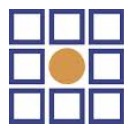




Agriculture and
Agri-Food Canada

Agriculture et
Agroalimentaire Canada



MERRICK[®]
& COMPANY

SPECIFICATION SET - ENGLISH

Agriculture and Agri-Food Canada

Neatby Building
960 Carling Ave., Ottawa, Ontario, K1Y 4X2

Lab 2044 & 2046 Renovation

ISSUE FOR 100%CONSTRUCTION DOCUMENTS

Prepared by
Merrick Canada ULC

July 24th, 2017

1 GENERAL

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2 PRODUCTS

2.01 NOT USED

.1 Not Used

3 EXECUTION

3.01 NOT USED

.1 Not Used

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section 01 11 00.

1.02 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.

1.03 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 Use only existing freight elevators in building for moving workers and material.
 - .1 Accept liability for damage, safety of equipment and overloading of existing equipment.
- .4 Closures: protect work temporarily until permanent enclosures are completed.

1.04 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

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

1.05 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 72 hours of notice for necessary interruption of mechanical or electrical service throughout course of work. Keep duration of interruptions minimum. Carry out interruptions after normal working hours of occupants, preferably on weekends. While owner will attempt to meet contractors proposed schedule, contractor shall account for off hours work to suit building occupants.
- .3 Provide for personnel, pedestrian, and vehicular traffic.

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

1.06 SPECIAL REQUIREMENTS

- .1 Not Used
- .2 Carry out noise generating Work Monday to Friday from 18:00 to 07:00 hours and on Saturdays, and Sundays, pending confirmation with Departmental Representative.
- .3 Submit schedule in accordance with 01 32 16.07 - Construction Progress Schedule - Bar (GANTT) Chart.
- .4 Ensure Contractor's personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.
- .5 Keep within limits of work and avenues of ingress and egress.
- .6 Ingress and egress of Contractor vehicles at site is determined by Departmental Representative.

1.07 BUILDING SMOKING ENVIRONMENT

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

2 PRODUCTS

2.01 NOT USED

- .1 Not Used.

3 EXECUTION

3.01 NOT USED

- .1 Not Used.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section 01 11 00.

1.02 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 two days in advance of meeting date to Departmental Representative.
- .4 Provide physical space and make arrangements for meetings.
- .5 Preside at meetings.
- .6 Consultant will 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 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.

1.03 PRECONSTRUCTION MEETING

- .1 Within 10 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
- .2 Departmental Representative, Consultant, 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 16.07 - Construction Progress Schedules - Bar (GANTT) Chart.
 - .3 Schedule of submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 - Submittal

- Procedures.
 - .4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences in accordance with Section 01 52 00 - Construction Facilities.
 - .5 Delivery schedule of specified equipment
 - .6 Site security in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.
 - .7 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
 - .8 Owner provided products.
 - .9 Record drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .10 Maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals.
 - .11 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 - Closeout Submittals.
 - .12 Monthly progress claims, administrative procedures, photographs, hold backs.
 - .13 Appointment of inspection and testing agencies or firms.
 - .14 Insurances, transcript of policies.
- .6 Contractor to also provide WSIB and Notice of Project.

1.04 PROGRESS MEETINGS

- .1 During course of Work and [__2__] weeks prior to project completion, schedule progress meetings bi-weekly.
- .2 Contractor, major Subcontractors involved in Work and Departmental Representative are to be in attendance.
- .3 Notify parties minimum [__5__] days prior to meetings.
- .4 The Consultant will record minutes of meetings and circulate to attending parties and affected parties not in attendance within [__2__] days after meeting.
- .5 Agenda to include the following:
 - .1 Review, approval of minutes of previous meeting.
 - .2 Review of Work progress since previous meeting.
 - .3 Field observations, problems, conflicts.
 - .4 Problems which impede construction schedule.
 - .5 Review of off-site fabrication delivery schedules.
 - .6 Corrective measures and procedures to regain projected schedule.
 - .7 Revision to construction schedule.
 - .8 Progress schedule, during succeeding work period.
 - .9 Review submittal schedules: expedite as required.
 - .10 Maintenance of quality standards.
 - .11 Review proposed changes for affect on construction schedule and on completion date.
 - .12 Other business.

2 PRODUCTS

2.01 NOT USED

.1 Not Used.

3 EXECUTION

3.01 NOT USED

.1 Not Used.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Not Used

1.02 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.

1.03 REQUIREMENTS

- .1 Ensure Master Plan and Detail Schedules are practical and remain within specified Contract duration.
- .2 Plan to complete Work in accordance with prescribed milestones and time

frame.

- .3 Limit activity durations to maximum of approximately [10] working days, to allow for progress reporting.
- .4 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Interim Certificate and Final Certificate as defined times of completion are of essence of this contract.

1.04 ACTION AND INFORMATIONAL SUBMITTALS

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

1.05 PROJECT MILESTONES

- .1 Project milestones form interim targets for Project Schedule:
 - .1 Interior finishing and fitting, mechanical, and electrical work completed within approximately 12 weeks of Award of Contract date, as agreed upon with Departmental Representative.

1.06 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.

1.07 PROJECT SCHEDULE

- .1 Develop detailed Project Schedule derived from Master Plan. Submit project schedule to the Department Representative to ensure appropriate level of detail and task breakdown. Incorporate all comments into the schedule.
- .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 Structural Steel.

- .6 Siding and Roofing.
- .7 Interior Architecture (Walls, Floors and Ceiling).
- .8 Plumbing.
- .9 Lighting.
- .10 Electrical.
- .11 Piping.
- .12 Controls.
- .13 Heating, Ventilating, and Air Conditioning.
- .14 Millwork / Casework.
- .15 Fire Systems.
- .16 Testing and Commissioning.
- .17 Supplied equipment long delivery items.
- .18 Engineer supplied equipment required dates.

1.08 PROJECT SCHEDULE REPORTING

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

1.09 PROJECT MEETINGS

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

2 PRODUCTS

2.01 NOT USED

- .1 Not used.

3 EXECUTION

3.01 NOT USED

- .1 Not used.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section 01 11 00.

1.02 REFERENCE STANDARDS

- .1 Not Used

1.03 ADMINISTRATIVE

- .1 Submit to Departmental Representative submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Do not proceed with Work affected by submittal until review is complete.
- .3 Present shop drawings, product data, samples and mock-ups in SI Metric units.
- .4 Where items or information is not produced in SI Metric units converted values are acceptable.
- .5 Review submittals prior to submission to Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .6 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7 Verify field measurements and affected adjacent Work are co-ordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.
- .10 Keep one reviewed copy of each submission on site.

1.04 SHOP DRAWINGS AND PRODUCT DATA

- .1 [Refer to CCDC 2 GC 3.11].

- .2 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.
- .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 10 working days for Departmental Representative's review of each submission, if there are concurrent submittals, 15 working days. Departmental Representative will request and be granted additional time when there are multiple submittals at the same time, or where complexity or coordination requires extra time.
- .5 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .6 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions other than those requested.
- .7 Accompany submissions with transmittal letter 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 Specification section affected by submittal, or if no section is applicable, then schedule/drawing.
 - .5 Other pertinent data.
- .8 Submissions include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
 - .5 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.

- .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to adjacent work.
- .9 After Departmental Representative's review, distribute copies.
 - .10 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.
 - .11 Submit electronic copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.
 - .12 Submit electronic copies of test reports for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
 - .2 Testing must have been within [3] years of date of contract award for project.
 - .13 Submit electronic copies of certificates for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
 - .2 Certificates must be dated after award of project contract complete with project name.
 - .14 Submit electronic copies of 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 electronic copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.
 - .16 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
 - .17 Submit electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.
 - .18 Delete information not applicable to project.

- .19 Supplement standard information to provide details applicable to project.
- .20 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, 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 Public Services and Procurement Canada (PSPC) is for sole purpose of ascertaining conformance with general concept.
 - .1 This review shall not mean that PSPC approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.
 - .2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.
- .22 In order to maintain project schedule, submit shop drawings for long lead time items/components (casework, fumehoods, etc.) within 3 weeks of contract award.

1.05 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.

1.06 MOCK-UPS

- .1 Not Used.

1.07 PHOTOGRAPHIC DOCUMENTATION

- .1 Submit electronic copy of colour digital photography in jpg format, standard resolution as directed by Departmental Representative.
- .2 Project identification: name and number of project and date of exposure indicated.
- .3 Number of viewpoints: 2 locations.
 - .1 Viewpoints and their location as determined by Departmental Representative.
- .4 Frequency of photographic documentation: weekly as directed by Departmental Representative].
 - .1 Upon completion of: demolition, framing and services before concealment, and as directed by Departmental Representative.

1.08 CERTIFICATES AND TRANSCRIPTS

- .1 Immediately after award of Contract, submit Workers' Compensation Board status.
- .2 Submit transcription of insurance immediately after award of Contract.

2 PRODUCTS

2.01 NOT USED

- .1 Not Used.

3 EXECUTION

3.01 NOT USED

- .1 Not Used.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section 01 11 00.

1.02 REFERENCE STANDARDS

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations
- .2 Province of Ontario
 - .1 Occupational Health and Safety Act and Regulations for Construction Projects, R.S.O. [1990, c.0.1, as amended and O. Reg. 213/91 as amended] - Updated [2005].
- .3 Province of Quebec
 - .1 An Act Respecting Occupational Health and Safety, R.S.Q., c.S-2.1 (current edition) - Updated [2005].

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit site-specific Health and Safety Plan: Within [7] days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
 - .1 Results of site specific safety hazard assessment.
 - .2 Results of safety and health risk or hazard analysis for site tasks and operation found in work plan.
- .3 Submit [__2__] copies of Contractor's authorized representative's work site health and safety inspection reports to Departmental Representative and or authority having jurisdiction, weekly.
- .4 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.
- .5 Submit copies of incident and accident reports.
- .6 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within [__5__] days after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative within [__5__] days after receipt of comments from Departmental Representative.
- .7 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.
- .8 Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Departmental Representative.

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

1.04 FILING OF NOTICE

- .1 File Notice of Project with Provincial authorities prior to beginning of Work.
- .2 Contractor shall be responsible and assume the Principal Contractor role for each work zone location and not the entire complex. Contractor shall provide a written acknowledgement of this responsibility with 3 weeks of contract award. Contractor to submit written acknowledgement to CSST along with Ouverture de Chantier Notice.
- .3 Work zone locations include:
 - .1 Room 2044 and 2046
- .4 Contractor shall agree to install proper site separation and identification in order to maintain time and space at all times throughout life of project.

1.05 SAFETY ASSESSMENT

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

1.06 MEETINGS

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

1.07 REGULATORY REQUIREMENTS

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

1.08 PROJECT/SITE CONDITIONS

- .1 Work at site will involve contact with:
 - .1 See abatement sections

1.09 GENERAL REQUIREMENTS

- .1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.
- .2 Departmental Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

1.10 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 Contractor will be responsible and assume the role Constructor as

described in the Ontario Occupational Health and Safety Act and Regulations for Construction Projects.

- .3 Contractor shall be the Principal Contractor as described in the Quebec Act Respecting Health and Safety code for the Construction for only their scope and areas of work as defined and described this project specification.
- .4 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.11 COMPLIANCE REQUIREMENTS

- .1 Comply with Ontario Occupational Health and Safety Act, R.S.O. 1990, c. 0.1 and Ontario Regulations for Construction Projects, O. Reg. 213/91.
- .2 Comply with R.S.Q., c. S-2.1, an Act respecting Health and Safety, and c. S-2.1, r.4 Safety Code for the Construction Industry.
- .3 Comply with Occupational Health and Safety Regulations, 1996.
- .4 Comply with Occupational Health and Safety Act, General Safety Regulations, O.I.C.
- .5 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

1.12 UNFORSEEN HAZARDS

- .1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Province having jurisdiction and advise Departmental Representative verbally and in writing.
- .2 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, advise Health and Safety co-ordinator/ Safety Officer and follow procedures in accordance with Acts and Regulations of Province having jurisdiction and advise Departmental Representative verbally and in writing.

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 work.
 - .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 having jurisdiction, and in consultation with Departmental Representative.

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 BLASTING

- .1 Blasting or other use of explosives is not permitted without prior receipt of written instruction by Departmental Representative.

1.17 POWDER ACTUATED DEVICES

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

1.18 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.

2 PRODUCTS

2.01 NOT USED

- .1 Not used.

3 EXECUTION

3.01 NOT USED

- .1 Not used.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section 01 11 00.

1.02 REFERENCE STANDARDS

- .1 Canadian Construction Documents Committee (CCDC)
 - .1 CCDC 2-2008 Stipulated Price Contract.
- .2 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].

1.03 DEFINITIONS

- .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humans; or degrade environment aesthetically, culturally and/or historically.
- .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction.

1.04 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit [2] copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Before commencing construction activities or delivery of materials to site, submit Environmental Protection Plan for review 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 task.
- .6 Include in Environmental Protection Plan:
 - .1 Name[s] of person[s] responsible for ensuring adherence to Environmental Protection Plan.
 - .2 Name[s] and qualifications of person[s] responsible for

- manifesting hazardous waste to be removed from site.
- .3 Name[s] and qualifications of person[s] responsible for training site personnel.
 - .4 Descriptions of environmental protection personnel training program.
 - .5 Erosion and sediment control plan, if required, 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.
 - .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, if required.
 - .7 Traffic Control Plan, if required, 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, if required, 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, if required, identifying methods and procedures for management 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.

1.05 FIRES

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

1.06 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.
- .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.

1.07 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.

1.08 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.

2 PRODUCTS

2.01 NOT USED

- .1 Not Used.

3 EXECUTION

3.01 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .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 - Cleaning.
- .5 Waste Management: separate waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 This Section references to laws, by laws, ordinances, rules, regulations, codes, orders of Authority Having Jurisdiction, and other legally enforceable requirements applicable to Work and that are; or become, in force during performance of Work.

1.02 RELATED REQUIREMENTS

- .1 [Section 02 82 00 - Asbestos Abatement]
- .2 [Section 02 85 00 - Mould Remediation]
- .3 [Section 22 05 05 - Selective Demolition for Plumbing]
- .4 [Section 23 05 05 - Selective Demolition for HVAC]
- .5 [Section 26 05 05 - Selective Demolition for Electrical]

1.03 REFERENCES TO REGULATORY REQUIREMENTS

- .1 Perform Work in accordance with [2015] [National Building Code of Canada (NBC)] OBC 2015, including amendments up to tender closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.
- .2 Specific design and performance requirements listed in specifications or indicated on Drawings may exceed minimum requirements established by referenced Building Code; these requirements will govern over the minimum requirements listed in Building Code
 - .1 Meet or exceed requirements of:
 - .1 Contract documents.
 - .2 Specified standards, codes and referenced documents.

1.04 HAZARDOUS MATERIAL DISCOVERY

- .1 Asbestos: demolition of spray or trowel-applied asbestos is hazardous to health. Stop work immediately when material resembling spray or trowel-applied asbestos is encountered during demolition work. Notify Departmental Representative. Refer to Section 02 82 00 - Asbestos Abatement.
- .2 PCB: Polychlorinated Biphenyl: stop work immediately when material resembling Polychlorinated Biphenyl is encountered during demolition work. Notify Departmental Representative.
- .3 Mould: stop work immediately when material resembling mould is encountered during demolition work. Notify Departmental Representative. Refer to Section 02 85 00.01 - Mould Remediation - Minimum Precautions.

1.05 BUILDING SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions and municipal by-laws.

1.06 QUALITY ASSURANCE

- .1 Regulatory Requirements: Except as otherwise specified, Constructor will apply for, obtain, and pay fees associated with, permits, licenses, certificates, and approvals required by regulatory requirements and Contract Documents, based on General Conditions of Contract and the following:
 - .1 Regulatory requirements and fees in force on date of Bid submission, and
 - .2 A change in regulatory requirements or fees scheduled to become effective after date of tender submission and of which public notice has been given before date of tender submission

2 PRODUCTS

2.01 NOT USED

- .1 Not Used.

2.02 EASEMENTS AND NOTICES

- .1 Owner will obtain permanent easements and rights of servitude that may be required for performance of Work.
- .2 Constructor will give notices required by regulatory requirements.

2.03 PERMITS

- .1 Development Permit: Owner has applied for, obtained, and paid for development permit.
- .2 Building Permit:
 - .1 Constructor will apply for, obtain and pay for building permit on behalf of Owner, and other permits required for Work and its various parts.
 - .2 Contractor is responsible for any required registration or inspection with TSSA.
 - .3 Constructor will require that specific Subcontractor's obtain and pay for permits required by authorities having jurisdiction, where their Work is affected by Work requiring permits including medical gas installation and asbestos abatement and control permits.
 - .4 Constructor will display building permit and other permits in a conspicuous location at Place of Work.
- .3 Occupancy Permits:
 - .1 Constructor will apply for, obtain, and pay for occupancy permits, including partial occupancy permits where required by authority having jurisdiction.

- .2 Representative will issue appropriate instructions to Constructor for correction to Work where Contract Document deficiencies are required to be corrected in order to obtain occupancy permits, including partial occupancy permits.
- .3 Constructor will correct deficiencies in accordance with Representative's instructions. Where deficiency is not corrected, Owner reserves the right to make correction and charge Constructor for costs incurred.
- .4 Constructor will turn occupancy permits over to Owner.

3 EXECUTION

3.01 NOT USED

- .1 Not Used.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Not Used.

1.02 REFERENCE STANDARDS

- .1 Canadian Construction Documents Committee (CCDC)
 - .1 CCDC 2-[94], Stipulated Price Contract.

1.03 INSPECTION

- .1 [Refer to CCDC 2, GC 2.3].
- .2 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.
- .3 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.
- .4 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.
- .5 Departmental Representative will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction.

1.04 INDEPENDENT INSPECTION AGENCIES

- .1 Independent Inspection/Testing Agencies will be engaged by Departmental Representative for purpose of inspecting and/or testing portions of Work.
- .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.

1.05 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.

1.06 PROCEDURES

- .1 Notify Departmental Representative in advance of requirement for tests, in order that attendance arrangements can be made.
- .2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in Work.
- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.07 REJECTED WORK

- .1 [Refer to CCDC, GC 2.4].
- .2 Remove defective Work, whether result of poor workmanship, use of defective or inappropriate 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.
- .3 Make good other Contractor's work damaged by such removals or replacements promptly.
- .4 If in opinion of Departmental Representative it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Owner will deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which will be determined by Departmental Representative.

1.08 REPORTS

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

1.09 TESTS AND MIX DESIGNS

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

1.10 MOCK-UPS

- .1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of Sections required to provide mock-ups.
- .2 Construct in locations acceptable to Departmental Representative.
- .3 Prepare mock-ups for Departmental Representative review with reasonable promptness and in orderly sequence, to not cause delays in Work.
- .4 Failure to prepare mock-ups in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .5 If requested, Departmental Representative will assist in preparing schedule fixing dates for preparation.
- .6 Remove mock-up at conclusion of Work or when acceptable to Departmental Representative.
- .7 Mock-ups may remain as part of Work.
- .8 Specification section identifies whether mock-up may remain as part of Work or if it is to be removed and when.

1.11 MILL TESTS

- .1 Submit mill test certificates as requested.

1.12 EQUIPMENT AND SYSTEMS

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

2 PRODUCTS

2.01 NOT USED

- .1 Not Used.

3 EXECUTION

3.01 NOT USED

- .1 Not Used.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Not Used.

1.02 REFERENCE STANDARDS

- .1 Canadian Construction Documents Committee (CCDC)
 - .1 CCDC 2-[1994], Stipulated Price Contract.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 1.189-[00], Exterior Alkyd Primer for Wood.
 - .2 CGSB 1.59-[97], Alkyd Exterior Gloss Enamel.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA-A23.1/A23.2-[04], Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA-0121-[M1978(R2003)], Douglas Fir Plywood.
 - .3 CAN/CSA-S269.2-[M1987(R2003)], Access Scaffolding for Construction Purposes.
 - .4 CAN/CSA-Z321-[96(R2001)], Signs and Symbols for the Occupational Environment.
- .4 Public Works Government Services Canada (PSPC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C', In Effect as of: May 14, 2004.
- .5 U.S. Environmental Protection Agency (EPA) / Office of Water
 - .1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

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

1.04 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.

1.05 SCAFFOLDING

- .1 Scaffolding in accordance with CAN/CSA-S269.2.
- .2 Provide and maintain scaffolding, ramps, ladders, and platforms.

1.06 HOISTING

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

1.07 ELEVATORS

- .1 Designated existing elevators to be used by construction personnel and transporting of materials. Co-ordinate use with Departmental Representative.
- .2 Provide protective coverings for finish surfaces of cars and entrances.

1.08 SITE STORAGE/LOADING

- .1 [Refer to CCDC 2, GC 3.12].
- .2 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products. Storage and lay down area to be confirmed with Departmental Representative.
- .3 Do not load or permit to load any part of Work with weight or force that will endanger Work.

1.09 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 Clean runways and taxi areas where used by Contractor's equipment.

1.10 SECURITY

- .1 Contractor responsible to secure rooms and contents of work site/area after working hours and during holidays.

1.11 OFFICES

- .1 Provide office heated to [22] degrees C, lighted [750] lx and ventilated, of sufficient size to accommodate site meetings and furnished with drawing laydown table.
- .2 Provide marked and fully stocked first-aid case in a readily available location.

- .3 Subcontractors to provide their own offices as necessary. Direct location of these offices.

1.12 EQUIPMENT, TOOL AND MATERIALS STORAGE

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

1.13 SANITARY FACILITIES

- .1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances. Permanent facilities may or may not be used pending approval of Departmental Representative
- .2 Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.

1.14 PROTECTION AND MAINTENANCE OF TRAFFIC

- .1 Provide access as necessary to maintain traffic.
- .2 Provide measures for protection and diversion of traffic, including provision of watch-persons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs
- .3 Protect travelling public from damage to person and property.
- .4 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.
- .5 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to roads caused by construction operations.
- .6 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.
- .7 Dust control: adequate to ensure safe operation at all times.

1.15 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 not in construction facilities.

2 PRODUCTS

2.01 NOT USED

- .1 Not Used.

3 EXECUTION

3.01 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section01 11 00.

1.02 REFERENCE STANDARDS

- .1 Canadian General Standards Board (CGSB)
 - .1 CGSB 1.59-[97], Alkyd Exterior Gloss Enamel.
 - .2 CAN/CGSB 1.189-[00], Exterior Alkyd Primer for Wood.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA-O121-[M1978(R2003)], Douglas Fir Plywood.
- .3 Public Works Government Services Canada (PSPC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C', In Effect as Of: May 14, 2004.

1.03 INSTALLATION AND REMOVAL

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

1.04 HOARDING

- .1 Erect temporary site enclosures using [38 x 89] mm construction grade lumber framing at [600] mm centres and [1200 x 2400 x 13] mm exterior grade fir plywood to CSA O121.
- .2 Apply plywood panels vertically [flush and butt jointed].
- .3 Not Used.
- .4 Erect and maintain pedestrian walkways including roof and side covers, complete with signs and electrical lighting as required by law.
- .5 Paint public side of site enclosure in selected colours with one coat primer to CAN/CGSB 1.189 and one coat exterior paint to CGSB 1.59. Maintain public side of enclosure in clean condition.
- .6 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 on centre. Provide [one] lockable truck gate. Maintain fence in good repair.
- .7 Provide barriers around trees and plants designated to remain. Protect from damage by equipment and construction procedures.

1.05 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.

1.06 DUST TIGHT SCREENS

- .1 Provide dust tight screens or insulated 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.
- .3 Construction Dust and Debris shall be confined to the spaces under construction. Protect services (HVAC, Piping, etc.) from ingress of dust or debris that may affect the remained of the building.

1.07 ACCESS TO SITE

- .1 Provide and maintain access pathways, ramps and construction runways as may be required for access to Work.
- .2 Ensure site access of non-authorized personnel is prevented.

1.08 PUBLIC TRAFFIC FLOW

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

1.09 FIRE ROUTES

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

1.10 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.

1.11 PROTECTION OF BUILDING FINISHES

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

1.12 WASTE MANAGEMENT AND DISPOSAL

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

2 PRODUCTS

2.01 NOT USED

.1 Not Used.

3 EXECUTION

3.01 NOT USED

.1 Not Used.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Not Used.

1.02 REFERENCE STANDARDS

- .1 Canadian Construction Documents Committee (CCDC)
 - .1 CCDC 2-[2008], Stipulated Price Contract.
 - .2 DOC 14-[2000], Design-Build Stipulated Price Contract.
 - .3 DOC 15-[2000], Design-Builder/ Consultant Contract.
- .2 If there is question as to whether products or systems are in conformance with applicable standards, Departmental Representative reserves right to have such products or systems tested to prove or disprove conformance.
- .3 Cost for such testing will be born by Departmental Representative in event of conformance with Contract Documents or by Contractor.

1.03 QUALITY

- .1 [Refer to CCDC 2].
- .2 Refer to [DOC 14] [DOC 15].
- .3 Products, materials, equipment and articles incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- .4 Procurement policy is to acquire, in cost effective manner, items containing highest percentage of recycled and recovered materials practicable consistent with maintaining satisfactory levels of competition. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of work.
- .5 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.
- .6 Should disputes arise as to quality or fitness of products, decision rests strictly with Departmental Representative based upon requirements of Contract Documents.
- .7 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .8 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.

1.04 STORAGE, HANDLING AND PROTECTION

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

1.05 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.

1.06 MANUFACTURER'S INSTRUCTIONS

- .1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.
- .2 Notify Departmental Representative in writing, of conflicts between specifications and manufacturer's instructions, so that Departmental Representative will establish course of action.

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

1.07 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.

1.08 CO-ORDINATION

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

1.09 CONCEALMENT

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

1.10 REMEDIAL WORK

- .1 Refer to [CCDC 2] [DOC 14] [DOC 15]
- .2 Refer to [DOC 14] [DOC 15].
- .3 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Co-ordinate adjacent affected Work as required.
- .4 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.11 LOCATION OF FIXTURES

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

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

1.12 FASTENINGS

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

1.13 FASTENINGS - EQUIPMENT

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

1.14 PROTECTION OF WORK IN PROGRESS

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

1.15 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, and/or building occupants and 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.

2 PRODUCTS

2.01 NOT USED

.1 Not Used.

3 EXECUTION

3.01 NOT USED

.1 Not Used.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Not Used.

1.02 REFERENCE STANDARDS

- .1 Canadian Construction Documents Committee (CCDC)
 - .1 CCDC 2-[2008], Stipulated Price Contract.
 - .2 DOCUMENT 14 - [2000], Design-Build Stipulated Price Contract (CCA, CSC, RAIC).
 - .3 DOCUMENT 15 - [2000], Design-Builder/Consultant Contract (CCA, CSC, RAIC).
- .2 Owner's identification of existing survey control points and property limits.

1.03 QUALIFICATIONS OF SURVEYOR

- .1 Qualified registered land surveyor, licensed to practise in Place of Work, acceptable to Departmental Representative.

1.04 SURVEY REFERENCE POINTS

- .1 Existing base horizontal and vertical control points are designated on drawings.
- .2 Locate, confirm and protect control points prior to starting site work. Preserve permanent reference points during construction.
- .3 Make no changes or relocations without prior written notice to Departmental Representative.
- .4 Report to Departmental Representative when reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
- .5 Require surveyor to replace control points in accordance with original survey control.

1.05 SURVEY REQUIREMENTS

- .1 Establish [two] permanent bench marks on site, referenced to established bench marks by survey control points. Record locations, with horizontal and vertical data in Project Record Documents.
- .2 Establish pipe invert elevations.
- .3 Establish foundation column locations and floor elevations.

- .4 Establish lines and levels for mechanical and electrical work.

1.06 EXISTING SERVICES

- .1 Before commencing work, establish location and extent of service lines in area of Work and notify Departmental Representative of findings.
- .2 Remove abandoned service lines within [2]m of structures. Cap or otherwise seal lines at cut-off points as directed by Departmental Representative.

1.07 LOCATION OF EQUIPMENT AND FIXTURES

- .1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.
- .2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.
- .3 Inform Departmental Representative of impending installation and obtain approval for actual location.
- .4 Submit field drawings to indicate relative position of various services and equipment when required by Departmental Representative.

1.08 RECORDS

- .1 Maintain a complete, accurate log of control and survey work as it progresses.
- .2 On completion of foundations and major site improvements, prepare a certified survey showing dimensions, locations, angles and elevations of Work.
- .3 Record locations of maintained, re-routed and abandoned service lines.

1.09 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit name and address of Surveyor to Departmental Representative.
- .2 On request of Departmental Representative, submit documentation to verify accuracy of field engineering work.
- .3 Submit certificate signed by surveyor certifying [and noting] those elevations and locations of completed Work that conform [and do not conform] with Contract Documents.

1.10 SUBSURFACE CONDITIONS

- .1 Promptly notify Departmental Representative in writing if subsurface conditions at Place of Work differ materially from those indicated in Contract Documents, or a reasonable assumption of probable conditions based thereon.

- .2 After prompt investigation, should Departmental Representative determine that conditions do differ materially, instructions will be issued for changes in Work as provided in Changes and Change Orders.

2 PRODUCTS

2.01 NOT USED

- .1 Not Used.

3 EXECUTION

3.01 NOT USED

- .1 Not Used.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Not Used.

1.02 REFERENCE STANDARDS

- .1 Canadian Construction Documents Committee (CCDC)
 - .1 CCDC 2-[2008], Stipulated Price Contract.

1.03 PROJECT CLEANLINESS

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris, including that caused by Owner or other Contractors.
- .2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site.
- .3 Clear snow and ice from access to building, bank/pile snow in designated areas only.
- .4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .5 Provide on-site containers for collection of waste materials and debris.
- .6 Provide and use marked separate bins for recycling. Refer to Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .7 Dispose of waste materials and debris off-site.
- .8 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.
- .9 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .10 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .11 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .12 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.04 FINAL CLEANING

- .1 [Refer to CCDC 2, GC 3.14].
- .2 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .3 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- .4 Prior to final review remove surplus products, tools, construction machinery and equipment.
- .5 Remove waste products and debris other than that caused by Owner or other Contractors.
- .6 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site, unless approved by Departmental Representative.
- .7 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .8 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.
- .9 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, and floors.
- .10 Clean lighting reflectors, lenses, and other lighting surfaces.
- .11 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .12 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.
- .13 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .14 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .15 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.
- .16 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.

1.05 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials in accordance with Section 01 74 21 -

Construction/Demolition Waste Management And Disposal.

2 PRODUCTS

2.01 NOT USED

.1 Not Used.

3 EXECUTION

3.01 NOT USED

.1 Not Used.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 This Section includes requirements for management of construction waste and disposal, which forms the Contractor's commitment to reduce and divert waste materials from landfill and includes the following:
 - .1 Preparation of a Draft Construction Waste Management Plan that will be used to track the success of the Construction Waste Management Plan against actual waste diversion from landfill.
 - .2 Preparation of a [Construction Waste Management Plan] that provides guidance on a logical progression of tasks and procedures to be followed in a pollution prevention program to reduce or eliminate the generation of waste, the loss of natural resources, and process emissions through source reduction, reuse, recycling, and reclamation.
 - .3 Preparation of monthly progress reports indicating cumulative totals representing progress towards achieving diversion and reduction goals of waste materials away from landfill and identifying any special programs, landfill options or alternatives to landfill used during construction.
 - .4 Preparation of a Construction Waste Management Report containing detailed information indicating total waste produced by the project, types of waste material and quantity of each material, and total waste diverted and diversion rates indicated as a percentage of the total waste produced.
- .2 Owner has established that this project shall generate the least amount of waste possible and that processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors be employed by the Contractor.

1.02 RELATED REQUIREMENTS

- .1 Section 01 52 00 - Construction Facilities

1.03 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM E 1609 01, Standard Guide for Development and Implementation of a Pollution Prevention Program
- .2 Canada Green Building Council (CaGBC)
 - .1 LEEDr Reference Guide for Building Design and Construction, Version 4
- .3 Recycling Certification Institute (RCI):
 - .1 RCI Certification Construction and Demolition Materials Recycling

1.04 DEFINITIONS

- .1 Clean Waste: Untreated and unpainted; not contaminated with oils, solvents, sealants or similar materials.
- .2 Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, re modeling, repair and demolition operations.
- .3 Hazardous: Exhibiting the characteristics of hazardous substances including properties such as ignitability, corrosiveness, toxicity or reactivity.
- .4 Non hazardous: Exhibiting none of the characteristics of hazardous substances, including properties such as ignitability, corrosiveness, toxicity, or reactivity.
- .5 Non toxic: Not poisonous to humans either immediately or after a long period of exposure.
- .6 Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- .7 Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
- .8 Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form; recycling does not include burning, incinerating, or thermally destroying waste.
- .9 Return: To give back reusable items or unused products to vendors for credit.
- .10 Reuse: To reuse a construction waste material in some manner on the project site.
- .11 Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
- .12 Sediment: Soil and other debris that has been eroded and transported by storm or well production run off water.
- .13 Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
- .14 Toxic: Poisonous to humans either immediately or after a long period of exposure.
- .15 Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- .16 Volatile Organic Compounds (VOC's): Chemical compounds common in and emitted by many building products over time through outgassing:

- .1 Solvents in paints and other coatings;
 - .2 Wood preservatives; strippers and household cleaners;
 - .3 Adhesives in particleboard, fiberboard, and some plywood; and foam insulation.
 - .4 When released, VOC's can contribute to the formation of smog and can cause respiratory tract problems, headaches, eye irritations, nausea, damage to the liver, kidneys, and central nervous system, and possibly cancer.
- .17 Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.
- .18 Construction Waste Management Plan: A project related plan for the collection, transportation, and disposal of the waste generated at the construction site; the purpose of the plan is to ultimately reduce the amount of material being landfilled.

1.05 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate waste management requirements with all Divisions of the Work for the project, and ensure that requirements of the Construction Waste Management Plan are followed.
- .2 Preconstruction Meeting: Arrange a pre-construction meeting in accordance with Section 01 31 19 - Project Meetings before starting any Work of the Contract attended by the Owner, Contractor, affected [Subcontractor]'s and [Representative] to discuss the Contractor's Construction Waste Management Plan and to develop mutual understanding of the requirements for a consistent policy towards waste reduction and recycling.

1.06 SUBMITTALS

- .1 Provide required information in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Draft Construction Waste Management Plan (Draft CWM Plan): Submit to Representative a preliminary analysis of anticipated site generated waste by listing a minimum of five (5) construction or demolition waste streams that have potential to generate the most volume of material indicating methods that will be used to divert construction waste from landfill and source reduction strategies; [Representative] will provide commentary before development of Contractor's Construction Waste Management Plan.
 - .2 Construction Waste Management Plan (CWM Plan): Submit a CWM Plan for this project prior to any waste removal from site and that includes the following information:
 - .1 Material Streams: Analysis of the proposed jobsite waste being generated, including material types and quantities forming a part of identified material streams in the [Draft CWM Plan] ; materials removed from site destined for

- alternative daily cover at landfill sites and land clearing debris cannot be considered as contributing to waste diversion and will be included as a component of the total waste generated for the site.
- .2 Recycling Haulers and Markets: Investigate local haulers and markets for recyclable materials, and incorporate into [CWM Plan].
 - .3 Alternative Waste Disposal: Prepare a listing of each material proposed to be salvaged, reused, recycled or composted during the course of the project, and the proposed local market for each material.
 - .4 Landfill Materials: Identify materials that cannot be recycled, reused or composted and provide explanation or justification; energy will be considered as a viable alternative diversion strategy for these materials where facilities exist.
 - .5 Landfill Options: The name of the landfill where trash will be disposed of; landfill materials will form a part of the total waste generated by the project.
 - .6 Materials Handling Procedures: A description of the means by which any recycled waste materials will be protected from contamination, and a description of the means to be employed in recycling the above materials consistent with requirements for acceptance by designated facilities.
 - .7 Transportation: A description of the means of transportation of the recyclable materials, whether materials will be site separated and self hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site, and destination of materials.

1.07 PROJECT CLOSEOUT SUBMISSIONS

- .1 Record Documentation: Submit as constructed information in accordance with Section 01 78 00 - Closeout Submittals as follows:
 - .1 [Construction Waste Management Report (CWM Report)]: Submit a [CWM Report] for this project in a format acceptable to submittal requirements and that includes the following information:
 - .1 Accounting: Submit information indicating total waste produced by the project.
 - .2 Composition: Submit information indicating types of waste material and quantity of each material.
 - .3 Diversion Rate: Submit information indicating total waste diverted from landfill as a percentage of the total waste produced by the project.
 - .4 [Diversion Documentation]: Submit copies of transportation documents or shipping manifests indicating weights of materials, and other evidence of disposal indicating final location of waste diverted from landfill and waste sent to landfill.
 - .5 Alternative Daily Cover (ADC): Submit quantities of material that were used as ADC at landfill sites, and that form a part of the total waste generated by the project.

- .6 Multiple Waste Hauling: Compile all information into a single CWM Report where multiple waste hauling and diversion strategies were used for the project.
- .7 Photographs: Submit photographs of waste diversion facilities documenting location and signage describing usage of waste separation containers.

1.08 QUALITY ASSURANCE

- .1 Resources for Development of Construction Waste Management Report (CWM Report): The following sources may be useful in developing the Draft Construction Waste Management Plan:
 - .1 Recycling Haulers and Markets: Investigate local haulers and markets for recyclable materials, and incorporate into [CWM Plan].
 - .2 Waste-to-Energy Systems: Investigate local waste-to-energy incentives where systems for diverting materials from landfill for reuse or recycling are not available.
- .2 Certifications: Provide proof of the following during the course of the Work:
 - .1 Compliance Certification: Provide proof that recycling center is third party verified and is listed as a Certified Facility through the registration and certification requirements of the Recycling Certification Institute.

1.09 DELIVERY, STORAGE AND HANDLING

- .1 Storage Requirements: Implement a recycling/reuse program that includes separate collection of waste materials as appropriate to the project waste and the available recycling and reuse programs in the project area.
- .2 Handling Requirements: Clean materials that are contaminated before placing in collection containers and ensure that waste destined for landfill does not get mixed in with recycled materials:
 - .1 Deliver materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to recycling process.
 - .2 Arrange for collection by or delivery to the appropriate recycling or reuse facility.
- .3 Hazardous Waste and Hazardous Materials: Handle in accordance with applicable regulations.

2 PRODUCTS

2.01 NOT USED

- .1 Not Used.

3 EXECUTION

3.01 (CWM PLAN) IMPLEMENTATION

- .1 Manager: Contractor is responsible for designating an on site party or parties responsible for instructing workers and overseeing and documenting results of the CWM Plan for the project.
- .2 Distribution: Distribute copies of the CWM Plan to the job site foreman, each Subcontractor, the Owner, the Representative and other site personnel as required to maintain CWM Plan.
- .3 Instruction: Provide on site instruction of appropriate separation, handling, and recycling, salvage, reuse, composting and return methods being used for the project to [Subcontractor]'s at appropriate stages of the project.
- .4 Separation Facilities: Lay out and label a specific area to facilitate separation of materials for potential recycling, salvage, reuse, composting and return:
 - .1 Recycling and waste bin areas are to be kept neat and clean and clearly marked in order to avoid contamination of materials.
 - .2 Hazardous wastes shall be separated, stored, and disposed of in accordance with local regulations.
- .5 Progressive Documentation: Submit a monthly summary of waste generated by the project to ensure that waste diversion goals are on track with project requirements:
 - .1 Submission of waste summary can coincide with application for progress payment, or similar milestone event as agreed upon between the Owner, Contractor and Representative.
 - .2 Monthly waste summary shall contain the following information:
 - .1 The amount in tonnes or m3 and location of material landfilled,
 - .2 The amount in tonnes or m3 and location of materials diverted from landfill, and
 - .3 Indication of progress based on total waste generated by the project with materials diverted from landfill as a percentage.

3.02 SUBCONTRACTOR'S RESPONSIBILITY

- .1 [Subcontractor]'s shall cooperate fully with the [Contractor] to implement the [CWM Plan].
- .2 Failure to cooperate may result in the Owner not achieving their environmental goals, and may result in penalties being assessed by the [Contractor] to the responsible [Subcontractor]'s.

3.03 SAMPLE CONSTRUCTION WASTE MANAGEMENT FORMS

- .1 Sample waste tracking form below can be used by the [Contractor] to establish their own forms for recording management of construction

waste:		SAMPLE WASTE MANAGEMENT FORM					
		Diverted Waste by Report Date					
		Sept	Oct	Nov	Dec	Total	Units
Material Streams Contributing to Credit	Plastic	1.25	2.5	10	5	18.75	mü
	Carpet	2.5	2.5	2.5	0	7.5	mü
	Paper/C	5	2.5	2.5	15		mü
	ardboard						
	Clean	0	25	0	1.25	26.25	mü
	Wood						
	Metal	1.25	2.5	5.5	7	16.25	mü
	Gypsum	2.5	2.5	4	5	14	mü
	Board						
	Brick/C	10.5	2.5	5.5	8.75	27.25	mü
	oncrete						
	Asphalt	10	0	0	0	10	mü
	Shingles						
					Total Diverte d Waste	135	mü
Material Streams not Contributing to Credit	Landfil	10.75	7.5	15	10	43.25	mü
	l						
	Screen	5	1.25	0	2.5	8.75	mü
	Fines						
	(ADC)						
	150 mm	1.25	1.25	5	5.5	13	mü
	Minus						
	(ADC						
					Total Landfil l/ADC Waste	65	mü
					Total Waste	200	mü
					Percent Diverte d	67.5	%

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END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Not Used.

1.02 REFERENCE STANDARDS

- .1 Not Used

1.03 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-warranty Meeting:
 - .1 Convene meeting [one] week prior to contract completion with contractor's representative and Departmental Representative, in accordance with Section 01 31 19 - Project Meetings to:
 - .1 Verify Project requirements.
 - .2 Review manufacturer's installation instructions and warranty requirements.
 - .2 Departmental Representative to establish communication procedures for:
 - .1 Notifying construction warranty defects.
 - .2 Determine priorities for type of defects.
 - .3 Determine reasonable response time.
 - .3 Contact information for bonded and licensed company for warranty work action: provide name, telephone number and address of company authorized for construction warranty work action.
 - .4 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work action.

1.04 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Two weeks prior to Substantial Performance of the Work, submit to the Departmental Representative, two final copies of operating and maintenance manuals in [English].
- .3 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.
- .4 Provide evidence, if requested, for type, source and quality of products supplied.

1.05 FORMAT

- .1 Submit one (1) copy in electronic PDF format, with all machine readable/searchable text, implementing the format as described below in 1.05.3.
- .2 If required by Departmental Representative, submit in hard copy format

as described in 1.05.3

- .3 Organize data as instructional manual.
 - .1 Binders: vinyl, hard covered, 3 'D' ring, loose leaf [219 x 279] mm with spine and face pockets.
 - .2 When multiple binders are used correlate data into related consistent groupings.
 - .1 Identify contents of each binder on spine.
 - .3 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
 - .4 Arrange content by systems, process flow, under Section numbers and sequence of Table of Contents.
 - .5 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
 - .6 Text: manufacturer's printed data, or typewritten data.
 - .7 Drawings: provide with reinforced punched binder tab.
 - .1 Bind in with text; fold larger drawings to size of text pages.

1.06 CONTENTS - PROJECT RECORD DOCUMENTS

- .1 Table of Contents for Each Volume: provide title of project;
 - .1 Date of submission; names.
- .2 Addresses, and telephone numbers of Consultant and Contractor with name of responsible parties.
- .3 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system:
 - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .5 Typewritten Text: as required to supplement product data.
 - .1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.

1.07 AS -BUILT DOCUMENTS AND SAMPLES

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

- .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Change Orders and other modifications to Contract.
 - .5 Reviewed shop drawings, product data, and samples.
 - .6 Field test records.
 - .7 Inspection certificates.
 - .8 Manufacturer's certificates.
-
- .2 Store record documents and samples in field office apart from documents used for construction.
 - .1 Provide files, racks, and secure storage.
 - .3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual.
 - .1 Label each document "PROJECT RECORD" in neat, large, printed letters.
 - .4 Maintain record documents in clean, dry and legible condition.
 - .1 Do not use record documents for construction purposes.
 - .5 Keep record documents and samples available for inspection by Departmental Representative.

1.08 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

- .1 Record information on set of black line opaque drawings, and in copy of Project Manual, provided by Departmental Representative.
- .2 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.
- .3 Record information concurrently with construction progress.
 - .1 Do not conceal Work until required information is recorded.
- .4 Contract Drawings and shop drawings: mark each item to record actual construction, including:
 - .1 Measured depths of elements of foundation in relation to finish first floor datum.
 - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
 - .4 Field changes of dimension and detail.
 - .5 Changes made by change orders.
 - .6 Details not on original Contract Drawings.
 - .7 Referenced Standards to related shop drawings and modifications.
- .5 Specifications: mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and change orders.

- .6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.
- .7 Provide digital photos, if requested, for site records.

1.09 FINAL SURVEY

- .1 Not Used

1.10 EQUIPMENT AND SYSTEMS

- .1 For each item of equipment and each system include description of unit or system, and component parts.
 - .1 Give function, normal operation characteristics and limiting conditions.
 - .2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.
 - .1 Include regulation, control, stopping, shut-down, and emergency instructions.
 - .2 Include summer, winter, and any special operating instructions.
- .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include test and balancing reports as specified in Section 01 45 00 -

Quality Control.

- .15 Additional requirements: as specified in individual specification sections.

1.11 MATERIALS AND FINISHES

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

1.12 MAINTENANCE MATERIALS

- .1 Spare Parts:
 - .1 Provide spare parts, in quantities specified in individual specification sections.
 - .2 Provide items of same manufacture and quality as items in Work.
 - .3 Deliver to site; place and store.
 - .4 Receive and catalogue items.
 - .1 Submit inventory listing to Departmental Representative.
 - .2 Include approved listings in Maintenance Manual.
 - .5 Obtain receipt for delivered products and submit prior to final payment.
- .2 Extra Stock Materials:
 - .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
 - .2 Provide items of same manufacture and quality as items in Work.
 - .3 Deliver to site; place and store.
 - .4 Receive and catalogue items.
 - .1 Submit inventory listing to Departmental Representative.
 - .2 Include approved listings in Maintenance Manual.
 - .5 Obtain receipt for delivered products and submit prior to final payment.
- .3 Special Tools:
 - .1 Provide special tools, in quantities specified in individual specification section.
 - .2 Provide items with tags identifying their associated function and equipment.
 - .3 Deliver to site; place and store.
 - .4 Receive and catalogue items.

- .1 Submit inventory listing to Departmental Representative.
- .2 Include approved listings in Maintenance Manual.

1.13 DELIVERY, STORAGE AND HANDLING

- .1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.
- .2 Store in original and undamaged condition with manufacturer's seal and labels intact.
- .3 Store components subject to damage from weather in weatherproof enclosures.
- .4 Store paints and freezable materials in a heated and ventilated room.
- .5 Remove and replace damaged products at own expense and for review by Departmental Representative.

1.14 WARRANTIES

- .1 Develop warranty management plan to contain information relevant to Warranties.
- .2 Submit warranty management plan, [30] days before planned pre-warranty conference, to Departmental Representative.
- .3 Warranty management plan to include required actions and documents to assure that Departmental Representative receives warranties to which it is entitled.
- .4 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.
- .5 Submit, warranty information made available during construction phase, to Departmental Representative for approval prior to each monthly pay estimate.
- .6 Assemble approved information in binder, submit upon acceptance of work and organize binder as follows:
 - .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
 - .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
 - .3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within [ten] days after completion of applicable item of work.
 - .4 Verify that documents are in proper form, contain full information, and are notarized.
 - .5 Co-execute submittals when required.
 - .6 Retain warranties and bonds until time specified for submittal.
- .7 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.

- .8 Conduct joint [4] month and [9] month warranty inspection, measured from time of acceptance, by Departmental Representative.
- .9 Include information contained in warranty management plan as follows:
 - .1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, subcontractors, manufacturers or suppliers involved.
 - .2 Listing and status of delivery of Certificates of Warranty for extended warranty items, to include HVAC balancing, pumps, motors, and commissioned systems such as fire alarm systems.
 - .3 Provide list for each warranted equipment, item, feature of construction or system indicating:
 - .1 Name of item.
 - .2 Model and serial numbers.
 - .3 Location where installed.
 - .4 Name and phone numbers of manufacturers or suppliers.
 - .5 Names, addresses and telephone numbers of sources of spare parts.
 - .6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.
 - .7 Cross-reference to warranty certificates as applicable.
 - .8 Starting point and duration of warranty period.
 - .9 Summary of maintenance procedures required to continue warranty in force.
 - .10 Cross-Reference to specific pertinent Operation and Maintenance manuals.
 - .11 Organization, names and phone numbers of persons to call for warranty service.
 - .12 Typical response time and repair time expected for various warranted equipment.
 - .4 Contractor's plans for attendance at [4] and [9] month post-construction warranty inspections.
 - .5 Procedure and status of tagging of equipment covered by extended warranties.
 - .6 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.
- .10 Respond in timely manner to oral or written notification of required construction warranty repair work.
- .11 Written verification to follow oral instructions.
 - .1 Failure to respond will be cause for the Departmental Representative to proceed with action against Contractor.

1.15 WARRANTY TAGS

- .1 Tag, at time of installation, each warranted item. Provide durable, oil and water resistant tag approved by Departmental Representative.
- .2 Attach tags with copper wire and spray with waterproof silicone coating.
- .3 Leave date of acceptance until project is accepted for occupancy.

- .4 Indicate following information on tag:
 - .1 Type of product/material.
 - .2 Model number.
 - .3 Serial number.
 - .4 Contract number.
 - .5 Warranty period.
 - .6 Inspector's signature.
 - .7 Construction Contractor.

2 PRODUCTS

2.01 NOT USED

- .1 Not Used.

3 EXECUTION

3.01 NOT USED

- .1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Comply with requirements of this Section when performing the following work:
 - .1 Removal and off-site disposal of non-friable cement (Transite) board inside three (3) fume hoods if the material is removed without being broken, cut, drilled, abraded, ground, sanded or vibrated; or,
 - .2 Breaking, cutting, drilling, abrading, grinding, sanding, or vibrating non-friable cement (Transite) board inside three (3) fume hoods using non-powered hand-held tools, and the material is wetted to control the spread of dust or fibres.

1.2 RELATED DOCUMENTS

- .1 Asbestos Abatement Plan Drawing: Renovation of Laboratories 2044 - 2046

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
- .2 Department of Justice Canada
 - .1 Canadian Environmental Protection Act (CEPA), 1999.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .4 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992 (TDGA).
- .5 Occupational Health and Safety Act (OHSA)
 - .1 Ontario Regulation 278/05, Designated Substances – Asbestos on Construction Projects and on Building Repair Operations 2005 (278).
 - .2 Regulation 213/91, as amended, Regulations for Construction Projects.

1.4 DEFINITIONS

- .1 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 direction at 99.97% efficiency.
- .2 Amended Water: water with nonionic surfactant wetting agent

added to reduce water tension to allow thorough wetting of fibres.

- .3 Asbestos-Containing Materials (ACMs): materials that contain 0.5 per cent or more asbestos by dry weight and are identified under Existing Conditions including fallen materials and settled dust.
- .4 Asbestos Work Area: area where work takes place which will, or may, disturb ACMs.
- .5 Authorized Visitors: designated representative(s), and representative(s) of regulatory agencies.
- .6 Competent worker or 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 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.
- .7 Friable material: means material that:
 - .1 When dry, can be crumbled, pulverized or powdered by hand pressure, or
 - .2 is crumbled, pulverized or powdered.
- .8 Non-Friable Material: material that when dry cannot be crumbled, pulverized or powdered by hand pressure.
- .9 Occupied Area: any area of the building or work site that is outside Asbestos Work Area.
- .10 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.
- .11 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must have appropriate capacity for work.

1.5 SUBMITTALS

- .1 Prior to Site mobilization submit the following documents:
- .2 Contractor shall submit proof to Departmental Representative that suitable arrangements have been made to dispose of asbestos-containing waste in accordance with requirements of

authority having jurisdiction.

- .3 Contractor shall submit proof to Departmental Representative of Contractor's Asbestos Liability Insurance.
- .4 Contractor shall 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.
- .5 Contractor shall submit to Departmental Representative proof that all asbestos workers and/or supervisor(s) have received appropriate training and education by a competent person in the hazards of asbestos exposure, good personal hygiene and work practices while working in Asbestos Work Areas, and the use, cleaning and disposal of respirators and protective clothing if required.
- .6 Contractor shall submit to Departmental Representative proof that employees required to don respirators have valid respirator training and fitting and testing. Workers must be fit tested with respirator that is personally issued if respirators are used. Respirator training and fit testing is valid for two years and must be provided by a competent person.

1.6 QUALITY ASSURANCE

- .1 Regulatory Requirements: comply with Federal, Provincial, and local requirements pertaining to asbestos, provided that in case of conflict among these requirements or with these specifications, the more stringent requirement applies. Comply with regulations in effect at time Work is performed.
- .2 Health and Safety:
 - .1 Safety Requirements: worker protection.
 - .1 Protective equipment and clothing to be worn by workers while in Asbestos Work Area include:
 - .1 If respirator requested by worker then Air purifying half-mask respirator with 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 respiratory protection program including 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 None required or if requested by worker then 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 requests protective clothing and who enters the work area, and the protective clothing shall 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 to include suitable footwear, and to be repaired or replaced if torn.

.2 Eating, drinking, chewing, and smoking are not permitted in Asbestos Work Area.

.3 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.

.4 Facilities for washing hands and face shall be provided within or close to the Asbestos Work Area.

.5 Ensure workers wash hands and face when leaving Asbestos Work Area.

.6 Ensure that no person required to enter an Asbestos Work Area has facial hair that affects seal between respirator and face.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Place materials defined as hazardous or toxic in designated containers.

- .2 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.
- .3 Disposal of asbestos waste generated by removal activities must comply with Federal, Provincial, and Municipal regulations. Dispose of asbestos waste in sealed double bagged 0.15mm thickness bags or leak proof drums used as outer container when waste contains sharp materials that may puncture bags. Label containers with appropriate warning labels.
- .4 Contractor shall submit to Departmental Representative manifests describing and listing waste created. Transport containers by approved means to licensed landfill for burial.

1.8 EXISTING CONDITIONS

- .1 The items listed in item 1.2 must be reviewed prior to conducting the works detailed in this specification. Contact the Owner to acquire a copy of these reports for review.
- .2 Contractor shall notify Departmental Representative of designated and hazardous substances discovered during work and not apparent from specifications, or report pertaining to Work. Do not disturb such material until instructed by Departmental Representative in writing.

1.9 SCHEDULING

- .1 Hours of Work: Work is to be completed during regular business hours.

1.10 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, and in use, cleaning, and disposal of respirators and protective clothing.
- .2 Instruction and training related to respirators includes, following minimum requirements if workers don respirators:
 - .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 a competent, qualified person.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Drop 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% polyethylene ester and 50% polyethylene ether mixed with water in a 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 waste 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 pre-printed cautionary asbestos warning in both official languages that is visible when ready for removal to disposal site.
- .4 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.
- .5 Tape: fibreglass - reinforced duct tape suitable for sealing polyethylene under both dry conditions and wet conditions using amended water.

PART 3 - EXECUTION

3.1 PROCEDURES

- .1 Before beginning Work, isolate Asbestos Work Area using, at minimum, preprinted cautionary asbestos warning signs in both official languages that are visible at access routes to Asbestos Work Area.
 - .1 Remove visible dust from surfaces in the work area where dust is likely to be disturbed during course of work.
 - .2 Use HEPA vacuum or damp cloths where damp cleaning does not create a hazard and is otherwise appropriate.
 - .3 Do not use compressed air to clean up or remove dust from any surface.
- .2 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 Asbestos Work Area where dust and contamination cannot otherwise be safely contained. Drop sheets are not to be reused.

- .3 Wet materials containing asbestos to be cut, ground, abraded, scraped, drilled, or otherwise disturbed unless wetting creates hazard or causes damage.
 - .1 Use garden reservoir type low - velocity fine - mist sprayer.
 - .2 Perform Work to reduce dust creation to lowest levels practicable.
 - .3 Work will be subject to visual inspection and air monitoring.
 - .4 Contamination of surrounding areas indicated by visual inspection or air monitoring will require complete enclosure and clean-up of affected areas.
- .4 Frequently and at regular intervals during Work and immediately on completion of work:
 - .1 Dust and waste to be cleaned up and removed using a vacuum equipped with a HEPA filter, or by damp mopping or wet sweeping, and placed in a waste container, and
 - .2 Drop sheets to be wetted and placed in a waste container as soon as practicable.
- .5 Cleanup:
 - .1 Place dust and asbestos containing waste in sealed dust-tight waste bags. Treat drop sheets and disposable protective clothing as asbestos waste; wet and fold these items to contain dust, and then place in plastic bags.
 - .2 Clean exterior of each waste-filled bag using damp cloths or HEPA vacuum and place in second clean waste bag immediately prior to removal from Asbestos Work Area.
 - .3 Seal waste bags and remove 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 the appropriate guidelines and regulations for asbestos disposal are followed.
 - .4 Perform final thorough clean-up of Work areas and adjacent areas affected by Work using HEPA vacuum.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Comply with requirements of this Section when performing following Work:
 - .1 Glovebag removal of friable thermal pipe insulation and cementitious pipe fittings.
 - .2 Removal and off-site disposal of asbestos-containing vinyl floor tile by breaking, cutting, drilling, abrading, grinding, sanding, or vibrating if:
 - 1. The material is not wetted to control the spread of dust or fibres; and
 - 2. The work is done by means of non-powered hand held tools.

1.2 RELATED DOCUMENTS

- .1 Designated Substance Report, Room 2044 and 2046, Neatby Building, Central Experimental Farm, CM3 Environmental, February 2017. Ref. No.: TLW-1288.
- .2 Asbestos Abatement Plan Drawing: Renovation of Laboratories 2044 - 2046.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA Standard Z94.4-11, Selection, Use and Care of Respirators.
- .2 Department of Justice Canada
 - .1 Canadian Environmental Protection Act (CEPA), 1999.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .4 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992 (TDGA).
- .5 Occupational Health and Safety Act (OHSA)
 - .1 Ontario Regulation 278/05, Regulation Respecting Asbestos on Construction Projects and in Buildings and Repair Operations.
 - .2 Ontario Regulation 213/91, Regulation for Construction Projects.
 - .3 Ontario Regulation 860/90, Workplace Hazardous Materials Information System (WHMIS) Regulation.

.4 Ontario Regulation 833/90, Control of Exposure to Biological and Chemical Agents.

.6 Ontario Ministry of Labour (MOL)

.1 A Guide to the Regulation Respecting Asbestos on Construction Projects and in Buildings and Repair Operations, November 2007.

.7 Ontario Ministry of the Environment (MOE)

.1 Ontario Regulation 347, General Waste Management.

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 0.5 percent or more asbestos by dry weight.

.3 Asbestos Work Area: area where work takes place which will, or may disturb ACMs.

.4 Authorized Visitors: designated representative(s), and representative(s) of regulatory agencies.

.5 Competent worker and/or 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, Federal, and local 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 Contractor: Asbestos Abatement Contractor.

.7 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.

.8 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.

- .10 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.
- .11 Non-Friable Material: material that when dry cannot be crumbled, pulverized or powdered by hand pressure.
- .12 Occupied Area: any area of building or work site that is outside Asbestos Work Area.
- .13 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.
- .14 Departmental Representative: Agriculture and Agri-Food Canada designate
- .15 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 Contractor shall submit proof to Departmental Representative that suitable arrangements have been made to dispose of asbestos-containing waste in accordance with requirements of authority having jurisdiction.
- .2 Contractor shall submit proof to Departmental Representative of Contractor's Asbestos Liability Insurance.
- .3 Contractor shall 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.
- .4 Contractor shall submit to Departmental Representative proof that all asbestos workers and/or supervisor(s) have received appropriate training and education by a competent person in the hazards of asbestos exposure, good personal hygiene and work practices while working in Asbestos Work Areas, and the use, cleaning and disposal of respirators and protective clothing if required.
- .5 Submit proof that supervisory personnel have attended asbestos abatement course approved by Departmental

Representative. Minimum of one supervisor for every ten workers

- .6 Contractor shall submit to Departmental Representative Worker's Compensation Board status and transcription of insurance.
- .7 Contractor shall submit to Departmental Representative 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;
 - .4 All additional controlled products.
- .8 Contractor shall submit to Departmental Representative proof that employees required to don respirators have valid respirator training and fitting and testing. Workers must be fit tested with respirator that is personally issued if respirators are used. Respirator training and fit testing is valid for two years and must be provided by a competent person.

1.6 QUALITY ASSURANCE

- .1 Regulatory Requirements: comply with Federal, Provincial 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 Safety Requirements: worker and visitor protection.
 - .1 Protective equipment and clothing to be worn by workers while in Asbestos Work Area include:
 - .1 Respirator 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 respiratory protection program including 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.

.2 Eating, drinking, chewing, and smoking are not permitted in Asbestos Work Area.

.3 Before leaving Asbestos Work Area, the worker must decontaminate their 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.

.4 Facilities for washing hands and face shall be provided within or close to the Asbestos Work Area.

.5 Ensure that no person required to enter an Asbestos Work Area has facial hair that affects seal between respirator and face.

.6 Visitor Protection:

.1 Provide protective clothing and approved fit-tested respirators to Authorized Visitors to work areas.

.2 Visitors must be trained in the use of protective clothing, respirators and procedures.

.3 Instruct Authorized Visitors in proper procedures to be followed when entering into and exiting the Asbestos Work Area.

**1.7 WASTE
MANAGEMENT AND
DISPOSAL**

- .1 Place materials defined as hazardous or toxic in designated containers.
- .2 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.
- .3 Disposal of asbestos waste generated by removal activities must comply with Federal, Provincial and Municipal regulations. Dispose of asbestos waste in sealed double-bagged 0.15mm thickness 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.

**1.8 EXISTING
CONDITIONS**

- .1 The report listed in item 1.2 must be reviewed prior to conducting the works detailed in this specification. Contact the Departmental Representative to acquire a copy of this report for review.
- .2 Contractor shall notify Departmental Representative in writing of designated and hazardous substances discovered during work and not apparent from specifications, or report pertaining to Work. Do not disturb such material until instructed by Departmental Representative in writing.

1.9 SCHEDULING

- .1 Hours of Work: perform work involving asbestos during normal working hours.
- .2 No later than five (5) days prior to mobilization to the site, Contractor must provide Departmental Representative with schedule in writing.

1.10 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, 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 or where glove bag method is used, glove bag itself.
 - .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 Labeling 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 Departmental Representative.
 - .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 Before beginning work make arrangements with Departmental Representative to conduct pre-contamination inspection(s) of work area(s). Asbestos abatement operations may only commence when Contractor has received notice from the Departmental Representative to proceed.
- .2 Before beginning Work, at each access to Asbestos Work Area, install warning signs in both official languages in accordance with O. Reg. 278/05.
- .3 Before beginning Work remove visible dust from surfaces in work area where dust is likely to be disturbed during course of work.
 - .1 Use HEPA vacuum or damp cloths where damp cleaning does not create hazard and is otherwise appropriate.
 - .2 Do not use compressed air or dry sweeping 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 asbestos containing material and walls themselves do not enclose work area erect an enclosure of polyethylene sheeting around work area, and seal ventilation ducts to and from work area.
- .5 Pipe Insulation Removal Using Glove Bag (If Required):
 - .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 Disable mechanical ventilation system serving the Asbestos Work Area and seal all openings or voids.
 - .3 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 repaired or replaced, as appropriate. 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.
 - .4 Place tools necessary to remove insulation in tool pouch. Wrap bag around pipe and close zippers. Seal bag to pipe with cloth straps.
 - .5 Place hands in gloves and use necessary tools to remove insulation. Arrange insulation in bag to obtain full capacity of bag.
 - .6 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.
 - .7 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.
 - .8 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.

.9 Upon completion of Work shift, cover exposed ends of remaining pipe insulation with polyethylene taped in place.

.6 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 at the contractor's expense.

.7 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 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.

.8 Removing non-friable asbestos containing materials by breaking, cutting, drilling, abrading, grounding, sanding or vibrating is allowed 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.

.9 Removing non-friable asbestos containing materials by breaking, cutting, drilling, abrading, grounding, sanding or vibrating is allowed if the work is done by means of power tools that are attached to dust-collecting devices equipped with HEPA filters.

.10 Following asbestos material removal and prior to removing work area control measures make arrangements with the Departmental Representative to conduct post-contamination inspection(s). Work area control measures must remain in place until notification is provided to the contractor stating that

work has been completed and control measures may be removed.

3.3 AIR MONITORING

- .1 From beginning of Work until completion of cleaning operations, Departmental Representative may take air samples at any time.
 - .1 Contractor will be responsible for monitoring inside enclosure in accordance with applicable Provincial Occupational Health and Safety Regulations.
- .2 If air monitoring shows that areas outside Asbestos Work Area(s) are contaminated, enclose, maintain and clean these areas in same manner as that applicable to Asbestos Work Area at the contractor's expense.
- .3 Contractor shall ensure that respiratory safety factors are not exceeded.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Division 1 General requirements

1.02 REFERENCE STANDARDS

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 National Research Council Canada (NRC)
 - .1 National Building Code of Canada [2015] (NBC).
- .3 Underwriter's Laboratories of Canada (ULC)
 - .1 ULC-S115-[1995], Fire Tests of Fire stop Systems.

1.03 DEFINITIONS

- .1 Fire Stop Material: device intended to close off opening or penetration during fire or materials that fill openings in wall or floor assembly where penetration is by cables, cable trays, conduits, ducts and pipes and poke-through termination devices, including electrical outlet boxes along with their means of support through wall or floor openings.
- .2 Single Component Fire Stop System: fire stop material that has Listed Systems Design and is used individually without use of high temperature insulation or other materials to create fire stop system.
- .3 Multiple Component Fire Stop System: exact group of fire stop materials that are identified within Listed Systems Design to create on site fire stop system.
- .4 Tightly Fitted; (ref: NBC Part 3.1.9.1(1) and 9.10.9.6(1)): penetrating items that are cast in place in buildings of noncombustible construction or have "0" annular space in buildings of combustible construction.
 - .1 Words "tightly fitted" should ensure that integrity of fire separation is such that it prevents passage of smoke and hot gases to unexposed side of fire separation.

1.04 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

- .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 - Quality Control.
 - .1 Test reports: in accordance with CAN-ULC-S101 for fire endurance and CAN-ULC-S102 for surface burning characteristics.
 - .1 Submit certified test reports from approved independent testing laboratories, indicating compliance of applied fire stopping with specifications for specified performance characteristics and physical properties.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.
 - .4 Manufacturer's Field Reports: submit to manufacturer's written reports within [3] days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

1.05 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: company specializing in fire stopping installations or approved by manufacturer.
- .2 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section, with contractor's representative and Departmental Representative 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 50% and [90% complete.
 - .3 Upon completion of Work, after cleaning is carried out.

1.06 DELIVERY, STORAGE AND HANDLING

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

- manufacturer's written instructions.
- .3 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, ULC markings.
- .2 Storage and Protection:
 - .1 Store materials 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 21 - Construction/Demolition Waste Management and Disposal and/or as directed by Departmental Representative

2 PRODUCTS

2.01 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 Service penetration assemblies: systems tested to CAN-ULC-S115.
- .3 Service penetration fire stop components: certified by test laboratory to CAN-ULC-S115.
- .4 Fire-resistance rating of installed fire stopping assembly in accordance with NBC.
- .5 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.
- .6 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal.
- .7 Primers: to manufacturer's recommendation for specific material, substrate, and end use.
- .8 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.
- .9 Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.
- .10 Sealants for vertical joints: non-sagging.

3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 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 .
- .4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.03 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.

3.04 SEQUENCES OF OPERATION

- .1 Proceed with installation only when submittals have been reviewed by Departmental Representative.
- .2 Mechanical pipe insulation: [certified] fire stop system component.
 - .1 Ensure pipe insulation installation precedes fire stopping.

3.05 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.

3.06 CLEANING

- .1 Proceed in accordance with Section [01 74 11 - Cleaning].
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .3 Remove temporary dams after initial set of fire stopping and smoke seal materials.

3.07 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: 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

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Division 1 General requirements.

1.02 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM C 919-[08], Standard Practice for Use of Sealants in Acoustical Applications.
- .2 Canadian General Standards Board (CGSB)
 - .1 CGSB 19-GP-5M-[1984], Sealing Compound, One Component, Acrylic Base, Solvent Curing (Issue of 1976 reaffirmed, incorporating Amendment No. 1).
 - .2 CAN/CGSB-19.13-[M87], Sealing Compound, One-component, Elastomeric, Chemical Curing.
 - .3 CGSB 19-GP-14M-[1984], Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing (Reaffirmation of April 1976).
 - .4 CAN/CGSB-19.17-[M90], One-Component Acrylic Emulsion Base Sealing Compound.
 - .5 CAN/CGSB-19.24-[M90], Multi-component, Chemical Curing Sealing Compound.
- .3 General Services Administration (GSA) - Federal Specifications (FS)
 - .1 FS-SS-S-200-[E(2)1993], Sealants, Joint, Two-Component, Jet-Blast-Resistant, Cold Applied, for Portland Cement Concrete Pavement.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .5 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1168-[A2005], Adhesives and Sealants Applications.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for [joint sealants] and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Manufacturer's product to describe:
 - .1 Caulking compound.
 - .2 Primers.
 - .3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.
 - .3 Submit 2 copies of WHMIS MSDS in accordance with Section

01 35 29.06 - Health and Safety Requirements.

- .3 Samples:
 - .1 Submit 2 samples of each type of material and colour.
 - .2 Cured samples of exposed sealants for each colour where required to match adjacent material.
- .4 Manufacturer's Instructions:
 - .1 Submit instructions to include installation instructions for each product used.
- .5 Sustainable Design Submittals:
 - .1 LEED Canada submittals: in accordance with [Section 01 35 21 - LEED Requirements].

1.04 CLOSEOUT SUBMITTALS

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

1.05 DELIVERY, STORAGE AND HANDLING

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

1.06 SITE CONDITIONS

- .1 Ambient Conditions:
 - .1 Proceed with installation of joint sealants only when:
 - .1 Ambient and substrate temperature conditions are within limits permitted by joint sealant manufacturer.
 - .2 Joint substrates are dry.
 - .3 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.
- .2 Joint-Width Conditions:
 - .1 Proceed with installation of joint sealants only where joint widths are more than those allowed by joint sealant manufacturer for applications indicated.

- .3 Joint-Substrate Conditions:
 - .1 Proceed with installation of joint sealants only after contaminants capable of interfering with adhesion are removed from joint substrates.

1.07 ENVIRONMENTAL REQUIREMENTS

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of Material Safety Data Sheets (MSDS) acceptable to Health Canada.
- .2 Ventilate area of work as directed by Departmental Representative by use of approved portable supply and exhaust fans.

2 PRODUCTS

2.01 SEALANT MATERIALS

- .1 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.
- .2 Where sealants are qualified with primers use only these primers.

2.02 JOINT SEALANTS MATERIAL DESIGNATIONS

- .1 General: All sealants and caulking compounds shall conform to the standards listed herein. The CAN/CGSB 19.28-M88 Glossary of Terms Related to Sealants shall be used as a reference standards. All colours shall be selected by the Departmental Representative from manufacturer's full colour range. All materials shall be freshly compounded, factory mixed, and from same batch.
 - Type 1: Shall be multi-component chemical curing, non-sagging, non-staining, gun-grade polysulphide sealant conforming to CAN/CGSB 19.24-M90 and U.S. Federal Specification TT-S0227E, Type II Class A compounds. Acceptable Products: Sternson's RC-2 and Tremco Dymeric 511; or other pre-approved sealant.
 - Type 2: Shall be one-part, non-sagging, gun-grade polysulphide sealant conforming to CAN/CGSB 19.13-M87 and U.S. Federal Specification TT-S-230C, Type II, Class A. Acceptable Products: Sternson's RC-5000-S; Tremco Tremflex25; or other pre-approved sealant.
 - Type 3: Shall be liquid polyurethane terpolymer, multi-component, non-staining, non-sagging, gun-grade sealant conforming to CAN/CGSB 19.24-M90 and U.S. Federal Specification TT-S00227E, Class A. Acceptable Products: Dymeric as manufactured by Tremco (Canada) Ltd.
 - Type 4: Shall be one-part, fast curing, self-priming, translucent silicone construction sealant, conforming to CAN/CGSB-19.18-M87; Acceptable Products: Tremsil 600 General Construction Sealant as manufactured by Tremco (Canada) Ltd; Silglaze N2501 as manufactured by Canadian General Electric Co. or other pre-approved sealant.
 - Type 5: Shall be one-part, chemically curing, silicone sealant

conforming to CAN/CSGB-19.18M87. Acceptable Products: Tremsil 200 General Construction Sealant as manufactured by Tremco (Canada) Ltd; Canadian General Electric Series 1700, or other pre-approved sealant.

Type 6: Shall be one-component sealing compound with acrylic latex emulsion base, conforming to CAN/CSGB-19.17-M90. Acceptable Products: Tremco 834, or other pre-approved sealant.

Type 7: Shall be a one-part, pourable polyurethane sealant conforming to CAN/CSGB-19.24-M90. Acceptable Manufacturer: Vulkem 116; Sika 1A; or Loadflex by Sternson's.

Type 8: Shall be a mildew resistant; one-component sealant conforming to CAN/CSGB-19.22M89; Acceptable Products: Dow Corning 786; Tremco Tremsil 200 General Construction Sealant as manufactured by Tremco (Canada) Ltd, in clear or White; or other pre-approved sealant.

Type 9: Shall be single component, non-skinning, non-hardening rubber sealant. Acceptable Products: Tremco Acoustic Sealant.

Back-Up Material: Shall be closed cell polyethylene foam backing rod and plates as detailed or required, non-staining and completely compatible with sealant used. Acceptable Products: Ethafoam SB as manufactured by Tremco (Canada) Ltd; Dow Chemical Canada; Rodofoam and Backer rod, closed cell polyethylene foam joint filler and rod, as manufactured by Tremco (Canada) Ltd; or Sternson's.

Primers: Shall be compatible products by the same manufacturer of the specific sealant.

.2 Bond breaker tape:

.1 Polyethylene bond breaker tape which will not bond to sealant.

2.03 JOINT CLEANER

.1 Non-corrosive and non-staining type, compatible with joint forming materials and sealant in accordance with sealant manufacturer's written recommendations.

.2 Primer: in accordance with sealant manufacturer's written recommendations.

3 EXECUTION

3.01 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for joint sealants installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.02 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.

3.03 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.

3.04 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.

3.05 MIXING

- .1 Mix materials in strict accordance with sealant manufacturer's instructions.

3.06 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.

3.07 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Clean adjacent surfaces immediately.
 - .3 Remove excess and droppings, using recommended cleaners as work progresses.
 - .4 Remove masking tape after initial set of sealant.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.08 PROTECTION

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

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Refer to Division 1, General Requirements.
- .2 All Contract Documents form an integral part of this Section.

1.02 REFERENCE STANDARDS

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A 653/A 653M-06a, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ASTM B 29-[03], Standard Specification for Refined Lead.
 - .3 ASTM B 749-[03], Standard Specification for Lead and Lead Alloy Strip, Sheet and Plate Products.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181Ready-Mixed Organic Zinc-Rich Coating.
 - .2 CGSB 41-GP-19MaRigid Vinyl Extrusions for Windows and Doors.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA-G40.20-[04]/G40.21-04 General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CSA W59-03, Welded Steel Construction (Metal Arc Welding).
- .4 Canadian Steel Door Manufacturers' Association (CSDMA)
 - .1 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames, [2000].
 - .2 CSDMA, Selection and Usage Guide for Commercial Steel Doors, [1990].
- .5 National Fire Protection Association (NFPA)
 - .1 NFPA 80-[99], Standard for Fire Doors and Fire Windows.
 - .2 NFPA 252-[03], Standard Methods of Fire Tests of Door Assemblies.
- .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-S701-[01], Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .2 CAN/ULC-S702-[97], Standard for Thermal Insulation, Mineral Fibre, for Buildings.
 - .3 CAN/ULC-S704-[03], Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.
 - .4 CAN4-S104-[M80], Standard Method for Fire Tests of Door Assemblies.
 - .5 CAN4-S105-[M85], Standard Specification for Fire Door Frames Meeting the Performance Required by CAN4-S104.

1.03 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 degrees C to 35 degrees C.
 - .2 Maximum deflection for exterior steel entrance screens under wind load of 1.2 kPa not to exceed 1/175th of span.

1.04 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Samples: Sample of materials may be requested by Departmental Representative for review.
- .2 Shop Drawings: Submit shop drawings to the Departmental Representative for review. Submit shop drawings prior to fabrication in accordance with General Conditions and any amendments thereto under Supplementary Conditions, and as follows:
 - .1 Doors and frames to be coded as per numbers in Architectural Door Schedule.
 - .2 Detail method of assembly, reinforcing, fastening, field jointing, splicing, stop securing.
 - .3 Indicate thickness and gauge of all materials.
- .3 Indicate material and quality of all finishes.
- .4 Identify, mark and key for site locations. Markings to be concealed when hollow metal items are installed and finished.
- .5 Include legend indicating all abbreviations and symbols.
- .6 Verify door and frame size by site measurement where walls are to be built prior to shop fabrication of frames and doors, and where locations will determine door and frame sizes.
- .7 Submit cut-sheets and MSDS (Material Data Safety Sheets), for each product used in the building.

1.06 DELIVERY, STORAGE AND HANDLING

- .1 Deliver all hollow metal doors and pressed steel frames to the site fully protected and with adequate location and installation details. Deliver to the site in accordance with construction schedule prepared by the Contractor.
- .2 Provide packaging such as cardboard or other containers, separators, banding and paper wrappings as required to completely protect all metal doors and frames during transportation and storage.
- .3 Store all hollow metal work in a dry location; off and away from ground contact; protect by suitable means required for installation; brace and stack to prevent racking, bending, twisting, or any other damage.

- .4 Leave spreaders in place until frames are braced or anchored in final locations.
- .5 In the event of damage, immediately make all repairs and replacements necessary to the acceptance of the Departmental Representative and at no additional cost to the Owner.

2 PRODUCTS

2.01 HOLLOW METAL DOORS

- .1 Hollow metal doors shall be fabricated from minimum 18 gauge steel having zinc coating finish, ZF075 for interior doors, and Z275 for exterior doors; or having Dofasco's Satincote or Stelco's Colorbond zinc coating; 45 mm (1-3/4") thick, full flush face, edge seam only.
- .2 Core material to interior doors shall be phenolic or resin impregnated kraft paper formed into a honeycomb core reinforcing to support door every 25 mm (1").
- .3 Core materials to exterior doors to be inorganic glass fibre preformed slab insulation of 4.5 lbs/cu.ft. density, or polyurethane rigid insulation to door manufacturer's standard.
- .4 Doors shall have seamless faces and continuous vertical mechanical interlocking joints at lock and hinge edges with visible edge seams.
- .5 All doors shall be "vermin and water proof" at the top and bottom edges. The top surface shall be ground smooth so as not to collect dust or water. Seal top and bottom edges of all door integrally with door construction or use 16 gauge inverted steel channels welded to form flush closure. Tops and Bottoms shall be factory primed. Exposed hardware reinforcements at these doors shall be caulked so as to waterproof the core of the door.
- .6 Flush end closure shall be installed and sealed to recessed channel at top of out-swinging exterior doors, as per manufacturer's standard.
- .7 Glazing stops for lights in hollow metal doors shall be 20 gauge zinc coated steel formed, screw-on stops.
- .8 Fabricate stile and rail glazed hollow metal doors as indicated, 45 mm (1-3/4") thick, from minimum 18 gauge steel having ZF075 zinc coating for interior doors and Z275 for exterior doors.
- .9 Stile and rail dimensions as detailed. Fabricate doors as specified above for flush hollow metal flush doors.

2.02 INTERIOR METAL WINDOWS

- .1 Fabricate frames from 16 gauge zinc coated steel stock as specified under clause 2.01 for door frames, all welded construction; complete with 20 gauge zinc coated steel formed screw-on glazing stops of the same material as frames. Countersink stops for OH screw attachment.
- .2 Frame profiles and dimensions shall be as detailed.
- .3 Stops shall be 16 mm (5/8") high by 13 mm (1/2") wide, as detailed.
- .4 Frames for interior windows shall be fabricated to accommodate single glazing.

2.03 FABRICATION & MANUFACTURE

- .1 Fabricate all hollow metal work in accordance with profiles as reviewed shop drawings. Flat work to be leveled and straight with surfaces smooth and true.
- .2 Edges, angles and corners to be square, clean and smooth. Curved work to be true to radii.
- .3 After welding, units to be square and true, free from distortion, such as wracking or twisting. Maximum twisting to be limited to 3 mm (1/8") measured on diagonal of door.
- .4 Fabricate frames in sections as large as practicable to minimize field jointing.
- .5 Mitre all corners of frames, reinforce and fully weld in accordance with manufacturer's standard.
- .6 Glazing stops to be mitred at corners and drilled for countersunk screws. Corners to be sanded smooth with no sharp edges.

2.04 ANCHORS

- .1 Floor Anchors: Shall be securely welded inside each jamb, with two (2) holes provided at each jamb for floor anchorage. Anchors shall be a minimum of 14 gauge steel.
- .2 Wall Anchors: Shall be as follows:
 - .1 Steel Stud Partitions: Wall anchors shall be welded "U" type steel twist type anchor.
 - .2 Number of wall anchors provided on each jamb shall be as follows.
 - .1 Frames up to 2134 mm (7'-0") high: Three (3) anchors minimum.
 - .2 Frames over 2134 mm (7'-0") high: Four (4) anchors min. and not less than 1 per each 610 mm (24") or portion thereof.
- .3 Steel Spreaders: All pressed steel door frames shall be provided with steel spreader temporarily attached to the feet of both jambs to serve as a brace during shipping and handling.

2.05 HARDWARE PREPARATION

- .1 Door Reinforcement: Doors shall be mortised, reinforced, drilled and tapped at the factory for fully templated hardware in conformance with the final reviewed hardware schedule and templates provided by the hardware supplier. Where surface mounted hardware is to be applied doors shall have reinforcing plates only with drilling and tapping done on site. Installation of the hardware into the door shall not allow the passage of air through the holes cut into the face or sides of the steel door skin. Penetrations shall be air and moisture tight.
- .2 Frames shall be mortised, reinforced, drilled and tapped at the factory for fully templated, mortised hardware only, in accordance with final reviewed hardware schedule and templates provided by the hardware supplier. Where surface mounted hardware is to be applied, frames shall have reinforcing plates only, with drilling and tapping done on site. Installation of the

hardware into the door frame shall not allow the passage of air through the holes cut into the face or sides of the steel door frame. Penetrations shall be air and moisture tight. Provide fully welded back boxes at all hardware connections.

- .3 Hardware Reinforcing Plates: Minimum thickness shall be follows:
 - .1 Hinge and pivot reinforcements: Shall be 10 gauge.
 - .2 Strike reinforcements: Shall be 12 gauge.
 - .3 Flush bolt reinforcements: Shall be 12 gauge.
 - .4 Closer reinforcements: Shall be 12 gauge.
 - .5 Reinforcements for lock face, flush bolts, concealed holders, concealed or surface mounted closers: Shall be 12 gauge.
- 4. All reinforcing plates shall be hard-tempered steel.

2.06 FINISHING

- .1 Sand and clean surfaces prior to epoxy filler application.
- .2 Fill seams, depressions, intersecting corners completely with epoxy filler and sand smooth.
- .3 Clean and chemically treat metal to provide maximum paint adhesion.

2.07 FRAMES FABRICATION GENERAL

- .1 Fabricate frames in accordance with CSDMA specifications.
- .2 Fabricate frames to profiles and maximum face sizes as indicated.
- .3 Interior frames: 1.6 mm welded type construction.
- .4 Blank, reinforce, drill and tap frames for mortised, templated hardware, using templates provided by finish hardware supplier. Reinforce frames for surface mounted hardware.
- .5 Protect mortised cutouts with steel guard boxes.
- .6 Prepare frame for door silencers, 3 for single door, 2 at head for double door.
- .7 Manufacturer's nameplates on frames and screens are not permitted.
- .8 Conceal fastenings except where exposed fastenings are indicated.
- .9 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.

2.08 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.

2.09 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.
- .7 Securely attach lead to inside of frame profile from return to jamb soffit (inclusive) on door side of frame only.

2.12 DOOR FABRICATION GENERAL

- .1 Doors: swing type, flush, with provision for glass as indicated.
- .2 Fabricate doors with longitudinal edges welded. Seams: [visible] [grind welded joints to a flat plane, fill with metallic paste filler and sand to a uniform smooth finish].
- .3 Factory prepare holes 12.7 mm diameter and larger except mounting and through-bolt holes, on site, at time of hardware installation.
- .4 Reinforce doors where required, for surface mounted hardware. Provide inverted, recessed, spot welded channels to top and bottom of interior doors.
- .5 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.
- .6 Manufacturer's nameplates on doors are not permitted.

3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

storage and installation instructions, and datasheets.

3.02 INSTALLATION GENERAL

- .1 Install doors and frames to CSDMA Installation Guide.

3.03 FRAME INSTALLATION

- .1 Set frames plumb, square, level and at correct elevation.
- .2 Secure anchorages and connections to adjacent construction.
- .3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.
- .4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.
- .5 Caulk perimeter of frames [between frame and adjacent material].

3.04 DOOR INSTALLATION

- .1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 00 - Door Hardware.
- .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.
- .4 Install louvres.

3.05 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.

3.06 GLAZING

- .1 Install glazing for doors in accordance with Section 08 80 50 - Glazing.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Refer to Division 1, General Requirements.
- .2 All Contract Documents form an integral part of this Section.
- .3 Refer to partition types on the drawings (A-103)

1.02 REFERENCE STANDARDS

- .1 Aluminum Association (AA)
 - .1 AA DAF 45-[03(R2009)], Designation System for Aluminum Finishes.
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM C 475-[02(2015)], Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
 - .2 ASTM C 514-[04(2014)], Standard Specification for Nails for the Application of Gypsum Board.
 - .3 ASTM C 557-[03(2009)e1], Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.
 - .4 ASTM C 840-[16], Standard Specification for Application and Finishing of Gypsum Board.
 - .5 ASTM C 954-[15], Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
 - .6 ASTM C 1002-[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.
 - .7 ASTM C 1047-[14a], Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
 - .8 ASTM C 1177/C 1177M-[13], Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
 - .9 ASTM C 1178/C 1178M-[13], Standard Specification for Glass Mat Water-Resistant Gypsum Backing Board.
 - .10 ASTM C 1280-[13a], Standard Specification for Application of Gypsum Sheathing.
 - .11 ASTM C1396/C1396M-[14a], Standard Specification for Gypsum board.
- .3 Association of the Wall and Ceilings Industries International (AWCI)
 - .1 AWCI Levels of Gypsum Board Finish-[GA-214-2015].
- .4 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.
- .5 Green Seal Environmental Standards (GS)
 - .1 GS-11-[2008, 2nd Edition], Paints and Coatings.

- .6 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.
- .7 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-[10], Standard Method of Test of Surface Burning Characteristics of Building Materials and Assemblies.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for gypsum board assemblies and include product characteristics, performance criteria, physical size, finish and limitations.

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section [01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address and applicable standard designation.
- .3 Exercise care in unloading gypsum board materials shipment to prevent damage.
- .4 Storage and Handling Requirements in accordance with ASTM C 840-16:
 - .1 Store gypsum board assemblies materials level flat indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect gypsum board from nicks, scratches, and blemishes.
 - .3 Protect gypsum board from direct exposure to rain, snow, sunlight, or other excessive weather conditions.
 - .4 Protect ready mix joint compounds from freezing, exposure to extreme heat and direct sunlight.
 - .5 Protect from weather, elements and damage from construction operations.
 - .6 Handle gypsum boards to prevent damage to edges, ends or surfaces.
 - .7 Protect prefinished aluminum surfaces with strippable coating. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.
 - .8 Replace defective or damaged materials with new.

1.05 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, clean, frost free surfaces.
- .3 Ventilation: ventilate building spaces as required to remove excess moisture that would prevent drying of joint treatment material immediately after its application.

2 PRODUCTS

2.01 MATERIALS

- .1 Standard board: to ASTM C1396/C1396M-14 [regular, 16 mm thick] 1200 mm wide x maximum practical length, ends square cut, edges bevelled
- .2 Gypsum Wallboard: Acceptable Manufacturers: Canadian Gypsum Co Ltd.; Western Gypsum Products Ltd.; Georgia Pacific or other pre-approved manufacturer.
- .3 Drywall furring channels: 0.5 mm core thickness galvanized steel channels for screw attachment of gypsum board.
- .4 Resilient drywall furring: 0.5 mm base steel thickness galvanized steel for resilient attachment of gypsum board.
- .5 Nails: to ASTM C 514-14.
- .6 Steel drill screws: to ASTM C 1002-14.
- .7 Stud adhesive: to CAN/CGSB-71.25 ASTM C 557.
- .8 Laminating compound: as recommended by manufacturer, asbestos-free.
- .9 Corner Beads: Shall be minimum 28 gauge galvanized sheet steel, beaded angle with perforated flanges; flanges 28 mm (1-1/8") or 32 mm (1-1/4"). Use extended leg bead at external corners of double wallboard application.
- .10 Cornice cap: 12.7 mm deep x partition width, of 1.6 mm base thickness galvanized sheet steel, prime painted] Include splice plates for joints.
- .11 Shadow mould: 35 mm high, snap-on trim, of 0.6 mm base steel thickness galvanized sheet pre-finished in satin enamel, white colour.
- .12 Sealants: in accordance with Section 07 92 00 - Joint Sealants.
 - .1 VOC limit 250 g/L maximum to SCAQMD Rule 1168.
 - .2 Acoustic sealant: in accordance with Section 07 92 00 - Joint Sealants.
- .13 Polyethylene: to CAN/CGSB-51.34, Type 2.
- .14 Joint compound: to ASTM C 475, asbestos-free.

2.02 FINISHING

- .1 Refer to drawing package.
 - .1 Field joints and internal angles shall be reinforced with a suitable paper embedded in joint filler.
- .2 For field joints, corners and exposed screw or nail heads, beads, joint filler shall be mixed and applied in strict accordance with the printed directions of the manufacturer and as follows:
 - .2 First: embed the tape.
 - .3 Second: apply fill coat.
 - .4 Third: apply leveling coat.
 - .5 Finishing Requirements;
 - .6 Provide Level 5 finish to walls and bulkheads
 - .7 Provide level 4 finish for all other areas.
 - .8 Sand all exposed joints, edges, corners, openings, screws, etc. to provide an acceptable finished surface ready for decoration.

2.03 ACCESSORIES

- .1 Corner Beads: Install to all external corners, using longest practical lengths. Fix at maximum 152 mm (6") o.c. (alternate sides).
- .2 Casing Beads and Miscellaneous Trim: Install to all openings and wherever gypsum wallboard abuts a dissimilar material, using longest practical lengths; secure at max. 305 mm (12") o.c.
- .3 At external corners of double layer application, use extended leg beads and anchor through both layers of drywall. Use angle section on external corner of first layer.
- .4 Use screws fixing for applying external corner beads.
- .5 Install partition closures where detailed on the drawings as "partition closure," in accordance with the manufacturers written instructions.
- .6 Special Reveal: Screw fasten reveal to steel studs. Use the longest practical lengths c/w butt joints. Touch-up all joints and lap gypsum board over reveal as detailed

3 EXECUTION

3.01 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 DCC Representative.
- .2 Inform DCC 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.

3.02 ERECTION

- .1 Erect gypsum board vertically or horizontally, whichever results in fewer end joints. Locate end joints over supporting members.
- .2 Arrange end joints to occur on different studs on opposite sides of a partition. Keep end joints away from prominent locations and central portions of ceilings.
- .3 Locate vertical joints at least 305 mm (12") from the jamb lines of openings.
- .4 Hold board firmly against the framing members while installing.
- .5 Perimeter screws shall not be less than 10 mm (3/8") nor more than 13 mm (1/2") from edges and ends and shall be opposite the screws of adjacent boards.
- .6 Screws shall be driven with a power screw gun and set with countersunk head slightly below the surface of the gypsum board. Paper face of the gypsum board shall not be broken by the screw.
- .7 Space screws for fire rated gypsum board 203 mm (8") o.c. at gypsum board edges and 305 mm (12") o.c. on gypsum board field on walls, 203 mm (8") o.c. on all ceilings.
- .8 Space screws for other applications at 305 mm (12") o.c. on the field and edges.

3.03 APPLICATION

- .1 Apply gypsum board after bucks, anchors, blocking, sound attenuation, electrical and mechanical work have been approved.
- .2 Apply singlelayer gypsum board to metal] furring or framing using screw self tapping fastenersMaximum spacing of screws 300 mm on centre.
 - .1 Single-Layer Application:
 - .1 Apply gypsum board on ceilings prior to application of walls to ASTM C 840-16.
 - .2 Apply gypsum board on walls vertically or horizontally, providing sheet lengths that will minimize number of board edges or end joints.
- .3 Apply 12 mm diameter bead of acoustic sealant continuously around periphery of each face of partitioning to seal gypsum board/structure

junction where partitions abut fixed building components. Seal full perimeter of cut-outs around electrical boxes, ducts, in partitions where perimeter sealed with acoustic sealant.

- .4 Install ceiling boards in direction that will minimize number of end-butt joints. Stagger end joints at least [250] mm.
- .5 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.
- .6 Install gypsum board with face side out.
- .7 Do not install damaged or damp boards.
- .8 Locate edge or end joints over supports. Stagger vertical joints over different studs on opposite sides of wall.

3.04 INSTALLATION

- .1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure at 150 mm on centre.
- .2 Install casing beads around perimeter of suspended ceilings.
- .3 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated
- .4 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.
- .5 Install shadow mould at gypsum board/ceiling juncture [as indicated]. Minimize joints; use corner pieces and splicers.
- .6 Provide continuous polyethylene dust barrier behind and across control joints.
- .7 Locate control joints at changes in substrate construction
- .8 Install control joints straight and true.
- .9 Ensure that screws or nails are properly applied in process of attaching gypsum board to framing without damaging of gypsum board edges and ends.
- .10 Construct expansion joints [as detailed], at building expansion and construction joints. Provide continuous dust barrier.
- .11 Install expansion joint straight and true.
- .12 Install cornice cap where gypsum board partitions do not extend to ceiling.

- .13 Fit cornice cap over partition, secure to partition track with two rows of sheet metal screws staggered at 300 mm on centre.
- .14 Splice corners and intersections together and secure to each member with 3 screws.
- .15 Install access doors to electrical and mechanical fixtures specified in respective sections.
 - .1 Rigidly secure frames to furring or framing systems.
- .16 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.
- .17 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 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.
- .18 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.
- .19 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board, invisible after surface finish is completed.
- .20 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.
- .21 Completed installation smooth, level or plumb, free from waves and other defects and ready for surface finish.
- .22 Apply one coat of white primer sealer over surface to be textured. When dry apply textured finish in accordance with manufacturer's instructions.
- .23 Mix joint compound slightly thinner than for joint taping.
- .24 Apply thin coat to entire surface using trowel or drywall broad knife to fill surface texture differences, variations or tool marks.
- .25 Allow skim coat to dry completely.
- .26 Remove ridges by light sanding or wiping with damp cloth.

3.05 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning
 - .1 Leave Work area clean at end of each day.
 - .2 Final Cleaning: upon completion remove surplus materials,

rubbish, tools and equipment in accordance with Section 01 74 11
- Cleaning.

3.06 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

1 GENERAL

1.01 GENERAL

.1 GENERAL REQUIREMENTS

- .1 Refer to Division 1, General Requirements.
- .2 All Contract Documents form an integral part of this Section.
- .3 Refer to drawings for areas to be left uncompleted (fit-out) work. These areas will be completed under a Separate Contract at a later date.
- .4 Refer to partition types in the Partition Type Schedule.

1.02 REQUIREMENTS INCLUDED

- .1 Furnish all labour, material, services and equipment necessary for the supply and installation of steel studs and furring as indicated on the drawings, schedules and as specified herein, including but not necessarily limited to the following:
 - .1 Steel studs and tracks for exterior and interior gypsum wallboard walls, partitions and office cubicles where indicated or scheduled.
 - .2 Steel stud furring for interior gypsum wallboard finishes and gypsum wallboard fireproofing enclosures, including 'Z' bars, strapping and Hat channels.
 - .3 Ceiling suspension system for interior suspended gypsum wallboard flat ceilings, dropped ceilings, bulkheads, cove light bulkheads, cove light valances, fascias and soffits
 - .4 Steel stud blocking, furring, reinforcing channels and sheet steel backing within drywall walls and partitions, and furring for attachment of anchors for fixtures or accessories anchored to such partitions or furring.
 - .5 Installation of access doors in suspended gypsum board walls and ceilings.
 - .6 Steel backing plates on steel studs for anchoring handrail brackets, wall stops, and grab bars.
- .2 Include also the following as work to be done under this Section:
 - .1 Unloading, moving into position and installation of pressed steel door frames in interior drywall steel stud partitions.
 - .2 Installation of valve and service point access panels in interior steel stud partitions and ceilings.
 - .3 Layout of all steel stud partitions and door frames within partitions.
 - .4 Installation of hollow metal frames, and interior hollow metal windows in steel stud walls

1.03 RELATED WORK SPECIFIED ELSEWHERE.

- .1 Rough Carpentry: Section 06 10 00
- .2 Hollow Metal Doors & Frames: Section 08 11 00.
- .3 Gypsum Wallboard: Section 09 25 00.

1.04 QUALITY ASSURANCE

- .1 All reference to standards published by CSA, CGSB, ASTM, Underwriters associations, trade associations or manufacturers, or to national or local building codes shall be to the latest printed edition of any such standards or codes.

1.05 PRODUCT DELIVERY, STORAGE & HANDLING

- .1 Store packaged material in original containers with manufacturer's seals and labels intact.
- .2 Prevent damage to materials during handling and storage. Keep materials under cover and free from dampness.

1.06 JOB CONDITIONS

- .1 Report any unsatisfactory conditions in writing to the Contractor.
- .2 Start no work until conditions are satisfactory. Commencement of work shall imply acceptance of conditions.
- .3 Protect work of this Section against damage by other Sections.
- .4 Protect work of other Sections against damage resulting from work of this Section. Repair and make good to approval of the Departmental Representative, any damage to other Sections caused by this work.
- .5 Carefully co-ordinate this Section of the work with the work of other trades on which it is in any way dependent. Ensure the correct positioning and installation of other work with which steel stud partitions have to align and upon which the work of subsequent trades is dependent.
- .6 Ensure that all bottom track fastenings only penetrate the floor slab to a maximum depth of 1 inch (25 mm).

1.07 FIELD DIMENSIONS

- .1 Before work is commenced, examine adjoining work on which work of this trade is in any way dependent and make any necessary adjustments to enable work to fit.
- .2 Verify measurements on the job site as required so that any preassembled work fits the job conditions.
- .3 The steel stud installer shall keep a copy of the AWCC Specification Standards Manual available for reference at the project site.

1.08 SUBMITTALS

- .1 Submit shop drawings to the Departmental Representative of load bearing steel studs walls, stud anchorage and ceiling suspension systems only.
- .2 Submit shop drawings in accordance with General Conditions as may be amended under the Supplementary Conditions.
- .3 The Departmental Representative who sealed the shop drawings, or their designated representative, shall provide field reviews of the installation. The Departmental Representative; or their designated representative, shall provide a signed and sealed letter (Letter of Assurance) to the Departmental Representative stating they provided field reviews and that the above installations substantially comply with the design and shop drawings sealed by them and with any field modifications so authorized by them.
- .4 Submit cut-sheets and MSDS (Material Data Safety Sheets), for each product used in the building.
- .5 Submit Materials Information Tables. (Refer to the sample form at the end of Section 01 30 00).

2 PRODUCTS

2.01 INTERIOR STEEL STUDS:

- .1 Shall be C-shaped steel studs conforming to CAN/CGSB-7.1- M95 with zinc coating to ASTM 525. Steel studs shall be roll formed from ASTM A446 Grade A steel with minimum yield point of 228 MPa for 1.2 mm material and thinner, and Grade D steel with minimum yield point of 345 MPa for 1.5 mm material and thicker, as follows;
 - .1 Zinc Coating for 0.49 mm studs to be Z120.
 - .2 Zinc Coating for 0.88 mm studs to be Z180.
 - .3 Flange shall be not less than 1-1/4" (32 mm) wide, edge to be bent back 90 degrees and doubled over to form a minimum 3/16" (4.8 mm) return. Fixing face to be knurled and have pre-punched pass through holes for services. Length to suit, minimum of splicing allowed.
 - .4 Width: Shall be 2-1/2", 3-5/8" & 6" (63.5, 92 mm & 152 mm) as scheduled and indicated.
- .2 Gauges shall be as scheduled on the Architectural drawings. Steel studs shall be colour coded for gauge to CSSBI Lightweight Steel Framing Manual Appendix 'B.'
- .3 Stud Runner Channel (Tracks): Floor and ceiling runner channels to be fabricated from the same materials as studs; leg design minimum 1-1/4" (32 mm) high, slightly bent in to hold studs; widths to suit. Use 0.91 mm, 2-1/2" (63.5 mm) deep leg top track as required for deflection of structure at interior partitions, as detailed.
- .4 Stud Fasteners: Manufacturer's standard, suitable for intended application. Ensure that all bottom track fastenings only penetrate the floor slab to a

maximum depth of 1 inch (25 mm).

- .5 Drywall Furring Channels: Hat sections shall be roll-formed from 0.53 mm hot-dipped galvanized steel, having a Z180 zinc coating to ASTM 525; dimensions 67 mm (2- 5/8") wide by 22 mm (7/8") deep; face to knurled. 'Z' bars to be 76 mm (3") or as detailed on the drawings.

- .6 Drywall Ceiling Suspension Framing:

- .1 Hangers: Shall be 9 ga. galvanized steel wire or 3/16" diameter zinc or cadmium plated steel rods.
- .2 Tie Wire: Shall be 18 ga. galvanized steel wire
- .3 Hangers: Ceiling area supported.

Area

Size of Hangers

Up to 12.5 sq.ft (1.2 m2)	9 ga. (3.7 mm) diameter galvanized wire
Up to 16 sq.ft (1.48 m2)	3/16" (4.8 mm) diameter rods

- .4 Inserts: shall be able to develop full strength of hangers.

Maximum Spacing
of Hangers

Maximum Spacing
of Runners

Weight of
Runner Channels

3'-0" (914 mm)	4'-0" (1200 mm)	1-1/2" x 1/2" x 17 ga.
4'-0" (1200 mm)	3'-0" (914 mm)	38 mm x 12 mm x 1.36 mm.

- .5 Channels shall be cold formed or hot rolled steel, rust inhibitor coated for interior work.
- .6 Drywall Cross Furring Members: For drywall ceilings shall be drywall furring channels as specified herein.

2.02 STEEL BACKING STRIPS

- .1 Steel Strips: Shall be 18 ga. thick galvanized sheet steel; 300mm (12") wide x full length of casework; behind wall stops 0.91 mm galvanized sheet, 300 mm wide x 450 mm (6" x 18") long to span between two (2) studs.

3 EXECUTION

3.01 DEFLECTION ALLOWANCES

- .1 Deflection spaces between exterior steel studs and interior steel stud wall partitions and the structural floor and roof components are essential to allow for deflection of the steel stud framing components. Such spaces shall be provide at top of exterior and interior steel stud wall and partitions, at junction with structural members, by use of movement joints as detailed or required and as hereinafter specified.

3.02 STEEL STUDS GENERAL

- .1 The layout of all drywall steel stud partitions and furring shall be the responsibility of the Contractor.
- .2 The Contractor shall notify the Departmental Representative when partition locations have been located and marked on the floor. The Departmental Representative will review and confirm those locations before proceeding with the erection of walls and partitions.
- .3 The sequence of installation of the drywall steel stud partitions and furring shall be closely coordinated with the various trades whose materials and/or services are being installed within the partitions and metal furring. Sequence of installation shall be in accordance with the requirements of the Construction Schedule.
- .4 An allowance shall be made in anchoring the floor track to accommodate tolerance in concrete floor slab of 1/8" in 10'-0" (3.2 mm in 3000 mm). Ensure that all bottom track fastenings only penetrate the floor slab to a maximum depth of 1 inch (25 mm).

3.03 INTERIOR STEEL STUDS

- .1 Layout: the steel stud walls and partition types are designated on the drawings. Refer to Schedule of Wall Types on the partition type schedule for details of the various types.
- .2 The steel stud drywall partition height requirements shall be as indicated on the wall schedule or drawings.
- .3 Install runner channels (track) at floor and ceiling, accurately align according to partition layout;
 - .1 Secure at centers at maximum 24" (600 mm) o.c. using shield screws, or power driven fasteners
 - .2 At concrete slabs or suitable screws at metal framing. Ensure that all bottom track fastenings only
 - .3 Penetrate the floor slab to a maximum depth of 1 inch (25 mm).
 - .4 Where ceiling track is to be anchored to structure, use special track with extended sides to allow for deflection, as detailed. Cut studs shorter than partition height.
 - .5 At partition corners, extend one runner to end of corner and butt other runner; allow clearance for wallboard thickness; do not miter runners.
- .4 Fix studs to runners by screws, crimping, or welding through each stud.
- .5 Install steel studs vertically at 16" or 12" (400 mm or 300 mm) o.c., to suit size of gypsum wallboard used, unless otherwise indicated or scheduled.
- .6 Splice studs where necessary by nesting and lap minimum 8" (200 mm); fix with minimum one screw per stud flange.
- .7 Stud height and spacing limitations to be in accordance with stud

manufacturer's recommendations.

- .8 Additional Framing & Bracing: Install additional studs as detailed, or as required at all partition intersections, openings or termination with dissimilar materials. Place studs not more than 2" (50 mm) from abutting walls, opening and each side of corners.
- .9 Where horizontal runs of service lines are to be installed, arrange with applicable trades to install lines simultaneously with partition. If standard openings in studs are too small for service lines, splice studs together as necessary, splice piece to be minimum 12" (300 mm) longer than height of the cutout; splice as specified above.
- .10 Refer to drawings and detail drawings for various conditions at specific locations.
- .11 For partitions requiring acoustical separation where indicated on the drawings, apply a bead(s) of acoustical sealant at floor, wall and ceiling locations at junctions with adjacent materials. Refer to the Acoustical Report.

3.04 FRAMED OPENINGS & INSTALLATION OF STEEL FRAMES

- .1 Reinforce and frame all openings in steel stud walls and partitions to adequately carry loads, by the use of additional framing members and bracing as specified herein and/or detailed on drawings, and as recommended by manufacturer of steel studs.
- .2 Frame openings and reinforce as required for all recessed items in steel stud walls and partitions and ceilings including but not necessarily limited to, mechanical and electrical equipment, electrical cabinets and boxes, fire hose cabinets, light fixtures, diffusers, speakers and other recessed fixtures as indicated or required.
- .3 Provide and install two (2) 0.49 mm boxed studs at each side of door openings, pressed steel framed sidelight and interior window openings in interior steel stud partitions and other openings exceeding one stud space. Extend boxed studs on each side of openings from floor to underside of structure over.
- .4 Install runner channel at head and/or sill or openings to accommodate intermediate studs. Each end of runner channel, cut out flanges, turn up web and screws to studs. Install intermediate studs above and/or below openings in same manner and spacing as specified above.
- .5 Install 1 door frames and pressed steel sidelight and window frames , plumb and square, in steel stud walls and partitions. Screw-fix frame anchor clips to jamb, header and/or sill members; fixing to be adequate to prevent movement of frame relative to stud and to manufacturer's directions, shop drawings and ULC requirements. Fix door frame to floor using floor anchor clips, fixing to be as required by structure and to manufacturer's directions, reviewed shop drawings and ULC or WHI requirements, where applicable.
- .6 Both sides of door frames to be in contact with substrate. Notify Contractor of any unacceptable levels or planeness of substrate prior to door

installation.

3.05 VERTICAL & HORIZONTAL FURRING

- .1 Provide all vertical and horizontal steel stud furring and furring channels as detailed and as required for gypsum wallboard finish, complete with furring studs and/or furring channels specified. Secure to structure.
- .2 Space furring channels at maximum 12" (300 mm) o.c. or as detailed. For channels installed horizontally, attach a furring channel not more than 4" (100 mm) from both floor and ceiling lines. For channels installed vertically, attach a furring channel not more than 4" (100 mm) from abutting walls.

3.06 CEILING SUSPENSION SYSTEM

- .1 Support grillage for suspended interior gypsum wallboard ceilings using hangers; suspend independent of walls, columns, pipes and ducts.
- .2 Securely anchor all hangers to structural elements.
- .3 Install hangers using drilled type anchors.
- .4 Space hangers at maximum 48" (1200 mm) centers along main carrying channels and not more than 6" (150 mm) from ends.
- .5 Space main carrying channels at maximum 36" (900 mm) o.c. and not more than 6" (150 mm) from perimeter walls. Splice main carrying channels by lapping minimum 12" (300 mm) and wire tie each end with double loops of 16 gauge diameter galvanized tie wire, 1" (50 mm) from each end of overlap.
- .6 Fix main carrying channels to wire or rod hangers by saddle-tying or wrapping around main channels so as to prevent turning or twisting of the channels and to develop full strength of the hangers.
- .7 Space drywall furring channels as applicable transverse to main carrying channels at maximum 16" (400 mm) o.c. Secure at each support with approved clip or saddle tie with minimum 2 loops of 1.51 mm diameter galvanized tie wire, 1" (25 mm) from each end of overlap.
- .8 At openings, including ceiling access panels, in ceiling suspension system that interrupt the main carrying channels or furring channels, reinforcing grillage with 3/4" (19 mm) cold rolled channels, wire tie to top and parallel to main runner channels, extend 3/4" (19 mm) channels minimum 12" (300 mm) past each end of openings.

3.07 BACKING & REINFORCING

- .1 Provide and install all backing plates and/or reinforcing within interior steel stud drywall partitions for items being hung from or anchored to such partitions or furring.
- .2 Backing or reinforcing to be provided shall include, but is not necessarily limited to, those for wall mounted millwork, control joints, wall stops and grab bars with required attachment as designated by the manufacturer of washroom accessories.

- .3 Backing of reinforcing shall be as specified and/or detailed or as recommended by the manufacturer of steel stud system for each type and weight of item. Prior review of all backing shall be received from the Departmental Representative before gypsum wallboard is installed.
- .4 Attachments for securing mechanical, electrical and other service outlets will be supplied and installed under those respective divisions.

3.08 ADJUST & CLEAN

- .1 Clean thoroughly and remove all excess materials from other finished surfaces.
- .2 Promptly remove all excess and waste material as work proceeds and at completion.

END OF SECTION

1 GENERAL

1.01 SUMMARY

.1 Section Includes:

- .1 Material and installation criteria for glass fibre reinforced ceiling.

1.02 REFERENCES

.1 Factory Mutual FM:

- .1 FM Approval 4880 - Class 1 Fire Rating of Insulated Wall or Wall and Roof/Ceiling Panels, Interior Finish Materials or Coatings, and Exterior; Wall Systems.

1.03 SUBMITTALS

- .1 Product Data: Submit Manufacturer's printed product literature, specifications and data sheet in accordance with Section - 01 33 00.
- .2 Shop Drawings: Showing layout, profiles and product components, including anchorage, accessories, finish colors, patterns and textures. Indicate location and dimension of joints and fastener attachment. Indicate the location of main tees and cross tees.
- .3 Two samples of each grid member and attachment clip.
- .4 Certificates: Product certificates signed by Manufacturer certifying materials comply with specified performance characteristics, criteria and physical requirements.
- .5 Test and Evaluation Reports: Showing compliance with specified performance characteristics and physical properties.
- .6 Manufacturer's Instructions: Manufacturer's Installation Guide

1.04 MAINTENANCE MATERIAL

- .1 Extra Materials: Deliver to Principal extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Division 01 Closeout Submittals Section.
- .2 Quantity: Furnish quantity of tiles and hold down clips units equal to 5 percent of amount installed.
- .3 Delivery, Storage and Protection: Comply with Principal's requirements for delivery, storage and protection of extra materials.

1.05 QUALITY ASSURANCE

- .1 Provide grid and clips and panels only from the Manufacturer specified to ensure warranty.
- .2 Manufacturer Qualifications:

.1 Provider of advanced installer training.

.3 Installer Qualifications:

.1 Employer of workers for this Project who are competent in techniques required by Manufacturer for installation indicated.

.4 Mock-Ups: Install at project site a job mock-up using acceptable products and Manufacturer approved installation methods. Obtain Departmental Representative approval and acceptance of finish color, texture, pattern, trim, fasteners and quality of installation.

1.06 DELIVERY, STORAGE AND HANDLING

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

.2 Delivery of Materials: Deliver grid and accessories in Manufacturer's unopened cartons.

.3 Storage of Materials: Store cartons in a dry place at the project site.

1.07 PROJECT CONDITIONS

.1 Installation shall not begin until building is enclosed, permanent heating and cooling equipment is in operation, and residual moisture from plaster, concrete or terrazzo work has dissipated.

.2 During installation and for not less than 48 hours before, maintain an ambient temperature and relative humidity similar to what will be the normal operating conditions of the room.

1.08 WARRANTY

.1 Manufacturer's standard form in which Manufacturer agrees to repair or replace GFRP panels that fail within specified warranty period.

.2 Failures shall include, but not be limited to substantial defects in material and workmanship, rotting, rusting, corrosion, development of structural surface cracks, or requiring painting or refinishing.

.3 Warranty Period: 24 months from date of Substantial Completion.

2 PRODUCTS

Materials: as required to achieve specified performance criteria; functionally compatible with adjacent materials and components.

2.01 CEILING GRID

.1 Basis of design: Kemlite Sanigrid II manufactured by Crane Composites, or equivalent.

- .2 Components:
 - .1 Wall Angles: 4m length fastened directly to the wall with Kemlite nylon drive rivets.
 - .2 Hanger Wire: Provided by others, Manufacturer's standard; secured with stainless steel anchors.
 - .3 Main Runners: 3.7m, notched on 0.6m centers.
 - .4 Cross Tee: 1.2m, 0.62m, and 0.62m lengths, pre-notched ends.
 - .5 Connector Clip: Joins main runners.
 - .6 Holddown Clips: Provide holddown clips (Part #C-24) for use with ceiling panels up to 7.1mm thick; and provide holddown clips (Part #C-25) for use with ceiling panels 7.1mm-12.7mm.
 - .7 Wall Anchor (Part #C-20): Secures main runner and cross tees to wall angle.
- .3 Colour:
 - .1 Grid Members: Manufacturer's standard white
 - .2 Clips: Manufacturer's standard white.
- .4 Properties:
 - .1 Sanigrid II products shall meet or exceed the following properties:
 - .2 Meets Class A finish requirements: Flame spread of less than 25, smoke developed less than 450 per ASTM E-84 latest version.

2.02 GLASS FIBRE REINFORCED PLASTIC (GFRP) PANELS

- .1 Basis of specification: Kemply Aluminium Composite Core Panel (ACP), or equivalent.
- .2 General: Fiberglass reinforced plastic panels
- .3 Colour: 85 White.
- .4 Surface Finish: 1.9mm Glasboard FSI (double sided), smooth.
- .5 Nominal thickness: 6.5mm.
- .6 Ceiling Panel Size: 600x600. Coordinate with reflected ceiling plan.
- .7 Performance:
 - 1. Scratch Resistance: Barcol Hardness of 45.
 - 2. Abrasion Resistance: Taber Abrasion Test using CS-17 abrasive wheels with 1000 g weight. Panels shall exhibit weight loss after 25 cycles of no more than 0.038 percent.
 - 3. Impact Strength: 4.0 in-lb (0.21 J) showing no visible damage on finish side.
- .8 Product Identification: Finish side identification and confirmation of meeting Class A interior finish requirements after installation and while in service, without labels.

3 EXECUTION

3.01 PREPARATION

- .1 Ensure that all HVAC, electrical, plumbing and similar work above the ceiling level has been completed.

3.02 INSTALLATION

- .1 Do all cutting with carbide tipped saw blade.
- .2 Install per Manufacturer's printed instructions.

3.03 CLEANING

- .1 Remove protective coverings from finished surfaces and components.
- .2 Repair or replace any installed products that have been damaged.
- .3 Clean installed panels in accordance with Manufacturer's instructions prior to Owner's acceptance.
- .4 Remove and lawfully dispose of construction debris from project site.

END OF SECTION

1 GENERAL

1.01 GENERAL REQUIREMENTS

- .1 Refer to Division 1, General Requirements.
- .2 All Contract Documents form an integral part of this Section.
- .3 Refer to partition types on the drawings
- .4 Refer to Code Compliance Plans for rated fire separations.

1.02 REFERENCES

- .1 American Society for Testing and Materials (ASTM International)
 - .1 ASTM F1303, Specification for Sheet Vinyl Floor Covering with Backing.
 - .2 ASTM F1913, Standard Specification for Vinyl Sheet Floor Covering Without Backing.

1.03 SUBMITTALS

- .1 Submit samples, and product data submittals in accordance with Section 01300 - Submittals.
- .2 Samples:
 - .1 Submit duplicate 300 x 300 mm sample pieces of sheet material, and 300 mm long piece of edge strips.

1.04 QUALITY ASSURANCE

- .1 Installer: company or person specializing in resilient sheet flooring that will install per manufacturer's instructions.

1.05 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- .2 Store materials protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
- .3 Store rolls in dry locations, stand rolls on end. Protect and secure rolls from falling.

1.06 ENVIRONMENTAL REQUIREMENTS

- .1 Maintain air temperature and structural base temperature at flooring installation area between 18° and 38° C for 48 hours before, during and 72 hours after installation.

1.07 WARRANTY

- .1 Provide warranty against defects in material and workmanship, in accordance with General Conditions, except for two years.

1.08 EXTRA MATERIALS

- .1 Provide extra materials of resilient sheet flooring and adhesives in accordance with Section 01700 - Closeout Submittals.
- .2 Provide resilient sheet flooring amounting to 5% of sheet flooring installed on project for each type, color, and pattern of flooring installed for maintenance use. Provide remnants over 1 m2 of each colour for maintenance use.
- .3 Extra materials to be in one piece and from same production run as installed materials.
- .4 Clearly identify each roll of sheet flooring and each container of adhesive.
- .5 Deliver to Owner, upon completion of the work of this section.
- .6 Store where directed by Owner.

2 PRODUCTS

2.01 MATERIALS

- .1 SVF-1: Sheet vinyl, homogeneous, single layer vinyl flooring to ASTM F 1913, polyurethane reinforced wearing surface, 2 mm thick, sheet width 1.83 m. Seaming method - heat welded. Surface shall not require sealers, waxes or polishes. Maintenance requirement to be dry buffing, with no polish treatment, sealers, waxes or spray buff solutions. Allow for up to four colours selected by Departmental Representative.
 - .1 Basis of Design: Armstrong Medintech, or equivalent.
- .2 Primers and adhesives: water-resistant, of types recommended by resilient flooring manufacturer for specific material on applicable substrate, above, on or below grade.
 - .1 Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- .3 Sub-floor filler and leveler: trowelable, non-shrinking, water resistant, alkali mould resistant, cementitious underlayment, two component compound consisting of liquid latex and Portland cement base, both supplied by same manufacturer.

- .4 Heat welding rods: solid strand product for sheet vinyl, manufacturer's standard for specific material joint treatment, colour matched to Departmental Representative approval. Allow for four colours.
- .5 Integral-Flash cove base accessories:
 - .1 Filler cove strips: 20 mm radius, required for specific material installation provided or approved by manufacturer.
 - .2 Metal edge strips. Aluminum extruded, smooth, mill finish stainless steel with lip to extend under floor finish, shoulder flush with top of adjacent floor finish.

3 EXECUTION

3.01 EXAMINATION

- .1 Examine substrates, with installation subcontractor present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.
- .2 Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor coverings.
- .3 Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- .1 Prepare substrates according to manufacturer's written recommendations to ensure adhesion of floor coverings.
- .2 Remove substrate coatings and other substances that are incompatible with floor covering adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- .3 Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with sub-floor filler.
- .4 Clean floor and apply filler; trowel and float to leave smooth, flat hard surface. Prohibit traffic until filler cured and dry.
- .5 Prime concrete slab to resilient flooring manufacturer's printed instructions.
- .6 Where flooring of different thickness abut apply filler to build a smooth gradual ramping so top of finished flooring meets top of adjacent material.
- .7 Move floor coverings and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

- .8 Do not install floor coverings until they are same temperature as space where they are to be installed.

3.03 APPLICATION: FLOORING

- .1 Unroll sheet vinyl floor coverings and allow them to stabilize before cutting and fitting.
- .2 Provide a high ventilation rate, with maximum outside air, during installation, and for 48 to 72 hours after installation. If possible, vent directly to the outside. Do not let contaminated air recirculate through a district or whole building air distribution system.
- .3 Apply adhesive uniformly using recommended trowel. Do not spread more adhesive than can be covered by flooring before initial set takes place.
- .4 Lay sheet flooring as follows:
- .1 With seams parallel to building lines to produce a minimum number of seams. Place seams in inconspicuous and low-traffic areas, at least 150 mm away from parallel joints in flooring covering substrates.
- .2 Maintain uniformity of floor covering direction.
- .3 Match edges of floor coverings for color shading at seams.
- .4 Border widths minimum 1/3 width of full material.
- .5 Run sheets in direction of traffic. Double cut sheet joints and heat weld according to manufacturer's printed instructions.
- .6 As installation progresses, and after installation roll flooring in two directions with 45 kg minimum roller to ensure full adhesion.
- .7 Cut flooring neatly around fixed objects.
- .8 Install feature strips and floor markings where indicated. Fit joints tightly.
- .9 Install flooring in pan type floor access covers. Maintain floor pattern.
- .10 Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and use welding bead to permanently fuse sections into a seamless floor covering. Prepare, weld, and finish seams to produce surfaces flush with adjoining floor covering surfaces.
- .11 Continue flooring over areas which will be under built-in furniture.
- .12 Continue flooring through areas to receive movable type partitions without interrupting floor pattern.

.13 Terminate flooring at centreline of door in openings where adjacent floor finish or colour is dissimilar.

.14 Install metal edge strips at unprotected or exposed edges where flooring terminates.

3.04 INTEGRAL FLASH COVE BASE

- .1 Where flooring and base material are indicated as same material in Room Finish Schedule cove base material up vertical surfaces.
- .2 Support floor coverings at horizontal and vertical junction by cove strip.
- .3 Butt at top against cap strip. Cap strips shall be provided in maximum length as possible to minimize joints.
- .4 Use same adhesive as for floor areas.
- .5 At flush door frames and other projections, taper cove former 300mm back from frame to provide flush cove at face of frame.
- .6 External corners: fit coved outside corners with "butterfly inset" wrapped around corner at 45° angle. Starting from base of corner and joined on each side to flash coved material. Heat weld joints.
- .7 Internal corners: fit coved inside corners with "half butterfly" formed by cutting material at 45° angle from base of coving sharply tucked into inside corner, wrapped and joined to coved material facing non-prominent side wall. Heat weld joints.

3.05 CLEANING

- .1 Perform the following operations immediately after completing floor covering installation:
 - .1 Remove adhesive and other blemishes from floor covering surfaces.
 - .2 Sweep and vacuum floor coverings thoroughly.
 - .3 Damp-mop floor coverings to remove marks and soil.
 - .4 Do not wash floor coverings until after time period recommended by manufacturer.
 - .5 Apply two coats manufacturer's recommended commercial floor polish.

3.6 PROTECTION

- .1 Protect floor coverings from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

.2 Prohibit traffic on floor for 48 hours after installation.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Refer to Division 1, General Requirements.
- .2 All Contract Documents form an integral part of this Section.
- .3 Submit cut-sheets and MSDS (Material Data Safety Sheets), for each product used in the building.

1.2 REQUIREMENTS INCLUDED

- .1 Furnish all labour, material, services and equipment necessary for completion of field applied painting work as indicated on the drawings and schedules and as specified herein.
- .2 Examine the specifications for the various other Trades and be thoroughly familiar with all their provisions regarding painting.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- .1 Metal Doors & Frames: Section 08 11 00.
- .2 Gypsum Wall Board: Section 09 25 00.
- .3 The following painting work will be done under Division 15, Mechanical
 - .1 Sealing of insulation covering.
 - .2 Colour code banding.
 - .3 Identification Stenciling

1.4 SURFACES NOT REQUIRED TO BE PAINTED

- .1 The following factory finished items do not require to be painted:
 - .1 Pre-finished sheet metal flashing.
 - .2 Aluminum entrances and curtain wall.
 - .3 Pre-finished exterior intake and discharge louvres. Pre-finished interior diffusers.
- .2 The following surfaces are not required to be painted:
 - .1 Surfaces scheduled as unexposed, or unfinished Interior of duct shafts
 - .2 Stainless steel.
 - .3 Surfaces scheduled as being taped, filled and sanded only.

1.5 QUALITY STANDARDS

- .1 Product environmental requirements, preparation of surfaces and application shall be in accordance with the applicable chapters of The Master Painters Institute MPI and MPDA Architectural Painting Specification Manual (2003).

- .2 A copy of The Master Painters Institute and Architectural Painting Specification Manual shall be kept on site during the duration of the painting work.
- .3 Should modifications to these standards occur in this specification, then the modifications shall govern.
- .4 All work, unless otherwise specified, shall be to MPI/MPDA Premium Grade.
- .5 The paint products of the paint manufacturer shall be as listed in the MPI/MPDA Manual (2003), under Paint Product Recommendation section.

1.6 SUBMITTALS

- .1 Furnish the Departmental Representative with full identification of the make of paints selected for this Project from the approved manufacturers. Submit copies of manufacturer's printed trade specifications and installation procedure for each type of paint to be used.
- .2 The Departmental Representative will determine all colours and patterns and issue the Contractor with a minimum of two (2) sets of colour cards and a schedule showing where the various colours and finishes shall be applied. Provide duplicate draw-down cards for all colours selected for the project prior to starting work. On-site work to match selected samples. No extra will be considered for repainting surfaces which do not conform.
- .3 Submit cut-sheets and Material Safety Data Sheet (MSDS) for each paint or coating used in the project, highlighting VOC limits and chemical component limits. Refer to Section 01300.

1.7 PRODUCT DELIVERY, STORAGE & HANDLING

- .1 Paint materials shall be delivered to job site in manufacturer's unbroken sealed containers.
- .2 Containers shall be labeled by manufacturers giving name, type of paint, important constituents of the paint (such as alkyd, titanium, zinc, acrylate esters, etc.), colour of paint and instructions for reducing.
- .3 Store and mix materials in adequate storage areas assigned for this purpose and take necessary precautions to prevent fire or spontaneous combustion.
- .4 Paint and materials shall be stored in minimum ambient temperature of 7°C.
- .5 Area to be well ventilated and heated and equipped with fire extinguisher.
- .6 Provide and use suitable metal pans in which mixing pails shall be placed.
- .7 Mixing shall be done in these pans only.

- .8 Take all necessary precautionary measures to prevent fire hazards and spontaneous combustion.
- .9 Where toxic materials and both toxic and explosive solvents are used, appropriate precautions and no smoking must be taken as a regular procedure.

1.8 ENVIRONMENTAL REQUIREMENTS

- .1 Temperatures and moisture content of the surfaces shall conform to the following:
 - .1 Moisture of Surfaces: Tests shall be by an electronic moisture meter.
 - .2 Wallboard: Maximum moisture content to be 12 percent.
 - .3 Temperatures: No painting shall be performed when temperatures on the surfaces or of the air in the vicinity of the painting work are below 7°C.
- .2 The minimum temperatures allowed for latex paints shall be 7°C (interior work) and 10°C (exterior work) UNLESS specifically approved by the specifying body.
- .3 Painting and decorating work shall not proceed unless a minimum of 15 candle power per square foot lighting is provided on the surfaces to be painted.
- .4 All areas where painting and decorating work is proceeding require adequate continuous ventilation and sufficient heating facilities to maintain temperatures above 7°C for 24 hours before and after paint application.
- .5 On exterior work, do not paint during temperatures below 7°C or on surfaces where condensation has or is likely to form (unless specifically formulated paints are used).

1.9 GUARANTEE/INSPECTION

- .1 Furnish either the local MPI/MPDA Accredited Quality Assurance Association two (2) year guarantee, or alternatively, a 100% two (2) year Maintenance Bond- both in accordance with MPI/MPDA Architectural Painting Specification Manual requirements. The maintenance Bond shall warrant that all painting work has been performed in accordance with the MPI/MPDA Architectural Painting Specification Manual (latest edition), requirements. The cost of the Guarantee or Bond shall be included in the tender price for this Section.
- .2 All painting and decorating work shall be in accordance with MPI/MPDA Architectural Painting Specification Manual requirements and shall be inspected by the local MPI/MPDA Accredited Quality Assurance Association's Paint Inspection Agency (inspector), whether using either the MPI/MPDA Accredited Quality Assurance Association's guarantee or the Maintenance Bond option. The cost of such inspections for either the Guarantee or Bond shall be included in the tender price for this Section.

- .3 Painting and decorating Subcontractors choosing the Maintenance Bond option shall provide a maintenance bond consent of surety from a reputable surety company licensed to do business in Canada. Cash or certified cheque are not acceptable in lieu of surety consent.
- .4 This guarantee or bond shall cover making good any defects in work of this trade due to faulty workmanship or defective material which appears during a two (2) year period following certified date of Substantial Performance of the Project.

2 PRODUCTS

2.1 MATERIALS

- .1 All paints, thinners, solvents, etc. used within this Project shall only be those products and materials with low Volatile Organic Compounds (VOC) content. All paint and coatings shall meet or exceed VOC and chemical component limits of Green Seal Requirements (see www.greenseal.org). All products and materials used must be listed and designated by the manufacturer as low VOC and environmentally friendly and be complete with appropriate "EcoLogo" clarification labeling.
- .2 Paint, varnish, stain, enamel, lacquer and fillers shall be of a brand and type approved in Chapter 5 of the MPI/MPDA Architectural Painting Specification Manual. These will be referred to herein by generic or common name but specifically indicate approved manufacturer's brands as published in Chapter 5 of the Manual.
- .3 Paint materials such as linseed oil, shellac, turpentine, etc. not specifically mentioned by brand name, shall be the highest quality product of an approved manufacturer.
- .4 Undercoats, primers and paint systems shall be of same manufacture as the final finish coat.
- .5 Materials shall be used and applied in strict accordance to manufacturer's directions and shall be compatible to one another within a finishing system.

2.2 GLOSS/SHEEN RATINGS

- .1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

	<u>Gloss @ 60</u> <u>degrees</u>	<u>Sheen @ 85</u> <u>degrees</u>
Gloss Level 1 - Matte Finish (flat)	Max. 5	Max. 10
Gloss Level 2 - Velvet-Like Finish	Max.10	10 to 35
Gloss Level 3 - Eggshell Finish	10 to 25	10 to 35
Gloss Level 4 - Satin-Like Finish	20 to 35	min. 35
Gloss Level 5 - Traditional Semi-Gloss Finish	35 to 70	
Gloss Level 6 - Traditional Gloss	70 to 85	
Gloss Level 7 - High Gloss Finish	More than 85	

3 EXECUTION

3.1 INSPECTION

.1 Examine all surfaces to be painted before commencing work. Report any unsatisfactory surfaces to the Contractor.

.2 The commencement of work indicates acceptance of the surfaces and job conditions.

.1 Inspect the exposed fastenings penetrating and visible through the perforated metal roof deck. Snip off all projecting exposed fastenings to a maximum projection depth of 3/8" before applying the finish painting coat. Verify that steel deck has been supplied with a pre-painted, factory applied finish.

3.2 PROTECTION

.1 Protect surrounding or adjoining work by adequately covering with tarpaulins or other necessary protective covering; make good any damage caused by failure to provide suitable protection.

.2 Before commencement of work, remove all electrical plates, surface hardware, canopies of lighting fixtures, etc. and replace in original condition at completion of painting in each space.

.3 Do not use solvent or thinners to clean hardware that will remove the permanent lacquer finish.

.4 Protect work of other trades against damage and soiling. Any damage to work of other caused by this trade shall be immediately made good, cleaned or replaced at no additional expense to the Owner and to the acceptance of the Departmental Representative.

.5 Wrap knobs and remove escutcheons during painting operations. Cover all other hardware such as strikes, butts, door closers, push and pull plates, etc.

3.3 PREPARATION

.1 Preparation of surfaces shall be in accordance with recommendations contained within the MPI/MPDA Architectural Painting Specifications Manual, Chapters 2 & 3, Surface Preparation, as applicable for various surfaces.

3.4 APPLICATION

.1 Application shall be in accordance with MPI/MPDA Architectural Painting Specifications Manual as applicable and as follows.

.2 Materials shall be thoroughly mixed before application and applied evenly, free from sags, runs, crawls and other defects.

.3 Do all cutting-in neatly.

.4 Thinning shall be done only in accordance with manufacturer's directions as required but no dilution, adulteration or misuses will be allowed.

.5 Job mixing or tinting will be allowed if specifically approved.

.6 All finish work shall be uniform in sheen, colour and texture.

- .7 Apply each coat at the proper consistency in accordance with the manufacturer's directions.
- .8 Sand lightly between coats to achieve desired finish.
- .9 Do not apply finishes on surfaces that are not sufficiently dry.
- .10 Each coat of painting shall be slightly darker than preceding coat unless otherwise directed.
- .11 Method of paint application shall be generally by brush or roller.
- .12 The number of coats specified is intended to cover surfaces satisfactorily when applied in strict accordance to manufacturer's recommendations.
- .13 Apply all materials under adequate illumination, evenly spread and smoothly flowed on without runs, sags or other defects.
- .14 Tint all undercoats (i.e. all coats prior to final coat) to the approximate shade of the final coat, and vary the tints of each undercoat to facilitate definite identification of all coats.

3.5 PAINTING & FINISHING SCHEDULE

- .1 The following titles and code numbers refer to the MPI/MPDA Architectural Painting Specification Manual (2003) edition, unless otherwise indicated, for type of coating, grade, named products and their manufacturers.
- .2 Range and selection of colours is based on products indicated on the Finish Schedule. Any alternate manufacturer shall have similar range and colour selection.

3.6 EXTERIOR PAINTING & FINISHING SCHEDULE

- .1 Reference MPI/MPDA Manual (2003) Chapter 2. Grade shall be as specified.
- .2 MISCELLANEOUS METAL: Premium Grade
 - .3 EXT. 5.1D Alkyd Finish (semi-gloss) Low VOC type.
 - .4 One (1) coat Alkyd Metal Primer, two (2) coats Alkyd.
- .5 STEEL: Premium Grade, Low VOC type.
 - .6 EXT. 5.1H Epoxy Urethane Finish (semi-gloss) two-component.
 - .7 One (1) coat Epoxy Primer, one (1) coat Epoxy, two (2) coats Polyurethane.
 - .8 Use this finish on exterior steel canopies etc., where scheduled.
- .9 GALVANIZED METAL: Premium Grade
 - .10 EXT. 5.3B Alkyd Finish (semi-gloss) Low VOC type.
 - .11 One (1) coat Cementitious Primer, two (2) coats Alkyd.
 - .12 Use this finish on exterior hollow metal doors and pressed steel door frames; roof top HVAC units and ducting, vents and piping; guardrails and handrails, and other exterior galvanized metal indicated.

3.7 INTERIOR PAINTING & FINISHING SCHEDULE

- .1 Reference MPI/MPDA Manual (2003), Chapter 3. Grade shall be as specified below.
- .2 MISCELLANEOUS METAL: Premium Grade
 - .1 INT. 5.1E Alkyd Finish (semi-gloss) Low VOC type.
 - .2 One (1) coat of Alkyd Primer Sealer, two (2) coats Alkyd.
- .3 CONCRETE VERTICAL SURFACES; including horizontal soffits:
 - .1 INT 3.1G - Waterborne epoxy (tile-like) finish for smooth concrete.
- .4 CONCRETE HORIZONTAL SURFACES; floors:
 - .1 INT 3.2D - Pigmented polyurethane finish.
 - .2 INT 3.2G - Waterborne concrete floor sealer.
- .5 CONCRETE MASONRY VERTICAL SURFACES; including horizontal soffits:
 - .1 INT 4.2c - Alkyd Finish (semi-gloss).
 - .2 One (1) coat LATEX BLOCK FILLER Primer, two (2) coats Alkyd Finish.
- .6 GALVANIZED METAL: Premium Grade
 - .1 INT. 5.3C Alkyd Finish (semi-gloss) Low VOC type.
 - .2 One (1) coat Cementitious Primer, two (2) coats Alkyd Finish.
 - .3 Use this finish on hollow metal doors and pressed steel frames, and other exposed interior galvanized metal indicated.
- .7 GYPSUM WALLBOARD: Premium Grade
 - .1 INT. 9.2E Epoxy (tile-like) finish.
 - .2 One (1) coat Epoxy Primer/Sealer, two (2) coats Epoxy.
 - .3 Use this finish on gypsum wallboard, where scheduled to be painted with epoxy finish.
- .8 GYPSUM WALLBOARD: Premium Grade
 - .1 INT. 9.2A Latex Finish (Eggshell) Low VOC type.
 - .2 One (1) coat Latex Primer/Sealer, two (2) coats Latex.
 - .3 Use this finish on gypsum wallboard, where scheduled to be painted with Latex finish.
- .9 GYPSUM WALLBOARD: Premium Grade
 - .1 INT. 9.2C Alkyd Finish (Eggshell) Low VOC type.
 - .2 One (1) coat Latex Primer/Sealer, two (2) coats Alkyd.
 - .3 Use this finish on gypsum wallboard ceilings to washrooms, and elsewhere where scheduled to be painted with alkyd finish.

- .10 Paint fire bells, and sprinkler caps where scheduled with INT. 5.1E alkyd finish.

3.8 MECHANICAL SERVICES

- .1 Paint exposed metalwork, including exposed and insulated piping, sprinkler lines, rainwater leaders, conduit, hangers, etc. in connection with plumbing, sprinkler mechanical and electrical trades in public areas, only. Paint as follows:
- .2 One (1) coat red oxide primer (galvanized primer where applicable); two (2) coats enamel (semi-gloss) in accordance with INT. 5.2A Heat Resistant Enamel Finish.
- .3 Paint covered and insulated pipes and ducts three (3) coats: 1 coat PVA sealer; two (2) coats enamel (flat) in accordance with INT. 10.1B Alkyd Enamel finish.
- .4 Prime and finish paint mechanical piping, plumbing piping, sprinkler piping, and equipment in mechanical rooms, in accordance with paint colour schedule specified under Division 23.
- .5 All equipment and materials with factory paint finish shall, after installation, be given a minimum of one coat of compatible finish paint to match the colour scheme scheduled.

3.9 STANDARD OF ACCEPTANCE

- .1 Paint finish shall continue through behind any wall and ceiling mounted items. (i.e, white boards, tack boards, furniture and casework systems, electrical outlets, surface mounted electrical fixtures, plumbing finish escutcheon plates, mechanical devices, heating units, etc) . It shall also include any other exposed surfaces such as interiors of cupboards and closets, top of doors, trims, whether in sight line or not.
- .2 Departmental Representative shall have right to make changes in colour tone of finishes prior to final coat to obtain desired results without additional cost to the owner.
- .3 Otherwise noted or scheduled, walls shall be same colour within a given area.
- .4 All surfaces, preparation and paint applications shall be inspected by the A/E.
- .5 Paint finishing interior surfaces shall be considered to lack uniformity and soundness if any of the following defects are apparent to the A/E:
- .6 Finishing shall be smooth.
- .7 Free of pin-holes and pits.
- .8 Brush or roller marks, streaks, laps, runs, sags, drips, heavy stippling, hiding or shadowing by inefficient application methods, skipped or missed areas, bubbles and pin holes of any size.
- .9 Any foreign materials in paint coatings such as hair, brush bristles, insects, visible screw heads, etc.
- .10 Any type of raised sharp edges that can cause a latex / nitrile glove or cotton batten to tear or puncture.

- .11 Evidence of poor coverage at rivet heads plate edges lap joints, crevices, pockets, corners and re-entrant angles.
- .12 Damage due to touching before paint is sufficiently dry or any other contributory cause.
- .13 Damage due to application on moist surfaces or caused by inadequate protection from weather.
- .14 Damage and / or contamination of paint due to blown contaminants (dust, spray paint, etc)
- .15 Painted surfaces shall be considered unacceptable if any of the following are evident under natural lighting and final lighting source for interior surfaces:
 - .16 Visible defects are evident on vertical surfaces when viewed at normal viewing angles from a distance of not less than 1000 mm.
 - .17 Visible defects are evident on horizontal surfaces when viewed at normal viewing angles from a distance of not less than 1000 mm.
 - .18 Visible defects are evident on ceiling, soffit and other overhead surfaces when viewed at normal viewing angles.
 - .19 When final coat on any surface exhibits a lack of uniformity of colour, sheen, texture and hiding across full surface area.
 - .20 When final coat on any transition between wall finishes, walls finishes and ceiling systems finishes and wall finishes to floor finish systems is evident and not smooth.
 - .21 Painted surfaces rejected by the MPI /Paint consultant and/or the A/E shall be made good at the expense of the subcontractor. Small affected areas may be touched up; large affected areas or areas without sufficient dry film thickness of paint shall be repainted. Runs, sags of damaged paint shall be fully removed by scrapper and sanding prior to re-application of product.

3.10 ADJUST & CLEAN

- .1 On completion of the work, remove all paint where spilled, splashed or splattered.
- .2 During the progress of the work, keep the premises free from any unnecessary accumulation of tools, equipment, surplus materials and/or debris.
- .3 At the conclusion of the work, leave the premises neat and clean to the satisfaction of the Departmental Representative.

END OF SECTION

1 General

1.1 GENERAL INSTRUCTIONS

1.1.1 Read and be governed by conditions of the Contract of Division
1

1.2 SECTION INCLUDES

1.2.1 Fume hoods.

1.2.1.1 Constant Air Velocity (CAV) type.

1.2.2 Fume hood work surface.

1.2.3 Service fixtures.

1.3 PERFORMANCE REQUIREMENTS

1.3.1 Fume hoods and exhaust systems in accordance with the
following:

1.3.2 ASHRAE Standard ANSI/ASHRAE 110.2016 - Methods of Testing
Performance of Laboratory Fume hoods.

1.3.3 ANSI/AIHA Z9.5-2012 *An American National Standard for
Laboratory Ventilation*

1.3.4 Standards and regulations IM15128-2013, Laboratory fume hood
- Canada Public Work.

1.3.5 Standard NFPA 30 - Flammable and Combustible Liquids Code
and NFPA 45, 2000 National Fire Protection Association.

1.3.6 SEFA 1-2010 - Laboratory Fume Hoods Recommended Practices

1.3.7 OSHA 1910.1450 Occupational Exposure to Hazardous Chemicals
in Laboratories

1.3.8 CSA Standard C22.2 No. 1010.1-92 & CSA-US

1.3.9 Prudent Practices in the Laboratory: Handling and Disposal
of Chemicals (2011), National Research Council

1.3.10 UL 61010A-1, 1st Edition - Electrical Equipment for
Laboratory Use, Part 1: General Requirements

1.3.11 Storage cabinets in accordance with the following:

1.3.11.1 NFPA 30 - Flammable and Combustible Liquids Code.

1.3.11.2 NFPA 45 - Fire Protection for Laboratories Using
Chemicals

1.4 QUALITY ASSURANCE

1.4.1 Qualifications:

- 1.4.1.1 Provide work of this section, executed by competent installers with experience in application of Products, systems and assemblies specified and with approval of Product manufacturers.
- 1.4.1.2 Manufacturer shall have successfully completed other laboratory projects of similar or greater magnitude.
- 1.4.1.3 Conduct a pre-installation meeting in accordance with Section 013119.
- 1.4.1.4 Manufacturer shall provide field review in accordance with Section 01 45 00.
- 1.4.1.5 Manufacturer of fume hoods shall have capability within their facility of performing fume hood tests based on latest ANSI/ASHRAE Specification 110.
- 1.4.1.6 The fume hood manufacturer must have an ISO-9001 accreditation and his products must meet the requirements of the Scientific Equipment & Furniture Association (SEFA) and more specifically meet the SEFA 1-2010 Laboratory Fume hoods Recommended Practices.

1.5 SUBMITALLS

- 1.5.1 Submit required submittals in accordance with Section 01 33 00.
- 1.5.2 Product data sheets:
 - 1.5.2.1 Submit manufacturer's standard Product data sheets for Products proposed for use in the work.
- 1.5.3 Shop drawings:
 - 1.5.3.1 Shop drawings shall clearly indicate materials being supplied and finishes, connections, attachments, reinforcing, locations of exposed fastening, colours, gloss intensities and coating types by name.
 - 1.5.3.2 Shop drawings for fume hoods shall be carefully coordinated with Division 1 & 2.
 - 1.5.3.3 Fume Hoods shop drawings shall include:
 - 1.5.3.3.1 Elevations and plan view location of the fume hoods.
 - 1.5.3.3.2 Construction details showing inside (I.D.) and outside dimensions (O.D.), openings, exhaust requirements and duct sizes.
 - 1.5.3.3.3 Locations of plumbing, electrical and ventilation services provided with the hoods.
- 1.5.4 Mock-up:
- 1.5.5 Provide a mock-up of one of each type of fume hood unit in rooms as directed by Departmental Representative.

1.5.5.1 Mock-up shall demonstrate construction and finishes.

1.5.5.2 Reviewed mock-up may remain as part of final installation, subject to approval by Departmental Representative.

1.5.6 Closeout submittals:

1.5.6.1 Submit closeout submittals in accordance with Section 01 77 00.

1.5.6.2 Operation and maintenance instructions:

1.5.6.2.1 Submit data for operation and maintenance of Products included in work of this section, for incorporation into operation and maintenance manuals.

1.6 COORDINATION

1.6.1 Work of this section is closely integrated with laboratory work of other sections. Coordinate work of this section with work of:

1.6.1.1 Laboratory casework under Section 12 35 53.

1.6.1.2 Laboratory counter tops under Section 12 36 53.

1.6.1.3 Stainless Steel Countertops under Section 12 36 54

1.7 DELIVERY, STORAGE AND HANDLING

1.7.1 Delivery, storage, and handling of Products in accordance with manufacturer's written instructions.

1.7.2 Package or crate, and brace Products to prevent damage or distortion of equipment in shipment and handling. Label packages and crates, and protect finish surfaces by sturdy wrappings or equivalent protection. Utilize temporary skids under large or heavy units.

1.7.3 Deliver Products to location at building site designated by Contractor.

1.7.4 Do not deliver Products to site until conditions are such that no damage will occur to them while in storage.

1.8 WARRANTY

1.8.1 Warrant work of this section for a period of 24 months.

1.8.1.1 Defects in materials and workmanship that may develop within this time are to be replaced without cost or expense to Owner.

1.8.2 Defects include, but are not limited to:

1.8.2.1 Ruptured, cracked, or stained coating.

1.8.2.2 Discoloration or lack of finish integrity.

1.8.2.3 Cracking or peeling of finish.

1.8.2.4 Slippage, shift, or failure of attachment to wall, floor, or ceiling.

1.8.2.5 Weld or structural failure.

1.8.2.6 Warping or unloaded deflection of components.

1.8.2.7 Failure of hardware.

2 Products

2.1 ACCEPTABLE MANUFACTURERS

2.1.1 Basis of Specification: **BedcoLab Ltd- Constant Air Volume- Vertical Sash Model #C10-60A-100, or equivalent.**

2.1.2 Substitutions: in accordance with Section 01 25 00.

2.2 FUME HOODS - GENERAL

2.2.1 Service terminations for plumbing and electrical connections to be provided at top of fume hood

2.3 FUME HOOD MATERIALS

2.3.1 Basic materials:

2.3.1.1 Exterior panels framing members, and furring panels: Cold rolled and levelled mild steel and shall conform to ASTM A366, factory painted finished.

2.3.1.2 Screws: Interior fastening devices; stainless steel screws complete with corrosion resistant plastic caps.

2.3.1.3 By-pass grilles: 1.2 mm (18 gauge) thick mild steel directionally louvred upward, finished same as exterior panels.

2.3.1.4 Upper panel: Laminated safety glass, 6 mm (1/4") thick.

2.3.1.5 Lower foil: formed 1.9 mm (14 gauge) Type 316 stainless steel.

2.3.1.6 Safety glass: Laminated safety glass, 6 mm (1/4") thick.

2.3.1.7 Sash guides: Corrosion resistant polyvinyl chloride (PVC) track.

2.3.1.7.1 Sash chain: #35 hardened steel.

2.3.1.8 Sprocket system for sash chain: Hardened sprockets with one full width shaft per sash running in ball bearings.

2.3.1.9 For sash chain:

2.3.1.10 Provide interior access panels on both sides, and secure using special moulded white vinyl gasket designed to be removed and reinstalled without use of special tools.

2.3.1.11 Sash pull: Continuous recessed sash pull, Type 316, 1.2 mm (18 gauge) thick stainless steel with AISI #4 satin finish.

2.3.1.12 Baffle support brackets: Fibreglass reinforced polyester thermoset resin of 5mm (3/16") thickness.

2.3.1.13 Duct stubs: Bell shaped Type 316, 18 gauge (1.2 mm) stainless steel.

- 2.3.1.14 Light switches: Light switches, black in colour, commercial specification grade or higher and ULC and CSA approved.
- 2.3.1.15 Electrical receptacles: Electrical receptacles shall be black in colour, commercial specification grade or higher and shall be ULC and CSA approved.
- 2.3.1.16 Cover plates: Electrical cover plates shall be black in colour, nylon and ULC and CSA approved.
- 2.3.1.17 Fluorescent fixture: Fixture shall be two tube rapid start or better. Energy saving cool white T8 lamps shall be provided. Ballast shall be sound rated to limit noise.

2.4 FUME HOOD LINER

2.4.1 1 FRP type:

- 2.4.1.1 Poly resin type hood lining and baffles shall be 5 mm (3/16") thick fibreglass reinforced polyester thermo set resin. Fibreglass reinforced polyester panel shall have a minimum flexural strength of 103,400 kPa (15,000 psi), with a flame spread of 25 or less as per ASTM E84.
- 2.4.1.2 Final appearance shall be smooth and white in colour.

2.5 HOOD BAFFLE

- 2.5.1 Two-piece main baffles shall provide controlled air vectors into and through fume hood and be fabricated of same material as liner. Provide exhaust slots on full perimeter of baffle with tip slot adjustable valve. A fixed, permanently open horizontal slot located at 800 mm (31-1/2") above work surface shall be provided at overlapping mid-point of main baffles.
- 2.5.2 Remote control baffle system shall provide controlled air vectors into and through the fume hood and be fabricated of the same material as the liner. Provide exhaust slots on the full perimeter of baffle with top slot adjustable. A fixed, permanently open horizontal slot located at 800 mm (31-1/2") above the work surface shall be provided at the overlapping mid-point of the main baffles.
 - 2.5.2.1 Adjustment shall be instantaneous, one-handed, with a single point control, accomplished while hood is in use, without disturbing apparatus.
 - 2.5.2.2 High thermal loading.
 - 2.5.2.3 Normal or average operation.
 - 2.5.2.4 Heavier than air gases of fumes generated near work surface.
- 2.5.3 For safety, fume hood shall maintain essentially constant exhaust volume at any baffle position. Changes in average face velocity and exhaust volume as a result of baffle adjustment shall not exceed 5% for any baffle position at the specified face velocity.

2.6 FUME HOOD FURRING PANELS

2.6.1 Where indicated on drawings, provide matching furring panels to enclose space between top edge of fume hoods and finished ceiling at 2450 mm AFF (Field verify)

2.6.2 Panels shall be flanged, notched and reinforced where required to form a well-fitted enclosure, free from oil-canning. Secure panels using cadmium-plated, self-tapping screws; panels shall be removable for maintenance purposes.

2.6.3 Finish shall match fume hood to which it is connected.

2.7 GENERAL PURPOSE FUME HOODS - (CONSTANT AIR VOLUME TYPE)

2.7.1 Bench fume hood construction:

2.7.1.1 The hood structure shall be a double wall construction with steel exterior panels painted with the same process as the furniture and a choice of interior finish as described under section F. All steel structural channels, supports and remote control faucet mechanisms are installed within the wall structure.

2.7.1.2 The hood structure must be self supporting, forming a complete rigid structure to support the inside lining, allowing the replacement of interior lining panels without the need to remove the hood from his installed position.

2.7.1.3 Wall thickness should not exceed 4 ¾" (120 mm) providing a maximum inner working area.

2.7.1.4 Access to faucet valves installed within the side walls is provided through removable access panels made with the same material as the inner lining and removable painted steel exterior side panels.

2.7.1.5 The sash is a vertical opening type permitting a maximum opening height of 27¾". The sash is designed to have a 30¾" clear view of the inside of the hood. A full length balanced counterweight mechanism (with stainless steel cables and pulleys), located at the back of the hood keeps sash on track and provides a fingertip control of the sash height. The full width aerodynamically designed handle is made of corrosion resistant black plastic.

2.7.1.6 The picture-frame contoured face opening must be beveled with rounded corners to form an aerodynamic opening.

2.7.1.7 The air foil at the bottom of opening is made of a type 316, 16 gauge (1.5 mm) stainless steel with electrical cord opening on both sides allowing the sash to close fully. The air foil is designed to continuously provide a minimum 1" (25 mm) opening under the foil to the work surface even when the sash is in the fully closed position.

2.7.1.8 Interior baffles are made of the same material as the inner lining of the hood and are at a factory-set position for optimal containment.

- 2.7.1.9 The fume hood is equipped with a fluorescent light fixture, a light switch and two double 120V/20A electrical outlets on the front posts. All electrical components are pre-wired to a junction box located on top of the hood and are CSA-US/UL approved.
- 2.7.1.10 The fluorescent light fixture, including two maximum width tubes based on the size of the hood, is installed on the exterior side of the roof of the hood with a ¼" (6 mm) laminated safety glass to insulate the lamps from vapors or fumes inside the hood. The chosen lamp must supply a minimum of 80 feet/candle at the working surface.
- 2.7.1.11 Hoods with fiber reinforced plastic Haysite H193, or Phenolic resin linings, are supplied with all interior hardware made of chemical resistant plastic.
- 2.7.1.12 The hoods are designed with the following minimum inside dimensions for working surface maximization: 26½" working surface depth between the baffles and the sash interior; 48" clear height between the working surface and the inside top of the hood.

2.8 FUME HOOD EXTERIOR FINISH

- 2.8.1 Exterior panels and framing members: Cold rolled and levelled mild steel; ASTM A366. Prepare surfaces, make free of defects with welds ground smooth and indistinguishable from surrounding metal.
- 2.8.2 Components shall be cleaned in a three-stage chemical spray process that produces an iron phosphate coating bonded to the steel surfaces, concluding with a final de-ionized water rinse. Components shall be thoroughly oven-dried before painting.
- 2.8.3 Components shall be sprayed in an electro-static three-stage process with a high-temperature, high-solids (60% minimum), semi-gloss (50%), epoxy/urethane baking enamel. The resulting paint coating shall provide a uniform coating on all surfaces of each component that has a minimum thickness of 0.03 mm (0.0012"). Components shall be properly baked and cured.
- 2.8.4 Colours:
 - 2.8.4.1 Provide fume hood exterior finish in manufacturer's standard colours.
 - 2.8.4.2 1 or 2 colour scheme may be used.

2.9 AIR FLOW MONITOR/ALARM

- 2.9.1 Acceptable Product:
 - 2.9.1.1 TEL AFA 1000 digital airflow alarm or equivalent shall be provided.

2.10 PRE-PLUMMED HOOD

- 2.10.1 Hood to be pre-plumbed to meet requirements of building code and authorities having jurisdiction.
- 2.10.2 Watersaver needle valves shall be supplied for services except water and steam, where compression type valves shall be used.
 - 2.10.2.1 Valve construction type:
 - 2.10.2.1.1 Front load valve.
- 2.10.3 Services shall be pre-piped using 10 mm (0.375") OD clean refrigeration tubing (ACR) for all services except natural gas which shall be type "G" 10 mm (0.375") OD copper tubing. Connections between valves, tubing and nozzles shall be made up using Swagelok double ferrule instrument grade compression fitting adapters. When used for natural gas, fittings shall be approved by the TSSA or equivalent in the destination province. To maintain tubing cleanliness, no soldering or brazing is permitted.
- 2.10.4 Tubing for each service shall be routed to the upper rear corner of the fume hood for field connection separately on each side.
- 2.10.5 Plumbing shall be pressure tested before shipment to ensure no leaks are present before leaving factory. Pressure testing shall be performed again on site after final connection.
- 2.10.6 Fixtures located in the fume hood shall be mounted and pre-plumbed in factory to 152 mm (6") above fume hood and capped off ready for connections at site by mechanical Subcontractor.

2.11 SERVICE FIXTURES

- 2.11.1 Remote control valves and related parts and accessories: as recommended by fume hood manufacturer with BOD products described below. Materials of valves, fixtures, and spigots must be compatible with the service fluid.
- 2.11.2 Remote-controlled service fittings installed inside fume hoods shall have a full epoxy colour coded finish. Colour coded nozzle/gooseneck shall match valve handle.
- 2.11.3 Watersaver CT740 compression valve for cold water and hot water with CT074WSA panel mounted swing arm gooseneck. Cold water to be located over cup sink, hot water to be adjacent to cold water.
- 2.11.4 Watersaver CT740N remote control needle valve and panel mounted wall nozzle with 45 degree angle serrated hose end (CT022WSA) for compressed air, natural gas, and vacuum.

2.11.5 Watersaver CT740WTL remote control valve and panel mounted faucet or nozzle of compatible material for Deionized and Reverse Osmosis water.

2.11.6 Services required to fume hood are as seen on drawing P-101 and positioned as described below.

2.11.6.1 Left Hand Side:

- Vacuum
- Compressed Air
- Natural Gas

2.11.6.2 Right Hand Side:

- Cold Water
- Hot Water
- Deionized Water
- Reverse Osmosis Water

2.12 CORROSION RESISTANT FINISH (CR) – COLOUR CODED

2.12.1 When specified, identify fittings as to type of service with colour-coded plastic removable index buttons with engraved lettering written in English, filled with enamel corresponding to the following standards:

Service	English	French	Colouring Code
Cold Water	CW	EF	Dark Green
Hot Water	HW	EC	Red
Distilled Water	DW	ED	White
Type II Water	IIW	IIW	White
Deionized Water	DI	DI	White
Reverse Osmosis	RO OR	RD OR	White
Vacuum	VAC	VIDE	Yellow
Air	AIR	AIR	Orange

Gas	GAS	GAZ	Dark Blue
Propane	PROP	PROP	Chrome
Oxygen	OXY	OXY	Light Green
Nitrogen	N	N	Grey
Argon	A	A	White
Hydrogen	H	H	Pink
Helium	HE	HE	Chrome
Carbon Dioxide	CO2	CO2	Chrome
Steam	ST	VAP	Black

2.12.2 Corrosion resistant finish on fixtures inside hood with matching colour coded handle on fume hood style for safety purposes. Colour code as follows:

Cold Water	Dark Green
Hot Water	Red
Vacuum	Yellow
Air	Orange
Reverse Osmosis	White

2.12.3 C.R. coating performance:

2.12.3.1 Apply acid of following types, applied at rate of 60 drops per minute for 10 minutes on fixture coatings, held approximately at angle of 45 degrees, shall show no rupture, other than slight discolouration, or possible softening when subjected to the following:

Hydrochloric Acid	36.9%
Nitric Acid	70.6%
Sulphuric Acid	96.4%
Acetic Acid	99.5%

- 2.12.3.2 Resistance to Alkali and Organic solvents: Reagents and solvents applied at rate of 60 drops per minute on fixture coatings held approximately at angle of 45 degrees: alkali (50% sodium hydroxide), ethyl alcohol, toluol, xylol, benzol, carbon tetrachloride, phenol and mineral oil.
- 2.12.3.3 Resistance to Salt Fog Spray: Samples of fixtures placed in salt fog cabinet for period of 125 h, at temperature of 34 - 37°C (93.1 - 98.6°F). Artificial sea water (composite per litre: 11 g MgGI26H2), 1.2 g Na2SO4, and 25 g NaCl). Fixtures tested to ASTM B117-61 for 1000h.
- 2.12.3.4 Resistant to High Humidity: Samples of fixtures placed in closed cylindrical glass containers approximately 20L in volume, together with beaker of concentrated hydrochloric acid, nitric acid, and sulphuric acid. Maintain 23°C (73.4°F) temperature for period of 250h.
- 2.12.3.5 Where called for, CR finished exposed parts of service fittings shall meet or exceed
- 2.12.3.6 ASTM B456-85, service condition SC4, coating classification CuNi 30d Cr.

2.13 FUME HOODS

2.13.1 Epoxy Resin:

- 2.13.1.1 Graphite grey epoxy resin tops shall be molded from a monolithic, modified epoxy resin, especially compounded and oven cured to give optimum physical and chemical resistance properties as well as high resistance to mechanical and thermal shock.
- 2.13.1.2 Tops shall be a uniform mixture throughout their full 32 mm (1.114") thickness and shall be a non-glare black color. Exposed front edges shall have 3 mm (1/8") bevelled edge. Work surfaces shall be installed with a 25 mm (1") overhang on the front and exposed edges, complete with a 3 mm (1/8") drip groove.
- 2.13.1.3 Countertops shall have a marine edge all four sides, width to accommodate the fume hood walls. The slope downwards of 45 degrees shall be provided with a vertical drop of 10 mm (3/8") creating the dishd portion. Two elliptical slots are provided to accommodate the services coming up from the floor into the fume hood wall cavity.
- 2.13.1.4 Cup sink where required shall be 152 mm X 76 mm (6" x 3") oval epoxy resin with a self-rim lip.
- 2.13.1.5 Butt joints cemented together using manufacture's recommended epoxy cement or Dow Corning Sealant No. 999.

2.14 FUME HOOD BASE CABINETS**2.14.1 General:**

- 2.14.1.1 The cabinets or tables used under fume hoods must be of a rigid construction to provide adequate support for the hood and its accessories.
- 2.14.1.2 All units are built according to the **Forte Inset** laboratory casework system, (BoD: Bedcolab Ltd).

2.14.2 "ACID" or "BASE" storage cabinets

- 2.14.2.1 **Basis of Design:** BedcoLab Ltd. # FI-A25-30
- 2.14.2.2 Acid storage cabinets will be of the same construction than the standard base cabinets, with a one piece white chemical resistant polyethylene (HDPE) interior box and doors lined with the same material $\frac{1}{4}$ " (6 mm) thick. Three integral shelf position supports are located on each side of the box. The bottom is equipped with an integral $\frac{1}{4}$ " high edge to prevent leakage to the exterior of the cabinet.
- 2.14.2.3 Air grills are provided at top and bottom of each door for air circulation.
- 2.14.2.4 Each unit comes with an adjustable white chemical resistant polyethylene (HDPE) perforated shelf.
- 2.14.2.5 Each unit is labelled "ACIDS - DANGER" for clear identification.
- 2.14.2.6 All interior hardware components are non-metallic.

2.14.3 Flammable solvent storage units

- 2.14.3.1 **Basis of Design:** BedcoLab Ltd. # FI-A23-30UL complete with ventilation kits (VVK-01 & VVK-02)
- 2.14.3.2 Construction shall meet O.S.H.A. 1910-105(d)(3), comply with *N.F.P.A.* Flammable and combustible liquids Code no. 30 and be UL certified..
- 2.14.3.3 They shall be made of 18 gauge (1.2 mm) thick cold rolled steel with double wall all welded construction. The floor shall be made of galvanized steel and be recessed 2" (51 mm) bellow the front opening of the cabinet.
- 2.14.3.4 The cabinets shall be equipped with four 5/16" (8 mm) diameter threaded bolt type steel levelers as on the standard base cabinets.
- 2.14.3.5 The back of the cabinet shall be supplied with two 1½" (38 mm) fire baffle vents.
- 2.14.3.6 Each cabinet shall be equipped with an adjustable galvanized 16 gauge (1.5 mm) steel shelf.
- 2.14.3.7 Each cabinet shall be clearly identified as such with the inscription: «*FLAMMABLE KEEP FIRE AWAY*».

- 2.14.3.8 Cabinet doors are equipped with a continuous piano hinge and can be equipped with an optional automatic emergency closing device.

2.14.4 Tables

- 2.14.4.1 Tables are of steel construction with the same finish as the hood exterior panels and are made of two fully welded leg sets mechanically fastened to front and rear aprons.

2.14.4.2

- 2.14.4.3 Depending on the table length, one or multiple drawers can be installed in the apron. Drawer construction and hardware are the same as for standard cabinets.

2.14.4.4

- 2.14.4.5 Each leg is supplied with an adjustable leveler the same construction as for standard cabinets.

2.14.5 Remote control units:

- 2.14.5.1 Remote control units are made of steel with the same finish as the hood exterior panels. Doors are 75% of the unit's height with a fixed upper front panel.

2.14.5.2

Back panels are removable from inside the unit and no shelves are provided.

2.14.5.3

- 2.14.5.4 Units are supplied with four adjustable levelers.

2.14.6 Exterior hood panels and painted steel support furniture finishing:

- 2.14.6.1 When fabrication of unit is completed, all surfaces shall be free of scratches, spot weld marks or material imperfections. Welds will be ground smooth where necessary. The unit will be washed using a three stage iron phosphate process for proper surface preparation, and subsequently dried in a dry off oven to remove all traces of humidity.

2.14.6.2

- 2.14.6.3 A high quality chemical resistant polyurethane paint will then be applied to all surfaces including the interior of door and drawer panels using an electrostatic spray process. The parts will pass through a baking oven for duration and at a temperature as recommended by the paint manufacturer. Painted surfaces will conform to A.A.M.A. 2603.

2.14.6.4 The painted surfaces will meet or exceed the SEFA 8-M specification for chemical resistance as specified by the "Scientific Equipment and Furniture Association" and will contribute to LEED credits

2.15 TECHNICAL PERFORMANCE:

- 2.15.1 Adhesion to substrate: 100% 5B (ASTM D3359)
- 2.15.2 Hardness: 3H (ASTM D3363)
- 2.15.3 Glosses: 60 +/- 5 units on 60°
- 2.15.4 Flexibility: 1/4" Conical Mandrel (ASTM D522)
- 2.15.5 Impact resistances: 100 in-lb direct: 100 in-lb reverse (ASTM D2794)
- 2.15.6 Corrosion resistance: 1000 hrs less 1/16" in creepage over B-1000
- 2.15.7 treated test panels (ASTM B117)
- 2.15.8 Humidity resistances: 1000 hrs no blistering over B-1000 treated test panels (ASTM D2247)
- 2.15.9 **Colors:** To be selected from manufacturer's chart. Cabinets may be painted in one solid color or a two color scheme may be applied, where all cabinet bodies are painted one color and the doors and drawers are painted a second color.

2.16 FUME HOOD ACCESSORIES :

- 2.16.1 Service fittings :
 - 2.16.1.1 Plumbing fittings shall be Water Saver.
 - 2.16.1.2 All are remote control type with the inside hood components finished with an acid and solvent resistant epoxy coat. The remote control valve is located on the exterior front post and is chrome plated.
 - 2.16.1.3 Water faucets are supplied with a rigid or swivel gooseneck vacuum breaker and nozzle.
 - 2.16.1.4 All other fittings are provided with angled nozzle.
 - 2.16.1.5 Typical service fitting models are from Water Saver Color Tech front type as follows:

Cold water CT740W-9RSVB

Mixing water	CT740W (2X)-9RSVB
Gas	CT740G-CR
Air	CT740A-CR
Vacuum	CT740V-CR

2.16.2 Cup sinks

- 2.16.2.1 Cup Sinks are solid epoxy resin. BoD: VCS-04
(5.7"w x 2.7"d x 3.7"h). Black epoxy resin oval
cup sink.

2.16.3 Countertop

- 2.16.3.1 **Modified thermosetting epoxy resin countertop.** Black. BoD: BedcoLab Ltd. # VT-EP-6030. Thickness of top is 1 ¼" (32 mm) on the sides and 1" (25 mm) in the central portion of the hood creating a cavity to contain spills inside the hood chamber.

2.16.4 Furring panels

- 2.16.4.1 All hood drawings must show painted steel removable furring panels located between the top of the hood and the underside of the ceiling, on the front both sides of the hood.
- 2.16.4.2
- 2.16.4.3 These panels should have the same quality finish and color as on the cabinets and hoods.

3 Execution**3.1 EXAMINATION**

- 3.1.1 Before installation commences, ensure that mounting devices, members and surfaces are satisfactory for fitting and adequate for securing of equipment; and that services are adequate and located correctly. Installation is not to proceed until completion of floor finishes so that flooring is continuous below floor supported assemblies, unless otherwise specified.
- 3.1.2 Take measurements of construction at the Place of the Work to which work fume hoods and storage cabinets must conform, and through which access must be made, before the fume hoods and storage cabinets are delivered to Place of the Work.

3.2 INSTALLATION

- 3.2.1 Install in accordance with manufacturer's recommendations, true, tightly fitted, and level or flush to adjacent surfaces, as suitable for installation, and closely coordinated with Divisions 21, 22, and 23 and Divisions 26, 27, and 28.
- 3.2.2 Install fume hoods in locations indicated. Align and set level with levelling devices.
- 3.2.3 Apply small bead of sealant to junction of fume hood counter top and adjacent hood liner.
- 3.2.4 Flooring installation to be complete prior to commencement of laboratory casework and equipment installation.

3.3 COMMISSIONING OF FUME HOODS

- 3.3.1 On-site commissioning of fume hoods shall be in accordance with ASHRAE 110 and EN 14175 and as follows:

- 3.3.1.1 Exhaust System Stability Test: The coefficient of variation (COV) of the exhaust system static pressure or duct velocity should not exceed 10 percent. Tuning, repair, or redesign of the system should be done prior to performing fume hood testing if the system is unstable.
- 3.3.1.2 Low-Volume Smoke Test and High Volume Smoke Test: The test results should be Good or Fair as defined by the following:
 - 3.3.1.2.1 Fail: Smoke observed escaping from the hood
 - 3.3.1.2.2 Poor: Reverse flow of smoke near opening. Lazy flow into opening along boundary. Observed potential for escape.
 - 3.3.1.2.3 Fair: Some reverse flow, not necessarily at the opening. No visible escape. In addition, in High Volume Test, there shall be limited turbulent vortex in hood with all smoke captured and cleared readily.
 - 3.3.1.2.4 Good: No reverse flow. No visible escape. Active flow streams into hood around boundary. In addition, in High Volume Test, there shall be limited hood roll vortex with good capture and quick clearance.
- 3.3.1.3 Face Velocity Test: 100 fpm \pm 20 percent
- 3.3.1.4 Turbulence Test: Average of the standard deviations of all traverse point velocities normalized by the mean velocity should not exceed 10 percent.
- 3.3.1.5 Profile Test: The standard deviation of all traverse point average velocities normalized by the mean velocity should not exceed 15 percent.
- 3.3.1.6 Instruments used shall have been calibrated within the last year or within the time period specified by the instrument manufacturer.
- 3.3.1.7 Calibration gases used shall have certificates of analysis.
- 3.3.1.8 Fume hoods shall be commissioned by a technician certified to perform the ASHRAE 110 test and EN 14175 test.
- 3.3.1.9 Factory test certificate on each type of fume hood supplied and as part of testing and inspection allowance onsite testing of every fume hood following commissioning room HVAC systems.

3.4 DEMONSTRATION OF EQUIPMENT AND OPERATING INSTRUCTIONS

- 3.4.1 Demonstrate in presence of Owner's representatives operation of equipment following installation. Give minimum 48 hours advance notice in writing of demonstration date.
- 3.4.2 Demonstrations shall be made:
 - 3.4.2.1 When installation is completed.
 - 3.4.2.2 When work is turned over to Owner.
- 3.4.3 Responsible representatives of manufacturers and installers of equipment being tested shall be present at demonstrations.

3.4.4 Provide on-site instructions to Owner's designated
representatives in operation and maintenance of installed
equipment.

END OF SECTION

1 General

1.1 SECTION INCLUDES

1.1.1 Metal laboratory casework; painted steel:

- 1.1.1.1 Laboratory furniture system.
- 1.1.1.2 Laboratory table frame assemblies.
- 1.1.1.3 Shelving system.
- 1.1.1.4 Modular Core and Panel Support Structure.

1.1.2 Provide cut-outs and holes in casework necessary for installation of service fittings.

1.2 REFERENCES

- 1.2.1 SEFA 8: Laboratory Furniture - Casework, Shelving and Tables Guidelines Science Equipment and Furniture Association (SEFA)
- 1.2.2 ISO 9001:2008 - Quality Management International Standards Organization (ISO)

1.3 QUALITY ASSURANCE

1.3.1 Qualifications:

- 1.3.1.1 Provide work of this section, executed by competent installers of Products, systems and assemblies specified.

1.3.2 Manufacturer shall have successfully completed other laboratory projects of similar or greater magnitude.

1.4 SUBMITTALS

1.4.1 Product data sheets:

- 1.4.1.1 Submit Manufacturer's Product data sheets for Products proposed for use in the work of this section.
- 1.4.1.2 Due to expected long lead time of casework components, submittal of casework items must be received within 3 weeks of contract award.

1.4.2 Samples:

- 1.4.2.1 Three (3) sets of 200 mm x 200 mm samples, or 200 mm long as applicable, of each specified Product, material and finish.
- 1.4.2.2 Prefinished metal.
- 1.4.2.3 Shelf Bracket
- 1.4.2.4 One complete set of color chips representing the manufacturer's full range of available colors. Minimum sample size 2 inches by 3 inches (50mm x 76mm).

1.4.3 Hardware, one unit of each type and finish.

1.4.4 Shop Drawings:

- 1.4.4.1 Clearly indicate materials being supplied and finishes, connections, attachments, reinforcing, locations or exposed fastening, colours, gloss intensities and coating types by name.
- 1.4.4.2 Completely detailed Shop Drawings including plans, elevations, sections and details shall clearly indicate:
 - 1.4.4.2.1 Laboratory casework, leg frame assembly, countertops, plumbing/mechanical service fittings, sinks, and miscellaneous items.
 - 1.4.4.2.2 Location of each furniture unit in plan and elevation for each assembly.
 - 1.4.4.2.3 Location for roughing-in of plumbing and electrical services.
 - 1.4.4.2.4 Coordinate elevations with floor plan for each room and indicate locations and dimensions required for services.

1.4.5 Mock-up:

- 1.4.5.1 Provide mock-up of one complete unit comprising of a cross section of wall storage and base units as directed by Departmental Representative.
- 1.4.5.2 Mock-up shall demonstrate construction and finishes.
- 1.4.5.3 Reviewed mock-up may remain as part of the final installation, subject to approval by the Departmental Representative.

1.4.6 Closeout Submittals:

- 1.4.6.1 Operation and maintenance instructions:
 - 1.4.6.1.1 Submit data for operation and maintenance of Products included in work of this section, for incorporation into operation and maintenance manuals.

1.5 COORDINATION

- 1.5.1 Work of this section is closely integrated with laboratory work of other sections. Coordinate work of this section with work of:

- 1.5.1.1 Laboratory counter tops under Section - 12 36 53 and Section - 12 36 54

- 1.5.2 Coordinate with mechanical, electrical, and other Subtrades for installation and connections.

1.6 DELIVERY, STORAGE, AND HANDLING

- 1.6.1 Delivery, storage, and handling of Products in accordance with Manufacturer's written instructions.

- 1.6.2 Package or crate, and brace Products to prevent damage or distortion during shipment and handling. Label packages and crates, and protect finish surfaces by sturdy wrappings or equivalent protection. Utilize temporary skids under large or heavy units.
- 1.6.3 Deliver Products to location at building site designated by General Trade.
- 1.6.4 Do not deliver Products to site until conditions are such that no damage will occur to them while in storage.
- 1.6.5 Casework Manufacturer and General Trade shall be jointly responsible to make certain that casework is not delivered until building and storage areas are sufficiently dry so that casework will not be damaged by excessive changes in moisture content.
- 1.6.6 Do not deliver casework until painting, wet work, grinding, and similar operations that could damage, soil, or deteriorate casework have been completed in installation areas.

1.7 SITE CONDITIONS, SCHEDULING

- 1.7.1 Scheduling: Deliver equipment or its parts ready for installation in accordance with construction schedule. Verify required delivery date sufficiently before delivery to ensure that construction is not delayed.
- 1.7.2 Coordinate scheduling and requirements with Divisions 22, 26, and 27.
- 1.7.3 Field measurements: Accurate field measurements to be completed before manufacturing. Show recorded measurements on final Shop Drawings. Coordinate manufacturing schedule with construction progress to avoid delay of Work.

1.8 PERFORMANCE REQUIREMENTS

- 1.8.1 For flexible laboratory furniture system:

- 1.8.1.1 Support systems shall be core and panel style support structure.
 - 1.8.1.2 Modular components shall be suitable for single faced wall cores or double faced peninsula or island configuration.
 - 1.8.1.3 Core assemblies shall have removable panels on all sides.

- 1.8.2 Static load performance of furniture units:

- 1.8.2.1 Furniture units shall withstand the following maximum static loads without causing deformation, drawer, or door malfunction, or tipping of the unit.
 - 1.8.2.2 Floor supported base cabinets shall carry 227 kg per linear feet of width evenly distributed over the full width and depth.
 - 1.8.2.3 Suspended cabinets shall carry 136 kg evenly distributed inside the cabinet on the lower surface and shelves or drawers with the cabinet suspended.

- 1.8.2.4 Post-supported shelves shall carry 23 kg per linear foot evenly distributed over the full width and depth of shelf or 114 kg applied on front edge of shelf at width midpoint.
- 1.8.2.5 Cabinet levelling device shall carry 227 kg and capable of adjustment after load is removed.
- 1.8.2.6 Cabinet door shall withstand 69 kg applied at outer edge of cabinet door that is swung 180 degrees.
- 1.8.2.7 Wall cabinets: Each shelf and cabinet bottom shall carry 23 kg per linear foot of width with load evenly distributed on shelves and cabinet bottom over full width and depth.
- 1.8.2.8 Base cabinet shelves shall carry 46 kg evenly distributed over full width and depth.

1.8.3 Dynamic load performance of furniture components:

- 1.8.3.1 Furniture components shall withstand following performance requirements without deformation of malfunction.
- 1.8.3.2 Cabinet drawers: shall perform to 150,000 opening and closing cycles with evenly distributed 46 kg load in the drawer.
- 1.8.3.3 Positive door catches: shall perform 300,000 opening and closing cycles without breakdown.
- 1.8.3.4 Door hinges: shall perform 300,000 opening and closing cycles with no static load added to the door.
- 1.8.3.5 Self-closing drawers: Drawers shall close when 152 mm open and have no static interior load.
- 1.8.3.6 Drawers 1219 mm wide: fully operable from either front corner with an interior 46 kg static load without racking or bending.
- 1.8.3.7 Drawer opening: operate with maximum opening force to fully open drawer with interior static load of 69 kg in properly levelled cabinet at 2.3 kg.

1.8.4 Physical performance of coatings:

- 1.8.4.1 Pencil hardness: 4H minimum
- 1.8.4.2 Abrasion resistance: 3.5 mg maximum weight loss per 100 cycles when tested on a calibrated E401 01 Taber Abrasion Tester using 1000 gm wheel pressure from a CD10 wheel
- 1.8.4.3 Humidity resistance: No visible effect after a 1000 hour exposure in saturated humidity at 100°F
- 1.8.4.4 Moisture resistance: No visible effect caused by 200°F +/- 5°F water trickles for 5 minutes over a test panel inclined at 45 degrees. No visible effect caused by a 1 00 hour continuous application of a 70°F water soaked 25 mm x 76 mm 25 mm cellulose sponge that remains wet throughout the entire test period.
- 1.8.4.5 Salt spray resistance: No visible effect after a 250 hour salt spray test

- 1.8.4.6 Adhesion: Minimum of 100 squares retain finish after a test panel is scored into 100 squares 1.6 mm x 1.6 mm by a razor blade that cuts completely through the finish with a minimum of substrate penetration and any loose particles are removed by a soft brush
- 1.8.4.7 Cold crack: No effect cause by 10 cycles of temperature change from 20°F for 60 minutes to 125°F for 60 minutes.
- 1.8.4.8 Adhesion and flexibility: no peeling or cracking of finish or no metal exposure when a test sample is bent 180 degree once over a 6 mm mandrel per ASTM 0522.
- 1.8.4.9 Impact resistance: No cracking of finish or metal exposure when a steel ball is dropped from a calibrated stand to deliver 100 inch pounds of impact
- 1.8.4.10 Gloss: 50 +I- 5 gloss when finish surface is measured at 60° reflectance

1.8.5 Chemical resistance performance:

1.8.5.1 Test Procedure:

- 1.8.6 Test panels shall withstand the following tests with no loss of adhesion or film protection, no discolouration or change in gloss, or no film softening. Concentrations identified as (*) can have slight discolouration or change in gloss, or temporary file softening. Concentrations are noted as percent by weight.

1.8.6.1 Test results:

- 1.8.6.1.1 Acids: Minimum of 5 drops (0.25 ml) shall be applied to the test site on panel and covered with a watch glass for 60 minutes, then washed and dried.

- Hydrochloric Acid: 37%*, 30%, 20%, 10%
- Sulphuric Acid: 70%*, 60%, 25%
- Nitric Acid: 50%*, 30%, 10%
- Phosphoric Acid: 75%, 25%
- Acetic Acid: 98%, 50%
- Formic Acid: 60%
- Perchloric Acid: 60%
- Phenol 85%

- 1.8.6.1.2 Solvents: Minimum of 5 drops (0.25 ml) shall be applied to the test site on panel and covered with a watch glass for 60 minutes, then washed and dried. Volatile solvents shall be applied by a saturate cotton ball method.

- Ethyl Alcohol Butyl Alcohol
- Methyl Alcohol Ethyl Acetate
- Ethyl Ether Methyleneethyl Ketone
- Toluene Acetone
- Benzene Carbon Tetrachloride
- Formaldehyde (37%) Gasoline

- Naphtha Kerosene
- Xylene Glycerine
- Furfural Ether
- Xylol Chloroform

1.8.6.1.3 Bases and Salts: Minimum of 5 drops (0.25 ml) shall be applied to the test site on panel and covered with a watch glass for 60 minutes, then washed and dried.

- Sodium Hydroxide 40%, 10%
- Ammonium Hydroxide 28%
- Potassium Hydroxide 40%, 10%
- Hydrogen Peroxide 5%
- Zinc Chloride Saturated
- Sodium Sulphide Saturated
- Sodium Carbonate Saturated
- Sodium Chloride Saturated

1.9 WARRANTY

1.9.1 Warrant work of this section for a period of 24 months, in accordance with Section 01 94 00.

1.9.1.1 Defects include, but are not limited to:

- 1.9.1.1.1 Ruptured, cracked, or stained coating.
- 1.9.1.1.2 Discoloration or lack of finish integrity.
- 1.9.1.1.3 Cracking or peeling of finish.
- 1.9.1.1.4 Slippage, shift, or failure of attachment to wall, floor, or ceiling.
- 1.9.1.1.5 Weld or structural failure.
- 1.9.1.1.6 Warping or unloaded deflection of components.
- 1.9.1.1.7 Failure of hardware.

2 Products

2.1 ACCEPTABLE MANUFACTURERS

2.1.1 Mott Manufacturing Ltd. Basis of Design: SigmaFrame - Laboratory Casework System

2.1.2 .

2.1.3 Kewaunee.

2.1.4 Waldner.

2.1.5 BEDCO

2.2 MATERIALS

2.1.6 Sheet steel:

2.1.6.1 Mild steel, cold rolled furniture grade, Drawing Steel OS Type B or higher, exposed, with smooth surfaces to furniture quality.

2.1.7 Galvanized steel:

2.1.7.1 Commercial quality galvanised sheet steel to ASTM 653, Designation Z275..

2.1.8 Stainless steel:

2.1.8.1 Sheet:, Type 316 alloy, weldable.

2.1.8.2 Finish: AISI No. 4 Brushed finish, unless otherwise indicated.

2.1.9 Glass:

2.1.9.1 Clear Float, 6 mm and 3 mm thick, conforming to CAN2 12.3-M76, Glazing Quality. Laminated Glass: CAN/CGSB-12.1-M90, Type 1 with clear PVB interlayer. Total nominal thickness of laminated glass: 6 mm.

2.1.10 Clear Acrylic

2.1.10.1 Types: Perspex, clear acrylic: 5 mm thick.

2.1.11 Sealant: One component, clear silicone sealant, chemical curing, antifungus composition.

2.1.11.1 Acceptable Products: "DC-786" by Dow Corning, and "Sanitary 1700" by CGE.

2.1.12 Solid Phenolic: in accordance with Section 12 36 53

2.1.13 Cabinet hardware:

2.1.13.1 Pulls: Handles for drawers and hinged doors in 101 mm satin finish stainless steel, O'Browne Co. Ltd. '417441010'.

2.1.13.2 Door catches: Adjustable zinc-plated, spring-loaded, nylon roller, Richelieu Martin Hardware '5526-2G.

2.1.13.3 Strike plates: Strike plates fabricated of stainless steel, deigned to be secured to cabinet stile without twisting, fixed with a single self-tapping stainless steel screw.

2.1.13.4 Door hinges: Five knuckle-type barrel door hinges of 14 gauge steel screwed into door and fastened to cabinet side stile with 2 counter sunk 8 - 32 cadmium-plated machine bolts & self-locking kep nuts, Larsen & Shaw '097 4-2114055P', nickel plated.

2.1.13.5 Locks; base and mobile cabinets: Locks for doors and drawers on cabinets, hinged doors on wall and floor-standing cabinets: 'M4-00542' by National Cabinet Lock. File cabinets and mobile cabinets all have locks.

2.1.13.5.1 Keys shall be removable in locked or unlocked positions.

- 2.1.13.5.2 Provide locks on each cabinet and each mobile cabinet is required to be keyed differently. All file cabinets are keyed alike.
- 2.1.13.5.3 Master keyed and 27 subgroup masters keyed by department.
- 2.1.13.5.4 Provide locks on all cabinets:
- All mobile cabinets are keyed differently.
 - All other cabinets are keyed alike.
- 2.1.13.6 Drawer and hinged door bumpers: Two tongue-type white rubber, press-fit bumpers per door or drawer, '132699' by Carson Rubber Products.
- 2.1.13.7 Press plugs: Plugs for cabinet levelling device holes in floors in black PVC, '245-006' by Ohio Nut & Bolt Co.
- 2.1.13.8 Shelf clips:
- 2.1.13.8.1 Clips for base cabinets, wall hung and tall storage cabinets; zinc-finished steel, Waterloo Furniture 'F607M'.
- 2.1.13.8.2 Clip for solvent storage: Roll-It '103BZ'.
- 2.1.13.9 Leg leveller bolt: 10 mm (3/8") diameter hex-head leg leveller bolt, Ohio Nut & Bolt Co., 'OPC-0349-FH.
- 2.1.13.10 Split pin for door handle, 16 mm (5/8"), Ohio Nut & Bolt Co., '607-293'.
- 2.1.13.11 Casters, levelling and locking: 'AC300F' Carrymaster by MJ Vail and Company or to suit loading requirements.
- 2.1.13.12 Levelling casters; mobile benches:
- 2.1.13.12.1 Carrymaster 'AC-300F' (flat plate mount) or Carrymaster 'AC-300S' (stem mount), for total four caster loads up to 598.8 kg. For loads in excess of 598.8 kg, Carrymaster 'AC-600F' (flat plate mount) or Carrymaster 'AC-600S' (stem mount).
- 2.1.13.12.2 Bosch Rexroth Corp., 'Caster Lifting Wheel #3 842 536 578', load capacity 203.7 kg per caster, Bosch Rexroth Corp., 'Mounting Plate #3 842 536 902', where required.
- 2.1.13.12.3 Atlas Castors 'Series 500 Levelling Casters CS Option' polyurethane wheels with precision bearings, maximum capacity 226.8 kg per caster; SB (square baseplate), CS (corner baseplate) or ST (stem) as required for application.
- 2.1.13.13 Drawer slides: 508 mm full-extension, load capacity 46 kg, Knape & Vogt '8400B'.
- 2.1.13.14 Grommet: Plastic grommet, 75 mm diameter, unless otherwise indicated.

2.2 DESIGN REQUIREMENTS

- 2.2.1 Support systems shall be a core and panel style support structure.
- 2.2.2 Core structure can be supported by anchoring to suitable flooring material or may be supported by structural end gables (outrigger legs).
- 2.2.3 Modular components shall be suitable for single faced wall cores or double faced peninsula or island configuration.
- 2.2.4 Core assemblies shall have removable panels on all sides.

2.3 CONSTRUCTION

.1 Suspended Base/Wall Cabinets:

- .1 Design and construction shall be as in section 12 35 53 - Laboratory Metal Casework.
- .2 Suspended cabinets shall be supported using hook shaped rails attached near the front and rear of the cabinets. It shall be possible to remove and relocate a fully loaded cabinet to any position between legs.
- .3 Suspended wall cases: Provide a system of cold-rolled steel hanger rails attached to the casework frames, to be vertically adjustable on one inch increments. Installation and removal to be accomplished without the use of tools.

.2 Service Core and Bench Frame:

- .1 Materials and Thicknesses: Use following minimum U.S. standard steel thicknesses for furniture manufacturing:
 - .1 11 Ga - "U" brackets, box brackets.
 - .2 14 Ga - Front cabinet support rails, rear cabinet support rails
 - .3 16 Ga - Vertical service core post, vertical island and wall posts, fixed bench frames, adjustable bench frames
 - .4 18 Ga - Upper service cover panels, lower service cover panels, end close off panels, service drops, adjustable service cover support rail, service cover support rails
- .2 The bench frame system shall provide complete independent rigid support for work surfaces, under counter suspended cabinets, over head shelving. Service cover panels, sinks and all mechanical and electrical line work as necessary to make the assembly operation.
- .3 The framing system shall accommodate the following design concepts:
 - .1 Separate service strip consisting of a flat counter top 24" deep with a 6" deep service strip top with integral 6" high back splash.
- .4 The system shall allow the addition, relocation or removal of suspended base cabinets, the removal of the entire leg frame module

including base cabinets and work surfaces, leaving intact the separate service strip with all its service fittings, service lines and cover panels as a finished operational component.

.5 The Standard Bench module shall be based on a standard 60" nominal inside dimension to accommodate any combination of cabinets up to 60" in width. It shall be possible to make 24", 36", 48" or custom length modules where necessary to suit room dimensions.

.3 Leg Frames:

.1 Each leg frame shall be fabricated from die-formed components. All welds are to be ground smooth ready for painting. Each leg frame shall have a 3/8 diameter levelling bolt, a slip on wrap around black PVC shoe and two welded studs for securing to service strip.

.2 Adjustable height leg frames shall be constructed as specified in 2.3.3.1 with the following additions. The front leg shall be constructed of two telescoping frames on 1/2" centres with a total height adjustment of 6" telescoping frames are to be locked in position with a spring loaded pin. Accessible from underside of the leg frame.

.4 Cabinet Support Front Rail:

.1 Front cabinet support rail shall be fabricated in a channel formation to be secured to the adjacent leg frames. The bottom edge of the rail shall be designed to engage with the front rail of the suspended base cabinet. The outer rail shall fit flush with the face of the cabinet. Flat ledges above the cabinet that will collect dust are not acceptable.

.5 Cabinet Support Rear Rail:

.1 Rear cabinet support rail shall be fabricated in a channel formation to over lapped the adjacent leg frames. The bottom edge of the rail shall be designed to engage with the front rail of the suspended base cabinet.

.6 Service Cover Support Rails:

.1 Service cover support rail shall be fabricated in a "Z" channel formation to be secured to the service strip. The bottom edge of the rail shall be designed to suspend the top edge of the service cover panel.

.7 Service Cover Panels:

.1 Rear cabinet support rail shall be provided between all leg frames to totally enclose the service strip space. Service Cover Panels shall be constructed in two sections. The lower section shall be fixed in place to the rear of the service strip. The upper section shall be easily removable, with out the use of tools. Each panel shall be formed to fit between each leg frame and to be supported in place by the service cover support rail.

.8 End Closure Panels:

.1 End closure panels shall be used to close off the ends of the service strip. End closure panels for wall benches shall be flanged on one edge, the other unformed edge shall slide in to a slip joint angle secured to the wall. Island assemblies shall have both edges flanged for securing to the service strip.

.9 Island Vertical Post Structure:

.1 Provide a two-piece telescoping upper vertical slotted post 1-5/8" by 1-5/8" sleeved into a 1- 7/8" by 1-7/8" lower post. . Upper and lower section shall be through bolted with 3/8" diameter zinc plated bolts to allow for field levelling.

.2 The vertical post system shall be attached with an upper horizontal "u" bracket, lateral "u" strut, 3/8" zinc plated bolts and spring nut. The lower horizontal box bracket shall be lagged to the floor, and attached to the furniture system with 3/8" zinc plated bolts and spring nuts.

.3 The vertical post system shall be slotted on 1" centres to except a notched shelf bracket. Shelves shall be fully adjustable without the use of tools.

.4 The shelf bracket shall be notched to fit in to the slotted post, and positively lock when weight is applied. The bottom shall be flanged to support the horizontal shelf, and will be tabbed and pre punched to mount the shelf.

.5 Shelves shall be of high pressure plastic laminate, painted steel, epoxy or similar material to support the desired weight. The rear of the shelf shall be blocked off with a painted steel angle running the open width of the shelf.

.10 Wall Vertical Post Structure:

.1 Provide a one piece vertical slotted post 1-5/8" by 13/16" by 36" or 48" as required.

.2 The vertical post system shall be through secured to the wall material with appropriate fasteners to suit wall conditions.

.3 The vertical post system shall be same as 2.4.I.3 above.

.4 The shelf bracket shall be the same as 2.4.I.4 above.

.5 Shelves shall be the same as 2.4.I.5 above.

.11 Service Drop Structure:

.1 Provide die-formed enclosed structure flange at the bottom to mount to the counter top. The front shall be formed and notched, and similar in construction to the base cabinets, and will except a removable door, Upper and lower Panel. The front of drop shall be open to allow for existing services to access the interior of the structure.

.2 The service drop shall be painted on all surfaces to match cabinet.

.3 No exposed fasteners are allowed. Upper and lower panels shall be fixed to the drop with zinc plated screws through the side flanges of the opening, the door shall be notched and formed to fit securely into the upper panel, and drop securely into the lower panel. Door shall sit flush with face of service drop, and will be removable without the use of special tools.

.12 Vertical Service Chases

.1 Fabricate 3-sided, 4-cornered, full height from countertop backsplash to ceiling, chase from 16mm thick solid phenolic panel material.

.1 Colour: as selected by Departmental Representative from Manufacturer's full range of colours.

.2 Internal reinforcement channels as required to carry loads imposed by shelving, piping, conduits, and pegboards.

.3 Internal hat channels for concealed screw attachment of any pipe and conduit clamping devices.

.4 Fourth side of chase facing sink shall be a 1-piece access panel from counter backsplash to ceiling, with exposed stainless steel fasteners.

.13 Core and Support Panel Structure

.1 Core and panel support structure is provided at peninsula bench configurations in order to provide seismic support to modular table frame assemblies, support adjustable shelving, and for distribution of power, data, and specialty gas piping.

.2 Top of panel section shall be finished with a 5/8" (16 mm) solid phenolic resin cap secured to metal stud framing top track. Refer to 12 36 53.

.14 Painted Steel Furniture Finish:

.1 Preparation and painting:

.1 Prepare surfaces, make free of defects with welds ground smooth and indistinguishable from surrounding metal.

.2 Components shall be cleaned in 4-stage chemical spray process that produces iron phosphate coating bonded to steel surfaces, concluding with a final deionized water rinse. Components shall be thoroughly oven-dried before.

.3 Components shall be sprayed in an electro-static three-stage process with high temperature, high-solids (60% minimum), semi-gloss (50%), epoxy/urethane baking enamel. Paint coating shall provide uniform coating on surfaces of each component with minimum thickness of 1.2 mils, and components properly baked and cured.

.4 Colours:

.1 Manufacturer's colour range, including custom colour as approved by Departmental Representative.

.2 A 1-colour scheme will be used.

3 Execution

3.1 INSTALLATION

.1 Install casework within system, align and set level with levelling devices, in accordance with Shop Drawings. Installation is not to proceed until completion of floor finishes so that flooring is continuous below floor supported casework, unless otherwise specified.

.2 At wall locations secure wall cabinets to face of finished walls and partitions, applying self-tapping countersunk screws through wall finish material into each concealed stud flange and steel backer plates where provided, complete with button washers and finished to match cabinet interiors.

.3 Flooring installation to be complete prior to commencement of laboratory casework and equipment installation.

.4 Install components to effect a secure, neat and complete installation.

.5 Casework shall be set with components plumb, straight and square, securely anchored to building structure with no distortion.
Concealed shims shall be used as required.

.6 Cabinets in continuous runs shall be fastened together with joints flush, uniform and tight with misalignment of adjacent units not to exceed 1/16 of an inch.

.7 Wall casework shall be secured to solid material, not lath, plastic or gypsum board.

.8 Top edge surfaces shall be abutted in one true plane. Joints are to be flush and gap shall not exceed 1/8 of an inch between tops units.

.9 Casework and hardware shall be adjusted and aligned to allow for accurate connection of contact points and efficient operation of doors and drawers without any warping or binding.

3.2 COUNTERTOP INSTALLATION:

.1 Countertops are to have been fabricated in lengths according to drawings, with ends abutting tightly and sealed with corrosion resistant sealant.

.2 Tops will be anchored to base casework in a single true plane with ends abutting at hairline joints with no raised edges at joints.

.3 Joints shall be factory prepared having no need for in-field processing of top and edge surfaces.

.4 Joints shall be dressed smoothly, surface scratches removed and entire surface cleaned thoroughly.

3.3 CLEANING

- .1 Ensure all products are unsoiled and match factory finish. Remove or repair damaged or defective units.
- .2 Clean all finished surfaces, including drawers and cabinet shelves, and touch up as necessary.
- .3 Countertops shall be cleaned and free of grease or streaks.

3.4 PROTECTION:

- .1 Counter tops and ledges shall be protected with 1/4 inch ribbed cardboard for the remainder of the construction process.
- .2 Examine casework for damaged or soiled areas; replace, repair, and touch-up as required.
- .3 Touch-up, repair or replace damaged products before Substantial Completion.

3.5 TOLERANCES

- .1 Installation tolerances:
 - between cabinet joints: 0.794 mm.
 - .2 Counters; level: 3.18 mm in 3048 mm.
 - .3 Base cabinets:
 - .1 Adjust top rails and sub tops to a single plane within: 1.588 mm.
 - .2 Align similar adjoining doors and drawers within: 1.588 mm.
 - .4 Wall cabinets:
 - fronts and bottoms to a single plane within: 1.588 mm.
 - similar adjoining doors within: 1.588 mm.

END OF SECTION

1 General

1.1 SECTION INCLUDES

1.1.1 Solid Phenolic Compact Laboratory Work Surfaces suitable for use on laboratory grade casework and as shelving, backsplashes, wall cladding, utility service chases partitions and other structural components.

1.2 RELATED SECTIONS

1.2.1 Section 12 35 53 - Metal Laboratory Casework

1.2.2 Section 12 35 54 - Laboratory Stainless Steel Counter Tops

1.3 REFERENCES

1.3.1 Scientific Equipment and Furniture Association (SEFA):

1.3.1.1 SEFA 3 Work Surfaces

1.3.2 ASTM International (ASTM):

1.3.2.1 EN 438-2:25 - Standard Test Method for Resistance to Scratch.

1.3.2.2 EN 438-2:16 - Standard Test Method for Resistance to Dry Heat.

1.3.2.3 EN 12721 - Standard Test Method for Resistance to Wet Heat

1.3.2.4 EN 438-2:17 - Standard Test Method for Dimensional Stability in Elevated Temperature.

1.3.2.5 5. EN ISO 178/ASTM 790-08 - Standard Test Method for Flexural Strength

1.3.2.6 EN ISO 1183/ASTM 792-08 - Standard Test Method for Density

7. ASTM E-84/UL 723 - Standard Test Method for Surface Burning Characteristics

1.3.3 International Organization for Standardization (ISO) 9001 - Quality Management Systems

1.4 QUALITY ASSURANCE

1.4.1 Qualifications:

1.4.1.1 Provide work of this section, executed by competent installers with experience in application of Products, systems and assemblies specified.

1.4.2 Manufacturer shall have successfully completed other laboratory projects of similar or greater magnitude.

1.4.3 Products manufactured in ISO certified facility.

1.5 SUBMITTALS

1.5.1 Product data sheets:

1.5.1.1 Submit Manufacturer's Product data sheets for Products proposed for use in the work of this section. Information shall include as a minimum:

1.5.1.1.1 Preparation instructions and recommendations.

1.5.1.1.2 Storage and handling requirements and recommendations.

1.5.1.1.3 Installation methods.

1.5.2 Samples:

1.5.2.1 450 x 450 mm solid phenolic, counter top including edge condition,

1.5.2.2 For each finish product specified, submit complete set of color chips representing manufacturer's full range of standard colors.

1.5.3 Shop Drawings:

1.5.3.1 Submit plan, section, elevation and perspective drawings necessary to describe and convey layout, profiles, and product components, including edge conditions, joints, fitting and fixture locations, anchorage, accessories, and finish colors.

1.5.3.2 Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on Shop Drawings.

1.5.3.3 Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

1.5.4 Closeout Submittals:

1.5.4.1 Maintenance instructions:

1.5.4.1.1 Submit data for maintenance, cleaning, and life cycle of Products included in work of this section, for incorporation into operation and maintenance manuals.

1.5.4.1.2 Include recommended cleaning materials and procedures, and list of materials detrimental to Solid Phenolic Compact.

1.6 COORDINATION

1.6.1 Work of this section is closely integrated with laboratory work of other sections. Coordinate work of this section with work of:

1.6.1.1 Laboratory casework under Section 12 35 53.

1.7 DELIVERY, STORAGE AND HANDLING

1.7.1 Delivery, storage, and handling of Products in accordance with Manufacturer's written instructions.

1.7.2 Package or crate, and brace Products to prevent damage or distortion during shipment and handling. Label packages and crates, and protect finish surfaces by sturdy wrappings or equivalent protection. Utilize temporary skids under large or heavy units.

1.7.3 Deliver Products to location at building site designated by General Contractor.

1.7.4 Do not deliver Products to site until conditions are such that no damage will occur to them while in storage.

1.7.5 Avoid direct exposure of products to sunlight.

1.7.6 Do not use work surfaces as bench, ladder, or seating.

1.8 WARRANTY

1.8.1 Warrant work of this section for a period of 24 months and in accordance with Section 01 94 00.

2 Products

2.1 ACCEPTABLE MANUFACTURER - SOLID PHENOLIC

2.1.1 Basis of Specification: **SPC Worksurfaces by Durcon Incorporated** - 206 Allison Drive, Taylor, TX 76574

2.1.2 Subject to compliance with requirements of Contract Documents, acceptable equivalent Products of the following Manufacturers may be used upon Departmental Representative approval:

2.1.3 Trespa - Top Lab Plus

2.1.4 DuraTop

2.2 GENERAL

2.2.1 Provide return splash sides where ends of tops butt against wall, blank side of cupboard, sides of fume hoods, or service enclosures.

2.2.2 For mobile units: Provide 4 edges polished.

2.3 MATERIALS

2.3.1 SOLID PHENOLIC -Solid Phenolic Compact (SPC) Laboratory Work Surface

2.3.2 Chemical Resistant SPC is a self-supporting flat panel based on thermosetting resins, homogeneously reinforced with cellulose fibers and manufactured under high pressure. The panels have a pigmented resin core with a decorative surface that is electron-beam (EB) cured.

2.3.3 MATERIAL PROPERTIES

2.3.3.1 Work surfaces shall be constructed of solid phenolic composite Chemical Resistant panels with black core. Thickness shall be as specified on drawings and shall be 5/8" (16mm) unless noted otherwise.

2.3.3.2 Colors: Dark Gray

2.3.3.3 Finish: Matte sheen (non-shinny)

2.3.3.4 Physical Properties: (CONTINUE NEXT PAGE)

Test	Test Method	Unit		Chemical Resistant SPC	
Resistance to Surface Wear	EN 438-2:10	Revolutions (Initial Point)	IP + FP/2	≤ 350	400
		Revolutions (Final Point)		≤ 500	
Resistance to Impact	EN 438-2:21	Indentation Diameter (mm)		0.4	
		Cracks or Scoring		No	
Resistance to Scratch	EN 438-2:25	Rating (Based on Load)		5	
Resistance to Dry Heat (160°C/320°F)	EN 438-2:16	Appearance (Rating)		5	
Resistance to Wet Heat (100°C/212°F)	EN 12721	Appearance (Rating)		5	
Resistance to Immersion in Boiling Water	EN 438-2:12	Appearance (Rating)		5	
		Percentage	Mass Increase	0.4	
			Thickness Increase	1.9	
Dimensional Stability in Elevated Temperature	EN 438-2:17	Percentage	Longitudinal (parallel)	0.05	
			Transversal (perpendicular)	0.05	
Resistance to Staining	EN 438-2:26	Appearance (Rating)	Acetone	5	
			NaOH	5	
			Hydrogen Peroxide (H ₂ O ₂ 3%)	5	
Resistance to Color Change	ASTM G53/EN 438-2:27	Rating (Grey Wool Scale)		5	
		Rating (Blue Wool Scale)		> 6	
Resistance to Crazing	EN 438-2:24	Appearance (Rating)		5	
Porosity	N/A	Appearance		Nonporous Surface and Edges	
Modulus of Elasticity	ASTM 638-08 /EN ISO 178	psi		≥ 1.85e6	
Flexural Strength	ASTM 790-08 /EN ISO 178	psi		≥ 2.87e4	
Tensile Strength	ASTM 638-08 /EN ISO 527-2	psi		≥ 2.71e4	
Density	ASTM 792-08 /EN ISO 1183	lbs/ft³		≥ 86.15	

2.3.3.5 Chemical resistance: Evaluation of chemical resistance is based on SEFA's (Scientific Equipment and Fixture Association) standard list of 49 chemicals/concentrations, their required methods of testing and their minimum acceptable results as a means of establishing a minimum acceptable level of performance for all exposed and semi-exposed surfaces.

2.3.3.6 Panels to have screw pull-out strength minimums per following chart (lb):

Screw	#6	#8	#10	#12	1/4"	5/16"	3/8"	7/16"
								1/2"

Dept:

1/2"	250	308	340	350	450	570	685	790	900
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Panels:

5/8"	310	370	435	492	560	710	855	990	1,100
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Panels:

3/4"		518	590	680	850	1,000		1,200	1,400
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2.3.3.7 Uniform load to cause no more than 6 mm deflection at center of the span:

Thickness	12" x 24"	12" x 36"	12"	x	48"
	24"x36"				

1/2" panels:	370	110	45	220
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5/8" panels:	690	210	85	410
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3/4" panels:	1,400	401	172	800
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1" panels:	2,605	785	335	1,500
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2.3.3.8 Chemical resistance

Chemical Reagent	Black	Chemical Reagent	Black
Amyl Acetate	0	Tincture of Iodine	0
Ethyl Acetate	0	Methyl Ethyl Ketone	1
Acetic Acid, 98%	0	Methylene Chloride	0
Acetone	0	Monochlorobenzene	0
Acid Dichromate, 5%	0	Napthaline	0
Butyl Alcohol	0	Nitric Acid, 20%	0
Ethyl Alcohol	0	Nitric Acid, 30%	0
Ammonium Hydroxide, 28%	0		Phenol,
90%	0		
Benzene	0	Phosphoric Acid, 85%	0
Carbon Tetrachloride	0	Silver Nitrate	0
Chloroform	0	Sodium Hydroxide, 10%	3
Chromic Acid, 60%	2	Sodium Hydroxide, 20%	3
Cresol	0	Sodium Hydroxide, 40%	3
Dichloroacetic Acid	0	Sodium Hydroxide Flakes	0
Dimethylformamide	0	Sodium Sulfide,	
		Saturated Solution	0
Dioxane	0	Sulfuric Acid, 33%	0
Ethyl Ether	0	Sulfuric Acid, 77%	0
Formaldehyde	0	Sulfuric Acid, 96%	0
Formic Acid	0	50% Sulfuric Acid (77%)	
Furfural	0	+50% Nitric Acid (70%)	2
Gasoline	0	Toulene	0
Hydrochloric Acid, 37%	0		
	Trichlorethylene		0
Hydrochloric Acid, 48%	1		Xylene
	0		
Hydrogen Peroxide	0	Saturated Zinc Chloride	0

2.3.3.9 Fabrication A.

2.3.3.9.1 Fabricated tops and accessories in accordance with manufacturer's recommendations, approved Shop Drawings, and SEFA 8.

2.3.3.9.2 Solid Phenolic Compact Work surfaces:

- Thickness:
 - * 3/4" [19 mm] countertops
 - * 5/8" [16 mm] mobile cabinetry tops
 - * Check each sheet at factory for required thickness.
 - * Maximum variation in thickness: plus or minus 1/16 inch (1.6 mm) from corner to corner.
- Warpage:
 - * Inspect tops for warpage prior to fabrication by placing on true flat surface.
 - * Maximum allowable warpage: 1/16 inch (1.5 mm) in 36 inch (900 mm) span or 3/16 inch (4.5 mm) in 96 inch (2400 mm) span.
- Fabrication:
 - * Shop fabricate in longest practical lengths.
 - * Bond joints with highly chemical resistant cement with properties and color similar to base material.
 - * Provide 1/8 inch (3 mm) drip groove at underside of exposed edges, set back 1/2 inch (13 mm) from face.
 - * Finish exposed edges.
- Edge treatment:
 - * Standard 1/4 inch (6 mm) radius edge with drip groove.
- Fabricate tops flat without marine edge
- Corner treatment: exposed corners shall be eased slightly for safety.
- Back and end splashes:
 - * Supplied loose for field installation.
 - * Same material and thickness as work surfaces.
 - * 4" inches ([100 mm) high unless otherwise indicated.

- * Back and end splashes: Furnish loose end splashes where work surfaces abut adjacent construction and locations indicated on Drawings.
- * Joints: Maximum 1/8 inch (3 mm), bonded with epoxy grout.
- * Make joints between two benches level.
- * Locate joints away from sinks and over or near supports.

3 Execution

3.1 EXAMINATION

- 3.1.1 Install tops in accordance with reviewed Shop Drawings, securing them in position by rigid, concealed fixing methods allowing no movement or rocking.
- 3.1.2 Installation is not to proceed until completion of floor finishes have been installed so that flooring is continuous below floor supported assemblies, unless otherwise specified.
- 3.1.3 Confirm that surfaces to receive tops are plumb and level, with maximum deflection of 1/4 inch (6 mm) in 20 feet (6 m).

3.2 PREPARATION

- 3.2.1 Prepare surfaces using methods recommended by manufacturer.

3.3 INSTALLATION

- 3.3.1 Install tops in accordance with reviewed Shop Drawings, securing them in position by rigid, concealed fixing methods allowing no movement or rocking. Installation is not to proceed until completion of floor finishes have been installed so that flooring is continuous below floor supported assemblies, unless otherwise specified.
- 3.3.2 Joints between 2 lengths of tops of either similar or dissimilar materials shall be level, flush and shall form a 1.6 mm joint. Fill joints with sealant. Install same types of tops to each other using bead sealant. Clean sealant from exposed surfaces in a manner precluding surface damage.
- 3.3.3 Install tops plumb and level.
- 3.3.4 Adhere to adjacent surfaces in accordance with manufacturer's recommendations.

3.4 PROTECTION

- 3.4.1 Counter tops must be protected, after their installation, with cardboard until the final inspection of this work.
- 3.4.2 Replace damaged products.

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END OF SECTION

1 General

1.1 DESCRIPTION OF WORK

- 1.1.1 Extent of stainless steel laboratory casework and fixtures is shown on drawings or indicated herein.
- 1.1.2 Work includes the fabrication and installation of stainless steel laboratory casework components consisting of: stainless steel countertops, backsplashes and integral sinks.
- 1.1.3 Waste Lines and traps are to be furnished and installed under Division 15. All sinks provided and installed by this Section are listed in Part 2 of this section. These sinks are provided with a tailpiece. Piping and fittings downstream from tailpiece are furnished and installed under the requirements of Division 15.
- 1.1.4 Sealants are specified under Division 7. Sealants which come into contact with any materials specified in 12 36 54 are to be installed under this Section.
- 1.1.5 Related Sections:
 - 1.1.5.1 Laboratory Casework section 12 35 53 and Laboratory Countertops 12 36 53
 - 1.1.5.2 Mechanical/Plumbing, Division 22
 - 1.1.5.3 Provide cut-outs and holes in casework necessary for installation of service fittings.

1.2 QUALITY ASSURANCE

- 1.2.1 Qualifications:
 - 1.2.1.1 Provide work of this section, executed by competent installers experience in application of Products, systems and assemblies specified.
- 1.2.2 Manufacturer shall have successfully completed other laboratory projects of similar or greater magnitude.

1.3 SUBMITTALS

- 1.3.1 Product data sheets:
 - 1.3.1.1 Submit Manufacturer's Product data sheets for Products proposed for use in the work of this section.
- 1.3.2 Samples:
 - 1.3.2.1 Three (3) sets of 200 mm x 200 mm samples, or 200 mm long as applicable, of specified product, material and finish:
 - 1.3.2.1.1 Stainless steel sheet.

1.3.3 Shop Drawings:

- 1.3.3.1 Clearly indicate materials being supplied and finishes, connections, attachments, reinforcing, locations or exposed fastening, colours, gloss intensities and coating types by name.
- 1.3.3.2 Completely detailed Shop Drawings including plans, elevations, sections and details shall clearly indicate:
 - 1.3.3.2.1 Laboratory casework, frame assembly, countertops, plumbing/mechanical service fittings, sinks, and miscellaneous items.
 - 1.3.3.2.2 Location for roughing-in of plumbing and electrical services.
 - 1.3.3.2.3 Coordinate elevations with floor plan for each room and indicate locations and dimensions required for services.
 - 1.3.3.2.4 The laboratory casework manufacturer shall furnish shop drawings illustrating the layout and placement of all laboratory casework and fume hoods as well as any products included in this section.
 - 1.3.3.2.5 Indicate the type and location of all service fittings and associated supply connections.
 - 1.3.3.2.6 Preparation instructions and recommendations.
 - 1.3.3.2.7 Storage and handling requirements and recommendations. Installation methods.

1.3.4 Closeout Submittals:

- 1.3.4.1 Operation and maintenance instructions:
 - 1.3.4.1.1 Submit data for operation and maintenance of Products included in work of this section, for incorporation into operation and maintenance manuals.

1.4 COORDINATION

- 1.4.1 Coordinate with mechanical, electrical, and other Subtrades for installation and connections.

1.5 DELIVERY, STORAGE, AND HANDLING

- 1.5.1 Delivery, storage, and handling of Products in accordance with Manufacturer's written instructions.
- 1.5.2 Package or crate, and brace Products to prevent damage or distortion during shipment and handling. Label packages and crates, and protect finish surfaces by sturdy wrappings or equivalent protection. Utilize temporary skids under large or heavy units.
- 1.5.3 Deliver Products to location at building site designated by General Trade.

1.5.4 Do not deliver Products to site until conditions are such that no damage will occur to them while in storage.

1.5.5 Casework Manufacturer and General Trade shall be jointly responsible to make certain that casework is not delivered until building and storage areas are sufficiently dry so that casework will not be damaged by excessive changes in moisture content.

1.5.6 Do not deliver casework until painting, wet work, grinding, and similar operations that could damage, soil, or deteriorate casework have been completed in installation areas.

1.6 SITE CONDITIONS, SCHEDULING

1.6.1 Scheduling: Deliver equipment or its parts ready for installation in accordance with construction schedule. Verify required delivery date sufficiently before delivery to ensure that construction is not delayed.

1.6.2 Coordinate scheduling and requirements with Divisions 22, 26, and 27.

1.6.3 Field measurements: Accurate field measurements to be completed before manufacturing. Show recorded measurements on final Shop Drawings. Coordinate manufacturing schedule with construction progress to avoid delay of Work.

1.7 PERFORMANCE REQUIREMENTS

1.7.1 Chemical resistance performance:

1.7.1.1 Test Procedure:

1.7.1.1.1 Test panels shall withstand the following tests with no loss of adhesion or film protection, no discolouration or change in gloss, or no film softening. Concentrations identified as (*) can have slight discolouration or change in gloss, or temporary file softening. Concentrations are noted as percent by weight.

1.7.1.2 Test results:

1.7.1.2.1 Acids: Minimum of 5 drops (0.25 ml) shall be applied to the test site on panel and covered with a watch glass for 60 minutes, then washed and dried.

- | | |
|---------------------|---------------------|
| • Hydrochloric Acid | 37%*, 30%, 20%, 10% |
| • Sulphuric Acid | 70%*, 60%, 25% |
| • Nitric Acid | 50%*, 30%, 10% |
| • Phosphoric Acid | 75%, 25% |
| • Acetic Acid | 98%, 50% |
| • Formic Acid | 60% |
| • Perchloric Acid | 60% |
| • Phenol | 85% |

1.7.1.2.2 Solvents: Minimum of 5 drops (0.25 ml) shall be applied to the test site on panel and covered with a watch glass for 60 minutes, then washed and dried. Volatile solvents shall be applied by a saturate cotton ball method.

Ethyl Alcohol	Butyl Alcohol
Methyl Alcohol	Ethyl Acetate
Ethyl Ether	Methylethyl Ketone
Toluene	Acetone
Benzene	Carbon Tetrachloride
Formaldehyde	(37%) Gasoline
Naphtha	Kerosene
Xylene	Glycerine
Furfural	Ether
Xylol	Chloroform

1.7.1.2.3 Bases and Salts: Minimum of 5 drops (0.25 ml) shall be applied to the test site on panel and covered with a watch glass for 60 minutes, then washed and dried.

Sodium Hydroxide	40%, 10%
Ammonium Hydroxide	28%
Potassium Hydroxide	40%, 10%
Hydrogen Peroxide	5%
Zinc Chloride	Saturated
Sodium Sulphide	Saturated
Sodium Carbonate	Saturated
Sodium Chloride	Saturated

1.8 WARRANTY

1.8.1 Warrant work of this section for a period of 24 months, in accordance with Section 01 94 00.

1.8.1.1 Defects include, but are not limited to:

- 1.8.1.1.1 Ruptured, cracked, or stained coating.
- 1.8.1.1.2 Discoloration or lack of finish integrity.
- 1.8.1.1.3 Cracking or peeling of finish.
- 1.8.1.1.4 Slippage, shift, or failure of attachment to wall, floor, or ceiling.
- 1.8.1.1.5 Weld or structural failure.
- 1.8.1.1.6 Warping or unloaded deflection of components.

2 Products

2.1 ACCEPTABLE MANUFACTURERS

2.1.1 Mott Manufacturing. (Basis of Specification)

2.1.2 Hamilton Scientific.

2.1.3 Kewaunee.

2.1.4 Substitutions in accordance with Section 01 25 00

2.2 MATERIALS

2.2.1 Stainless steel:

2.2.1.1 Sheet: Type 316 alloy, weldable.

2.2.1.2 Finish: AISI No. 4 Brushed finish, unless otherwise indicated.

2.2.2 Sealant: One component, clear silicone sealant, chemical curing, antifungal composition.

2.2.2.1 Acceptable Products:

2.2.2.1.1 'DC-748' by Dow Corning.

2.3 COUNTER TOPS

2.3.1 Provide counter tops of the following materials where shown on drawings:

2.3.2 Stainless Steel: Provide 1.5mm thick (16 gauge) stainless steel sheet, AISI Type 316 with No. 4. Finish. Weld all joints, grind smooth and polish to become practically invisible. Keep welded field jointing to a minimum. Apply reinforcing channels to underside of top where necessary to insure rigidity without deflection.

2.3.3 Extend top down to provide a 38mm thickness and a full return flange under frame.

2.3.4 Form backsplash to be coved to and integral with top surface. Provide 45° beveled top edge with concealed return leg.

2.3.5 Provide a 6mm raised marine edge around perimeter of tops. Pitch top surface two ways to bowl to provide adequate drainage.

2.3.6 Where stainless steel sinks occur in stainless steel tops, factory assemble sinks and tops into one integral unit with welds ground smooth and polished.

2.3.7 Grind all edges smooth.

2.4 STAINLESS STEEL SINKS:

2.4.1 16 gauge, Type 316, with No. 4 Finish. Fabricate with horizontal and vertical corners rounded and coved to at least 15mm radius. Slope sink bottoms to pitch to outlet. Provide double wall construction for sink partitions with top edge rounded to at least 15mm diameter. Continuous butt weld joints and provide factory punching for fixtures. Weld sink units to tops and finish to produce an integral unit with invisible joint line.

2.4.2 Sink Schedule: Refer to drawings for location, dimensions and quantities of the following sinks:

2.4.2.1 **SK-1:** Stainless steel double compartment integral sink: 400 mm long, 400 mm wide, and 275 mm deep, each. Provide 100 mm high backsplash as required with 45 degree beveled top edge with concealed return leg. Provide raised rim - marine edge - on all sides.

2.4.2.2 **SK-2:** Stainless steel single compartment integral sink: 600 mm long, 400 mm wide, and 275 mm deep. Provide 100 mm high backsplash as required with 45 degree beveled top edge with concealed return leg. Provide raised rim - marine edge - on all sides.

3 Execution

3.1 INSTALLATION

3.1.1 Install casework within system, align and set level with levelling devices, in accordance with Shop Drawings. Installation is not to proceed until completion of floor finishes so that flooring is continuous below floor supported casework, unless otherwise specified.

3.1.2 At wall locations secure wall cabinets to face of finished walls and partitions, applying self-tapping countersunk screws through wall finish material into each concealed stud flange and steel backer plates where provided, complete with button washers and finished to match counter.

3.1.3 Install components to effect a secure, neat and complete installation.

3.1.4 Protection: Protect materials and installed laboratory casework and fixtures from damage by work of other trades.

3.2 TOLERANCES

3.2.1 Installation tolerances:

3.2.1.1 Plumb between cabinet joints: 0.794 mm.

3.2.1.2 Counters; level: 3.18 mm in 3048 mm.

END OF SECTION

1 GENERAL

1.01 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings where required.
 - .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.
 - .6 Showing sleeves through walls and slabs including penetrations through fire rated partitions.
 - .7 Operations and maintenance manuals will not constitute acceptable shop drawings.
 - .8 Shop drawings shall be reviewed beforehand by the contractor to ensure envelopes account for actual site conditions.
 - .4 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

1.02 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
 - .1 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
All manuals shall be machine readable PDF format.
 - .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 - Testing, Adjusting and Balancing for HVAC.
- .5 Approvals:
 - .1 Submit [2] copies of draft Operation and Maintenance Manual to Departmental Representative for approval.
 - .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 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 review 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.

1.03 MAINTENANCE MATERIAL SUBMITTALS

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

- .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.

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal

1.05 COORDINATION

- .1 Cooperate and coordinate with other trades and verify order of installation of overlapping or interconnecting services or equipment before starting Work
- .2 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.
- .3 Coordinate location of access to cleanouts, valves, equipment, and duct access doors above continuous ceilings; coordinate access panel and door requirements with Section 08 31 00.
- .4 Coordinate installation of Work with adjacent work by others in accordance with requirements listed in Section 01 73 00 - Execution and as follows:
- .5 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.

- .6 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.
- .7 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.
- .8 Coordinate dimensional details with applicable architectural and structural drawings.
- .9 Full size and detailed drawings will take precedence over scale measurements from drawings when laying out the Work.
- .10 Coordinate requirements of, and connect to, equipment specified in other Sections, and to equipment supplied and installed by other contractors or by Owner; uncrate equipment, assemble, move in place, and install complete, start-up and test.

1.06 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.
- .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 Owner.
- .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, Owner 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.

2 PRODUCTS

2.01 NOT USED

- .1 Not used.

3 EXECUTION

3.01 EXAMINATION

- .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 Failure to advise Departmental Representative of discrepancies in writing will mean that Constructor accepts documents as presented without potential of additional costs.
- .5 Unforeseen conditions or discrepancies that could not be readily ascertained at the time of Bid will be administered as a change to the Contract.

3.02 PAINTING REPAIRS AND RESTORATION

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

3.03 SYSTEM CLEANING

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

3.04 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 -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.

3.05 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 all 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 Departmental Representative may record these demonstrations on video tape for future reference.

3.06 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
.1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal

3.07 PROTECTION

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

END OF SECTION

1 GENERAL

1.01 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers International (ASME)
 - .1 ANSI/ASME B16.15-[13], Cast Copper Alloy Threaded Fittings, Classes 125 and 250.
 - .2 ANSI/ASME B16.18-[12], Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 ANSI/ASME B16.22-[13], Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - .4 ANSI/ASME B16.24-[11], Cast Copper Alloy Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
 - .5 ASME B16.26-[13], Cast Copper Alloy Fittings for Flared Copper Tubes.
 - .6 ASME B31.9-[14], Building Services Piping.
 - .7 ASME B36.19M-[04], Stainless Steel Pipe.
- .2 ASTM International
 - .1 ASTM A 182/A 182M-[16], Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
 - .2 ASTM A 269-[15a], Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - .3 ASTM A 307-[14], Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .4 ASTM A 312/A 312M-[16], Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
 - .5 ASTM A 351/A 351M-[16], Castings, Austenitic, for Pressure Containing Parts.
 - .6 ASTM A 403/A 403M-[16], Wrought Austenitic Stainless Steel Piping Fittings.
 - .7 ASTM A 536-[84(2014)], Standard Specification for Ductile Iron Castings.
 - .8 ASTM B 32-[08(2014)], Standard Specification for Solder Metal.
 - .9 ASTM B 42-[15a], Seamless Copper Tube, Standard Sizes.
 - .10 ASTM B 88M-[14], Standard Specification for Seamless Copper Water Tube (Metric).
- .3 American National Standards Institute/American Water Works Association (ANSI) / (AWWA)
 - .1 ANSI/AWWA C111/A21.11-[12], Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - .2 ANSI/AWWA C151/A21.51-[09], Ductile Iron Pipe, Centrifugally Cast, for Water.
- .4 CSA Group
 - .1 CSA B137.5-[13], Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications.
 - .2 CSA B242-[05], Groove and Shoulder Type Mechanical Pipe Couplings.
- .5 Underwriters Laboratories of Canada (ULC)

- .1 CAN/ULC S101-[07], Fire Endurance Tests of Buildings Construction and Materials.
- .2 CAN/ULC S102.2-[10], Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies.
- .3 CAN/ULC S115-[11], Standard Method of Fire Tests of Firestop.
- .6 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).
- .7 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .8 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
 - .1 MSS-SP-67-[02a], Butterfly Valves.
 - .2 MSS-SP-70-[06], Grey Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS-SP-71-[05], Grey Iron Swing Check Valves, Flanged and Threaded Ends.
 - .4 MSS-SP-80-[03], Bronze Gate, Globe, Angle and Check Valves.
- .9 National Research Council (NRC)
 - .1 National Plumbing Code of Canada (NPC) [2015].
- .10 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992, c. 34 (TDGA).

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data
 - .1 Provide manufacturer's printed product literature and datasheets for insulation and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Store and manage materials in accordance with Section 01 61 00.
- .2 Packaging Waste Management: remove for reuse in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Place materials defined as hazardous or toxic in designated containers.
- .4 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.
- .5 Materials and Resources: prepare Construction Waste Management plan in accordance with Section 01 74 21 - Construction/Demolition Waste

Management and Disposal.

1.05 RELATED REQUIREMENTS

- .1 Section 22 05 00, 23 05 15, 23 05 29, 23 07 15.

2 PRODUCTS

All piping, fittings, valves, etc. shall be certified in accordance with NSF/ANSI 61 Annex G or NSF 372 to not have a weighted average of greater than 0.25 percent lead.

This section is applicable to all water piping serving fixtures within the laboratory, including piping labelled as "Laboratory" water instead of "Domestic".

2.01 PIPING

- .1 Domestic hot, cold and recirculation systems, within building.
 - .1 Above ground:
 - .1 Copper tube, hard drawn, type L to ASTM B 88M.

2.02 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 ANSI/ASME B16.15.
- .3 Cast copper, solder type: to ANSI/ASME B16.18.
- .4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.
- .5 NPS 2 and larger:
 - .1 ANSI/ASME B16.18 or ANSI/ASME B16.22 roll grooved to CSA B242.
- .6 NPS 1 ½ and smaller:
 - .1 Wrought copper to ANSI/ASME B16.22, cast copper to ANSI/ASME B16.18; with 301 stainless steel internal components and EPDM seals. Suitable for operating pressure to 1380 kPa.

2.03 JOINTS

- .1 Flanged Joints: Rubber gaskets, latex-free 1.6 mm thick: to AWWA C111.
- .2 Flanged Joints: Bolts, nuts, hex head and washers: to ASTM A 307, heavy series.
- .3 Solder: [95/5] tin copper alloy
- .4 Teflon tape: for threaded joints.
- .5 Grooved couplings: designed with angle bolt pads to provide rigid

joint, complete with EPDM gasket.

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

2.04 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 as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 Standard of Acceptance
Kitz 43
Crane 1334
Jenkins 813J
Newman Hattersley T608 with NPT to copper adapters
Nibco S-131
- .2 NPS 2 and under, threaded:
 - .1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc as specified Section [23 05 23.01 - Valves - Bronze].
 - .2 Standard of Acceptance
Kitz 42
Crane 431
Jenkins 2810J
Newman Hattersley T608
Nibco T-131
- .3 NPS 2 1/2 and over, flanged:
 - .1 Rising stem: to MSS-SP-70, Class 125, 860 kPa, flat flange faces, cast-iron body, OS&Y bronze trim specified Section [23 05 23.02 - Valves - Cast Iron].
 - .2 Standard of Acceptance
Kitz 72
Crane 465 ½
Jenkins 454J
Newman Hattersley #504
Nibco F-617-O

2.05 GLOBE VALVES

- .1 NPS2 and under, soldered:
 - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, renewable composition disc, screwed over bonnet as specified Section [23 05 23.01 - Valves - Bronze].
 - .2 Lockshield handle as indicated.
 - .3 Standard of Acceptance
Kitz 10
Crane 1334/1320
Jenkins 813J
Newman Hattersley 13 with NPT copper adaptors

Nibco S-235-Y

- .2 NPS 2 and under, threaded:
 - .1 To MSS-SP-80, Class 150, 1 MPa, bronze body, screwed over bonnet, renewable composition disc as specified Section [23 05 23.01 - Valves - Bronze].
 - .2 Lockshield handles: as indicated.
 - .3 Standard of Acceptance
 - Kitz 09
 - Crane 7TF
 - Jenkins 106BJ
 - Newman Hattersley 13
 - Nibco T-235-Y

2.06 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 as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 Standard of Acceptance
 - Kitz 23
 - Crane 1342
 - Jenkins 4093J
 - Newman Hattersley 47 with NPT copper adaptors
 - Nibco S-413
- .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 as specified Section [23 05 23.01 - Valves - Bronze.
 - .2 Standard of Acceptance
 - Kitz 22
 - Crane 37
 - Jenkins 4073J
 - Newman Hattersley 47
 - Nibco T-413
- .3 NPS 2 1/2 and over, flanged:
 - .1 To MSS-SP-71, Class 125, 860 kPa, cast iron body, flat flange faces, renewable seat, bronze disc, bolted cap specified Section 23 05 23.02 - Valves - Cast Iron: Gate, Globe, Check.
 - .2 Standard of Acceptance
 - Kitz 78
 - Crane 373
 - Jenkins 587J
 - Newman Hattersley 651
 - Nibco F-918 .

2.07 BALL VALVES

- .1 NPS 2 and under, screwed:

- .1 Class 150.
 - .2 Bronze body, chrome plated brass ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle, full port. as specified Section [23 05 23.01 - Valves - Bronze].
 - .3 Standard of Acceptance
 - Kitz 58 (threaded)
 - Crane 9302 (threaded)
 - Jenkins 201J (threaded)
 - Newman Hattersley 1969F (threaded)
 - Nibco T-FP-600 (threaded)
 - Anvil Fig 171N (threaded)
-
- .2 NPS 2 and under, soldered:
 - .1 To ANSI/ASME B16.18, Class 150.
 - .2 Bronze body, chrome plated brass ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle, with NPT to copper adaptors as specified Section [23 05 23.01 - Valves - Bronze].
 - .3 Standard of Acceptance
 - Kitz 59(soldered)
 - Crane 9322 (soldered)
 - Jenkins 202J (soldered)
 - Newman Hattersley 1999 (soldered)
 - Nibco S-FP-600 (soldered)

2.08 BUTTERFLY VALVES

- .1 NPS 2-1/2 and over, lug:
 - .1 To MSS-SP-67, Class 200.
 - .2 Cast iron body, ductile iron chrome plated disc, stainless steel stem, EPT liner.
 - .3 Lever operated, NPS8 and over, gear operated.

3 EXECUTION

3.01 APPLICATION

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

3.02 INSTALLATION

- .1 Install in accordance with NPC and local authority having jurisdiction.
- .2 Install pipe work in accordance with Section 23 05 15 - Installation of Pipework, supplemented as specified herein.
- .3 Assemble piping using fittings manufactured to ANSI and Standards Council of Canada (SCC) 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 Valves
 - .1 Isolate equipment, fixtures and branches with gate, butterfly, or ball valves.
 - .2 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.

3.03 PRESSURE TESTS

- .1 Conform to requirements of Section 21 05 01 - Common Work Results for Mechanical.
- .2 Pressure test piping before insulation is applied. Cut-out and replace leaking soldered or brazed fittings and retest.
- .3 Test pressure: greater of 1 times maximum system operating pressure or 860 kPa.

3.04 FLUSHING AND CLEANING

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

3.05 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.

3.06 DISINFECTION

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

3.07 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 HWS storage tank up to design temperature slowly.
 - .4 Monitor piping HWS and HWC 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.

3.08 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 objectives.
 - .2 TAB in accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
 - .3 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.
 - .4 Sterilize HWS and HWC systems for Legionella control.
 - .5 Verify performance of temperature controls.
 - .6 Verify compliance with safety and health requirements.
 - .7 Check for proper operation of water hammer arrestors. Run [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.

3.09 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Waste Management: separate waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section 22 05 00, 23 05 15, 23 05 29, 23 07 15.

1.02 REFERENCE STANDARDS

- .1 ASTM International Inc.
 - .1 ASTM D 2235-[04], Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
 - .2 ASTM D 2564-[04e1], Standard Specification for Solvent Cements for Poly(Vinyl-Chloride) (PVC) Plastic Piping Systems.
- .2 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-Series B1800-[06], Thermoplastic Nonpressure Pipe Compendium - B1800 Series.
- .3 Green Seal Environmental Standards (GSES)
 - .1 Standard GS-36-[00], Commercial Adhesives.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .5 National Research Council Canada (NRC)
 - .1 National Plumbing Code of Canada [2015] (NPC).
- .6 Ontario Building Code (2015)
- .7 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1168-[A2005], Adhesive and Sealant Applications.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for piping and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Provide [two] copies WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 29.06 - Health and Safety Requirements

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with

manufacturer's name, address.

- .3 Store at temperatures and conditions recommended by manufacturer.
- .4 Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2 PRODUCTS

2.01 PIPING

- .1 Waste and Vent Pipe from Connection to Plumbing Fixture (Including P-Trap) to Sanitary or Vent Riser Connection:
 - .1 Pipe: Flame-retardant Polypropylene, schedule 40, acid waste piping with no-hub/plain ends in accordance with ASTM D4101 and dimensional tolerances of ASTM F1412. Piping shall be factory grooved.
 - .2 Fittings: Flame-retardant Polypropylene, schedule 40, acid waste piping with no-hub/plain ends in accordance ASTM D4101. Fitting layouts will conform to ASTM D3311, and ASTM F1412.
 - .3 Joints: No-Hub/Plain mechanical joints method in accordance with ASTM F1412, with an outer band of 300 series stainless steel, 5/16" bolts, nuts, and washers plated to meet 100 hour salt spray test per ASTM B117.
 - .4 Joints to Dissimilar Materials: Flanged.
 - .5 P-Trap: Schedule 40 Polypropylene in accordance with ASTM D4101
 - .6 Serviceable Items: All piping and fittings shall be by same manufacture.
 - .7 Basis of Design: Orion Blueline, IPEX Labline Elastolive, or equivalent.

2.02 CLEANOUTS

- .1 Materials similar to piping provided.

2.03 ISOLATION VALVES

- .1 Zone Isolation Valves: Ball valve, fully ported, polypropylene with ANSI 150# flange connections, PTFE seals and packing, and padlocking lever.

3 EXECUTION

3.01 APPLICATION

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

3.02 INSTALLATION

- .1 Execution
 - 1. Pipe to be installed per manufacturer's recommendations for threaded fittings
 - 2. Pipe shall be supplied in 3050mm (10 foot) lengths.
 - 3. Install piping neat and orderly; accomplish changes of direction using proper pipe fittings. Connect to sinks, cup sinks, floor drains, and other devices as shown on drawings. Piping within casework shall be coordinated with casework supplier.
 - 4. Support all waste and vent piping to manufacturer's recommendations, applicable codes, and design details.
 - 5. Pitch vent piping to waste line.
 - 6. Install horizontal waste piping above ground with a minimum pitch 1:50. Make changes in direction of flow by use of drainage pattern fittings.
 - 7. Set floor drains level and at low points. Floors shall slope toward drain. Drains installed without proper slope shall not be acceptable and shall be repaired to the Departmental Representative satisfaction at the contractor's cost.
 - 8. Install cleanouts as required. Locate cleanout access cover so that snake of 100 ft. can be properly used.
 - 9. Provide caps and plugs on open pipe ends during construction phase to prevent construction debris from entering pipe.
 - 10. Provide necessary transition fitting and couplings required when changing from one piping material to dissimilar material.
- .2 Install in accordance with National Plumbing Code, Ontario Building Code (2015) and local authority having jurisdiction.

3.03 TESTING

- 1. Testing of all waste and vent piping must conform to the requirements of the Canadian Plumbing Code, latest edition.
- 2. Hydrostatically test both waste and vent piping applying a water column of at least 3m. Maintain hydrostatic pressure for 2 hrs without leakage.

3. Replace or repair piping system until satisfactory test is obtained.
No piping shall be concealed until satisfactorily tested.
4. Provide documentation of successful, no leakage, hydrostatic testing of all drain piping to the owner and Departmental Representative. Results of testing must be approved by the Departmental Representative prior to burying or enclosing the waste and vent piping
- .5 Hydraulically test to verify grades and freedom from obstructions.

3.04 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 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:
Not Used
- .4 Ensure fixtures are properly anchored, connected to system and effectively vented.
- .5 Affix applicable label (storm, sanitary, vent, pump discharge) c/w directional arrows every floor or 4.5 m (whichever is less).

3.05 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal

END OF SECTION

1 GENERAL

1.01 SUMMARY

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

1.02 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME Boiler and Pressure Vessel Code Section VIII Pressure Vessels.
 - .1 BPVC-VIII B - [2004], BPVC Section VIII - Rules for Construction of Pressure Vessels Division 1.
 - .2 BPVC-VIII-2 B - [2004], BPVC Section VIII - Rules for Construction of Pressure Vessels Division 2 - Alternative Rules.
 - .3 BPVC-VIII-3 B - [2004], BPVC Section VIII - Rules for Construction of Pressure Vessels Division 3 - Alternative Rules High Press Vessels.
 - .2 ASME B16.5-[03], Pipe Flanges and Flanged Fittings.
 - .3 ASME B16.11-[01], Forged Fittings, Socket-Welding and Threaded.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A 53/A 53M-[04], Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A 181/A 181M-[01], Standard Specification for Carbon Steel Forgings for General Purpose Piping.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA B51-[03], Boiler, Pressure Vessel, and Pressure Piping Code.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.
 - .2 Submit WHMIS MSDS in accordance with Section 02 81 01 - Hazardous Materials. Indicate VOC's for adhesive and solvents during application and curing.
- .3 Shop Drawings:
 - .1 Submit shop drawings to indicate project layout including layout, dimensions and extent of piping system.
 - .1 Vertical and horizontal piping locations and elevations and connections details.
 - .2 Test Reports: submit certified test reports from approved

- independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Instructions: submit manufacturer's installation instructions.
- .5 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals
- .4 Contractor to apply for and cover cost of TSSA Registration and Inspection

1.04 RELATED REQUIREMENTS

- .1 Section 22 05 00, 23 05 15, 23 05 29, 23 07 15.

2 PRODUCTS

2.01 PIPING/TUBING

- .1 Type 'L' copper to ASTM B819;
 - .1 Factory cleaned and marked with classification symbols,
 - .2 Shipped sealed with plastic end caps, and
 - .3 Hard drawn.
- .2 Fittings:
 - .1 Wrought copper suitable for silver soldering
- .3 Jointing Materials
 - .1 Silver brazing alloy AWS Classification BCUP-5.

2.02 BALL VALVES

- .1 Shut-off valves for compressed air up to NPS 2:
 - .1 Forged brass, bolted pattern, ball type with 200 mm (8 in) type "k" copper extensions,
 - .2 Quarter turn from open to closed,
 - .3 Stainless steel, brass or chrome plated bronze ball, with teflon seat and viton seals,
 - .4 Blow-out resistant stem with viton seal, and
 - .5 Gauge port.

- .6 Pressure rating of 4137 kPa (600 psi), 2.03
- .7 Factory assembled, cleaned for oxygen service with extension ends sealed with plastic caps and shipped in sealed plastic bag.
- .2 Standard of Acceptance:
 - .1 Amico/Vitalaire
 - .2 Medigas
 - .3 Essex Medical Products
 - .4 Canadian Liquid Air, or Approved Alternate.

3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 COMPRESSED AIR PIPING CONNECTIONS AND INSTALLATION

- .1 Install flexible connection in accordance with Section [23 05 16 - Expansion Fittings and Loops for HVAC Piping].
- .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 Provide drain from refrigerated air dryer.
- .11 Weld steel piping in accordance with Section [23 05 17 - Pipe Welding] and;
 - .1 To ASME code and requirements of authority having jurisdiction.
 - .2 Weld concealed and inaccessible piping regardless of size.

3.03 FIELD QUALITY CONTROL

- .1 Site Tests/Inspection:
- .1 Testing: pressure test for 4 hours minimum, to 1100 kPa, with outlets closed and with compressor isolated from system. Pressure drop not to exceed 10 kPa.

3.04 CLEANING

- .1 Cleaning: blow out piping to clean interior thoroughly of oil and foreign matter.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 General

1.1 SCOPE

1.1.1 This Section specifies pipe, fittings, and methods for all pure water system piping.

1.2 SHOP DRAWINGS AND PRODUCT DATA

1.2.1 Submit shop drawings for;

1.2.1.1 Pipe distribution.

1.2.2 Submit manufacturers product sheets with performance and installation data for;

1.2.2.1 Pipe & fittings,

1.2.2.2 Joints,

1.2.2.3 Fusion weld methods and equipment.

1.3 APPLICABLE CODES AND STANDARDS

1.3.1 ASTM D3222, Standard Specification for Unmodified Polyvinylidene Fluoride (PVDF).

1.4 RELATED REQUIREMENTS

1.4.1 Section 22 05 00, 23 05 15, 23 05 29, 23 07 15.

2 Products

2.1 PURE WATER PIPING

2.1.1 Application: high purity water systems as shown in the contract documents. Confirm existing piping system matches as specified here, and advise if different than shown.

2.1.2 Piping

2.1.2.1 Material: virgin, unpigmented PVDF (polyvinylidene fluoride) resin to ASTM D3222.

2.1.2.2 Dimensions: Schedule 80, iron pipe dimensions, minimum 3000mm lengths

2.1.2.3 Working pressure:

2.1.2.3.1 1500 kPa @ 23°C (230 psi at 73°F)

2.1.2.3.2 410 kPa @ 120°C (60 psi @ 248°F).

2.1.2.4 Pipe to be supplied clean and capped.

2.1.3 Fittings

2.1.3.1 Material: virgin, unpigmented PVDF (polyvinylidene fluoride) resin to ASTM D3222. Suitable for infrared butt welding.

2.1.3.2 Dimensions: minimum wall thickness to Schedule 80 iron pipe dimensions.

2.1.3.3 Injection molded.

2.1.3.4 Fittings to be supplied clean and individually bagged.

2.1.4 Valves

2.1.4.1 Material: virgin, unpigmented PVDF (polyvinylidene fluoride) resin to ASTM D3222, fully compatible with piping system. Pressure tested to 1030 kPa. Suitable for infrared butt welding or mechanical joint.

2.1.4.2 Working pressure: 1000 kPa @ 23°C (150 psi at 73°F)

2.1.4.3 Diaphragm valves: EPDM diaphragm with BCF tail pieces

2.1.4.4 Ball valves: double block type with O-ring, PTFE seats, and union connections with BCF tail pieces

2.1.4.5 Ball check valves: single union design.

2.1.4.6 Union connection joints

2.1.4.7 Each valve to be supplied clean and individually bagged.

2.1.5 Pipe Supports

2.1.5.1 U.V. stabilized polypropylene pipe bracket,

2.1.5.2 Allows free axial movement of pipe.

3 Execution

3.1 INSTALLATION

3.1.1 Install in accordance with manufacturer's instructions and contract documents.

3.1.2 Provide pipe hangers of type and spacing as recommended by pipe manufacturer, and as shown.

3.1.3 Connections to equipment shall be via mechanical connection to facilitate maintenance. Should there be options base on equipment connections, flanged connection will be chosen.

3.1.4 Install level and with adequate access to allow for servicing, at minimum to manufacturer's directions or as required to properly service and maintain the equipment.

3.1.5 Cut pipe ends clean and prepare for welding. Clean pipe ends of dirt inside and outside of pipe before threading, grooving or welding.

3.1.6 Cap ends during construction to prevent entry of foreign matter.

3.1.7 Fusion weld piping in accordance with manufacturer's directions, using proprietary fusion tool specific to the product. Welds shall be crevice free. Installer to have experience with product on other jobs and have received training from factory-authorized representatives in the use of the tool and installation of product.

3.1.8 Pressure Test:

- 3.1.8.1 Leak test water system after field assembly with initial pneumatic pressure test at 350 kPa (50 psig) and repair leaks. Conduct a hydraulic pressure test at 150% of design pressure for 10 minutes, then reduce to design pressure and hold for 24 hours.
- 3.1.8.2 Obtain TSSA inspection report for piping system components that are registered as pressure piping.
- 3.1.8.3 Conduct pressure test with water of same quality as piping system design water product.

3.1.9 Final Flush:

- 3.1.9.1 Provide a final flush and filling of water system.
- 3.1.9.2 Fill piping with design water quality water and circulate for four hours. Where faucets or other points-of-use fittings are installed, flush water through each fixture at the end of the flush period.
- 3.1.9.3 Periodically take water samples and test for pH and conductivity, until product water quality in piping is equal to pure water generation equipment product water.

- 3.1.10 Provide testing and commissioning services and documentation for the pure water distribution system

END OF SECTION

1 GENERAL

1.01 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets, include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings where required.
 - .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 - Submittal Procedures]: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

1.02 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data 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 - Testing, Adjusting and Balancing for HVAC.
- .5 Approvals:
 - .1 Submit [2] copies of draft Operation and Maintenance Manual to Departmental Representative for approval.
- .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.

1.03 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Furnish spare parts as follows:
 - .1 One glass for each gauge glass.
 - .2 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.

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements
- .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 Store and protect from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .5 Packaging Waste Management: remove in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal

1.05 COORDINATION

- .1 Cooperate and coordinate with other trades and verify order of installation of overlapping or interconnecting services or equipment before starting Work
- .2 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.
- .3 Coordinate location of access to cleanouts, valves, equipment, and duct access doors above continuous ceilings; coordinate access panel and door requirements with Section 08 31 00.
- .4 Coordinate installation of Work with adjacent work by others in accordance with requirements listed in Section 01 73 00 - Execution and as follows:
- .5 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.
- .6 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.
- .7 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.

- .8 Coordinate dimensional details with applicable architectural and structural drawings.
- .9 Full size and detailed drawings will take precedence over scale measurements from drawings when laying out the Work.
- .10 Coordinate requirements of, and connect to, equipment specified in other Sections, and to equipment supplied and installed by other contractors or by Owner; uncrate equipment, assemble, move in place, and install complete, start-up and test.

1.06 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.
- .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 Owner.
- .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, Owner 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.

2 PRODUCTS

2.01 not used

3 EXECUTION

3.01 EXAMINATION

- .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 Failure to advise Departmental Representative of discrepancies in writing will mean that Constructor accepts documents as presented without potential of additional costs.
- .5 Unforeseen conditions or discrepancies that could not be readily ascertained at the time of Bid will be administered as a change to the Contract.

3.02 PAINTING REPAIRS AND RESTORATION

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

3.03 SYSTEM CLEANING

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

3.04 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 applicable equipment and 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.

3.05 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials in accordance with Section

01 74 21 - Construction/Demolition Waste Management and Disposal

3.06 PROTECTION

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

END OF SECTION

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1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section 01 11 00.

1.02 REFERENCE STANDARDS

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181-[99], Ready-Mixed Organic Zinc-Rich Coating. Building Rating System Reference Guide For Commercial Interiors.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA B139-[04], Installation Code for Oil Burning Equipment.
- .3 Green Seal Environmental Standards (GSES)
 - .1 Standard GS-11-[2008, 2nd Edition], Environmental Standard for Paints and Coatings.
- .4 National Research Council Canada (NRC)
 - .1 National Fire Code of Canada [2015] (NFC).
- .5 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], Adhesive and Sealant Applications.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

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

1.04 QUALITY ASSURANCE

- .1 Sustainability Standards Certification:
 - .1 Low-Emitting Materials: provide listing of sealants and coatings used in building, comply with VOC and chemical component limits or restriction requirements.

1.05 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance 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 21 - Construction/Demolition Waste Management and Disposal.

2 PRODUCTS

2.01 MATERIAL

- .1 Paint: zinc-rich to CAN/CGSB-1.181.
 - .1 [Primers, Paints, Coatings, in accordance with manufacturer's recommendations for surface conditions.
 - .2 Primer: maximum VOC limit 250 g/L to Standard GS-11.
 - .3 Paints: maximum VOC limit 150 g/L to Standard GS-11
- .2 Sealants: in accordance with Section 07 92 00 - Joint Sealants.
 - .1 Sealants: maximum VOC limit to GSES GS-36].
- .3 Sealants: maximum VOC limit to GSES GS-36.
- .4 Adhesives: maximum VOC limit to GSES GS-36.
- .5 Fire Stopping: in accordance with Section 07 84 00 - Fire Stopping.

3 EXECUTION

3.01 APPLICATION

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

3.02 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.

3.03 CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer and National Fire Code of Canada and/or CSA B139.
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer without interrupting operation of other

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system, equipment, components.

3.04 DRAINS

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

3.05 AIR VENTS

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

3.06 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.

3.07 PIPEWORK INSTALLATION

- .1 Install pipework to CSA B139.
- .2 Screwed fittings jointed with Teflon tape.
- .3 Protect openings against entry of foreign material.
- .4 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .5 Assemble piping using fittings manufactured to ANSI standards.
- .6 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.
- .7 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .8 Install concealed pipework to minimize furring space, maximize

headroom, conserve space.

- .9 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .10 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .11 Group piping wherever possible and as indicated.
- .12 Ream pipes, remove scale and other foreign material before assembly.
- .13 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .14 Provide for thermal expansion as indicated.
- .15 Valves:
 - .1 Install in accessible locations.
 - .2 Remove interior parts before soldering.
 - .3 Install with stems above horizontal position unless indicated.
 - .4 Valves accessible for maintenance without removing adjacent piping.
 - .5 Install globe valves in bypass around control valves.
 - .6 Use shutoff valves at branch take-offs for isolating purposes except where 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 plug cocks or ball valves for glycol service.
 - .10 Use chain operators on valves NPS 2 1/2 and larger where installed more than [2400] mm above floor in Mechanical Rooms.
- .16 Check Valves:
 - .1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and as indicated.
 - .2 Install swing check valves in horizontal lines on discharge of pumps and as indicated.

3.08 SLEEVES

- .1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and as indicated.
- .2 Material: schedule 40 black steel pipe.
- .3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.
- .4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 Installation:
 - .1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.

- .2 Other floors: terminate 25 mm above finished floor.
- .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.
- .6 Sealing:
 - .1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.
 - .2 Elsewhere:
 - .1 Provide space for firestopping.
 - .2 Maintain fire rating integrity.
 - .3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.
 - .4 Ensure no contact between copper pipe or tube and sleeve.

3.09 ESCUTCHEONS

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

3.10 PREPARATION FOR FIRE STOPPING

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

3.11 FLUSHING OUT OF PIPING SYSTEMS

- .1 Flush system in accordance with other sections included within
- .2 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 11 - Cleaning 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 Pipework: test as specified in relevant sections of heating, ventilating and air conditioning work.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .5 Conduct tests in presence of 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 by Departmental Representative 10 days minimum, prior to commencement of work.
- .3 Be responsible for damage to existing plant by this work.

3.14 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

.1 Sections

22 11 16

23 05 15

1.02 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
 - .1 ANSI/ASME B1.20.1-[1983(R2006)], Pipe Threads, General Purpose (Inch).
 - .2 ANSI/ASME B16.18-[2001], Cast Copper Alloy Solder Joint Pressure Fittings.
- .2 ASTM International
 - .1 ASTM A 276-[08], Standard Specification for Stainless Steel Bars and Shapes.
 - .2 ASTM B 62-[02], Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .3 ASTM B 283-[08a], Standard Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
 - .4 ASTM B 505/B 505M-[08a], Standard Specification for Copper-Base Alloy Continuous Castings.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
 - .1 MSS-SP-25-[1998], Standard Marking System for Valves, Fittings, Flanges and Unions.
 - .2 MSS-SP-80-[2008], Bronze Gate Globe, Angle and Check Valves.
 - .3 MSS-SP-110-[1996], Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS MSDS - Material Safety Data Sheets where required.
- .3 Shop Drawings:
 - .1 Submit drawings stamped where required.
 - .2 Submit data for valves specified in this Section.

1.04 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.05 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials/Spare Parts:
 - .1 Furnish following spare parts:
 - .1 Valve seats: one for every 10 valves each size, minimum 1.
 - .2 Discs: one for every 10 valves, each size. Minimum 1.
 - .3 Stem packing: one for every 10 valves, each size. Minimum 1.
 - .4 Valve handles: 2 of each size.
 - .5 Gaskets for flanges: one for every 10 flanged joints.
- .2 Tools:
 - .1 Furnish special tools for maintenance of systems and equipment.
 - .2 Include following:
 - .1 Lubricant gun for expansion joints.

1.06 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .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 21 - Construction/Demolition Waste Management and Disposal.

2 PRODUCTS

2.01 MATERIALS

- .1 Not Used.
- .2 Valves:
 - .1 Except for specialty valves, to be single manufacturer.
 - .2 Products to have CRN registration numbers.
- .3 End Connections:
 - .1 Connection into adjacent piping/tubing:
 - .1 Steel pipe systems: screwed ends to ANSI/ASME B1.20.1.
 - .2 Copper tube systems: solder ends to ANSI/ASME B16.18.
- .4 Lockshield Keys:
 - .1 Where lockshield valves are specified, provide 5 keys of each size: malleable iron cadmium plated.
- .5 Gate Valves:

- .1 Requirements common to gate valves, unless specified otherwise:
 - .1 Standard specification: MSS SP-80.
 - .2 Bonnet: union with hexagonal shoulders.
 - .3 Connections: screwed with hexagonal shoulders.
 - .4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.
 - .5 Packing: non-asbestos.
 - .6 Handwheel: non-ferrous.
 - .7 Handwheel Nut: bronze to ASTM B 62.
- .2 NPS 2 and under, rising stem, split wedge disc, Class 125:
 - .1 Body: with long disc guides, screwed bonnet.
 - .2 Disc: split wedge, bronze to ASTM B 283, loosely secured to stem.
 - .3 Operator: handwheel.
- .3 NPS 2 and under, rising stem, solid wedge disc, Class 150:
 - .1 Body: with long disc guides, screwed bonnet.
 - .2 Operator: handwheel.
- .6 Globe Valves:
 - .1 Requirements common to globe valves, unless specified otherwise:
 - .1 Standard specification: MSS SP-80.
 - .2 Bonnet: union with hexagonal shoulders.
 - .3 Connections: screwed with hexagonal shoulders.
 - .4 Pressure testing: to MSS SP-80. Tests to be hydrostatic.
 - .5 Stuffing box: threaded to bonnet with gland follower, packing nut, high grade non-asbestos packing.
 - .6 Handwheel: non-ferrous.
 - .7 Handwheel Nut: bronze to ASTM B 62.
 - .2 NPS 2 and under, composition disc, Class 125:
 - .1 Body and bonnet: screwed bonnet.
 - .2 Disc and seat: renewable rotating PTFE disc, regrindable bronze seat, loosely secured to bronze stem to ASTM B 505.
 - .3 Operator: handwheel.
 - .3 NPS 2 and under, composition disc, Class 150:
 - .1 Body and bonnet: union bonnet.
 - .2 Disc and seat: renewable rotating PTFE disc in easily removable disc holder, regrindable bronze seat, loosely secured to bronze stem to ASTM B 505.
 - .3 Operator: handwheel.
- .7 Check Valves:
 - .1 Requirements common to check valves, unless specified otherwise:
 - .1 Standard specification: MSS SP-80.
 - .2 Connections: screwed with hexagonal shoulders.
 - .2 NPS 2 and under, swing type, bronze disc, Class 125:
 - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
 - .2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.
- .8 Ball Valves:
 - .1 NPS 2 and under:
 - .1 Body and cap: cast high tensile bronze to ASTM B 62.
 - .2 Pressure rating: Class 125, 860 kPa steam.
 - .3 Connections: screwed ends to ANSI B1.20.1 and with

- hexagonal shoulders or solder ends to ANSI.
- .4 Stem: tamperproof ball drive.
- .5 Stem packing nut: external to body.
- .6 Ball and seat: replaceable stainless steel or hard chrome solid ball and Teflon seats.
- .7 Stem seal: TFE with external packing nut.
- .8 Operator: removable lever handle.
- .9 Butterfly Valves:
 - .1 NPS 2 1/2 through NPS 6, 2068 kPa with grooved ends.
 - .1 Body: cast bronze, with copper-tube dimensioned grooved ends.
 - .2 Disc: elastomer coated ductile iron with integrally cast stem.
 - .3 Operator: lever or handwheel.

3 EXECUTION

3.01 INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Remove internal parts before soldering.
- .3 Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.

3.02 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section 230505.

1.02 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
 - .1 ASME B16, Fittings and Valves Package.
 - .2 ASME B16.5-[2009], Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard.
 - .3 ANSI/ASME B16.10-[2009], Face-to-Face and End-to-End Dimensions Valves.
 - .4 ANSI/ASME B16.25-[2007], Buttwelding Ends.
 - .5 ANSI/ASME B16.34-[2009], Valves Flanged, Threaded and Welding End. Includes Supplement (2010).
- .2 American Petroleum Institute (API)
 - .1 API STD 598-[2009], Valve Inspection and Testing.
- .3 ASTM International
 - .1 ASTM A 49-[12], Standard Specification for Heat-Treated Carbon Steel Joint Bars, Micro Alloyed Joint Bars, and Forged Carbon Steel Comprise Joint Bars.
 - .2 ASTM A 182/A 182M-[11a], Standard Specification for Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valve Parts for High Temperature Service.
 - .3 ASTM A 193/A 193M-[12], Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature or High Pressure Service and Other Special Purpose Applications.
 - .4 ASTM A 194/A 194M-[2011], Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service, or Both.
 - .5 ASTM A 216/A 216M-[08], Standard Specification for Steel Castings, Carbon Suitable for Fusion Welding for High-Temperature Service.
 - .6 ASTM B 85/B 85M-[10], Standard Specification for Aluminum-Alloy Die Castings.
- .5 Efficiency Valuation Organization (EVO)
 - .1 International Performance Measurement and Verification Protocol (IPMVP)
 - .1 IPMVP [2007] Version.
- .6 Green Seal Environmental Standards (GS)
 - .1 GS-11-[11], Standard for Paints and Coatings.
 - .2 GS-36-[11], Standard for Commercial Adhesives.
- .7 Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)
 - .1 MSS SP-25-[2008], Standard Marking System for Valves, Fittings,

- Flanges and Unions.
- .2 MSS SP-61-[2009], Pressure Testing of Valves.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for [each valve] and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings when applicable.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.04 CLOSEOUT SUBMITTALS

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

1.05 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Extra Stock Materials:
- .3 Furnish following spare parts:
 - .1 Valve seats: one for every [10] valves each size, minimum [1].
 - .2 Discs: one for every [10] valves, each size, minimum [1].
 - .3 Stem packing: one for every [10] valves, each size. Minimum [1].
 - .4 Valve handles: [2] of each size.
 - .5 Gaskets for flanges: one for every [10] flanged joints.

2 PRODUCTS

2.01 MATERIAL

- .1 Valves:
 - .1 To be of single manufacturer.
 - .2 Test valves individually.
- .2 Requirements common to valves, unless specified otherwise:
 - .1 Pressure-temperature ratings: to ANSI B16.34.
 - .2 Inspections and tests: to API 598.
 - .3 Pressure testing: to MSS SP-61.
 - .4 Flanged valves:
 - .1 Face-to-face dimensions: to ANSI B16.10.

- .2 Flange dimensions: to ANSI B16.5 with 1.6 mm raised face.
- .5 Butt-weld valves:
 - .1 End-to-end dimensions: to ANSI B16.10.
 - .2 End dimensions: to ANSI B16.25 bored for [standard pipe schedule].
- .6 Handwheel: non-heating type with raised rim of die-cast aluminum alloy to ASTM B 85 or malleable iron to ASTM A 49.
- .7 Markings: to MSS SP-25.
- .8 Identification:
 - .1 Plate showing catalogue number, size, material of body disc, stem seat, fluid, pressure-temperature rating.
 - .2 Body markings: manufacturer, size, primary service rating, material symbol.
- .9 CRN registration number required for all products.

2.02 GATE VALVES

- .1 NPS 2 1/2 - 12, rising stem, OS&Y, solid wedge disc, flanged ends, Class 150
 - .1 Body and multiple-bolted integral yoke and bonnet: cast steel to ASTM A 216/A 216M WCB, with full length disc guides designed to ensure correct re-assembly.
 - .2 Body/bonnet joint: male-female face with corrugated metallic gasket.
 - .3 Bonnet studs: to ASTM A 193/A 193M Type B7.
 - .4 Bonnet nuts: to ASTM A 194/A 194M Type 2H.
 - .5 Stuffing box: including non-galling two-piece ball jointed packing gland, with swing-type eye bolts and nuts.
 - .6 Gland packing: containing corrosion inhibitor to prevent stem pitting.
 - .7 Yoke sleeve: Ni-Resist, minimum melting point above 954 degrees C.
 - .8 Hydraulic grease fitting: for lubrication of yoke sleeve bearing surfaces.
 - .9 Disc: with disc stem ring to connect to stem, guided throughout its travel.
 - .1 NPS 2 1/2 - 6: solid corrosion and heat resistant 13% chromium steel with minimum hardness of 350 HB.
 - .2 NPS 8 and larger: carbon steel faced with corrosion and heat resistant 13 chromium steel with minimum hardness of 350 HB.
 - .10 Seat ring: seamless carbon steel with hard-faced cobalt-chromium-tungsten alloy seating surface, slipped in, seal welded, ground to match disc.
 - .11 Stem: heat treated corrosion and heat resistant 13% chromium steel with accurately-cut precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut, T-head disc-stem connection.
 - .12 Operator: see elsewhere in this Section.

2.03 GLOBE VALVES

- .1 NPS 2 1/2 - 12, rising stem, OS&Y, flanged ends, Class 150
 - .1 Body and multiple-bolted integral yoke and bonnet: cast steel to

- ASTM A 216/A 216M WCB.
- .2 Body/bonnet joint: male-female face with corrugated metallic gasket.
- .3 Bonnet studs: to ASTM A 193/A 193M Type B7.
- .4 Bonnet nuts: to ASTM A 194/A 194M Type 2H.
- .5 Stuffing box: including non-galling two-piece ball-jointed packing gland, with swing-type eye bolts and nuts.
- .6 Gland packing: containing corrosion inhibitor to prevent stem pitting.
- .7 Yoke bushing: Ni-Resist, minimum melting point above 954 degrees C.
- .8 Hydraulic grease fitting: for lubrication of yoke sleeve bearing surfaces.
- .9 Disc: plug type with 15 degrees taper seat and bottom guide or ball type with 35 degrees taper seat.
- .10 Seat rings: with 1.6 mm thick cobalt-chromium-tungsten alloy facings with minimum hardness of 375 HB (cold), slipped in, seal welded, ground to match disc.
- .11 Stem: heat treated corrosion and heat resistant 13% chromium steel with bonnet bushing, long engagement with yoke bushing for accurate seating, accurately-cut precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut.
- .12 Operator: see elsewhere in this Section.

2.04 VALVE OPERATORS

- .1 Handwheel: on all valves.
- .2 Handwheel with chain operators: on valves installed more than 2400 mm above floor in mechanical equipment rooms.
- .3 Motors:
 - .1 Application: full open and full close applications.
- .4 Hydraulic operators:
 - .1 Application: conveyor and feeder drives.
- .5 Pneumatic operators:
 - .1 Application: media with high dirt content, media with high viscosity, high ambient temperatures, large flow quantities, damp environments and where there is a risk of explosion.

2.05 BYPASSES FOR GATE AND GLOBE VALVES

- .1 Locations: on valves as indicated.
- .2 Position of bypass valve on main valves
- .3 Size of bypass valve:
 - .1 Main valve up to NPS 8: NPS 3/4.
 - .2 Main valve NPS 10 and over: NPS 1.
- .4 Type of bypass valves:
 - .1 On gate valve: globe, with composition disc, bronze trim, to Section 23 05 23.01 - Valves - Bronze.

- .2 On globe valve: globe, with bronze disc, bronze trim, to Section 23 05 23.01 - Valves - Bronze.

2.06 CHECK VALVES

- .1 NPS 2 1/2 and over, flanged ends, Class 150: swing check.
 - .1 Body and multiple-bolted cap: cast steel to ASTM A 216/A 216M WCB.
 - .2 Cap studs: to ASTM A 193/A 193M Type B7.
 - .3 Cap nuts: to ASTM A 194/A 194M Type 2H.
 - .4 Body/cap joint: male-female face with corrugated metallic gasket.
 - .5 Disc: heat treated corrosion and heat resistant 13% chromium steel.
 - .6 Seat rings: heat treated corrosion and heat resistant 13% chromium steel, slipped in, seal welded, ground to match disc.
 - .7 Hinge: ASTM A 182/A 182M.
 - .8 Hinge pin: ASTM A 182/A 182M.
 - .9 Hinge pin plugs: ASTM A 182/A 182M.

2.07 SILENT CHECK VALVES

- .1 Construction:
 - .1 Body: cast steel with integral seat.
 - .2 Pressure rating: Class 125
 - .3 Connections: flanged ends.
 - .4 Double bronze disc with SS seat and stem. Renewable disc, seat, stem and spring. Spring rating must match system design for silent operation and installation.
 - .5 Stainless steel spring, heavy duty.
 - .6 Seat: regrindable.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.02 INSTALLATION

- .1 Install in accordance with manufacturer's recommendations in upright position with stem above horizontal.

3.03 COMMISSIONING

- .1 As part of commissioning activities, develop schedule of valves and

record thereon identifier, location, service, purchase order number and date, manufacturer, identification data specified above.

3.04 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal

3.05 PROTECTION

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

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section 23 05 00, 22 11 16, 22 13 18, 22 15 00, 22 67 13, 23 31 13.

1.02 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B31.1-[07], Power Piping.
- .2 ASTM International
 - .1 ASTM A 125-[1996(2007)], Standard Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A 307-[07b], Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A 563-[07a], Standard Specification for Carbon and Alloy Steel Nuts.
- .3 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-[2004], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum [2007]).
 - .2 LEED Canada-CI Version 1.0-[2007], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
- .4 Factory Mutual (FM)
- .5 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP 58-[2002], 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.
- .6 National Research Council Canada (NRC)
 - .1 National Plumbing Code of Canada [2015] (NPC).
- .7 Underwriter's Laboratories of Canada (ULC)

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics,

performance criteria, physical size, finish and limitations.

- .3 Shop Drawings:
 - .1 Submit drawings where required.
 - .2 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.

1.04 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.05 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2 PRODUCTS

2.01 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.

2.03 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with MSS SP 58. ANSI B31.1 and
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.
- .3 Ensure compliance with MSS SP-69

2.04 PIPE HANGERS

- .1 Finishes:
 - .1 Pipe hangers and supports: galvanize.
 - 2 Use dipped galvanizing process.
 - .3 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.
- .2 Upper attachment structural: suspension from lower flange of I-Beam:
 - .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
 - .1 Rod: 13 mm FM approved.
 - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, FM approved to MSS-SP 58 and MSS-SP 69.
- .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, FM approved to MSS SP 69.
 - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut FM approved.
- .4 Upper attachment to concrete:
 - .1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye [6] mm minimum greater than rod diameter.
 - .2 Concrete inserts: wedge shaped body with knockout protector plate FM approved to MSS SP 69.
- .5 Shop and field-fabricated assemblies:
 - .1 Trapeze hanger assemblies
 - .2 Steel brackets
 - .3 Sway braces for seismic restraint systems
- .6 Hanger rods: threaded rod material to MSS 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 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 A 563.
 - .1 Finishes for steel pipework: black or galvanized.
 - .2 Finishes for copper, glass, brass or aluminum pipework: to match piping material.
- .11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP 69.

2.05 RISER CLAMPS

- .1 Steel or cast iron pipe: galvanized or black carbon steel to MSS SP 58, type 42, FM approved.
- .2 Copper pipe: carbon steel copper plated to MSS SP 58, type 42.
- .3 Bolts: to ASTM A 307.
- .4 Nuts: to ASTM A 563.

2.06 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.

2.07 CONSTANT SUPPORT SPRING HANGERS

- .1 Springs: alloy steel to ASTM A 125, 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.

2.08 VARIABLE SUPPORT SPRING HANGERS

- .1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.
- .2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.
- .3 Variable spring hanger complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.
- .4 Steel alloy springs: to ASTM A 125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.10 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

- .1 Provide templates to ensure accurate location of anchor bolts.

2.13 OTHER EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports from structural grade steel meeting requirements
- .2 Submit structural calculations with shop drawings.

3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 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.

3.03 HANGER SPACING

- .1 Plumbing piping: to National Plumbing Code of Canada (NPC), Ontario Building Code (2015).
- .2 Fire protection: to applicable fire code.
- .3 Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.
- .4 Copper piping: up to NPS 1/2: every 1.5 m.
- .5 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.
- .6 Within [300] mm of each elbow.

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.4 m	1.8 m
1-1/2	3.0 m	2.4 m
2	3.0 m	2.4 m
2-1/2	3.7 m	3.0 m
3	3.7 m	3.0 m
3-1/2	3.7 m	3.3 m
4	3.7 m	3.6 m

5	4.3 m
6	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.

3.04 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.

3.05 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.

3.06 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.

3.07 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - 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.

3.08 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 Section Includes:
 - .1 Materials and requirements for the identification of piping systems, duct work, valves and controllers, including the installation and location of identification systems.
 - .2 Sustainable requirements for construction and verification.

1.02 REFERENCE STANDARDS

- .1 Canadian Gas Association (CGA)
 - .1 CSA/CGA B149.1-[05], 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-[2002], Standard for the Installation of Sprinkler Systems.
 - .2 NFPA 14-[2003], Standard for the Installation of Standpipe and Hose Systems.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
- .2 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Product data to include paint colour chips, other products specified in this section.
- .4 Samples:
 - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Samples to include nameplates, labels, tags, lists of proposed legends.

1.05 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .2 Dispose of unused paint, coating material at official hazardous

- material collections site approved by Departmental Representative
- .3 Do not dispose of unused paint, coating material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

2 PRODUCTS

2.02 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.

2.03 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 PSPC 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.

2.04 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

2.05 PIPING SYSTEMS GOVERNED BY CODES

- .1 Identification:
 - .1 Natural gas: to CSA/CGA B149.1 and authority having jurisdiction.
 - .2 Propane gas: to CSA/CGA B149.1 and authority having jurisdiction.
 - .3 Sprinklers: to NFPA 13.
 - .4 Standpipe and hose systems: to NFPA 14.

2.06 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 degrees C and intermittent temperature of 200 degrees C.

.7 Colours and Legends:

.1 Where not listed, obtain direction from Departmental Representative

.2 Colours for legends, arrows: to following table:

Background colour:	Legend, arrows:
Yellow	BLACK
Green	WHITE
Red	WHITE

.3 Background colour marking and legends for piping systems:

Contents	Background colour marking	Legend
Raw water	Green	RAW WATER
River water	Green	RIVER WATER
Sea water	Green	SEA WATER
City water	Green	CITY WATER
Treated water	Green	TREATED WATER
Brine	Green	BRINE
Condenser water supply	Green	COND. WTR. SUPPLY
Condenser water return	Green	COND. WTR. RETURN
Chilled water supply	Green	CH. WTR. SUPPLY
Chilled water return	Green	CH. WTR. RETURN
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
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 [] kPa	Yellow	[] kPa 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
Chilled drinking water	Green	CH. DRINK WTR
Drinking water return	Green	CH. DRINK WTR. CIRC
Domestic hot water supply	Green	DOM. HW SUPPLY
Dom. HWS recirculation	Green	DOM. HW CIRC
Domestic cold water supply	Green	DOM. CWS
Waste water	Green	WASTE WATER
Contaminated lab waste	Yellow	CONT. LAB WASTE
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
Engine exhaust	Yellow	ENGINE EXHAUST
Lubricating oil	Yellow	LUB. OIL
Hydraulic oil	Yellow	HYDRAULIC OIL
Gasoline	Yellow	GASOLINE

Natural gas	to Codes	
Propane	to Codes	
Gas regulator vents	to Codes	
Distilled water	Green	DISTILL. WTR
Demineralized water	Green	DEMIN. WATER
Chlorine	Yellow	CHLORINE
Nitrogen	Yellow	NITROGEN
Oxygen	Yellow	OXYGEN
Compressed air (<700kPa)	Green	COMP. AIR [_____] kPa
Compressed air (>700kPa)	Yellow	COMP. AIR [_____] kPa
Vacuum	Green	VACUUM
Fire protection water	Red	FIRE PROT. WTR
Sprinklers	Red	SPRINKLERS
Carbon dioxide	Red	CO2
Instrument air	Green	INSTRUMENT AIR

2.07 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.

2.08 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.

2.09 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.

2.10 LANGUAGE

- .1 Identification in English and French.
- .2 Use one nameplate and label for each language.

3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 TIMING

- .1 Provide identification only after painting has been completed.

3.03 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC and or CSA registration plates as required by respective agency.
- .3 Identify systems, equipment to conform to PSPC PMSS.

3.04 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.

3.05 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.

3.06 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.

3.07 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.
- .2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.02 QUALIFICATIONS OF TAB PERSONNEL

- .1 Submit names of personnel to perform TAB to Departmental Representative within 60 days of award of contract.
- .2 Provide documentation confirming qualifications, successful experience.
- .3 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:
 - .1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1-[2002].
 - .2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-[1998].
 - .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-[2002].
- .4 Recommendations and suggested practices contained in the TAB Standard: mandatory.
- .5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
- .6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.
- .7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
 - .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
 - .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.03 PURPOSE OF TAB

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads
- .2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.
- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.04 EXCEPTIONS

- .1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.

1.05 CO-ORDINATION

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.
- .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.06 PRE-TAB REVIEW

- .1 Review Contract Documents before project construction is started and confirm in writing to Departmental Representative adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to Departmental Representative in writing proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.07 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.

1.08 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.

1.09 START OF TAB

- .1 Notify Departmental Representative 7 days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:
- .3 Installation of ceilings, doors, windows, other construction affecting TAB.
- .4 Application of weatherstripping, sealing, and caulking.
- .5 Pressure, leakage, other tests specified elsewhere Division 23.
- .6 Provisions for TAB installed and operational.
- .7 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
 - .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Air systems:
 - .1 Filters in place, clean.
 - .2 Duct systems clean.
 - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
 - .4 Correct fan rotation.
 - .5 Fire, smoke, volume control dampers installed and open.
 - .6 Coil fins combed, clean.
 - .7 Access doors, installed, closed.
 - .8 Outlets installed, volume control dampers open.
 - .3 Liquid systems:
 - .1 Flushed, filled, vented.
 - .2 Correct pump rotation.
 - .3 Strainers in place, baskets clean.
 - .4 Isolating and balancing valves installed, open.
 - .5 Calibrated balancing valves installed, at factory settings.
 - .6 Chemical treatment systems complete, operational.

1.10 APPLICATION TOLERANCES

- .1 Do TAB to following tolerances of design values:
 - .1 [Laboratory] HVAC systems: plus [5] %, minus [0] %.
 - .2 [Other] HVAC systems: plus [5] %, minus [5] %.
 - .3 Hydronic systems: plus or minus [5] %.

1.11 ACCURACY TOLERANCES

- .1 Measured values accurate to within plus or minus [2] % of actual values.

1.12 INSTRUMENTS

- .1 Prior to TAB, submit to Departmental Representative list of instruments used together with serial numbers.

- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate within [3] months of TAB. Provide certificate of calibration to Departmental Representative.

1.13 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit, prior to commencement of TAB:
- .2 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.14 PRELIMINARY TAB REPORT

- .1 Submit for checking and approval of Departmental Representative prior to submission of formal TAB report, sample of rough TAB sheets.
Include:
 - .1 Details of instruments used.
 - .2 Details of TAB procedures employed.
 - .3 Calculations procedures.
 - .4 Summaries.

1.15 TAB REPORT

- .1 Format in accordance with Departmental Representative standard.
- .2 TAB report to show results in SI units and to include:
 - .1 Project record drawings.
 - .2 System schematics.
- .3 Submit [3] copies of TAB Report to Departmental Representative for verification and approval, in both official languages in D-ring binders, complete with index tabs.

1.16 VERIFICATION

- .1 Reported results subject to verification by Departmental Representative
- .2 Provide personnel and instrumentation to verify up to 20 % of reported results.
- .3 Number and location of verified results as directed by Departmental Representative
- .4 Pay costs to repeat TAB as required to satisfaction of Departmental Representative.

1.17 SETTINGS

- .1 After TAB is completed to satisfaction of Departmental Representative, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life

of facility. Do not eradicate or cover markings.

1.18 COMPLETION OF TAB

- .1 TAB considered complete when final TAB Report received and approved by Departmental Representative.

1.19 AIR SYSTEMS

- .1 Standard: TAB to most stringent of TAB standards of AABC, NEBB, SMACNA.
- .2 Do TAB of systems, equipment, components, controls specified Division 22 & 23
- .3 Qualifications: personnel performing TAB qualified to standards of AABC or NEBB.
- .4 Quality assurance: perform TAB under direction of supervisor qualified by AABC or NEBB.
- .5 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
- .6 Locations of equipment measurements: to include as appropriate:
 - .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
 - .2 At controllers, controlled device.
- .7 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.20 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 Laboratory fume hoods:
 - .1 Standard: Treasury Board of Canada Handbook of Occupational Health and safety, 4th edition and PWGSC MD15128.
 - .2 TAB procedures: as described in standard.
- .3 Zone pressure differences:
 - .1 Adjust HVAC systems, equipment, controls to establish specified directional airflow, with systems in every possible combinations of normal operating modes.

1.21 POST-OCCUPANCY TAB

- .1 Measure DBT, WBT (or %RH), air velocity, air flow patterns, NC levels in

occupied zone of following areas: 2044 & 2046.

- .2 Emergency evacuation: participate in full scale emergency evacuation exercises. [Repeat smoke management tests at this time].
- .3 Participate in systems checks twice during Warranty Period - #1 approximately 3 months after acceptance and #2 within 1 month of termination of Warranty Period.

2 PRODUCTS

2.01 NOT USED

- .1 Not used.

3 EXECUTION

3.01 NOT USED

- .1 Not used.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section 23 05 93.

1.02 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)
 - .1 ANSI/ASHRAE 110-[1995], Method of Testing Performance of Laboratory Fume Hoods.
 - .2 ANSI/AIHA Z9.5-[2003], Laboratory Ventilation.
- .2 Public Works and Government Services Canada (PSPC)
 - .1 PSPC MD15128 [2008], Laboratory Fume Hoods.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

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

1.04 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Record Documentation:
 - .1 Submit list of materials used in fume hood work.

1.05 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 PSPC MD15128.
- .2 Test Agency Qualification: submit proof of qualifications to Departmental Representative to demonstrate experience in the testing of fume hoods.

2 PRODUCTS

2.01 TESTING EQUIPMENT

- .1 Test equipment to ANSI/AIHA Z9.5 and PSPC 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: [averaging function over twenty second period for each location] [or] [output recorded for [20] seconds minimum at a rate of one reading/second on data logger].
 - .3 Accuracy:
 - .1 Below 0.50 m/s: $\pm [0.025]$ 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 PSPC MD15128.

3 EXECUTION

3.01 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 PSPC MD15128 at design sash position to ensure compliance with design criteria in PSPC MD15128.

3.02 "AI" TESTS FOR CAV BYPASS FUME HOODS

- .1 Cross draft tests:
 - .1 Test air currents external to fume hood to [PSPC 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 [PSPC MD15128].
- .3 Face velocity and flow response test pass ratings: to [PSPC MD15128] [and] [ANSI/ASHRAE 110].
 - .1 Average face velocity for CAV bypass fume hoods: [0.5] m/s
 - .2 CAV bypass effectiveness at [150] mm sash opening; [1.25] m/s maximum average face velocity.
 - .3 Average face velocity for high performance fume hoods: [0.35] m/s, with no reading less than [0.25] m/s.
 - .4 VAV face velocity and flow response tests:
 - .1 Average face velocity at design sash position: [0.5] m/s
 - .2 Average face velocity with sash at 66% of design sash position: [0.5] m/s \pm [0.025] m/s
 - .1 Variation allowed for individual readings: \pm [20]%
 - .3 Average face velocity with sash at 33% of design sash position: [0.5] m/s \pm [0.025] m/s.
 - .1 Variation allowed for individual readings: \pm [20]%
 - .4 Response time: time to reach [90]% of the average steady state value: within [5] seconds of initial sash movement
 - .5 Test for VAV minimum flow with sash closed: to [ANSI/AIHA Z9.5] capable of maintaining [375] air changes per hour.
- .4 Tracer Gas tests:
 - .1 Performance criteria: to [PSPC 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.
- .5 Conduct VAV Response Tests, Stability Tests and SME simultaneously for VAV fume hoods.

3.03 AS USED (AU) TESTS WITH LAB APPARATUS IN PLACE

- .1 Repeat smoke tests and velocity tests

3.04 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.

3.05 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.

3.06 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.

3.07 VERIFICATION LABELS

- .1 Affix label to front of fume hood indicating verification, name of testing agency, and date.

3.08 COMMISSIONING - INTEGRATED SYSTEMS TESTS

- .1 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.
- .2 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.

3.09 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 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.11 PROTECTION

- .1 Protect adjacent materials from work associated with testing and maintenance of fume hoods.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 Section Includes:
 - .1 Materials and methods for pressure testing ducts over [5] m in length, forming part of a supply, return or exhaust ductwork system directly or indirectly connected to air handling equipment.

1.02 REFERENCE STANDARDS

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
 - .1 SMACNA HVAC Air Duct Leakage Test Manual, 1985.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Co-ordinate submittal requirements and provide submittals required by Section [01 47 15 - Sustainable Requirements: Construction].
- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties. Include pressure test information and results as follows:
 - .1 Submit proposed report form and test report format to Departmental Representative for approval at least two months before proposed date of first series of tests. Do not start tests until approval received in writing from Departmental Representative.
 - .2 Prepare report of results and submit to Departmental Representative within 72 hours of completion of tests. Include:
 - .1 Schematic of entire system.
 - .2 Schematic of section under test showing test site.
 - .3 Required and achieved static pressures.
 - .4 Orifice differential pressure at test sites.
 - .5 Permissible and actual leakage flow rate (L/s) for test sites.
 - .6 Witnessed certification of results.
 - .3 Include test reports in final TAB report.
 - .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .5 Instructions: submit manufacturer's installation instructions.
 - .6 Manufacturer's field reports specified.

1.04 QUALITY ASSURANCE

- .1 Pre-Installation Meetings:
 - .1 Convene pre-installation meeting one week prior to beginning work of this Section in accordance with section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart
 - .1 Verify project requirements.
 - .2 Review installation [and substrate] conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review [manufacturer's] installation instructions and warranty requirements.
 - .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

2 PRODUCTS

2.01 TEST INSTRUMENTS

- .1 Test apparatus to include:
 - .1 Fan capable of producing required static pressure.
 - .2 Duct section with calibrated orifice plate mounted and accurately located pressure taps.
 - .3 Flow measuring instrument compatible with the orifice plate.
 - .4 Calibration curves for orifice plates used.
 - .5 Flexible duct for connecting to ductwork under test.
 - .6 Smoke bombs for visual inspections.
- .2 Test apparatus: accurate to within +/- [3] % of flow rate and pressure.
- .3 Submit details of test instruments to be used to Departmental Representative at least two months before anticipated start date.
- .4 Test instruments: calibrated and certificate of calibration deposited with Departmental Representative no more than [28] days before start of tests.
- .5 Re-calibrated every six months thereafter.

2.02 EQUIPMENT LEAKAGE TOLERANCES

- .1 Equipment and system components such as VAV boxes, duct heating leakage: 2%.

3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 TEST PROCEDURES

- .1 Maximum lengths of ducts to be tested consistent with capacity of test equipment.
- .2 Section of duct to be tested to include:
 - .1 Fittings, branch ducts, tap-ins.
- .3 Repeat tests until specified pressures are attained. Bear costs for repairs and repetition to tests.
- .4 Base partial system leakage calculations on SMACNA HVAC Air Duct Leakage Test Manual.
- .5 Seal leaks that can be heard or felt, regardless of their contribution to total leakage.

3.03 SITE TOLERANCES

- .1 System leakage tolerances specified are stated as percentage of total flow rate handled by system. Pro-rate specified system leakage tolerances. Leakage for sections of duct systems: not to exceed total allowable leakage.
- .2 Leakage tests on applicable systems not to exceed specified leakage rates per SMACNA standards and ductwork table.
- .3 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

3.04 TESTING

- .1 Test ducts before installation of insulation or other forms of concealment.
- .2 Test after seals have cured.
- .3 Test when ambient temperature will not affect effectiveness of seals, and gaskets.
- .4 Flexible connections to VAV boxes.

3.05 FIELD QUALITY CONTROL

- .1 Performance Verification:
 - .1 Departmental Representative to witness tests and to verify reported results.
 - .2 To be certified by same TAB agency approved by Departmental Representative to undertake TAB on this project.

3.06 CLEANING

- .1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

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END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section 23 31 13

1.02 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE/IESNA 90.1-[04], SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 ASTM International Inc.
 - .1 ASTM B 209M-[07], Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
 - .2 ASTM C 335-[05ae1], Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
 - .3 ASTM C 411-[05], Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C 449/C 449M-[00], Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C 547-[07e1], Standard Specification for Mineral Fiber Pipe Insulation.
 - .6 ASTM C 553-[02e1], Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .7 ASTM C 612-[04e1], Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .8 ASTM C 795-[03], Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .9 ASTM C 921-[03a], Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma-[89], Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .5 Green Seal Environmental Standards (GSES)
 - .1 Standard GS-36-[00], Commercial Adhesives.
- .6 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1168-[A2005], Adhesive and Sealant Applications.
- .7 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).
- .8 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-[03], Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701-[05], Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.03 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.

1.04 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings where required.
- .4 Manufacturers' Instructions:
 - .1 Provide manufacture's written duct insulation jointing recommendations. and special handling criteria, installation sequence, cleaning procedures.

1.05 QUALITY ASSURANCE

- .1 Qualifications:
- .2 Installer: specialist in performing work of this section, and have experience in this size and type of project.

1.06 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address and ULC markings.
- .3 Packaging Waste Management: remove for reuse in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2 PRODUCTS

2.01 FIRE AND SMOKE RATING

- .1 To CAN/ULC-S102:
- .1 Maximum flame spread rating: 25.

- .2 Maximum smoke developed rating: 50.

2.02 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 degrees C mean temperature when tested in accordance with ASTM C 335.
- .3 TIAC Code C-1: Rigid mineral fibre board to ASTM C 612, 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 C 553 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 C 553.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to ASTM C 553.

2.03 JACKETS

- .1 Canvas:
 - .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
- .2 Lagging adhesive: compatible with insulation.
- .3 Aluminum:
 - .1 To ASTM B 209 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: 19 mm wide, 0.5 mm thick stainless steel.
 - .1 Stainless steel:
 - .5 Type: 304.
 - .6 Thickness: 0.25 mm sheet.
 - .7 Finish: Smooth
 - .8 Jacket banding and mechanical seals: 19 mm wide, 0.5 mm thick stainless steel.

2.04 ACCESSORIES

- .1 Vapour retarder lap adhesive:
 - .1 Water based, fire retardant type, compatible with insulation.
- .2 Indoor Vapour Retarder Finish:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C 449.
- .4 ULC Listed Canvas Jacket:

- .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
- .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, 75 mm wide minimum.
- .7 Contact adhesive: quick-setting
- .8 Canvas adhesive: washable.
- .9 Tie wire: 1.5 mm stainless steel.
- .10 Banding: 19 mm wide, 0.5 mm thick stainless steel.
- .11 Facing: 25 mm stainless or galvanized steel hexagonal wire mesh stitched on one face of insulation with expanded metal lath on other face.
- .12 Fasteners: 4 mm diameter pins with 35 mm square clips, length to suit thickness of insulation.

3 EXECUTION

3.01 APPLICATION

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

3.02 PRE-INSTALLATION REQUIREMENTS

- .1 Pressure test ductwork systems complete, witness and certify.
- .2 Ensure surfaces are clean, dry, free from foreign material.

3.03 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers 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 - Hangers and Supports for HVAC Piping and Equipment.
 - .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.

3.04 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

3.05 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 GENERAL

1.01 SUMMARY

- .1 Section Includes:
 - .1 Thermal insulation for piping and piping accessories in commercial type applications.

1.02 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ASHRAE Standard 90.1-[01], Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM B 209M-[04], Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate [Metric].
 - .2 ASTM C 335-[04], Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C 411-[04], Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C 449/C 449M-[00], Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C 533-[2004], Calcium Silicate Block and Pipe Thermal Insulation.
 - .6 ASTM C 547-[2003], Mineral Fiber Pipe Insulation.
 - .7 ASTM C 795-[03], Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .8 ASTM C 921-[03a], Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma-[89], Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .2 CAN/CGSB-51.53-[95], Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts
- .4 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
 - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
 - .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .6 Manufacturer's Trade Associations
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).
- .7 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-[03], Surface Burning Characteristics of Building

- Materials and Assemblies.
- .2 CAN/ULC-S701-[01], Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .3 CAN/ULC-S702-[1997], Thermal Insulation, Mineral Fibre, for Buildings
- .4 CAN/ULC-S702.2-[03], Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.03 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - will mean "not concealed" as specified.
- .2 TIAC ss:
 - .1 CRF: Code Rectangular Finish.
 - .2 CPF: Code Piping Finish.

1.04 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit one copy of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .4 Samples:
 - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix label beneath sample indicating service.
- .5 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .1 Departmental Representative will make available [1] copy of systems supplier's installation instructions.

1.05 QUALITY ASSURANCE

- .1 Qualifications:
- .2 Installer: specialist in performing work of this Section, and have successful experience in this size and type of project, qualified to standards of TIAC.
- .3 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.06 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - .3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Storage and Protection:
 - .1 Protect from weather, construction traffic.
 - .2 Protect against damage.
 - .3 Store at temperatures and conditions required by manufacturer.
- .3 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .2 Place excess or unused insulation and insulation accessory materials in designated containers.
 - .3 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.
 - .4 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.

2 PRODUCTS

2.01 SUSTAINABLE REQUIREMENTS

- .1 Not Used

2.03 INSULATION2.02 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC-S102.
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.
- .1 Mineral fibre specified includes glass fibre, rock wool, slag wool.

- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C 335.
- .3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.
 - .1 Mineral fibre: to CAN/ULC-S702 and/or ASTM C 5 47.
 - .2 Maximum "k" factor: to CAN/ULC-S702.
- .4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
 - .1 Mineral fibre: to CAN/ULC-S702 and/or ASTM C 5 47.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/ULC-S702 and/or ASTM C 547.
- .5 TIAC Code C-2: mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to CAN/ULC-S702 and/or ASTM C 5 47.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/ULC-S702 and/or ASTM C 547.
- .6 TIAC Code A-6: flexible unicellular tubular elastomer.
 - .1 Insulation: with vapour retarder jacket.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/ULC-S702 and/or ASTM C 547.
 - .4 Certified by manufacturer: free of potential stress corrosion cracking corrodants.
- .7 TIAC Code A-2: rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.
 - .1 Insulation: to ASTM C 533.
 - .2 Maximum "k" factor: to CAN/ULC-S702 and/or ASTM C 547.
 - .3 Design to permit periodic removal and re-installation.

2.04 INSULATION SECUREMENT

- .1 Tape: self-adhesive, aluminum, plain, 50 mm wide minimum.
- .2 Contact adhesive: quick setting.
- .3 Canvas adhesive: washable.
- .4 Tie wire: 1.5 mm diameter stainless steel.
- .5 Bands: stainless steel, 19 mm wide, 0.5 mm thick.

2.05 CEMENT

- .1 Thermal insulating and finishing cement:
 - .1 Air drying on mineral wool, to ASTM C 449/C 449M.

2.06 VAPOUR RETARDER LAP ADHESIVE

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

2.07 INDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.

2.08 OUTDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: fibrous glass, untreated 305 g/m².

2.09 JACKETS

- .1 Polyvinyl Chloride (PVC):
 - .1 One-piece moulded type [and sheet] to CAN/CGSB-51.53 with pre-formed shapes as required.
 - .2 Colours: [to match adjacent finish paint] [by [Departmental Representative]].
 - .3 Minimum service temperatures: -20 degrees C.
 - .4 Maximum service temperature: 65 degrees C.
 - .5 Moisture vapour transmission: 0.02 perm.
 - .6 Thickness: 2 mm.
 - .7 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.
- .2 Canvas:
 - .1 [220][and 120] gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
 - .2 Lagging adhesive: compatible with insulation.
- .3 Stainless steel:
 - .1 Type: 304.
 - .2 Thickness: 0.25 mm.
 - .3 Finish: corrugated.
 - .4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
 - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
 - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 PRE-INSTALLATION REQUIREMENT

- .1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.
- .2 Surfaces clean, dry, free from foreign material.

3.03 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers instructions and this specification.
- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Install hangers, supports outside vapour retarder jacket.
- .5 Supports, Hangers:
 - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.04 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

- .1 Application: at expansion joints, primary flow measuring elements, flanges and unions at equipment.
- .2 Design: to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.
- .3 Insulation:
 - .1 Insulation, fastenings and finishes: same as system.
 - .2 Jacket: PVC.

3.05 INSTALLATION OF ELASTOMERIC INSULATION

- .1 Insulation to remain dry. Overlaps to manufacturers instructions. Ensure tight joints.
- .2 Provide vapour retarder as recommended by manufacturer.

3.06 PIPING INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code: [A-1].
 - .1 Securements: SS wire at 300 mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code 1501-H.

- .3 TIAC Code: [A-3].
 - .1 Securements: SS wire at 300 mm on centre.
 - .2 Seals: VR lap seal adhesive, VR lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .4 TIAC Code: [A-6].
 - .1 Insulation securements: SS wire at 300 mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code: 1501.
- .5 TIAC Code: [C-2][with][without] vapour retarder jacket.
 - .1 Insulation securements: SS wire at 300 mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .6 TIAC Code: [A-2].
 - .1 Insulation securements: SS wire at 300 mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code: 1501-H.
- .7 Thickness of insulation as listed in following table.
 - .1 Run-outs to individual units and equipment not exceeding 4000 mm long.
 - .2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Applic a-tion	Temp degree s C	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)						
	Run out	to 1	1 1/4 to 2	2 1/2 to 4	5 to 6	8 & over			
Steam	up to 175	[A-1]	38	50	65	75	90	90	
Steam, Satura ted and Super heated Conden sate	over 175	[A-1]	38	65	65	75	90	90	
Return Pumped Conden sate	60 - 94	[A-1]	25	38	38	38	38	38	
Boiler Feed Water Hot Water Heatin g	up to 94	[A-1]	25	38	38	38	38	38	
Hot Water Heatin g	up to 59	[A-1]	25	25	25	25	38	38	

g Glycol Heatin	60 - 94	[A-1]	25	38	38	38	38	38
g Glycol Heatin	up to 59	[A-1]	25	25	25	25	38	38
g Domest ic HWS		[A-1]	25	25	25	38	38	38
Chille d	4 - 13	[A-3]	25	25	25	25	25	25
Water Chille d	below 4	[A-3]	25	25	38	38	38	38
Water or Domest ic CWS		[A-3]	25	25	25	25	25	25
Domest ic CWS with vapour retard er		[C-2]	25	25	25	25	25	25
Coolin g Coil cond. drain		[C-2]	25	25	25	25	25	25

- .8 Finishes:
- .1 Exposed indoors: PVC jacket.
 - .2 Exposed in mechanical rooms: PVC jacket.
 - .3 Concealed, indoors: canvas on valves, fittings. No further finish.
 - .4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.
 - .5 Outdoors: water-proof SS.
 - .6 Finish attachments: SS bands, at 150 mm on centre. Seals: closed.
 - .7 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.07 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Not Used

1.02 REFERENCE STANDARDS

- .1 ASME

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for [pneumatic control system] and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings where required.
 - .2 Provide diagrams showing normal positions, model numbers, air piping and wiring layouts.
 - .3 Provide valve and damper schedule indicating size, configuration, capacity and locations. If size varies greater than [10]%, obtain approval of Departmental Representative
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.04 CLOSEOUT SUBMITTALS

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

2 PRODUCTS

2.01 AIR PRESSURE GAUGES

- .1 At components and as indicated, minimum 40 mm diameter, with applicable range.

2.02 PILOT POSITIONERS

- .1 Full relay type: with interconnecting linkage for mechanical feedback on damper and valve operators acting in unison or sequenced from single controller.

2.03 VALVES

- .1 Pressure rating: as indicated.
- .2 Valve operators: spring return for "fail safe" in normally open or normally closed position, as indicated.
- .3 Water valves:
 - .1 Two-way: seated as indicated, equal percentage, linear, quick opening characteristics, as indicated.
 - .2 Three-way mixing: linear characteristics.
 - .3 Three-way diverting: linear characteristics as indicated.
 - .4 Flow rate and maximum pressure drop: as indicated.
- .4 Steam valves:
 - .1 Modified linear characteristics, with stainless steel seat for dead end service.
 - .2 Flow rate and inlet pressure as indicated.
 - .3 Flow rate and maximum pressure drop: as indicated .

2.04 DAMPERS

- .1 Operating type dampers are as existing

2.05 DAMPER OPERATORS

- .1 Dampers for fans: not required.
- .3 Provide spring return for "fail-safe" in normally open or normally closed position as indicated.
- .4 Size operator[s] to control dampers against maximum pressure or dynamic closing pressure, whichever is greater.
- .5 Provide piston type operators with adjustable spring and stroke. Provide adjustable external stops to limit stroke in either direction.
- .6 Where pneumatic damper operators are connected into fire alarm system, provide additional control devices to allow dampers to respond and go to required position upon signal in less than [15] seconds.

2.06 IDENTIFICATION

- .1 Provide in accordance with Section 23 05 53.01 - Mechanical Identification.

2.07 CONTROL AIR TUBING

- .1 Plastic: flame retardant PVC tubing with minimum burst gauge pressure

of 1.4 MPa at 80 degrees C.

- .2 Copper: type L complete with flared fittings.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for pneumatic control system for HVAC installation in accordance with manufacturer's written instructions.

3.02 MANUFACTURER'S INSTRUCTIONS

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

3.03 INSTALLATION

- .1 Identify and code pneumatic tubing at every branch and at each piece of equipment and components.
- .2 Use copper tubing with flared fittings in following locations:
 - .1 Inaccessible areas.
 - .2 Where single lines travel from tube tray to instruments.
 - .3 Areas of heat above 80 degrees C.
 - .4 Mechanical rooms.
 - .5 Rooms where piping subject to damage.
 - .6 Adjacent to heating pipes passing through common sleeve.
 - .7 Where air pressures above 200 kPa.
 - .8 Where codes will not permit use of PVC.
 - .9 In fire rated walls and ceilings.
- .3 Run PVC tubing in cable trays or metal conduit [as indicated]. Use barb type fittings.
- .4 Follow building lines. Do not cover with insulation. Install drip legs and drains at low points.
- .6 Submit detail of damper motor location and support for review.
- .7 Install pilot positioners on operators.

3.04 FIELD QUALITY CONTROL

- .1 Start-Up and Adjustment:
 - .1 Upon completion of installation, test, adjust and regulate controls or safety equipment provided under this Section.
 - .2 Adjust and place in operating condition.

3.05 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section 23 82 36

1.02 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI) / American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.1-[05], Cast Iron Pipe Flanges and Flanged Fittings: Class 25, 125, 250 and 800.
 - .2 ASME B16.25-[07], Buttwelding Ends.
 - .3 ASME B16.3-[06], Malleable Iron Threaded Fittings: Classes 150 and 300.
 - .4 ANSI/ASME B16.5-[03], Pipe Flanges and Flanged Fittings: NPS ½ through 24.
 - .5 ANSI/ASME B16.9-[07], Factory-Made Wrought Steel Buttwelding Fittings.
 - .6 ANSI B18.2.1-[96(R2005)], Square and Hex Bolts and Screws (Inch Series).
 - .7 ANSI/ASME B18.2.2-[87(R2005)], Square and Hex Nuts (Inch Series).
- .2 American National Standards Institute (ANSI) / American Water Works Association (AWWA)
 - .1 ANSI/AWWA C111/A21.11-[07], Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .3 ASTM International Inc.
 - .1 ASTM A 47/A 47M-[99(2004)], Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A 53/A 53M-[07], Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
 - .3 ASTM A 126-[04], Standard Specification for Grey Iron Castings for Valves, Flanges, and Pipe Fittings.Rating System Reference Guide For Commercial Interiors.
- .4 Canadian Standards Association (CSA International)
 - .1 CSA W48-[06], Filler Metals and Allied Materials for Metal Arc Welding.
- .5 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.
 - .1 MSS-SP-70-[2006], Cast Iron Gate Valves, Flanged and Threaded Ends.
 - .2 MSS-SP-71-[2005], Grey Iron Swing Check Valves, Flanged and Threaded Ends.
 - .3 MSS-SP-80-[2003], Bronze Gate, Globe, Angle and Check Valves.
 - .4 MSS-SP-85-[2002], Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for valves and pipes and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings as required.

1.04 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals and include following:
 - .1 [Special servicing requirements].

1.05 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.06 EXTRA MATERIALS

- .1 Extra Stock Materials:
 - .1 Provide spare parts as follows:
 - .1 Valve seats: one for every ten valves, each size. Minimum one.
 - .2 Discs: one for every ten valves, each size. Minimum one.
 - .3 Stem packing: one for every ten valves, each size. Minimum one.
 - .4 Valve handles: 2 of each size.
 - .5 Gaskets for flanges: one for every ten flanges.

2 PRODUCTS

2.01 SUSTAINABLE REQUIREMENTS

- .1 Materials and products in accordance with Section [01 47 15 Sustainable Requirements: Construction].

2.02 PIPE

- .1 Steel pipe: to ASTM A 53/A 53M, Grade [B], as follows:

- .1 Steam;
 - .1 To NPS 2: ASTM A106 Schedule 80 Seamless Black Steel.
 - .2 NPS 2 ½ and over: ASTM A53 Grade B Schedule 40, ERW.
- .2 Condensate: ASTM A106 Schedule 80 Seamless Black Steel.

2.03 PIPE JOINTS

- .1 NPS 2 and under: screwed fittings with PTFE tape.
- .2 NPS 2-1/2 and over: welding fittings and flanges to CSA W48.
- .3 Flanges: plain or raised face. Flange gaskets to ANSI/AWWA C111/A21.11.
- .4 Pipe thread: taper.
- .5 Bolts and nuts: carbon steel, to ANSI/ASME B18.2.1 and ANSI/ASME B18.2.2.

2.04 FITTINGS

- .1 Pipe flanges: cast-iron to ASME B16.1, Class 125.
- .2 Screwed fittings: malleable iron to ASME B16.3, Class 150.
- .3 Steel pipe gaskets, flanges and flanged fittings: to ANSI/ASME B16.5.
- .4 Unions: malleable iron, to ASTM A 47/A 47M and ASME B16.3.

2.05 VALVES

- .1 Connections:
 - .1 NPS 2 and smaller: screwed ends.
 - .2 NPS 2 1/2 and larger:
 - .1 Equipment: Flanged.
 - .2 Elsewhere: Flanged.
- .2 Gate valves: Application: Steam service, for isolating equipment, control valves, pipelines.
 - .1 NPS 2 and under:
 - .1 Class 125, rising stem, wedge disc, as specified Section 23 05 23.01 - Valves-Bronze.
 - .2 NPS 2 1/2 -8:
 - .1 Elsewhere: Class 150, rising stem, wedge disc, cast iron with bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.
- .3 Globe valves: Application: Steam service, throttling, flow control, emergency bypass.
 - .1 NPS 2 and under:
 - .1 With composition disc as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 NPS 2 1/2 and over:
 - .1 With composition bronze disc, cast iron with bronze trim, to Section 23 05 23.02 - Valves - Cast Iron.

- .4 Gate valves: Application: pumped and gravity condensate return service, steam drip point assemblies.
 - .1 NPS 2 and under:
 - .1 Class 125, rising stem, wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 NPS 2 1/2 and over:
 - .1 Class 125, rising stem, wedge disc, cast iron with bronze trim, as specified Section 23 05 23.02 - Valves - Cast Iron.
- .5 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.
- .6 Lift check valves:
 - .1 NPS 2 and under: Class 125, lift, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 NPS 2 1/2 and over: as specified Section 23 05 23.02 - Valves - Cast Iron.

2.06 VALVE OPERATORS

- .1 Handwheel with chain operators: on valves installed more than 2400 mm above floor in Mechanical Equipment rooms.

3 EXECUTION

3.01 APPLICATION

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

3.02 PIPING

- .1 Install pipework in accordance with Section 23 05 05 - Installation of Pipework, supplemented as specified below.
- .2 Connect branch lines into top of mains.
- .3 Install piping in direction of flow with slopes as follows, unless indicated:
 - .1 Steam: 1:240.
 - .2 Condensate return: 1:70.
- .4 Make provision for thermal expansion.
- .5 Drip pocket: line size.

3.03 VALVES

- .1 Install globe valves around, NPS 8 and over, gate valves.

3.04 TESTING

- .1 Test system in accordance with Section 21 05 01 - Common Work Results for Mechanical.
- .2 Test pressure: 1-1/2 times maximum system operating pressure or 860 kPa whichever is greater.

3.05 SYSTEM START-UP

- .1 In accordance with Section 21 05 01.

3.06 PERFORMANCE VERIFICATION (PV)

- .1 Timing, only after:
 - .1 Pressure tests successfully completed.
 - .2 Flushing as specified has been completed.
 - .3 Water treatment system has been commissioned.
- .2 PV Procedures:
 - .1 Verify complete drainage of condensate from steam coils.
 - .2 Verify proper operation of system components, including, but not limited to:
 - .1 Steam traps - verify no blow-by.
 - .2 Flash tanks.
 - .3 Thermostatic vents.
 - .3 Monitor operation of provisions for controlled pipe movement including expansion joints, loops, guides, anchors.
 - .1 If bellows type expansion joints flex incorrectly, shut down system, re-align, repeat start-up procedures.

3.07 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

PART 1- GENERAL

1.1 SCOPE

- .1 Provide ductwork systems as shown.
- .2 Provide fire rated ductwork enclosure and/or fire rated duct wrap insulation systems as shown, and if required. The contractor under this Section of the Work is responsible for providing the ductwork fire protection system, including any sub-contracting of all or a portion of the Work to another trade.

1.2 APPLICABLE CODES AND STANDARDS

- .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition.
- .2 SMACNA HVAC Air Duct Leakage Test Manual, 2012, 2nd Edition.
- .3 Conform to;
- .4 NFPA 90A - Installation of air conditioning and ventilating systems.
- .5 NFPA 90B - Installation of warm air heating and air conditioning systems.
- .6 Letter and number designations, shown as "CR3-16" etc., are taken from ASHRAE Duct Fitting Data Base. (DFDB)
- .7 ASTM A525 Specification for General Requirements for Steel Sheet, Zinc Coating (Hot Dipped galvanized)
- .8 ASTM A480 Specification for General requirements for Flat Rolled Plate, Sheet, and Strip
- .9 ASTM A621 Specification for Steel Sheet and Strip Carbon Hot Rolled Drawing Quality

1.3 SHOP DRAWINGS AND SUBMITTALS

- .1 Product Data: submit manufactures' product data and catalogue literature for:
 - .1 Sealants.
 - .2 Tape.
 - .3 Proprietary Joints.
 - .4 Hardware
- .2 Submit field/fabrication drawings at 1:50 ($\frac{1}{4}$ inch=1 foot) or larger scale, with piping, ductwork, and fittings in double line format, to show;
 - .1 Arrangements in congested areas,
 - .2 Where installation proposed deviates from layout shown, and
 - .3 Where installation requires joints for field assembly in welded duct construction.
- .3 For greater clarity, do not submit field/fabrication drawings for other areas of the Work.
 - .1 Submit schedules and details to show;

1. Fabrication details of
 - .1 Connections to risers in duct shafts
 - .2 Balancing damper construction,
 - .3 Fittings where geometry contemplated is different from that specified.
2. In chart form
 - .1 Duct system pressure class,
 - .2 Duct sheet gauges,
 - .3 Joint types and application criteria,
 - .4 Location criteria and dimensions for bracing, stiffeners and balancing dampers
 - .5 Duct leakage class, and
 - .6 Extent of sealing.

1.4 RECORD DRAWINGS

- .1 As work progresses, mark-up field drawings and submit as part of record of "As-Built" conditions.

1.5 QUALITY ASSURANCE

- .1 Certification of Ratings:
- .2 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .3 Ductwork systems to be provided by firm having and established reputation in this field.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Protect exposed ductwork on site from damage, dust and debris. Cover unused ductwork, and fittings while being stored. Cover open ends of ductwork and fittings with plastic sheeting after installation and while being stored to protect from construction dust and damage. Installed absorptive material to protect from moisture damage.

PART 2- PRODUCTS

2.1 GENERAL

- .1 Construction: round.
 - .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 Fittings:

1. Elbows: smooth radius. Centreline radius: 1.5 x diameter.
2. Branches: conical transition with conical branch at 45 degrees and 45 degrees elbow.
- .2 Construction: rectangular:
 - .1 Ducts: Provide external reinforcing to SMACNA.
 - .2 Transverse joints: proprietary duct joints SMACNA seal Class A.
 - .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.

2.2 MATERIALS

- .1 Galvanized steel:
 - .1 Lock forming quality to ASTM A525, G90 zinc coating. Satin coat steel for painted surfaces.
- .2 Stainless Steel:
 - .1 Type 304L Flat Rolled Plate, Sheet and Strip
 - .2 Fully welded construction for zero leakage.
- .3 Seal Classification:
 - .1 Refer to Schedule on ductwork Drawings
 - .2 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.

2.3 GALVANIZED STEEL

- .1 Lock forming quality: G90 zinc coating.
- .2 Thickness, fabrication and reinforcement: to SMACNA.
- .3 Joints: to SMACNA or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint to be considered to be a class A seal.

2.4 STAINLESS STEEL

- .1 Supply ductwork as indicated using type 304L stainless steel sheets with longitudinal joints.
 - .1 Anneal stainless steel sheets before welding. For circular ducts roll sheets circular and weld flush. Provide integral 2 mm flanges on abutting ends of manufactured ducts.
- .2 Continuously weld all joints using Tungsten Inert Gas arc (GTAW) process without burning parent metal, using filler rods type ER308L as specified in CSA W48. Grind smooth and polish all joints.
- .3 Construction:
 - .1 Construct ductwork from following thicknesses of stainless steel sheet

1. Rectangular ducts 1.3 mm minimum.
2. Circular ducts up to 500 mm diameter 0.8 mm minimum.
3. Circular ducts over 500 mm diameter 1.0 mm minimum.
- .4 Reinforce rectangular ducts with stainless steel angle frames at 1200 mm on centres 40 x 40 x 3 mm up to 900 mm maximum dimension and 50 x 50 x 6 mm for larger ducts.

2.5 SEALANT

- .1 Sealant: oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of minus 30 degrees C to plus 93 degrees C

2.6 TAPE

- .1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

2.7 DUCT LEAKAGE

- .1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual. See section 3.3 Leak Testing for more information.
- .2 In accordance with SMACNA Seal Class as specified on Ductwork Tables in drawing package.

2.8 PRESSURE CLASS

- .1 In accordance with Ductwork Tables shown in Drawing package

2.9 FIRE RATED DUCT WRAP INSULATION

- .1 Fire rating: 2 hrs or as shown.
- .2 ULC/Warnock Hersey/ETI listed:
 - .1 Maximum flame spread and smoke development rating: 25/50, to ULC-S102.
 - .2 2 hr ventilation duct: CAN/ISO 6944, or CAN/ULC-S101
- .3 Material: foil encapsulated, fireproof insulation blanket
 - .1 Standard of Acceptance
 1. Thermal Ceramics - Firemaster
 2. 3M - Fire Barrier Duct Wrap Systems
 3. Royal - Quickwrap
 4. FyreWrap
 5. CL4Fire - Fire Protection Thermal Insulation

2.10 PROPRIETARY MANUFACTURED FLANGED DUCT JOINTS

- .1 Material to match that of ductwork being joined.
 - .1 Standard of Acceptance

1. Ductmate
2. Exanno Nexus

2.11 BACKDRAFT DAMPERS

- .1 Frames shall be minimum 60 mm deep x 25 mm and no less than 1.5 mm in thickness, mill finish extruded aluminum with mounting flanges on both sides of frame. Frame to be assembled using plated steel mounting fasteners.
- .2 Blades shall be extruded aluminum profiles and shall not be less than 1.5 mm in thickness.
- .3 Blade and frame seals shall be of extruded silicone and shall be secured in an integral slot within the aluminum extrusions. Blade and frame seals are to be mechanically fastened to eliminate shrinkage and movement over the life of the damper. Adhesive or clip-on type blade seals are not acceptable.
- .4 Maintenance-free bearings system rotating on 12 mm aluminum pivot points.
- .5 Linkage system shall consist of hard alloy aluminum crank arms fastened to aluminum pivot rods and shall be doubly secured within channel running along top of blade. Large diameter 8.73 mm hard alloy aluminum linkage rod shall connect the crank arms by means of a zinc-plated steel trunnion.
- .6 Cup point trunnion set screw shall create a compression hard spot where it secures to the linkage rod for a slip-proof grip.
- .7 Trunnions shall be zinc-plated to provide a hard, smooth and long-lasting rotating surface.
- .8 Air leakage through a 610 mm x 610 mm back draft damper shall not exceed 21.95 l/s/m² against 250 Pa differential static pressure at standard air. Standard air leakage data to be certified under a Certified Ratings Program.

2.12 ACCESS DOORS

- .1 DESIGN STANDARD MANUFACTURER: AIR BALANCE INC. Substitutions are permitted subject to approval.
- .2 Material: Minimum 24 gauge metal, matching material specified for duct.
- .3 Pressure Rating: Suitable for duct pressure classifications shown.

Duct Width	Door length x Width	No. Required
450 mm and Smaller	300 mm x 300 mm	1
500 mm to 1200 mm	450 mm x 450 mm	1
1250 mm and larger	450 mm x 450 mm	2

- .4 Hardware:
 - .1 Hinges: Wrought steel, zinc plated; brass pins; sized to suit door; minimum two per door.
 - .2 Fasteners: Brass, window sash type; minimum two per door.
 - .3 Pull: Brass; minimum one per door on suction side of fan.

- .5 Reinforce doors with flat or angle iron stiffening frame to avoid racking. Make doors on insulated ductwork of double panel construction with an acceptable type insulated filler not less than 25mm thick. Frame out duct openings with a continuous reinforcing bar or angle against which door shall close. At insulated ducts, provide an extended metal collar flush with butt face of insulation. Attach gaskets to bar or angle with flameproof adhesive for airtight construction. Attach low pressure doors with at least two hinges.

2.13 INSTRUMENT TEST PORTS

- .1 Construction:
 - .1 1.6mm thick steel body zinc plated after manufacture,
 - .2 Chain secured neoprene expansion plug with cam lock handle,
 - .3 28mm minimum inside diameter, length to suit insulation thickness,
 - .4 Neoprene mounting gasket: flat for rectangular duct and moulded for round duct

2.14 FLEXIBLE CONNECTIONS

- .1 Acceptable Product: Proflex. Vinyl Super Duty Fabric. Minimum lateral movement of 38mm, minimum elongation or compression of 30mm.
 - .1 Sloped to base of riser where horizontal run is more than 3m (10 ft.), with NPS $\frac{3}{4}$ drain connection from low points in bottom of duct, trapped and piped to drain.

2.15 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Rectangular.
 - .1 Elbows are to installed as shown, or if not shown, in order of preference as follows:
 - 1. CR3-1, with throat radius 0.75 times duct width, and full heel radius.
 - 2. rectangular reducing elbow with throat radius equal to 0.75 times radial duct dimension of larger duct, and heel radius equal to throat radius plus radial duct dimension of smaller duct, (SMACNA HVAC FIG 2-2 Type RE-5),
 - 3. 150 mm (6 in) throat radius with full heel radius, CR3-3,4, or 5 and full radius single thickness splitter vanes,
 - 4. 75 mm (3 in) throat radius with full heel radius, CR3-3,4, or 5 and full radius single thickness splitter vanes,
 - 5. square throat, square heel, 115 mm (4.5 in) radius heel vane and 80 mm (3.25 in) spaced double thickness turning vanes with 115 mm (4.5 in) radius of curvature, CR3-16,

6. square throat, square heel, 115 mm (4.5 in) radius heel vane and 80 mm (3.25 in) spaced single thickness turning vanes with 115 mm (4.5 in) radius of curvature and 1.625 in long trailing edges, CR3-13.
- .2 Wye and tee branches (supply systems):
 1. Where flow divides at high pressure and high velocity SR5-1(parallel flow branch)
 2. Where round branch is taken from rectangular main followed by transition fitting SR5-12 .(spin-in collar- flared)
 3. Where rectangular branch is taken from rectangular main followed by a transition fitting SR5-13. (shoe)
 4. Where flow divides from rectangular duct into round diffuser neck followed by a transition fitting SR5-11
 5. Where flow divides in a "bull nose tee" SR5-14. (dovetail symmetrical wye) $Q_b = (0.35 \text{ to } 0.65) \text{ times } Q_c$.
- .3 Wye and tee branches (return/exhaust systems):
 1. Where flow combines at high pressure and high velocity ER5-1 (parallel flow branch)
 2. Where equal flows are combined in "bull nose tee" configuration. ER5-4 (dovetail symmetrical wye)
 3. Where small rectangular branch is combined with large main ER5-3 (shoe)
 4. Where small round or rectangular duct is connected into main at right angles to main flow direction ER5-2 (spin in collar - straight, or dovetail collar)
- .4 Transitions (Rectangular and Round):
 1. converging: maximum angle between ductside and direction of flow: 20
 2. diverging: maximum angle between ductside and direction of flow: 15
- .5 Offsets:
 1. single offset in single plane, less than duct height, made up with two 45 elbows of type selected as above.
 2. single offset, of greater displacement, made up with 90 elbows of type selected as above.
 3. double offset in single plane, less than duct height, made up with four 45 elbows of type selected as above.
 4. double offset in single plane, of greater displacement than duct height, made up with 90 elbows of type selected as above
- .6 First elbow on discharge side of fan:
 1. unvaned elbow, CR3-1, with throat radius 0.75 times duct width, and full heel radius, arrangement SR7-5 or 9 with L Le.
- .7 Obstructions passing through duct:
 1. Not permitted.
- .3 Round:

- .1 30 round elbow:
 - 1. up to 300 mm (12 in): die stamped,
 - 2. 350 mm (14 in) and larger: 2-gore
- .2 45 round elbow:
 - 1. up to 300 mm (12 in): die stamped,
 - 2. 350 mm (14 in) and larger: 3-gore.
- .3 60 round elbow:
 - 1. up to 300 mm (12 in): die stamped,
 - 2. 350 mm (14 in) and larger: 4-gore.
- .4 90 round elbow:
 - 1. up to 200 mm (8 in): die stamped with centreline radius equal to 1.5 times duct diameter,
 - 2. from 225 mm (9 in) to 350 mm (14 in): pleated with centreline radius equal to 1.5 times duct diameter
 - 3. from 375 mm (15 in) to 900 mm (36 in): 9-gore elbow with centreline radius equal to 2.5 times duct diameter,
 - 4. (950 mm (38 in) and larger: 7-gore elbow with centreline radius equal to 2.5 times duct diameter.
- .5 Wye branches:
 - 1. downstream of supply fan: wye branch SD5-2, plus 45 elbow,
 - 2. downstream of terminal boxes, and return or exhaust: wye branch SD5-1, plus 45 elbow.
- .6 Tee branch (supply):
 - 1. downstream of supply fan: tapering tee SD5-12,
 - 2. downstream of terminal boxes: conical tee SD5-10.
- .7 Tee branch (return/exhaust):
 - 1. converging branches, where main and branch are of similar size: tapering 45 lateral SD5-2 and 45 elbow,
 - 2. converging flow where branch is small: tapering tee SD5-12.

2.16 HANGERS AND SUPPORTS

- .1 Hangers and Supports: in accordance with Section 20 05 29 Hangers and Supports, but also these items below.
- .2 Duct side up to maximum 500 mm (20") supported with strap hangers of same material as duct but one sheet metal thickness heavier.
- .3 Extend strap hangers down duct side and turn under 50 mm (2") fastening securely to side and underside of duct.
- .4 Duct side greater than 500 mm (20") supported with trapeze hangers constructed from same material of duct steel angle with steel rods in accordance with following table;

- .5 Hanger configuration: to SMACNA.
- .6 Hangers: black steel angle with black steel rods to the following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
Up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

- .7 Provide additional hangers to comply with required building codes and standards.
- .8 Maximum hanger spacing: 2.4 m (8 ft.) on centre.
- .9 Upper hanger attachments;
 - .1 In new concrete: manufactured concrete inserts.
 - 1. Standard of Acceptance
 - .1 Myatt Fig. 485
 - .2 For steel joist: galvanized joist clamps or steel plate washer.
 - 1. Standard of Acceptance
 - .1 Anvil Fig. 61 or 86
 - .2 Anvil Fig. 60 for plate washer
 - .3 For steel beams: galvanized beam clamps.
 - 1. Standard of Acceptance
 - .1 Anvil Fig. 60

2.17 FIRE DAMPERS AND SLEEVES

- .1 Floors, and Walls:
 - .1 Intumescent type, rigid galvanized steel frame with minimum 2 hour fire rating.
 - .2 Standard of Acceptance:
- .2 Fire Damper Sleeves: Damper manufacturer's metal sleeve with mounting angles, for matching assembly.

PART 3- EXECUTION

3.1 INSTALLATION

- .1 Assemble, mount, and seal ductwork systems. Install duct and plenum mounted equipment in accordance with manufacturer's recommendations.

- .2 Suspend ducts securely, so that under conditions of operation, there will be no vibration.
- .3 Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pivot tube openings where required for testing of systems.
- .4 Holes in Ductwork:
 - .1 Where ducts are insulated, neatly cut a 75mm wide strip of insulation away from hole site.
 - .2 Drill holes in ducts, casings and plenums not exceeding 300mm OC in locations as directed by Balancing Agency.
 - .3 Use snap-in plugs for low and medium pressure systems with material gauges of 14 through 26.
 - .4 Use instrument test holes for HEPA filter casings, high pressure and Class 1 systems, and all other low and medium pressure system applications.
 - .5 Reinstall cut away insulation and cover with 100mm wide duct tape. Identify plug and instrument hole locations on insulated ducts as "test holes" for future reference and use.
- .5 Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- .6 Install turning vanes of standard construction in duct elbows where center line radius is less than 1.25 times width of duct.
- .7 Provide gravity backdraft dampers on all exhaust air outlets to outdoor and exhaust fans where motorized dampers are not indicated, and where shown on drawings.
- .8 Set plenum doors 150 to 300mm above floor. Arrange door swings so that fan static pressure holds door in closed position.
- .9 Connect ducts to fans with flexible sleeves.
- .10 Do not use elbows or flexible ductwork within 3 inlet diameters of the inlet-to-air terminal units.
- .11 Do not use flexible duct to form elbows or turns exceeding 90 degrees. Use rigid metal duct for such applications.
- .12 Hanging from steel roof or floor decks is approved only when there is at least 100mm of concrete over deck. Provide supplementary or structural steel as required for seismic and structural support.
- .13 During construction, provide temporary closures of metal or taped polyethylene on open ductwork, to prevent construction dust from entering ductwork system.
- .14 Install mechanical duct connection systems in strict conformance with manufacturer's instructions. Over tightening of corner piece nuts and bolts may cause leakage in excess of allowable levels.
- .15 Install fire dampers in duct extension sleeves and with perimeter angles and breakaway fittings in accordance with manufacturer's instructions and SMACNA details. Provide control wiring for smoke dampers back to auxiliary contacts in fan starter.

- .16 Install access doors at plenums, automatic dampers, temperature and humidity sensors in fan discharges, control devices, fire dampers, smoke dampers, smoke detectors and other locations where shown. Locate doors on duct sidewalls.
- .17 Cut, fit and install blank out panels at portions of louvers not used. Seal seams, perimeter, cut-outs and duct connection. Provide angle closure collars where ducts meet blank out panels.
- .18 Locate pressure relief doors between fan and first fire damper. Provide multiple doors when required to match system capacity. Select doors based on capacity and settings to match duct construction classification shown.

3.2 LEAK TESTING

- .1 All ductwork shall be leak tested. Refer to schedule on drawings. Leakage Test Pressure to be at least 1.0 times the Pressure Rating as shown in the Ductwork Tables shown in the drawing package.
- .2 Conduct test in accordance with Associated Air Balance Council (AABC) recommended procedures.
- .3 Leak test supply and exhaust air ductwork. Maximum allowable leakage shall be one percent of total air volume.
- .4 Leak test laboratory exhaust air ductwork. Maximum allowable leakage shall be per SMACNA procedures.
- .5 Test each system as a whole or in segments as required by progress of work. Use test pressure of pressure-velocity classifications shown, unless otherwise noted.
- .6 Prior to testing, manually remove debris from inside equipment, plenums and ductwork. Do not use fans to remove debris. Verify that duct mounted equipment, accessories and components are installed complete, including access doors as specified. Set fire and smoke dampers in their proper position with "Fire Links" or other devices required for operation, in place and set.
- .7 Pressure test completed ductwork system before ductwork is insulated and concealed. Retest systems found to be incomplete during initial test.
- .8 If tests show ductwork system leakage is greater than allowed, reseal and retest until allowable leakage is not exceeded.
- .9 If, by test, pressure drop across ductwork fittings and duct mounted devices furnished under other Sections exceeds by 10 percent the pressure drop ratings listed in SMACNA HVAC Duct System Design, inspect inside ductwork fittings and devices, and report findings to Departmental Representative. If fittings and devices do not have access doors, cut inspection openings in ductwork, and provide airtight access covers secured with sheet metal screws. Repair or replace fittings and devices, and retest until allowable pressure drop is not exceeded.

3.3 SEALING AND TAPING

- .1 Apply sealant in accordance with SMACNA and to manufacturer's recommendations.

- .2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturer's recommendations.

3.4 DUCT CLEANING

- .1 Cleaning to be performed by agent specializing in this field of work, be a member in good standing with National Air Duct Cleaners Association (NADCA), and to comply with NADCA standards.
- .2 Clean new horizontal and vertical ducts (supply, return, exhaust, transfer), as well as, existing supply and return ductwork connected to new fan systems.
- .3 Clean ductwork using high powered vacuum system, hand tools and mechanical brushing systems such that metal surfaces are visibly clean.
- .4 Reset balancing dampers to original settings if moved during work. Have TAB Agent confirm damper settings.
- .5 Maintain set of drawings on site, coloured each day during cleaning to indicate extent of duct cleaning completed.
- .6 Submit a written report, verified by TAB Agent, identifying extent of duct system cleaning and certifying that NADCA standards have been met.

END OF SECTION 23 31 13

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section 23 05 29.

1.02 REFERENCE STANDARDS

Not used.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for [fan coil units] and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Product data to include:
 - .1 Filters, fan accessibility.
 - .2 Suspension of cabinet.
 - .3 Thermostat, transformer, controls where integral.
 - .4 kW rating, voltage, phase.
 - .5 Cabinet material thicknesses.
- .3 Shop Drawings:
 - .1 Submit drawings where required.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect fan coil units from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

2 PRODUCTS

2.01 FAN COIL UNITS

- .1 Cabinet: steel, 1.2 mm thick, ceiling mounting, recessed. Front inlet/ front outlet.
- .2 Elements: stainless steel sheathed with corrosion protected aluminum fins covering full length of element.
- .3 Blower motors: single phase, ECM motor.
- .4 Wall mounted thermostats: see drawings.
- .5 Fan delay switch.
- .6 Fresh air duct adapter.
- .7 Filter: replaceable.
- .8 Trim for flush installation.
- .9 Finish: 3 stage phosphatized treatment followed by enamel.
- .10 Assembly fully wired to one outlet location.
- .11 Multiple knockouts for up to 38 mm diameter conduit.
- .12 Complete with condensate discharge pump if required for drainage.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for fan coil units 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.

3.02 INSTALLATION

- .1 Hang units.
- .2 Make electrical and control connections.

3.03 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

3.04 CLEANING

- .1 Progress Cleaning: clean in accordance with Section [01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section 23 22 13

1.02 REFERENCE STANDARDS

- .1 Institute of Boiler and Radiator Manufacturers (IBR)
- .2 US Department of Commerce
 - .1 CS 140-47, Commercial Standard.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for finned tube radiation heaters and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings where required.
 - .2 Indicate on drawings:
 - .1 Equipment, capacity, piping, and connections.
 - .2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.
 - .3 Special enclosures.
- .4 Samples: Not Used.
- .5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.04 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for finned tube radiation heaters for incorporation into manual.

1.05 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect finned tube radiation heaters from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

2 PRODUCTS

2.01 DAMPERS

- .1 Factory built, internal damper, at enclosure air outlet grille for each convection type heating unit not thermostatically controlled. Refer to schedules on drawings.

2.02 CAPACITY

- .1 As indicated on drawings and schedules.

2.03 FINNED TUBE RADIATION

- .1 Heating elements: NPS 1 1/4 steel tube 3.1 mm minimum wall thickness, mechanically expanded into flanged collars of evenly spaced steel fins 108 x 92 mm nominal fins.
- .2 Element hangers: ball bearings cradle type providing unrestricted longitudinal movement on enclosure brackets. Space brackets 900 mm centres maximum.
- .3 Special enclosures: as indicated on drawings. Provide floor mounting support bare tube elements.
- .4 Dimensions for enclosures: measure site conditions. Do not scale from drawing.
- .5 Provide for noiseless expansion of components.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for finned tube radiation convector heater installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.02 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Install in accordance with piping layout and reviewed shop drawings.
- .3 Provide for pipe movement during normal operation.
- .4 Maintain sufficient clearance to permit performance of service maintenance.
- .5 Check final location with Departmental Representative if different from that indicated prior to installation. Should deviations beyond allowable clearances arise, request and follow Departmental Representative's directive.
- .6 Valves:
 - .1 Install valves with stems upright or horizontal unless approved otherwise.
 - .2 Install isolating valves on inlet and lockshield balancing valves on outlet of each unit.
- .7 Venting:
 - .1 Install screwdriver vent on cabinet convector, terminating flush with surface of cabinet.
 - .2 Install standard air vent with cock on continuous finned tube radiation.
- .8 Clean finned tubes and comb straight.
- .9 Install flexible expansion compensators as indicated.

3.03 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

.1 Sections

26 05 29 Hangers and supports for electrical systems

26 24 16.01 Panel boards: breaker type

1.02 REFERENCE STANDARDS

.1 CSA Group

.1 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.

.2 CAN3-C235-83(R2010), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

.2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)

.1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.03 DEFINITIONS

.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

1.04 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for shop drawing review and O&M manual and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop drawings:

.1 Submit drawings stamped by the contractor.

.2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.

.3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.

.4 Indicate on drawings clearances for operation, maintenance, and replacement of operating equipment devices.

- .5 If changes are required, notify Departmental Representative of these changes before they are made.
- .4 Certificates:
 - .1 Provide CSA certified equipment and material.
 - .2 Where CSA certified equipment and material] is not available, submit such equipment and material] to authority having jurisdiction for special approval before delivery to site.
 - .3 Submit test results of installed electrical systems and instrumentation.
 - .4 Permits and fees: in accordance with General Conditions of contract.
 - .5 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
 - .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.
- .5 Manufacturer's Field Reports: submit to Departmental Representative manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

1.05 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
 - .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
 - .2 Operating instructions to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - .3 Safety precautions.
 - .4 Procedures to be followed in event of equipment failure.
 - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
 - .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
 - .4 Post instructions where directed.
 - .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
 - .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

1.06 DELIVERY, STORAGE AND HANDLING

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

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse of packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2 PRODUCTS

2.01 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
 - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification nameplates and labels for control items in English and French.
- .4 Use one nameplate or label for each language.

2.02 MATERIALS AND EQUIPMENT

- .1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .3 Factory assemble control panels and component assemblies.

2.03 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

2.04 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of authority having jurisdiction and Departmental Representative.
- .2 Porcelain enamel and decal signs, minimum size 175 x 250 mm.

2.05 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.06 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates as follows:
 - .1 Nameplates: lamicoid 3 mm thick plastic engraving sheet, black face, white core, lettering accurately aligned and engraved into core.
 - .2 Sizes as follows:

NAMEPLATE SIZES

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .1 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .2 Wording on nameplates and labels to be approved by Departmental Representative and match the existing building label prior to manufacture.
- .3 Allow for minimum of twenty-five (25) letters per nameplate and label.
- .4 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .5
- .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .7 Terminal cabinets and pull boxes: indicate system and voltage.
- .8 Transformers: indicate capacity, primary and secondary voltages.

2.07 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, numbered on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

2.08 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .3 Colours: [25] mm wide prime colour and [20] mm wide auxiliary colour.

Type	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red
Telephone	Green	
Other	Green	Blue
Communication Systems		
Fire Alarm	Red	
Emergency	Red	Blue
Voice		
Other	Red	Yellow
Security Systems		

2.09 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Paint indoor switchgear and distribution enclosures light gray.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions

- immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied.

3.02 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Do overhead and underground systems in accordance with CAN/CSA-C22.3 No.1 except where specified otherwise.

3.03 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.04 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete.
 - .1 Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.05 LOCATION OF OUTLETS

- .1 Refer to drawings for the height.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .4 Locate light switches on latch side of doors and refer to drawings.
 - .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor for the height of the equipment.

3.07 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.08 FIELD QUALITY CONTROL

- .1 Load Balance:
 - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between

- phases and record changes.
- .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- .3 Provide upon completion of work, load balance report as directed in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS, phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .5 Systems: fire alarm and communications.
 - .6 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Check resistance to ground before energizing.
- .3 Carry out tests in presence of Departmental Representative..
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 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.

3.09 SYSTEM STARTUP

- .1 Instruct Departmental Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

3.10 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Sections
 - 26 05 00 Common work results for electrical
 - 26 05 21 Wires and cables (0-1000V)

1.02 REFERENCE STANDARDS

- .1 CSA International
 - .1 CAN/CSA-C22.2 No.18 -98(R2003), Outlet Boxes, Conduit Boxes and Fittings.
 - .2 CAN/CSA-C22.2 No.65 -03(R2008), Wire Connectors (Tri-National Standard with UL 486A-486B and NMJ-J-543-ANCE-03).
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2-1961, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA)

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for wire and box connectors and include product characteristics, performance criteria, physical size, finish and limitations.

1.04 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals].

1.05 DELIVERY, STORAGE AND HANDLING

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

- .2 Store and protect wire and box connectors from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse by manufacturer of [packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2 PRODUCTS

2.01 MATERIALS

- .1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper or aluminum conductors as required.
- .2 Fixture type splicing connectors to: [CAN/CSA-C22.2 No.65], with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Bushing stud connectors: to EEMAC 1Y-2 to consist of:
 - .1 Connector body and stud clamp for stranded.
 - .2 Clamp for stranded copper conductors.
 - .3 Stud clamp bolts.
 - .4 Bolts for copper conductors.
 - .5 Sized for conductors as indicated.
- .4 Clamps or connectors for TECK cable as required to: CAN/CSA-C22.2 No.18.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wire and box connectors installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative and Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.02 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and cables and:
 - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
 - .2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No.65.
 - .3 Install fixture type connectors and tighten to CAN/CSA-C22.2 No.65. Replace insulating cap.
 - .4 Install bushing stud connectors in accordance with EEMAC 1Y-2 [NEMA].

3.03 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Sections
 - 26 05 00 Common work results for electrical
 - 26 05 20 . Wire and box connectors

1.02 REFERENCE STANDARDS

- .1 Canadian Electrical code-2012

1.03 PRODUCT DATA

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

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Packaging Waste Management: remove for reuse packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2 PRODUCTS

2.01 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE.
- .3 Copper conductors: size as indicated, with thermoplastic insulation type TWU rated at 600 V.
- .4 Neutral supported cable: 1phase insulated conductors of Copper and one neutral conductor of Copper steel reinforced, size as indicated. Type: NS75 Insulation: Type NS-1 rated 300 V.

2.02 TECK 90 CABLE

- .1 Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper size as indicated.
- .3 Insulation:

- .1 Cross-linked polyethylene XLPE.
- .2 Rating:, 600V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: flat.
- .6 Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project.
- .7 Fastenings:
 - .1 One hole malleable irons traps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables at __2000__] mm centers.
 - .3 Threaded rods: 6 mm diameter to support suspended channels.
- .8 Connectors:
 - .1 Watertight approved for TECK cable.

2.06 CONTROL CABLES

- .1 Type: LVT: 2 soft annealed copper conductors, sized as indicated:
 - .1 Insulation: thermoplastic.
 - .2 Sheath: cotton braid.
- .2 Type: low energy 300 V control cable: solid or stranded annealed copper conductors sized as indicated LVT: 2 soft annealed copper conductors, sized as indicated:
 - .1 Insulation: PVC.
 - .2 Shielding: tape coated with paramagnetic material over each pair.
 - .3 Overall covering: PVC jackets.

3 EXECUTION

3.01 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform Megger_ tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

3.02 GENERAL CABLE INSTALLATION

- .1 Lay cable in cable trays in accordance with Section 26 05 36 - Cable Trays for Electrical Systems.
- .2 Terminate cables in accordance with Section 26 05 20 - Wire and Box

Connectors - (0-1000 V).

- .3 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .4 Conductor length for parallel feeders to be identical.
- .5 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .6 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .7 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.
- .8 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.03 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section [26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings].

3.04 INSTALLATION OF TECK90 CABLE (0 -1000 V)

- .1 Group cables wherever possible on channels.
- .2 Install cable exposed securely supported by hangers.

3.08 INSTALLATION OF CONTROL CABLES

- .1 Install control cables in conduit.
- .2 Ground control cable shield.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Sections
 - 26 05 00 Common works result for electrical
 - 26 05 36 Cable trays for electrical systems

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 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 hangers and supports from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse of packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2 PRODUCTS

2.01 SUPPORT CHANNELS

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended set in poured concrete walls and ceilings.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for hangers and supports installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative and Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied [and after receipt of written approval to proceed from Consultant.

3.02 INSTALLATION

- .1 Secure equipment to hollow or solid masonry, tile and plaster surfaces with lead anchors.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole malleable iron straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.
- .7 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.

- .8 For surface mounting of two or more conduits use channels at 2 m on centre spacing.
- .9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .11 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.
- .13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

3.03 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal].
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section
 - 26 05 00- Common work results for electrical
 - 26 05 22- Connectors and terminations
 - 26 05 32- Outlet boxes, conduit boxes and fittings
 - 26 05 34- Conduits, conduit fastenings and conduit fittings.

1.02 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-06, Canadian Electrical Code, Part 1, 20th Edition.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit drawings by the contractor.

1.04 DELIVERY, STORAGE AND HANDLING

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

2 PRODUCTS

2.02 JUNCTION AND PULL BOXES

- .1 Construction: welded steel enclosure.
- .2 Covers Flush Mounted: 25 mm minimum extension all around.
- .3 Covers Surface Mounted: screw-on flat covers.

3 EXECUTION

CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.
- .3 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

3.03 IDENTIFICATION

- .1 Equipment Identification: to Section 26 05 00- Common Work Results for Electrical .
- .2 Identification Labels: size 2 indicating system name, voltage and phase or as indicated.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section
 - 26 05 00 - Common work results for electrical
 - 26 05 33 - Raceway and boxes for electrical systems
 - 26 05 34 - Conduits, conduit fastenings and conduit fittings

1.02 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-06, Canadian Electrical Code, Part 1, 20th Edition.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

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

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2 PRODUCTS

2.01 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required.
- .3 Gang boxes where wiring devices are grouped. (Single gang for power and double gang for alarm monitoring).
- .4 Blank cover plates for boxes without wiring devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.

2.02 GALVANIZED STEEL OUTLET BOXES

- .1 One-piece electro-galvanized construction.
- .2 Single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .3 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.
- .4 102 mm square or octagonal outlet boxes for lighting fixture outlets.

2.08 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to [35]mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

3 EXECUTION

3.01 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.
- .5 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .6 Identify systems for outlet boxes as required.
- .7 Do not install boxes back to back.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section.
 - 26 27 26 - Wiring devices
 - 26 05 00 - Common work results for electrical

1.02 REFERENCE STANDARDS

- .1 CSA International
 - .1 CSA C22.2 No.40-M1989(R2009), Cutout, Junction and Pull Boxes.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for raceway and boxes and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 For prewired installations, submit drawings for approval showing the complete layout of all products that make up the complete system for each floor prior to installation with raceway lengths, device type (power and data), locations and circuits identified.
 - .3 If variations from approved shop drawings occur during the installation of the system, final, as built drawings, shall be submitted for each floor that has been altered.

1.04 CLOSEOUT SUBMITTALS

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

1.05 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect raceway and boxes from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section [01 35 21 - LEED Requirements].
- .5 Packaging Waste Management: remove for reuse in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2 PRODUCTS

2.01 SURFACE MOUNT AL5200 DUAL CHANNEL ALUMINUM RACEWAY

The aluminum surface metal raceway system specified herein for branch circuit wiring and/or data network, voice, video and other low-voltage wiring basis of design shall be the AL5200 System as manufactured by The Wiremold Company, or equivalent. Systems of other manufacturers may be considered equal if, in the opinion, and the written approval of the Departmental Representative, they meet all the performance standards specified herein. Manufacturers requesting consideration as an equal to the Wiremold system shall submit a list of similar installations in service for two (2) years or longer.

- .1 The raceway and all system components must be UL Listed in full compliance with their standard for surface metal raceways and fittings (UL-5). All extrusions are to be 6063-T5 aluminum alloy, with nominal wall thickness of 0.080" (2.03mm) throughout. The surface finish is to be satin, anodized #204 Type clear, Class R1 Mil-Spec with minimum anodized finish of 0.004" (.10mm).
- .2 The raceway shall be a two-piece design with a base and snap-on cover. The base and cover sections shall be furnished in 5' and 10' (1.52m and 3.048m) lengths. The overall dimensions of assembled raceway shall be 5" (127mm) wide by 2" (51mm) deep with a cross sectional area of 8.5 square inches (5484mm²).

The AL5200B base shall have four integral ribs in the bottom to accept the AL5200D divider sections. A field installed divider, to separate the 5" (127mm) width into two or three separate wiring compartments to handle both power and communications wiring, must be available. The snap-in divider is extruded 0.050" (1.27mm) aluminum offered in 5' and 10' (1.52m and 3.048m) lengths.

- .3 A full compliment of fittings for the raceway shall be available including, but not limited to, flat, internal and external elbows, tee and cross fittings, wire clips, couplings for joining sections of raceway, grounding adapters as an CEC approved secondary grounding method and transition connectors to 1/2" and 3/4" (25mm and 19mm) trade

size conduit. The fittings shall have a satin anodized finish to match the raceway.

- .4 Device cover plates for mounting the following commercially available devices must be available: duplex devices, single 1.40" and 1.59" (35.5mm and 40.39mm) dia. receptacles, GFCI, Sentrex surge receptacles and other rectangular faced devices and modular voice and data jacks. All devices must be mounted to the cover plates, which are securely held in place by extruded protrusions. Cover plates are to be removable by use of a standard screwdriver without marring the extrusion finish.
 - .1 Use "move hole device cover plate" for alarm monitoring points to route pigtail control wire.
- .5 The raceway manufacturer will provide a complete line of connectivity outlets and modular inserts for UTP/STP, Fiber Optic, Coaxial and other cabling types with face plates and bezels to facilitate mounting. A complete line of preprinted station and port identification labels, snap-in icon buttons as well as write-on station identification labels shall be available.

3 EXECUTION

3.02 INSTALLATION

Prior to and during installation, refer to system layout drawing containing all elements of the system. Installer shall comply with detailed manufacturer's installation instruction sheets, which accompany system components, as well as, system instruction sheets, whichever is applicable.

- .1 All raceway systems shall be mechanically continuous and connected to all electrical outlets, boxes, cabinets, in accordance with manufacturer's installation sheets.
- .2 All metal raceway shall be electrically continuous and bonded in accordance with the Canadian Electric Code for proper grounding.
- .3 Work shall include fastening all raceway and appropriate fittings and device plates to install a complete aluminum surface raceway system as indicated on the electrical, communication and/or laboratory equipment drawings and in the applicable specifications. All raceway systems shall be installed complete, including wire clips and grommets where required by manufacturer's installation sheets.

END OF SECTION

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1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section.
 - 26 05 00 Common work results for electrical
 - 26 05 22 Connectors and Terminations
 - 26 05 29 Hanger and supports for electrical systems

1.02 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.2 No. 18 -98(R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
 - .2 CSA C22.2 No. 45 -M1981(R2003), Rigid Metal Conduit.
 - .3 CSA C22.2 No. 56-04, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .4 CSA C22.2 No. 83 -M1985(R2003), Electrical Metallic Tubing.
 - .5 CAN/CSA C22.2 No. 227.3-[05], Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data: submit manufacturer's printed product literature, specifications and datasheets.
 - .1 Submit cable manufacturing data.
- .3 Quality assurance submittals:
 - .1 Test reports: submit certified test reports.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Instructions: submit manufacturer's installation instructions.

1.04 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

2 PRODUCTS

2.01 CABLES AND REELS

- .1 Provide cables on reels or coils.
 - .1 Mark or tag each cable and outside of each reel or coil, to indicate cable length, voltage rating, conductor size, and manufacturer's lot number and reel number.
- .2 Each coil or reel of cable to contain only one continuous cable without splices.
- .3 Identify cables for exclusively dc applications.
- .4 Reel and mark shielded cables rated 2,001 volts and above.

2.02 CONDUITS

- .1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steelthreaded.
- .2 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.
- .3 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .4 Flexible metal conduit: to CSA C22.2 No. 56, steel and liquid-tight flexible metal.

2.03 CONDUIT FASTENINGS

- .1 One hole malleable ironstraps to secure surface conduits NPS 2(50 mm) and smaller.
 - .1 Two hole steel straps for conduits larger than NPS 2(50 mm).
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at ___2___ m on centre.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.

2.04 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.
- .2 Ensure factory "ells" where 90 degrees bends for NPS 1(25 mm) and larger conduits.
- .3 Watertight connectors and couplings for EMT.
 - .1 Set-screws are not acceptable.

2.06 FISH CORD

- .1 Polypropylene.

3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in the ceiling interstitial space.
- .3 Use rigid galvanized steelthreaded conduit except where specified otherwise.
- .4 Use epoxy coated conduit [underground] [in corrosive areas].
- .5 Use electrical metallic tubing (EMT) above 2.4 m not subject to mechanical injury.
- .6 Use flexible metal conduit for connection to motors in dry areas connection to recessed light fixtures without prewired outlet boxwork in movable metal partitions.
- .7 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .8 Minimum conduit size for lighting and power circuits: NPS 3/4(19 mm).
- .9 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .10 Mechanically bend steel conduit over 19 mm diameter.
- .11 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .12 Install fish cord in empty conduits.
- .13 Run 2-NPS 1(25 mm) spare conduits up to ceiling space and 2-NPS 1 (25 mm)spare conduits down to ceiling space from each flush panel.
 - .1 Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in flush concretetype box.
- .14 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.

.15 Dry conduits out before installing wire.

3.03 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.04 CONCEALED CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

3.08 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section
 - 26 05 00 Common work results for electrical
 - 26 05 29 Hangers and supports for electrical systems

1.02 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.1 No.126.1-[02], Metal Cable Tray Systems.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA FG 1-1993, Fibreglass and Cable Tray Systems.
 - .2 NEMA VE 1-2002, Metal Cable Tray Systems.
 - .3 NEMA VE 2-2001, Cable Tray Installation Guidelines.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit manufacturer's product data sheets for cable tray indicating dimensions, materials, and finishes, including classifications and certifications.
- .3 Shop Drawings: submit shop drawings showing materials, finish, dimensions, accessories, layout, and installation details.
- .4 Identify types of cabletroughs used.
- .5 Show actual cabletrough installation details and suspension system.

1.04 WASTE MANAGEMENT AND DISPOSAL

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

2 PRODUCTS

2.01 CABLETROUGH

- .1 Cabletroughs and fittings: to NEMA VEI / CSA C22.2 No.126.1-02.
- .2 Wire mesh type, Class A to CAN/CSA C22.2 No. 126.1 .
- .3 Trays: extruded aluminum, 150 mm wide with depth of 40mm.
- .4 Fittings: horizontal elbows, end plates, drop outs, vertical risers and

drops, tees, wyes, expansion joints and reducers where required, manufactured accessories for cabletrough supplied.

.1 Radii on fittings: 300mm minimum.

.5 Solid covers for complete cabletrough system including fittings.

.6 Barriers where different voltage systems are in same cabletrough.

.7 Ground cable trays with #2 AWG bare copper conductor attached to each tray section in accordance with CEC requirements.

.8 Provide fire stop material at firewall penetrations.

2.02 SUPPORTS

.1 Provide splices, supports for a continuously grounded system as required.

3 EXECUTION

3.01 INSTALLATION

.1 Install complete cabletrough system in accordance with NEMA VE 2.

.2 Support cabletrough on both sides.

.3 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

3.02 CABLES IN CABLETROUGH

.1 Install cables individually.

.2 Lay cables into cabletrough. Use rollers when necessary to pull cables.

.3 Secure cables in cabletrough at 6m centres, with nylon ties.

.4 Identify cables every 30m with size 2 nameplates.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section
26 05 00 - Common work results for electrical

1.02 REFERENCE STANDARDS

- .1 CSA International
 - .1 CSA C22.2 No.29-11, Panelboards and Enclosed Panelboards.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for panelboards and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings where applicable.
 - .2 Include on drawings:
 - .1 Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.04 CLOSEOUT SUBMITTALS

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

1.05 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect panelboards from nicks, scratches, and blemishes.

- .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan] related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse by manufacturer packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2 PRODUCTS

2.01 PANELBOARDS

- .1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
 - .1 Install circuit breakers in panelboards before shipment.
 - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .2 250 V panelboards: bus and breakers rated for 10000A symmetrical interrupting capacity or as indicated.
- .3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .5 Minimum of 2 flush locks for each panel board.
- .6 Two keys for each panelboard and key panelboards alike.
- .7 Copper bus with neutral of same ampere rating of mains.
- .8 Mains: suitable for bolt-on breakers.
- .9 Trim with concealed front bolts and hinges.
- .10 Trim and door finish: baked enamel.
- .11 Isolated ground bus.
- .12 Include grounding busbar with 3 of terminals for bonding conductor equal to breaker capacity of the panel board.
- .13 Existing panel tubs must remain the new chassis must fit into the following tub dimension:

Height: 46.5"

Width: 20"

Depth: 7"

.14 Chassis must have the following requirements:

- .1 120/240V single phase, 3 wire system.
- .2 42 circuits
- .3 Main disconnect (200A0
- .4 225A bus rating
- .5 Bottom fed

Refer to the drawings for the schedule.

2.02 BREAKERS

- .1 Breakers: Moulded Case Circuit Breakers rated at 80%..
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .4 Lock-on devices for 10% of 20A breakers installed as indicated. Turn over unused lock-on devices to. Departmental Representative
- .5 Lock-on devices for receptacles.

2.03 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Nameplate for each panelboard size 4 engraved.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for panelboards 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.

3.02 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Mount panelboards to existing tubs.
- .3 Connect loads to circuits.
- .4 Connect neutral conductors to common neutral bus.

3.03 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for [reuse] [and] [recycling] in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.04 PROTECTION

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

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section
 - 26 05 00 - Common work results for electrical
 - 26 05 22 - Connectors and terminations
 - 26 05 32 - Outlet boxes, conduit boxes and fittings
 - 26 05 33 - Raceway and boxes for electrical systems

1.02 REFERENCE STANDARDS

- .1 CSA International
 - .1 CSA C22.2 No.42-10, General Use Receptacles, Attachment Plugs and Similar Devices.
 - .2 CAN/CSA C22.2 No.42.1-00(R2009), Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
 - .3 CSA C22.2 No.55-M1986(R2008), Special Use Switches.
 - .4 CSA C22.2 No.111-10], General-Use Snap Switches (Bi-national standard, with UL 20).

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for wiring devices and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings where applicable.

1.04 CLOSEOUT SUBMITTALS

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

1.05 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in

original factory packaging, labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wiring devices from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan according to section 01 74 21..5 Packaging Waste Management: remove for reuse packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2 PRODUCTS

2.01 SWITCHES

- .1 20 A, 120 V, single pole, double pole, three-way, four-way switches as shown on drawings to: CSA C22.2 No.55 and CSA C22.2 No.111.
- .2 Manually-operated general purpose AC switches with following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine moulding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 White toggle for lights and black toggle for equipment.
 - .6 Heavy duty grade.
- .3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- .4 Switches of one manufacturer throughout project.

2.02 RECEPTACLES

- .1 Duplex receptacles, CSA type 5-20 R, 125 V, 20 A, U ground, to: CSA C22.2 No.42 with following features:
 - .1 white urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and rivetted grounding contacts.
 - .6 Extra heavy duty grade
- .2 Receptacles of one manufacturer throughout project.

2.03

- .1 Duplex receptacle with USB charger.

- .1 CSA type 5-20R, 125V, 20A
- .2 two USB type 2.0 ports 3.8A, 5 V DC.
- .3 Heavy duty grade or hospital grade
- .2 Duplex receptacle with ground fault protection.
 - .1 CSA type B-20R, 125V, 20A
 - .2 Extra heavy duty grade
 - .3 Self-Test GFCI (auto-monitoring)
 - .4 Status indicator light
 - .5 Low profile
 - .6 White

2.05 COVER PLATES

- .1 Cover plates for wiring devices to: CSA C22.2 No.42.1.
- .2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .3 Stainless steel, vertically brushed, 1 mm thick cover plates, thickness for wiring devices mounted in flush-mounted outlet box.
- .4 Cover plate for receptacles installed in the raceway, must be part of the raceway system provided by the manufacturer.

2.06 SOURCE QUALITY CONTROL

- .1 Cover plates from one manufacturer throughout project.

3 EXECUTION

3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wiring devices installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.02 INSTALLATION

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
 - .3 Mount toggle switches at height 1200mm AFF.
- .2 Receptacles:

- .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
- .2 Mount receptacles at height as indicated.
- .4 Install GFI type receptacles [as indicated].
- .5 Install USB type receptacle as indicated
- .3 Cover plates:
 - .1 Install suitable common cover plates where wiring devices are grouped.
 - .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.
- .4 Install receptacles in the raceway as recommended by raceway manufacturer.

3.03 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.04 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .3 Repair damage to adjacent materials caused by wiring device installation.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section
 - 26 05 00 - Common work results for electrical
 - 26 05 29 - Hanger and supports for electrical systems

1.02 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)
 - .1 ANSI C82.1-04, Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.
- .2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE C62.41-1991, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- .3 ASTM International Inc.
 - .1 ASTM F 1137-00(2006), Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- .4 Canadian Standards Association (CSA International)
- .5 ICES-005-07, Radio Frequency Lighting Devices.
- .6 Underwriters' Laboratories of Canada (ULC)

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Provide complete photometric data prepared by independent testing laboratory for luminaires where specified, for approval and review] by Departmental Representative.
 - .3 Photometric data to include: VCP Table where applicable.
- .3 Quality assurance submittals: provide following in accordance with Section 01 45 00 - Quality Control.
 - .1 Manufacturer's instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence, cleaning procedures.

1.04 QUALITY ASSURANCE

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

1.05 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse of packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .4 Divert unused metal materials from landfill to metal recycling facility.
- .5 Disposal and recycling of fluorescent lamps as per local regulations.
- .6 Disposal of old PCB filled ballasts.

2 PRODUCTS

2.01 LAMPS

- .1 LED: -average efficacy > 100 Lum/W and L70 > 50000 hours.
-24 month warranty.

2.02 BALLASTS

- .1 LED driver: CBM and CSA certified, energy efficient type, IC electronic dimmable.
 - .1 Rating: 0-10 V to match furniture requirement.
 - .2 Totally encased and designed for 40 degrees Celsius ambient temperature.
 - .3 Power factor: minimum 95 % with 95% of rated lamp lumens.
 - .4 Current crest factor: 1.maximum.
 - .5 Harmonics: 10 % maximum THD.
 - .6 Operating frequency of electronic ballast: 20 kHz minimum.
 - .7 Total circuit power: 62 Watts.
 - .8 Ballast factor: greater than 0.90.
 - .9 Sound rated: Class A.
 - .10 Mounting: integral with luminaire.

2.03 FINISHES

- .1 Light fixture finish and construction to meet ULC listing[s] and CSA certification[s] related to intended installation.

2.05 LUMINAIRES

- .1 Shallow housing depth of maximum 2-3/8".
- .2 Access to electrical from room-side of fixture.
- .3 Die-formed 22 gauge cold rolled steel.
- .4 IC rated for direct contact with insulation.
- .5 Diffused ribbed acrylic diffuser.
- .6 Polyester powder coat frame.
- .7 82 CRI.
- .8 24 month warranty.
- .9 Size and Lumen as indicated on drawing.
- .10 Any substitute must be submitted with light level calculation for Departmental Representative review and approval.

3 EXECUTION

3.01 INSTALLATION

- .1 Locate and install luminaires as indicated.
- .2 Provide adequate support to suit ceiling system.

3.02 WIRING

- .1 Connect luminaires to lighting circuits:
 - .1 Install flexible or rigid conduit for luminaires as indicated.

3.03 LUMINAIRE SUPPORTS

- .1 For suspended ceiling installations support luminaires independently of ceiling and support luminaires from ceiling grid in accordance with local inspection requirements.

3.04 LUMINAIRE ALIGNMENT

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

3.05 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and

equipment.

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

END OF SECTION