-Depleting Substances (ODSs).....	33-5
	33.2.8 Urea Formaldehyde Foam Insulation (UFFI).....	33-5
	33.2.9 Fuel, Oil, and/or Waste Oil Storage.....	33-5
	33.2.10 Chemical Storage.....	33-5
	33.2.11 Radioactive Materials.....	33-5
	33.2.12 Mould.....	33-5
34.	WW18 – INDUSTRIAL SHOPS BUILDING.....	34-1
	34.1 Building Description.....	34-1
	34.2 Survey Findings.....	34-1
	34.2.1 Asbestos-Containing Materials (ACMs).....	34-1
	34.2.2 Lead-Containing Materials.....	34-5
	34.2.3 Mercury.....	34-6
	34.2.4 Silica.....	34-6
	34.2.5 Other Designated Substances.....	34-6
	34.2.6 Polychlorinated Biphenyls (PCBs).....	34-9
	34.2.7 Ozone-Depleting Substances (ODSs).....	34-9
	34.2.8 Urea Formaldehyde Foam Insulation (UFFI).....	34-10
	34.2.9 Fuel, Oil, and/or Waste Oil Storage.....	34-10
	34.2.10 Chemical Storage.....	34-10
	34.2.11 Radioactive Materials.....	34-10
	34.2.12 Mould.....	34-10
35.	WW19 – MAINTENANCE GARAGE.....	35-1

35.1	Building Description	35-1
35.2	Survey Findings.....	35-1
35.2.1	Asbestos-Containing Materials (ACMs)	35-1
35.2.2	Lead-Containing Materials.....	35-3
35.2.3	Mercury.....	35-3
35.2.4	Silica	35-3
35.2.5	Other Designated Substances	35-3
35.2.6	Polychlorinated Biphenyls (PCBs)	35-5
35.2.7	Ozone-Depleting Substances (ODSs).....	35-5
35.2.8	Urea Formaldehyde Foam Insulation (UFFI).....	35-6
35.2.9	Fuel, Oil, and/or Waste Oil Storage	35-6
35.2.10	Chemical Storage.....	35-6
35.2.11	Radioactive Materials	35-7
35.2.12	Mould	35-7
36.	WW21 – GUARD HOUSE.....	36-1
36.1	Building Description	36-1
36.2	Survey Findings.....	36-1
36.2.1	Asbestos-Containing Materials (ACMs)	36-1
36.2.2	Lead-Containing Materials.....	36-3
36.2.3	Mercury.....	36-3
36.2.4	Silica	36-3
36.2.5	Other Designated Substances	36-3
36.2.6	Polychlorinated Biphenyls (PCBs)	36-5
36.2.7	Ozone-Depleting Substances (ODSs).....	36-5
36.2.8	Urea Formaldehyde Foam Insulation (UFFI).....	36-5
36.2.9	Fuel, Oil, and/or Waste Oil Storage	36-5
36.2.10	Chemical Storage.....	36-5
36.2.11	Radioactive Materials	36-5
36.2.12	Mould	36-5
37.	WW22 – WORKS EQUIPMENT STORAGE BUILDING	37-1
37.1	Building Description	37-1
37.2	Survey Findings.....	37-1
37.2.1	Asbestos-Containing Materials (ACMs)	37-1
37.2.2	Lead-Containing Materials.....	37-3
37.2.3	Mercury.....	37-3
37.2.4	Silica	37-3
37.2.5	Other Designated Substances	37-3
37.2.6	Polychlorinated Biphenyls (PCBs)	37-5
37.2.7	Ozone-Depleting Substances (ODSs).....	37-5
37.2.8	Urea Formaldehyde Foam Insulation (UFFI).....	37-5
37.2.9	Fuel, Oil, and/or Waste Oil Storage	37-5
37.2.10	Chemical Storage.....	37-5
37.2.11	Radioactive Materials	37-5
37.2.12	Mould	37-6
38.	WW23 – SPORTS PAVILION.....	38-1
38.1	Building Description	38-1
38.2	Survey Findings.....	38-1
38.2.1	Asbestos-Containing Materials (ACMs)	38-1
38.2.2	Lead-Containing Materials.....	38-1

	38.2.3 Mercury.....	38-1
	38.2.4 Silica	38-3
	38.2.5 Other Designated Substances	38-3
	38.2.6 Polychlorinated Biphenyls (PCBs)	38-3
	38.2.7 Ozone-Depleting Substances (ODSs).....	38-3
	38.2.8 Urea Formaldehyde Foam Insulation (UFFI).....	38-3
	38.2.9 Fuel, Oil, and/or Waste Oil Storage	38-3
	38.2.10 Chemical Storage.....	38-3
	38.2.11 Radioactive Materials	38-3
	38.2.12 Mould	38-3
39.	WW24 – MAINTENANCE GARAGE ANNEX	39-1
	39.1 Building Description	39-1
	39.2 Survey Findings.....	39-1
	39.2.1 Asbestos-Containing Materials (ACMs)	39-1
	39.2.2 Lead-Containing Materials.....	39-3
	39.2.3 Mercury.....	39-3
	39.2.4 Silica	39-3
	39.2.5 Other Designated Substances	39-3
	39.2.6 Polychlorinated Biphenyls (PCBs)	39-3
	39.2.7 Ozone-Depleting Substances (ODSs).....	39-3
	39.2.8 Urea Formaldehyde Foam Insulation (UFFI).....	39-4
	39.2.9 Fuel, Oil, and/or Waste Oil Storage	39-4
	39.2.10 Chemical Storage.....	39-4
	39.2.11 Radioactive Materials.....	39-4
	39.2.12 Mould	39-4
40.	WW25 – SALLYPORT BUILDING	40-1
	40.1 Building Description	40-1
	40.2 Survey Findings.....	40-1
	40.2.1 Asbestos-Containing Materials (ACMs)	40-1
	40.2.2 Lead-Containing Materials.....	40-3
	40.2.3 Mercury.....	40-3
	40.2.4 Silica	40-3
	40.2.5 Other Designated Substances	40-3
	40.2.6 Polychlorinated Biphenyls (PCBs)	40-5
	40.2.7 Ozone-Depleting Substances (ODSs).....	40-5
	40.2.8 Urea Formaldehyde Foam Insulation (UFFI).....	40-5
	40.2.9 Fuel, Oil, and/or Waste Oil Storage	40-5
	40.2.10 Chemical Storage.....	40-5
	40.2.11 Radioactive Materials.....	40-5
	40.2.12 Mould	40-5
41.	WW26 – SPORTS COMPLEX	41-1
	41.1 Building Description	41-1
	41.2 Survey Findings.....	41-1
	41.2.1 Asbestos-Containing Materials (ACMs)	41-1
	41.2.2 Lead-Containing Materials.....	41-4
	41.2.3 Mercury.....	41-4
	41.2.4 Silica	41-4
	41.2.5 Other Designated Substances	41-4
	41.2.6 Polychlorinated Biphenyls (PCBs)	41-6
	41.2.7 Ozone-Depleting Substances (ODSs).....	41-6

	41.2.8 Urea Formaldehyde Foam Insulation (UFFI).....	41-6
	41.2.9 Fuel, Oil, and/or Waste Oil Storage	41-6
	41.2.10 Chemical Storage.....	41-6
	41.2.11 Radioactive Materials.....	41-6
	41.2.12 Mould.....	41-6
42.	WW27 – VISITOR, CORRESPONDENCE & CONTROL CENTRE.....	42-1
	42.1 Building Description	42-1
	42.2 Survey Findings.....	42-1
	42.2.1 Asbestos-Containing Materials (ACMs)	42-1
	42.2.2 Lead-Containing Materials.....	42-3
	42.2.3 Mercury.....	42-3
	42.2.4 Silica	42-3
	42.2.5 Other Designated Substances	42-3
	42.2.6 Polychlorinated Biphenyls (PCBs)	42-5
	42.2.7 Ozone-Depleting Substances (ODSs).....	42-5
	42.2.8 Urea Formaldehyde Foam Insulation (UFFI).....	42-5
	42.2.9 Fuel, Oil, and/or Waste Oil Storage	42-5
	42.2.10 Chemical Storage.....	42-5
	42.2.11 Radioactive Materials.....	42-6
	42.2.12 Mould.....	42-6
43.	WW31 – ACCOMMODATION BUILDING (80-MAN UNIT)	43-1
	43.1 Building Description	43-1
	43.2 Survey Findings.....	43-1
	43.2.1 Asbestos-Containing Materials (ACMs)	43-1
	43.2.2 Lead-Containing Materials.....	43-3
	43.2.3 Mercury.....	43-3
	43.2.4 Silica	43-3
	43.2.5 Other Designated Substances	43-3
	43.2.6 Polychlorinated Biphenyls (PCBs)	43-5
	43.2.7 Ozone-Depleting Substances (ODSs).....	43-5
	43.2.8 Urea Formaldehyde Foam Insulation (UFFI).....	43-6
	43.2.9 Fuel, Oil, and/or Waste Oil Storage	43-6
	43.2.10 Chemical Storage.....	43-6
	43.2.11 Radioactive Materials.....	43-6
	43.2.12 Mould.....	43-6
44.	WW32 – PRIVATE FAMILY VISIT DUPLEX (UNITS 1 & 2)	44-1
	44.1 Building Description	44-1
	44.2 Survey Findings.....	44-1
	44.2.1 Asbestos-Containing Materials (ACMs)	44-1
	44.2.2 Lead-Containing Materials.....	44-3
	44.2.3 Mercury.....	44-3
	44.2.4 Silica	44-3
	44.2.5 Other Designated Substances	44-3
	44.2.6 Polychlorinated Biphenyls (PCBs)	44-5
	44.2.7 Ozone-Depleting Substances (ODSs).....	44-5
	44.2.8 Urea Formaldehyde Foam Insulation (UFFI).....	44-5
	44.2.9 Fuel, Oil, and/or Waste Oil Storage	44-5
	44.2.10 Chemical Storage.....	44-5
	44.2.11 Radioactive Materials.....	44-5
	44.2.12 Mould.....	44-6

45.	WW33 – WAREHOUSE.....	45-1
45.1	Building Description	45-1
45.2	Survey Findings.....	45-1
45.2.1	Asbestos-Containing Materials (ACMs).....	45-1
45.2.2	Lead-Containing Materials.....	45-1
45.2.3	Mercury.....	45-1
45.2.4	Silica	45-1
45.2.5	Other Designated Substances	45-1
45.2.6	Polychlorinated Biphenyls (PCBs)	45-1
45.2.7	Ozone-Depleting Substances (ODSs).....	45-2
45.2.8	Urea Formaldehyde Foam Insulation (UFFI).....	45-2
45.2.9	Fuel, Oil, and/or Waste Oil Storage	45-2
45.2.10	Chemical Storage.....	45-2
45.2.11	Radioactive Materials.....	45-2
45.2.12	Mould.....	45-2
46.	WW34 – PRIVATE FAMILY VISIT DUPLEX (UNITS 3 & 4)	46-1
46.1	Building Description	46-1
46.2	Survey Findings.....	46-1
46.2.1	Asbestos-Containing Materials (ACMs).....	46-1
46.2.2	Lead-Containing Materials.....	46-3
46.2.3	Mercury.....	46-3
46.2.4	Silica	46-3
46.2.5	Other Designated Substances	46-3
46.2.6	Polychlorinated Biphenyls (PCBs)	46-5
46.2.7	Ozone-Depleting Substances (ODSs).....	46-5
46.2.8	Urea Formaldehyde Foam Insulation (UFFI).....	46-5
46.2.9	Fuel, Oil, and/or Waste Oil Storage	46-5
46.2.10	Chemical Storage.....	46-5
46.2.11	Radioactive Materials.....	46-6
46.2.12	Mould.....	46-6
47.	WW35 – PRIVATE FAMILY VISIT DUPLEX (UNITS 5 & 6)	47-1
47.1	Building Description	47-1
47.2	Survey Findings.....	47-1
47.2.1	Asbestos-Containing Materials (ACMs).....	47-1
47.2.2	Lead-Containing Materials.....	47-3
47.2.3	Mercury.....	47-3
47.2.4	Silica	47-3
47.2.5	Other Designated Substances	47-3
47.2.6	Polychlorinated Biphenyls (PCBs)	47-5
47.2.7	Ozone-Depleting Substances (ODSs).....	47-5
47.2.8	Urea Formaldehyde Foam Insulation (UFFI).....	47-5
47.2.9	Fuel, Oil, and/or Waste Oil Storage	47-5
47.2.10	Chemical Storage.....	47-5
47.2.11	Radioactive Materials.....	47-6
47.2.12	Mould.....	47-6
48.	WW36 – PRIVATE FAMILY VISIT DUPLEX (UNITS 7 & 8)	48-1
48.1	Building Description	48-1
48.2	Survey Findings.....	48-1
48.2.1	Asbestos-Containing Materials (ACMs).....	48-1

	48.2.2 Lead-Containing Materials.....	48-3
	48.2.3 Mercury.....	48-3
	48.2.4 Silica	48-3
	48.2.5 Other Designated Substances	48-3
	48.2.6 Polychlorinated Biphenyls (PCBs)	48-5
	48.2.7 Ozone-Depleting Substances (ODSs).....	48-5
	48.2.8 Urea Formaldehyde Foam Insulation (UFFI).....	48-5
	48.2.9 Fuel, Oil, and/or Waste Oil Storage	48-5
	48.2.10 Chemical Storage.....	48-5
	48.2.11 Radioactive Materials.....	48-5
	48.2.12 Mould.....	48-5
49.	WW37 – GUARD CONTROL POST	49-1
	49.1 Building Description	49-1
	49.2 Survey Findings.....	49-1
	49.2.1 Asbestos-Containing Materials (ACMs)	49-1
	49.2.2 Lead-Containing Materials.....	49-3
	49.2.3 Mercury.....	49-3
	49.2.4 Silica	49-3
	49.2.5 Other Designated Substances	49-3
	49.2.6 Polychlorinated Biphenyls (PCBs)	49-3
	49.2.7 Ozone-Depleting Substances (ODSs).....	49-3
	49.2.8 Urea Formaldehyde Foam Insulation (UFFI).....	49-3
	49.2.9 Fuel, Oil, and/or Waste Oil Storage	49-3
	49.2.10 Chemical Storage.....	49-4
	49.2.11 Radioactive Materials.....	49-4
	49.2.12 Mould.....	49-4
50.	CONCLUSIONS AND RECOMMENDATIONS.....	50-1

TABLES

Table 1.1	Site Buildings	1-4
Table 3.1	Summary of Asbestos Survey, Building WA01.....	3-2
Table 3.2	Summary of Lead Paint Survey, Building WA01.....	3-5
Table 4.1	Summary of Asbestos Survey, Building WA04.....	4-2
Table 4.2	Summary of Lead Paint Survey, Building WA04.....	4-5
Table 5.1	Summary of Asbestos Survey, Building WA05.....	5-2
Table 5.2	Summary of Lead Paint Survey, Building WA05	5-4
Table 6.1	Summary of Lead Paint Survey, Building WA06.....	6-4
Table 7.1	Summary of Lead Paint Survey, Building WA07	7-3
Table 8.1	Summary of Lead Paint Survey, Building WA08	8-4
Table 9.1	Summary of Asbestos Survey, Building WA09.....	9-2
Table 9.2	Summary of Lead Paint Survey, Building WA09	9-4
Table 10.1	Summary of Lead Paint Survey, Building WA16.....	10-2
Table 13.1	Summary of Asbestos Survey, Building WGP12	13-2
Table 13.2	Summary of Lead Paint Survey, Building WGP12.....	13-4
Table 14.1	Summary of Asbestos Survey, Building WGP13	14-2
Table 14.2	Summary of Lead Paint Survey, Building WGP13.....	14-4
Table 15.1	Summary of Lead Paint Survey, Building WGP14.....	15-3

Table 16.1	Summary of Lead Paint Survey, Building WGP15.....	16-3
Table 18.1	Summary of Asbestos Survey, Building WW02.....	18-2
Table 18.2	Summary of Lead Paint Survey, Building WW02.....	18-4
Table 19.1	Summary of Asbestos Survey, Building WW03.....	19-2
Table 19.2	Summary of Lead Paint Survey, Building WW03.....	19-4
Table 20.1	Summary of Asbestos Survey, Building WW04.....	20-2
Table 20.2	Summary of Lead Paint Survey, Building WW04.....	20-4
Table 21.1	Summary of Asbestos Survey, Building WW05.....	21-2
Table 21.2	Summary of Lead Paint Survey, Building WW05.....	21-4
Table 22.1	Summary of Asbestos Survey, Building WW06.....	22-2
Table 22.2	Summary of Lead Paint Survey, Building WW06.....	22-4
Table 23.1	Summary of Asbestos Survey, Building WW07.....	23-2
Table 23.2	Summary of Lead Paint Survey, Building WW07.....	23-5
Table 24.1	Summary of Asbestos Survey, Building WW08.....	24-2
Table 24.2	Summary of Lead Paint Survey, Building WW08.....	24-4
Table 25.1	Summary of Asbestos Survey, Building WW09.....	25-2
Table 25.2	Summary of Lead Paint Survey, Building WW09.....	25-4
Table 26.1	Summary of Asbestos Survey, Building WW10.....	26-2
Table 26.2	Summary of Lead Paint Survey, Building WW10.....	26-4
Table 27.1	Summary of Asbestos Survey, Building WW11.....	27-2
Table 27.2	Summary of Lead Paint Survey, Building WW11.....	27-4
Table 28.1	Summary of Asbestos Survey, Building WW12.....	28-2
Table 28.2	Summary of Lead Paint Survey, Building WW12.....	28-5
Table 29.1	Summary of Asbestos Survey, Building WW13.....	29-2
Table 29.2	Summary of Lead Paint Survey, Building WW13.....	29-4
Table 30.1	Summary of Asbestos Survey, Building WW14.....	30-2
Table 31.1	Summary of Asbestos Survey, Building WW15.....	31-2
Table 31.2	Summary of Lead Paint Survey, Building WW15.....	31-4
Table 32.1	Summary of Asbestos Survey, Building WW16.....	32-2
Table 33.1	Summary of Asbestos Survey, Building WW17.....	33-2
Table 33.2	Summary of Lead Paint Survey, Building WW17.....	33-4
Table 34.1	Summary of Asbestos Survey, Building WW18.....	34-2
Table 34.2	Summary of Lead Paint Survey, Building WW18.....	34-7
Table 35.1	Summary of Asbestos Survey, Building WW19.....	35-2
Table 35.2	Summary of Lead Paint Survey, Building WW19.....	35-4
Table 36.1	Summary of Asbestos Survey, Building WW21.....	36-2
Table 36.2	Summary of Lead Paint Survey, Building WW21.....	36-4
Table 37.1	Summary of Asbestos Survey, Building WW22.....	37-2
Table 37.2	Summary of Lead Paint Survey, Building WW22.....	37-4
Table 38.1	Summary of Lead Paint Survey, Building WW23.....	38-2
Table 39.1	Summary of Asbestos Survey, Building WW24.....	39-2
Table 40.1	Summary of Asbestos Survey, Building WW25.....	40-2
Table 40.2	Summary of Lead Paint Survey, Building WW25.....	40-4
Table 41.1	Summary of Asbestos Survey, Building WW26.....	41-2
Table 41.2	Summary of Lead Paint Survey, Building WW26.....	41-5
Table 42.1	Summary of Asbestos Survey, Building WW27.....	42-2

Table 42.2	Summary of Lead Paint Survey, Building WW27	42-4
Table 43.1	Summary of Asbestos Survey, Building WW31	43-2
Table 43.2	Summary of Lead Paint Survey, Building WW31	43-4
Table 44.1	Summary of Asbestos Survey, Building WW32	44-2
Table 44.2	Summary of Lead Paint Survey, Building WW32	44-4
Table 46.1	Summary of Asbestos Survey, Building WW34	46-2
Table 46.2	Summary of Lead Paint Survey, Building WW34	46-4
Table 47.1	Summary of Asbestos Survey, Building WW35	47-2
Table 47.2	Summary of Lead Paint Survey, Building WW35	47-4
Table 48.1	Summary of Asbestos Survey, Building WW36	48-2
Table 48.2	Summary of Lead Paint Survey, Building WW36	48-4
Table 49.1	Summary of Asbestos Survey, Building WW37	49-2
Table 50.1	Summary of Asbestos Mitigative Measures and Class D Cost Estimates	50-3
Table 50.2	Summary of Lead-Based Paint Mitigative Measures and Class D Cost Estimates	50-4

FIGURES

Figure 1-1	Site Location Plan	1-2
Figure 1-2	Facility Layout	1-3

APPENDICES

Appendix 3	WA01 – Finance and Personnel Building - Floor Plans, Certificates of Analyses, Selected Photographs
Appendix 4	WA04 – General Stores Building - Floor Plans, Certificates of Analyses, Selected Photographs
Appendix 5	WA05 – Central Heating Plant - Floor Plans, Certificates of Analyses, Selected Photographs
Appendix 6	WA06 – Maintenance Storage Building - Floor Plans, Certificates of Analyses, Selected Photographs
Appendix 7	WA07 – Inflammable Stores Building - Floor Plans, Certificates of Analyses, Selected Photographs
Appendix 8	WA08 – Fire Hall - Floor Plans, Certificates of Analyses, Selected Photographs
Appendix 9	WA09 – Sewage Disposal Building - Floor Plans, Certificates of Analyses, Selected Photographs
Appendix 10	WA16 – Clarification Building - Floor Plans, Certificates of Analyses, Selected Photographs
Appendix 11	WA18 – Rifle Range – Floor Plans
Appendix 12	WA19 – Aggregate Building - Floor Plans, Certificates of Analyses, Selected Photographs
Appendix 13	WGP12 – Guard Post - Floor Plans, Certificates of Analyses, Selected Photographs

Appendix 14 WGP13 – Guard Post - Floor Plans, Certificates of Analyses, Selected Photographs

Appendix 15 WGP14 – Guard Post - Floor Plans, Certificates of Analyses, Selected Photographs

Appendix 16 WGP15 – Guard Post - Floor Plans, Certificates of Analyses, Selected Photographs

Appendix 17 WW01 – Entrance Gate - Floor Plans, Certificates of Analyses, Selected Photographs

Appendix 18 WW02 – Staff and Training Building - Floor Plans, Certificates of Analyses, Selected Photographs

Appendix 19 WW03 – Administration Building - Floor Plans, Certificates of Analyses, Selected Photographs

Appendix 20 WW04 – Programs and SBC Building - Floor Plans, Certificates of Analyses, Selected Photographs

Appendix 21 WW05 – Intensive Support Building - Floor Plans, Certificates of Analyses, Selected Photographs

Appendix 22 WW06 – Segregation Building - Floor Plans, Certificates of Analyses, Selected Photographs

Appendix 23 WW07 – Hospital Building - Floor Plans, Certificates of Analyses, Selected Photographs

Appendix 24 WW08 – Accommodation Building (Unit 4) - Floor Plans, Certificates of Analyses, Selected Photographs

Appendix 25 WW09 – Accommodation Building (Unit 1) - Floor Plans, Certificates of Analyses, Selected Photographs

Appendix 26 WW10 – Accommodation Building (Unit 2) - Floor Plans, Certificates of Analyses, Selected Photographs

Appendix 27 WW11 – Accommodation Building (Unit 3) - Floor Plans, Certificates of Analyses, Selected Photographs

Appendix 28 WW12 – Inmate Canteen/Hobby Craft Building - Floor Plans, Certificates of Analyses, Selected Photographs

Appendix 29 WW13 – Cafeteria Building - Floor Plans, Certificates of Analyses, Selected Photographs

Appendix 30 WW14 – Catholic Chapel - Floor Plans, Certificates of Analyses, Selected Photographs

Appendix 31 WW15 – S.I.S. Building - Floor Plans, Certificates of Analyses, Selected Photographs

Appendix 32 WW16 – Protestant Chapel - Floor Plans, Certificates of Analyses, Selected Photographs

Appendix 33 WW17 – Education and Library Building - Floor Plans, Certificates of Analyses, Selected Photographs

Appendix 34 WW18 – Industrial Shops Building - Floor Plans, Certificates of Analyses, Selected Photographs

Appendix 35 WW19 – Maintenance Garage - Floor Plans, Certificates of Analyses, Selected Photographs

Appendix 36 WW21 – Guard House - Floor Plans, Certificates of Analyses, Selected Photographs

- Appendix 37 WW22 – Works Equipment Storage Building - Floor Plans, Certificates of Analyses, Selected Photographs
- Appendix 38 WW23 – Sports Pavilion - Floor Plans, Certificates of Analyses, Selected Photographs
- Appendix 39 WW24 – Maintenance Garage Annex - Floor Plans, Certificates of Analyses, Selected Photographs
- Appendix 40 WW25 – Sallyport Building - Floor Plans, Certificates of Analyses, Selected Photographs
- Appendix 41 WW26 – Sports Complex - Floor Plans, Certificates of Analyses, Selected Photographs
- Appendix 42 WW27 – Visitor, Correspondence and Control Centre - Floor Plans, Certificates of Analyses, Selected Photographs
- Appendix 43 WW31 – Sports Complex - Floor Plans, Certificates of Analyses, Selected Photographs
- Appendix 44 WW32 – Private Family Visit Duplex (Units 1 & 2) - Floor Plans, Certificates of Analyses, Selected Photographs
- Appendix 45 WW33 – Warehouse - Floor Plans, Certificates of Analyses, Selected Photographs
- Appendix 46 WW34 – Private Family Visit Duplex (Units 3 & 4) - Floor Plans, Certificates of Analyses, Selected Photographs
- Appendix 47 WW35 – Private Family Visit Duplex (Units 5 & 6) - Floor Plans, Certificates of Analyses, Selected Photographs
- Appendix 48 WW36 – Private Family Visit Duplex (Units 7 & 8) - Floor Plans, Certificates of Analyses, Selected Photographs
- Appendix 49 WW37 – Guard Control Post - Floor Plans, Certificates of Analyses, Selected Photographs

1. INTRODUCTION

XCG Consultants Ltd (XCG) was retained by Public Works and Government Services Canada (PWGSC), acting on behalf of Correctional Service of Canada (CSC), to conduct a Designated Substances and Hazardous Materials Survey (DSHMS) of the forty-seven (47) buildings located at the Warkworth Institution.

1.1 Site Description

Warkworth Institution is a medium-security correctional facility located in Northumberland County, south of Campbellford, Ontario. It is situated on the south side of Northumberland County Road 29, approximately 2 kilometres east of Highway 30. The facility opened in 1967 and has undergone some recent renovations, resulting in a new 80-bed living unit with an additional 48-cell expansion. Warkworth Institution has a rated capacity of 537 and the actual number of inmates is currently approximately 557. The facility has approximately 300 full-time employees.

The main portion of the subject property covers an area of approximately 76.5 hectares. A separate portion was located approximately 2 kilometres northeast of the main facility, adjacent to the Trent River. This 0.2 hectare property formerly housed a water filtration building and was sold in late-2004 after the institution was connected to the municipal water supply.

The topography of the property is relatively flat with a slight slope to the south from County Road 29. The east and west sides slope gently downward approximately 5 metres. At the south section, the land slopes steeply approximately 10 metres down to a marshy area. The marshy area is part of a tributary to Salt Creek, which approaches the property from the south and joins the tributary at the southeast corner of the subject property. A closed landfill is located at the top of this slope, while a Rifle Range (Building WA18) is cut into the bottom of the slope.

The subject property is surrounded by private agricultural lands on all sides. As indicated in a previous report, agricultural activities conducted on these adjacent lands appear to be beef and dairy cattle, and grain crop operations. There are farm buildings, such as residences and barns, located in close proximity to the Warkworth Institution on the west and east sides, just south of County Road 29.

There are a total of 47 buildings on the subject property. Thirty-three of these buildings are located within the security fencing, while the other 14 are situated outside the fence. As noted above, the water filtration building (Building Number WA10) was formerly located approximately 2 kilometres northeast of the main property. Figure 1-1 is a site location plan, while the facility layout is presented in Figure 1-2. A summary of the site buildings, their use, and year of construction is provided in Table 1.1.

Table 1.1 Site Buildings

Building No.	Building Use	Year Constructed
WA01	Finance and Personnel Building	1965
WA04	General Stores Building	1965
WA05	Central Heating Plant	1965
WA06	Maintenance Storage Building	1965
WA07	Inflammable Stores Building	1968
WA08	Fire Hall	1968
WA09	Sewage Disposal Building	1992
WA16	Clarification Building	1992
WA18	Rifle Range	1991
WA19	Aggregate Building	1995
WGP12	Guard Post	1977
WGP13	Guard Post	1977
WGP14	Guard Post	1994
WGP15	Guard Post	1995
WW01	Entrance Gate	1965
WW02	Staff and Training Building	1965
WW03	Administration Building	1965
WW04	Programs and SBC Building	1965 (additions in 1997)
WW05	Intensive Support Building	1965
WW06	Segregation Building	1965
WW07	Hospital Building	1965
WW08	Accommodation Building (Unit 4)	1965
WW09	Accommodation Building (Unit 1)	1965
WW10	Accommodation Building (Unit 2)	1965
WW11	Accommodation Building (Unit 3)	1965
WW12	Inmate Canteen/Hobby Craft Building	1965
WW13	Cafeteria Building (Kitchen)	1965
WW14	Catholic Chapel	1967
WW15	S.I.S. Building	1965
WW16	Protestant Chapel	1967
WW17	Education and Library Building	1965 (additions in 1997)
WW18	Industrial Shops Building	1970
WW19	Maintenance Garage	1965
WW21	Field House	1968

Table 1.1 Site Buildings

Building No.	Building Use	Year Constructed
WW22	Works Equipment Storage Building	1965
WW23	Sports Pavilion	1969
WW24	Maintenance Garage Annex	1978
WW25	Sallyport Building	1979
WW26	Sports Complex	1979
WW27	Visitor, Correspondence & Control Centre	1981
WW31	Accommodation Building (80-man Unit)	1990
WW32	Private Family Visit Duplex (Units 1 & 2)	1992
WW33	Warehouse	1992
WW34	Private Family Visit Duplex (Unit 3 & 4)	1994
WW35	Private Family Visit Duplex (Unit 5 & 6)	1994
WW36	Private Family Visit Duplex (Unit 7 & 8)	1994
WW37	Guard Control Post	1997

1.2 Scope of Work

The original scope of work was outlined in XCG's proposal entitled, "Revised Proposal for Environmental Condition and Operations Audit, Millhaven and Warkworth Correctional Institutions," dated May 31, 2004. Some modifications were made at the request of PWGSC and CSC, namely an increase in the number of samples to be collected. The final scope of work was as follows:

- Review previous reports and drawings;
- Prepare a health and safety plan;
- Conduct site inspections and sampling. The designated substances surveyed were those designated under the Ontario Occupational Health and Safety Act and included (but were not limited to) asbestos, lead, mercury and silica. The hazardous materials surveyed included polychlorinated biphenyl (PCB)-containing equipment, ozone-depleting substances (ODSs), urea formaldehyde foam insulation (UFFI), fuel, oil, and/or waste oil storage, chemical storage, radioactive materials, and mould.
- Collect representative building material samples for analytical testing. As requested by PWGSC and CSC, each building was sampled separately to avoid inferring asbestos and lead paint concentrations for similar materials between buildings. A total of 92 building material samples were collected for bulk asbestos analysis using the polarized light microscopy (PLM) method. Also, 140 vinyl floor tile samples were analyzed for asbestos using the transmission electron microscopy (TEM) method. In addition, 260 paint samples were submitted for laboratory analysis of lead;
- Prepare a survey report and provide estimated costs for the mitigation of all designated substances and hazardous materials identified in each of the buildings.

XCG conducted this assessment in conjunction with an Environmental Condition and Operations Audit study. Additional information regarding issues such as petroleum products, hazardous chemicals, and air emissions is provided in a separate Audit Report.

1.3 Project Team

In the performance of this DSHMS, XCG utilized the PWGSC-approved project team comprised of the following staff:

- Mr. Kevin Shipley, M.A.Sc., P.Eng., CEA, CEAS, QA Reviewer;
- Mr. Basil Wong, M.Eng., P.Eng., Senior Project Manager;
- Mr. Andreas Kouremenos, B.A.Sc., E.I.T., Environmental Site Assessor;
- Mr. Kevin Robertson, M.Sc., Environmental Site Assessor; and,
- Mr. Jonathan Ho, CET, Senior Field Technologist.

This project team was selected because of experience with DSHMS and projects directed by PWGSC Environmental Services. XCG used a small project team in order to maintain continuity within the project and minimize duplications during inspections and sampling efforts.

1.4 Report Format

This report is divided into 50 sections with the first being this introduction. Section 2 documents the methods used in the investigation. Sections 3 to 49 present the results of the DSHMS for the forty-seven (47) buildings on a building-by-building basis. Each of these sections includes a brief summary of the building in terms of construction date, other basic information, and the results for each designated substance and hazardous material assessed in each building. Recommendations are not provided within these sections. Rather, Section 50 provides a summary of recommendations for the entire facility for each substance that may be disturbed, handled, and disposed of during future demolition or renovation work. Recommendations are also provided for areas requiring mitigation measures to bring it to compliance. Class "D" cost estimates are provided for each recommendation.

Floor plans are included in the appendices and are identified by the building number and floor number. For example, the floor plans showing the basement and first floor of Building WA06 are labeled as figure number WA06-B and WA06-1, respectively. One set of appendices is provided for each building and is identified by the section number for that particular building (as opposed to the more commonly used nomenclature of Appendix A, B, C, etc.). For example, Building WA01 is described in Section 3 and the appendix is labeled as Appendix 3, for ease of locating. The appendix for each building includes in order, the floor plans, certificates of analyses, and selected photographs for areas of concern (if any), such as exposed asbestos pipe wrap. Photos are not included if there are no issues of concern in a particular building.

1.5 Limitations

The findings of this report are based upon visual observations and a survey of accessible areas of the forty-seven (47) buildings surveyed at the Warkworth

Institution in Campbellford, Ontario, between February 9 and March 2, 2005. While every attempt was made to ensure that samples collected were representative of the general sampling area, it is possible that conditions outside specific sampling locations may differ. Therefore, users of this report are advised to observe conditions prior to conducting any repairs, removal, or renovation/demolition.

This study was limited to a survey of accessible aboveground structures. No destructive work was conducted. As such, conditions below floors, above drywall ceilings, behind walls, and inside service trenches cannot be anticipated at this time. Access to every building in the institution was granted, with the exception of WA18, the Rifle Range. This building, which is located at the bottom of a 10-metre slope, was not inspected because the snow that has accumulated on the access road had not been ploughed. The CSC escort indicated that this building is only used during the summertime. Certain rooms within some of the buildings were also not accessible because keys to unlock them were not available during the site visit. These included WA01 (106), WA05 (M01 and 102), WA06 (B01), WW10 (Rooms H104, H107, and H108), WW11 (H108), WW21 (104, 105, and 106), WW26 (107), and WW31 (M03 and M04). Also, not every inmate cell in the accommodation buildings was surveyed. Approximately one to two cells from each accommodation building were examined, and taken as representative for the rest within the same structure. The CSC escort indicated the cells were all the same.

In cases where buildings and rooms were not surveyed, XCG relied upon information obtained from interviews with CSC representatives and previous documents supplied by PWGSC. Thus, XCG cannot be held responsible for conditions that were not apparent from the interviews conducted with CSC representatives and from documentation supplied to XCG.

This report was not intended to provide direction or procedures for the handling of designated substances and hazardous materials. Only persons with documented, current training in the safe handling of the designated substances and hazardous materials should handle them. Persons handling any of the asbestos-containing materials (ACMs) identified in this survey, or conducting work in the vicinity of these ACMs are advised to consult this survey and individuals with appropriate experience and training, prior to doing so.

The scope of this report is limited to the matters expressly covered. This report is prepared for the sole benefit of Correctional Service of Canada and Public Works and Government Services Canada and may not be relied upon by any other person or entity without written authorization of XCG Consultants Ltd. As such, the scope of services performed in the execution of this investigation may not be appropriate to satisfy the needs of other users. If others use or reuse this document or the findings, conclusions, or recommendations represented herein it is at the sole risk of said users

2. SURVEY METHODOLOGY

Mr. Andreas Kouremenos and Mr. Jonathan Ho conducted the survey at the Warkworth Correctional Institution between February 9 and March 2, 2005. Messrs. Kouremenos and Ho were joined by Mr. Kevin Robertson on March 1, as a second sampling team, for the remainder of the field work.

Prior to commencing the on-site inspections, the document provided by PWGSC entitled "Baseline Environmental Assessment, Warkworth Institution, Volumes 1 to 4" dated March 1999, by SNC Lavalin, Engineers & Constructors Inc. (SNC), was reviewed. In addition, on-site interviews were conducted with Mr. John Sipos, the Acting Chief, Plant Maintenance, Warkworth Institution. Mr. Kenny Foster, Mason Instructor, and Mr. Dan O'Brien, Carpentry Instructor, were XCG's escorts during the inspections and provided information when questions were asked.

Key findings from the information review and the interviews conducted included:

- The Institution formerly treated its own domestic water, but it is now connected to the municipal water distribution system of the Town of Campbellford. This conversion occurred a few years ago (post-1999). The associated water tower was removed in the fall of 2003;
- Any surface that needs re-painting is simply painted over and not scraped;
- Fluorescent light fixtures, for the most part, are considered to be non-PCB containing. Most fixtures throughout the facility have been replaced within the last few years, but a few have remained from earlier times when PCBs were used in their ballast. WW18, the Industrial Shops Building, may have some of the older ballasts in it. There are no PCB waste storage sites at the Institution;
- There are currently no halon-containing fire extinguishers at the facility;
- Mercury use at the facility is limited to minor amounts remaining in thermostat switches for temperature control. In addition, fluorescent lamp tubes may contain small amounts of mercury vapour;
- There are no sources of silica at the facility outside of silica contained in concrete and related materials such as brick and ceramic tiles; and
- It is believed that all of the lead pipe and wiring that once existed at the facility has been replaced over time.

All field work was conducted in accordance with XCG's Health and Safety Plan for the subject property. Details regarding the approach used in conducting the field investigations, including sampling procedures and analytical methodologies, are outlined in this section.

2.1 Site Inspections and Sampling

Inspections of 46 of the 47 buildings were conducted. As mentioned in the Section 1.5, Building WA18 (Rifle Range) could not be surveyed due to access limitations. This facility is used only in the summer and the snow covering the route to the building was not ploughed. Mr. Andreas Kouremenos, Mr. Jonathan Ho, and Mr. Kevin Robertson of XCG surveyed the buildings. The survey in each of the buildings was a thorough room-by-room inspection in all accessible areas including:

- above suspended ceiling tiles;
- areas behind inspection panels;
- pipe chases;
- suspended flooring systems; and
- exterior features (cladding, cement pipes, large painted surfaces).

The study was limited to a survey of aboveground structures in areas with reasonable accessibility. As such, conditions within walls, above drywall ceilings, below floors, underground, and in other inaccessible areas could not be accurately determined.

DSHMS are commonly undertaken in a manner that minimizes repetition of inspection and sampling of like areas (e.g. similar pipe chases or floor tiles). However, PWGSC and CSC requested that each building be treated separately, as they wanted to firmly know whether or not certain substances are present within a given building based on analytical testing. PWGSC and CSC did not want to use the results from one building to infer the asbestos or lead concentrations in similar material in another building. However, within a given building, materials that appeared similar from room-to-room were not re-sampled, since it is reasonable to assume that the same materials were used during construction or previous renovation work. XCG made its best effort to sample every different material within a specific building. However, this was not always possible because of access restrictions and safety concerns. For example, insulating pipe wrap on the ceiling in Building WW18 (Industrial Shops Building) could not be sampled safely because it was approximately 5 metres (16.5 feet) high. Sampling for asbestos and lead paint is usually conducted in older buildings suspected to contain these materials (i.e. 1970s and earlier). However, XCG also sampled newer buildings (WW31 – Accommodation Building was built in 1990) in order to firmly verify whether or not these substances are present, to meet PWGSC/CSC's mandate.

During all inspections and sampling within the security fences of the Institution, XCG field staff was accompanied by a representative of CSC on a full-time basis. When outside the security fence, a CSC escort was not required.

All samples were collected and handled according to applicable occupational health and safety regulations. The safety of building occupants was ensured at all times.

2.2 Record Keeping

Prior to on-site inspection and sampling, a unique and logical sample identification system was developed. This sample identification consisted of the following:

- Building number;
- Room number; and,
- Material type followed by the sequential sample number.

For example, WW16-105-FT1 was the first floor tile sample collected in Room 105 of Building WW16.

All sampling locations were recorded on copies of the existing building plans provided by PWGSC and later transferred into the digital CAD drawing. Some

buildings were altered slightly from what was indicated on the site plans. These slight alterations consisted solely of different room configurations, where some rooms may have been added, removed or divided. The room numbers used in this report are the current room numbers, as indicated on the figures in Appendices 3 to 49.

Data tables were developed by XCG in advance of the fieldwork and were filled out during the field survey. The tables were completed with information on the sample identification, location collected, physical description, condition of material sampled, and quantity of material.

2.3 **Asbestos-Containing Materials**

“Room-by-room” visual inspections of all accessible areas of the buildings were made in order to identify suspected asbestos-containing materials (ACMs). Areas above suspended lay-in tile ceilings, above plaster or gypsum board ceiling with access hatches and accessible pipe chases were also inspected. The survey included but was not limited to: thermal insulation, sprayed fireproofing, acoustic plaster, textured coat, plaster applications, ceiling tiles, vinyl flooring material and drywall joint compounds. When materials suspected of containing asbestos were found, the risk of exposure to building occupants was assessed. In addition, the accessibility of the material was also noted. Samples of materials suspected of containing asbestos were collected and were later submitted to Entech, a Division of Agri-Service Lab Inc. (Entech), in Mississauga, Ontario. If laboratory analysis confirmed the presence of asbestos in the materials sampled, recommendations for any remedial actions considered necessary were developed.

2.3.1 **Assessment of Condition and Accessibility, and Remedial Actions**

The methodology used to assess the risk of exposure to building occupants was consistent with the PWGSC document entitled *DM Directive 057- Asbestos Management* (1997), as adopted by the Treasury Board. The criteria used to assess the condition of the ACM are based on the type of asbestos material. In evaluating the condition of ACM spray applied as fireproofing, thermal insulation or texture, decorative or acoustic finishes the following criteria apply:

GOOD	Surface of material shows no significant signs of damage, deterioration or delamination. Up to one percent visible damage to surface is allowed within range of GOOD. Evaluation of sprayed fireproofing requires the surveyor to be familiar with the irregular surface texture typical of sprayed asbestos products. GOOD condition includes unencapsulated or unpainted fireproofing or texture finishes, where no delamination or damage is observed, and encapsulated fireproofing or texture finishes where the encapsulation has been applied after the damage or fallout occurred.
POOR	Sprayed materials show signs of damage, delamination or deterioration. More than one percent damage to surface of ACM spray.

In evaluating the condition of mechanical insulation (on boilers, breeching, ductwork, piping, tanks, equipment, etc.) the following criteria were used:

GOOD	Insulation is completely covered in jacketing and exhibits no evidence of damage or deterioration. No insulation is exposed. Includes conditions where the jacketing has minor surface damage (i.e. scuffs or stains), but the jacketing is not penetrated.
FAIR	Minor penetration damage to jacketed insulation (cuts, tears, nicks, deterioration or delamination) or undamaged insulation that has never been jacketed. Insulation is exposed but not showing surface disintegration. The extent of missing insulation ranges should be minor to none.
POOR	Original insulation jacket is missing, damaged, deteriorated or delaminated. Insulation is exposed and significant areas have been dislodged. Damage cannot be readily repaired.

Non-friable materials (e.g. vinyl floor tiles) generally have little potential to release airborne fibres, even when damaged by mechanical breakage. However, some non-friable materials (i.e. exterior asbestos cement products) may have deteriorated so that the binder no longer effectively contains the asbestos fibres. In such cases of significantly deteriorated non-friable material, the material will be treated as a friable product.

The accessibility of building materials known or suspected of containing ACMs was rated in the field according to the following criteria:

ACCESS A	Areas of the building within reach (from floor level) of all building users.
ACCESS B	Frequently entered maintenance areas within reach of maintenance staff, without the need of a ladder.
ACCESS C (Exposed)	Areas of the building above 2.4m where use of a ladder is required to reach the asbestos containing material.
ACCESS C (Concealed)	Areas of the building that require the removal of a building component, including lay-in ceilings and access panels into solid ceiling systems.
ACCESS D	Areas of the building behind inaccessible solid ceiling systems, walls or mechanical equipment etc. where demolition of the ceiling, wall or equipment etc. is required to reach the asbestos containing material.

If laboratory analysis confirmed the presence of asbestos in the materials sampled, recommendations for remedial actions (if any) based on the condition and accessibility of the ACM were made and are discussed later in this report.

The Action Matrix provided below establishes the recommended asbestos control action for friable ACMs and was used to determine the appropriate remedial actions with respect to ACMs in the buildings. The matrix considers the exposure risk and accessibility of the ACMs. The Actions are described in full following the matrix.

ACCESSs	CONDITION			DEBRIS
	GOOD	FAIR	POOR	
A	Action 5/7 ¹	Action 5/6 ²	Action 3	Action 1
B	Action 7	Action 5/6 ³	Action 3	Action 1
C (Exposed)	Action 7	Action 6	Action 4	Action 2
C (Concealed)	Action 7	Action 7	Action 4	Action 2
D	Action 7	Action 7	Action 7	Action 7

Notes:

1. If material in ACCESS A/ GOOD Condition is not removed ACTION 7 is required.
2. If material in ACCESS A/ FAIR CONDITION is not removed ACTION 6 is required.
3. Remove ACM in ACCESS B/ FAIR CONDITION if ACM is likely to be disturbed.

ACTION 1	<p>Immediate Clean-up of Debris That is Likely to be Disturbed</p> <p>Restrict access that is likely to cause a disturbance of the ACM debris and clean up ACM debris immediately. Utilize correct asbestos procedures. This action is necessary for compliance with regulatory requirements. The surveyor should immediately notify the Regional Asbestos Co-ordinator of this condition.</p>
ACTION 2	<p>Entry into Areas with ACM Debris –Type 2 Precautions</p> <p>At all locations where ACM debris can be isolated in lieu of removal or cleaned up, use appropriate means to limit entry to the area. Restrict access to the area to persons utilizing Type-2 asbestos work precautions. The precautions will be required until the ACM debris has been cleaned up and the source of the debris has been stabilized or removed.</p>
ACTION 3	<p>ACM Removal Required for Compliance</p> <p>Remove ACM for compliance with regulatory requirements. Utilize asbestos procedures appropriate to the scope of the removal work.</p>
ACTION 4	<p>Access into Areas Where ACM is present and likely to be disturbed by Access-Type 2 Precautions</p> <p>Use Type 2 asbestos precautions when entry of access into an area is likely to disturb the ACM. Action 4 must be used until the ACM is removed. (Use Action 1 or 2 if debris is present).</p>
ACTION 5	<p>Proactive ACM Removal</p> <p>Remove ACM in lieu of repair, or at locations where the presence of asbestos with an Exposure Risk of 1 is not desirable.</p>
ACTION 6	<p>ACM Repair</p> <p>Repair ACM that has an exposure risk of 2, and is not likely to be damaged again or disturbed by normal use of the area or room. Upon completion of the repair work, treat ACM as material with an exposure risk of 1 and implement Action 7. If ACM is likely to be damage of disturbed, during normal use of the area or room, implement Action 5.</p>
ACTION 7	<p>Routine Surveillance</p> <p>Institute routine surveillance of the ACM. Trained workers or contractors must use appropriate asbestos precautions (Type 1, Type 2 or Type 3) during the disturbance of the</p>

remaining ACM.

For non-friable materials, such as vinyl floor tiles, reported in GOOD condition, Action 7 (surveillance) is recommended regardless of accessibility.

DM Directive 057 defines Type 1, 2, and 3 work as follows:

Type 1 Work

- Installation or removal of a non-friable ACM with a hand tool;
- Disturbance of a non-friable ACM with a powered tool equipped with a HEPA dust collection device;
- Removal of drywall materials where joint filling materials contain asbestos;
- Removal or replacement of ten or less asbestos-containing compressed mineral fibre type ceiling tiles;
- Collecting samples of asbestos-suspect friable materials; and,
- Working close to friable sprayed asbestos, where the material may be affected by the work activities.

Type 2 Work

- Removal or replacement of more than ten asbestos-containing compressed mineral fibre type ceiling tiles;
- Entry into ceiling spaces, crawlspaces, pipe tunnels, etc., where friable asbestos debris is present;
- In British Columbia, removal of drywall installed before 1980;
- Minor removal of friable ACM. Type 2 removal is limited to a maximum per work period of:
 - In British Columbia – 0.1 m² surface area, or 3 lineal metres of pipe insulation;
 - In Quebec – 0.03 m² of Debris; and,
 - All Others – 1 m² of surface area.
- Repair of asbestos mechanical insulation. (No limit is imposed as to the amount of repair permitted under Type 2 conditions).

Type 3 Work

- More than minor removal or disturbance of friable ACM;
- Use of a power tool on non-friable ACM without HEPA exhausted dust collection;
- The spray application of an encapsulant or sealer to friable asbestos surfacing materials;
- Disturbance of ductwork and air handling equipment serving or passing through areas of buildings with sprayed asbestos fireproofing or insulation; and,
- Repair, alteration or demolition of a boiler, furnace, kiln, or smaller equipment with asbestos-containing refractory.

Ontario Regulation 838 (amended to O. Reg. 104/04) has similar, but not exactly the same definitions.

2.3.2 Sampling of Suspected Asbestos-Containing Materials

During the "room-by-room" survey, a sufficient number of bulk samples were collected and submitted for laboratory analysis in order to determine the existence and quantities of all friable and non-friable asbestos containing materials present. All the layers of a material suspected of containing asbestos were sampled.

For any vinyl flooring and ceiling tile applications, only the predominant types of material were tested for asbestos content.

With friable materials, the entire area was completely soaked with water prior to sampling. All areas where bulk samples were obtained were repaired/patched using industry-approved methods.

2.3.3 Analytical Methodology

Analysis of bulk samples for determination of asbestos content were performed using the procedures detailed in the U.S Environmental Protection Agency "Methods for the Determination of Asbestos in Bulk Building Materials, U.S EPA Report No./600/R-93/116", or an equivalent recognized method. Polarized light microscopy methodology (PLM) was used for the analysis of all bulk asbestos samples collected with the exception of the vinyl flooring samples collected. Vinyl flooring material was analyzed using transmission electron microscopy (TEM) methodology. Asbestos, if present, is identified as one or more fibrous asbestos minerals, most commonly Chrysotile, Amosite, or Crocidolite. The detection limit for analysis of asbestos was 0.5%.

As indicated in *DM Directive 057*, ACMs have been defined as materials containing 0.5 percent or greater of asbestos fibres. The materials that are commonly found are actinolite, amosite, anthrophyllite, chrysotile, crocidolite or tremolite.

2.4 Lead

During the "room-by-room" survey of the buildings, the presence of any materials or equipment that may contain lead were identified. These materials included (but were not limited to) paint applications, wiring and plumbing. The quantity and the condition of these materials were noted on the field data sheets. The condition of the paint surface was evaluated using XCG's Classification System outlined below in Section 2.5.1.

A representative paint sample was collected from all painted surfaces and submitted to Entech for laboratory analysis. The analysis of paint samples for the determination of lead content was performed using Inductively Coupled Plasma Emission Spectrometry. The Federal Hazardous Products Act (1976) limits the quantity of lead permissible in newly manufactured paints to 0.5% (5,000 ppm). Paints having a lead content greater than 0.5 % are thus considered to be lead-based.

Areas of paint in good condition (which was observed to encompass the majority of painted surfaces at this institution) were sampled in such a way as to minimize visual impacts. All painted areas of significant size (and different colours) were discretely

sampled and analyzed for lead. Areas where several layers of paint existed did not necessarily have identification of each layer unless the paint was in poor condition. However, every attempt to identify the number and colours of the layers was made.

Other potentially lead-containing materials found include the battery packs in emergency lighting, automobile batteries found in the buildings WA19 and WA05 as well as operational vehicles, and the solder on copper water piping. Inspections to identify other lead-containing materials (such as pipes, wiring, etc.) were conducted, but no potentially lead-containing materials of this type were found.

2.4.1 XCG Classification System

XCG's evaluation of the condition of painted surfaces was based on the following definitions:

GOOD	No peeling of painted surfaces.
FAIR	Some minor cracking on painted surfaces. Repainting is possible without surface treatment.
POOR	Significant cracking and or peeling of painted surfaces. Removal of loose material will be necessary prior to repainting.

2.4.2 Lead Paint Sampling

XCG field staff used a scraper blade to collect bulk lead paint samples. Paint was scraped directly off the substrate and into a plastic-sampling bag, which was then sealed and labelled. Special care was made to ensure that all layers of paint were removed equally but none of the substrate.

2.5 Mercury

During the "room-by-room" survey, the presence of any materials or equipment containing mercury (or suspected of containing mercury), including thermometers, pressure gauges and electrical equipment were identified and recorded on the field data sheets.

XCG relied upon the Warkworth Correctional Institution maintenance staff for information regarding mercury-containing equipment. Discussions with the maintenance staff revealed that there is no equipment containing significant quantities of mercury. It was also revealed that mercury-containing thermostat switches, containing small amounts of mercury in addition to fluorescent light tubes, which contain small amounts of mercury vapour, are used throughout the Warkworth Correctional Institution.

2.6 Silica

During the "room-by-room" survey activities, the presence of any materials suspected of containing silica, the locations of these materials and the quantities were recorded on the field data survey sheets.

Inspections for potential sources of silica were conducted during the XCG inspections at the facility. Sources of silica observed at the facility included concrete and brick. No samples were taken.

2.7 Other Designated Substances

Other designated substances that were included in the current survey were: acrylonitrile, arsenic, benzene, coke oven emissions, ethylene oxide, isocyanates, and vinyl chloride. None of these substances were observed in any of the buildings during the site inspection.

2.8 Polychlorinated Biphenyls (PCBs)

During the "room by room" survey, information on nameplates on electrical equipment including transformers, switchgear, representative fluorescent lights and high intensity discharge lamps were recorded and compared against published information provided by the equipment manufacturers regarding confirmed or potential PCB content in dielectric fluids. The plate covers on a select number of fluorescent light ballasts were opened to record the product information. XCG only conducted this on fluorescent lights that were low enough where the task could be completed safely and within a reasonable amount of time. Because of the short timeframe on this project and amount time typically required to open, inspect and re-assemble the covers, only a limited number of ballasts were assessed. The locations of any equipment suspected of containing PCBs were noted on the building floor plans.

During the survey, if any PCB wastes and/or storage sites were identified, their presence and location were also recorded. If PCB wastes were found to be present, the type of waste material or equipment and quantities were recorded and compliance with applicable regulatory requirements was assessed. If PCB storage sites were identified, only an inventory of contents was taken.

2.9 Ozone-Depleting Substances (ODSs)

During survey activities, the presence of any equipment containing refrigerants, which contain ozone-depleting substances (ODSs), were recorded. According to the CSC representatives contacted, no halon-containing fire extinguishers are used at the facility. Random inspections by the XCG field staff confirmed the absence of halon in the fire extinguishers. The field team surveyed and catalogued all other ODS found in the Institution. This included refrigerators, wall mounted and central air conditioners, water fountains, and the air conditioning units found in the fleet automobiles. The CSC site contact was able to provide XCG with a refrigerant inventory of ODSs, which included those in the vehicles and on building rooftops, which were inaccessible during the current survey.

2.10 Urea Formaldehyde Foam Insulation (UFFI)

During the "room-by-room" survey activities, inspections of the exterior and interior walls were made in order to determine the presence of any urea formaldehyde foam insulation (UFFI). The interior and exterior walls were inspected for evidence of repaired openings (i.e., "nozzle holes") made for installation of the insulation. In order to assist in the determination of whether or not any insulation is present, visual observations of the wall cavities were made at representative locations. Any UFFI material identified and its location was recorded on the field data survey sheets.

2.11 Fuel, Oil, and/or Waste Oil Storage

The locations inside or outside of the buildings that stored fuel/oil were examined during the inspection of each building. The approximate quantity, storage practices, and disposal procedures for waste oil were noted.

2.12 Chemical Storage

The locations and types of chemicals stored in each building were noted and recorded. Any concerns, such as spills, missing MSDS sheets, or the need for disposal, were identified and summarized in this report.

2.13 Radioactive Materials

During survey activities, the presence of any equipment with labels indicating the use of radioactive materials was recorded. CSC staff members were also interviewed to determine if there are any radioactive materials present.

2.14 Mould

As part of the DSHMS, inspections were conducted in each room for evidence of potential mould growth. XCG utilized the Health Canada document entitled *Fungal Contamination in Public Buildings: A Guide to Recognition and Management (June 1995)* as a guide in this assessment.