

Federal Building

PROJECT MANUAL

for

**Project No. 7222198
TBU 8 Resource Centre Fit-Up
Regina, Saskatchewan**

Issued for Construction
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Part 1 General

1.1 WORK COVERED BY CONTRACT DOCUMENTS

- .1 Work of this Contract comprises renovation of the interior of the TBU 8 Building on the grounds at 5600 - 11th Avenue, Regina, Saskatchewan.

1.2 CONTRACT METHOD

- .1 Construct Work under stipulated price contract.

1.3 SUPPLEMENTARY INFORMATION FOR PROGRESS PAYMENTS

- .1 Successful Contractor will be required to submit a detailed breakdown of costs for each elemental section into three funding accountabilities within 5 business days of Contract Award and with every change to the project. After review by Owner Representative, cost breakdown will be used as basis for progress payment.

1.4 CONTRACTOR USE OF PREMISES

- .1 Unrestricted use of site until Substantial Performance.
- .2 Co-ordinate use of premises under direction of Owner Representative.
- .3 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.
- .4 Remove or alter existing work to prevent injury or damage to portions of existing work that remain.
- .5 Repair or replace portions of existing work that have been altered during construction operations to match existing or adjoining work, as directed by Owner Representative.
- .6 At completion of operations condition of existing work: equal to or better than that which existed before new work started.

1.5 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 Owner Representative to facilitate execution of work.

1.6 EXISTING SERVICES

- .1 Notify Owner 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 Owner Representative 48 hours' notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities.
- .3 Establish location and extent of service lines in area of work before starting Work. Notify Owner Representative of findings.

- .4 Submit schedule to and obtain approval from Owner Representative for shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.
- .5 Provide temporary services when directed by Owner Representative to maintain critical building and tenant systems.
- .6 Where unknown services are encountered, immediately advise Owner Representative and confirm findings in writing.
- .7 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
- .8 Record locations of maintained, re-routed and abandoned service lines.
- .9 Construct barriers in accordance with Section 01 53 00 – Temporary Construction.

1.7 DOCUMENTS REQUIRED

- .1 Successful bidding Contractor is to obtain required sets of Contract Documents for construction purposes, which includes two (2) sets for "as-built" and record purposes.
 - .1 Contractor is responsible for costs of printing, handling, and shipping of Contract Documents.
- .2 Maintain at job site, one copy of each document as follows:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Reviewed Shop Drawings.
 - .5 List of Outstanding Shop Drawings.
 - .6 Change Orders.
 - .7 Other Modifications to Contract.
 - .8 Field Test Reports.
 - .9 Copy of Approved Work Schedule.
 - .10 Health and Safety Plan and Other Safety Related Documents.
 - .11 Other documents as specified.

END OF SECTION

Part 1 General

1.1 ACCESS AND EGRESS

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

1.2 USE OF SITE AND FACILITIES

- .1 Execute work with least possible interference or disturbance to normal use of premises. Arrange with Owner Representative to facilitate work as stated.
- .2 Maintain existing services to building and provide for personnel and vehicle access.
- .3 Where security is reduced by work, provide temporary means to maintain security.
- .4 Closures: Protect work temporarily until permanent enclosures are completed.

1.3 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

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

1.4 EXISTING SERVICES

- .1 Notify Owner 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 Owner Representative 48 hours' notice for necessary interruption of mechanical or electrical service. Keep duration of interruptions to a minimum. Carry out interruptions after normal working hours of occupants, preferably on weekends.
- .3 Construct barriers in accordance with Section 01 53 00 - Temporary Construction.

1.5 SPECIAL REQUIREMENTS

- .1 Submit schedule in accordance with Section 01 32 16 - Construction Progress Schedule - Bar (GANTT) Chart.
- .2 Ensure Contractor's personnel employed on site become familiar with and obey regulations including safety, fire, traffic, and security regulations.
- .3 Keep within limits of work and avenues of ingress and egress.

1.6 SECURITY

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

- .2 Security clearances:
 - .1 Personnel employed on this project will be subject to security check. Obtain clearance, as instructed, for each individual who will require entry to premises.
 - .2 Contractor's personnel will require satisfactory RCMP-initiated security screening in order to complete Work in premises and on site.
 - .3 Obtain requisite clearance, as instructed, for each individual requiring entry to premises.
 - .4 Personnel will be checked daily at start of work shift and provided with pass that must be worn at all times. Pass must be returned at end of work shift and personnel checked out.
 - .5 Engage and pay for security for escort for personnel without reliability status, and for personnel performing work after hours.
 - .1 Right of first refusal for security provision is to be given to the Canadian Corps of Commissionaires.

1.7 BUILDING SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions.
- .2 Smoking is not permitted inside building.
- .3 Confirm, with building management, outdoor locations where personnel may smoke.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE

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

1.2 PRECONSTRUCTION MEETING

- .1 Within 15 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
- .2 Owner Representative, Contractor, major Subcontractors, field inspectors, and supervisors will be in attendance.
- .3 Establish time and location of meeting and notify parties concerned minimum five 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 - 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, storage sheds, utilities, in accordance with Section 01 52 00 - Construction Facilities.
 - .5 Site security in accordance with Section 01 53 00 - Temporary Construction.
 - .6 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.

- .7 Owner Representative-provided products.
- .8 Record drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .9 Maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals.
- .10 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 - Closeout Submittals.
- .11 Monthly progress claims, administrative procedures, photographs, hold backs.
- .12 Appointment of inspection and testing agencies or firms.
- .13 Insurances, transcript of policies.

1.3 PROGRESS MEETINGS

- .1 During course of Work and two weeks prior to project completion, schedule progress meetings bi-weekly.
- .2 Contractor, major Subcontractors involved in Work, and Owner Representative are to be in attendance.
- .3 Notify parties minimum three days prior to meetings.
- .4 Record minutes of meetings; circulate to attending parties and affected parties not in attendance within three 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 that 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 and expedite as required.
 - .10 Maintenance of quality standards.
 - .11 Review proposed changes for effect on construction schedule and on completion date.
 - .12 Other business.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

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

1.2 REQUIREMENTS

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

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit to Owner 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 Owner Representative within 5 working days of receipt of acceptance of Master Plan.

1.4 MASTER PLAN

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

1.5 PROJECT SCHEDULE

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

1.6 PROJECT SCHEDULE REPORTING

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

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

1.7 PROJECT MEETINGS

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

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE

- .1 Provide submittals listed for review to Owner Representative. 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 for 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 are not produced in SI Metric units, converted values are acceptable.
- .5 Review submittals prior to submission to Owner 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 Owner Representative at time of submission, in writing, 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 Owner Representative's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Owner Representative review.
- .10 Keep one reviewed copy of each submission on site.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data that are to be provided by Contractor to illustrate details of a portion of Work.
- .2 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Saskatchewan.
- .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 Owner Representative's review of each submission.

- .5 Adjustments made on shop drawings by Owner Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Owner Representative prior to proceeding with Work.
- .6 Make changes in shop drawings as Owner Representative may require, consistent with Contract Documents. When resubmitting, notify Owner 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 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 Owner Representative's review, distribute copies.
- .10 Submit electronic copies of shop drawings for each requirement requested in specification Sections and as Owner Representative may reasonably request.
- .11 Submit electronic copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Owner 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 Owner 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 Owner 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 Owner 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 Owner Representative:
 - .1 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .16 Submit electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Owner Representative.
- .17 Delete information not applicable to project.
- .18 Supplement standard information to provide details applicable to project.
- .19 If upon review by Owner 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.

1.3 SAMPLES

- .1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to Owner Representative's business address.

- .3 Notify Owner 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 Owner Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Owner Representative prior to proceeding with Work.
- .6 Make changes in samples that Owner Representative may require, consistent with Contract Documents.
- .7 Reviewed and accepted samples will become standard of quality of work and material against which installed Work will be verified.

1.4 MOCK-UPS

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

1.5 PHOTOGRAPHIC DOCUMENTATION

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations
- .2 Province of Saskatchewan
 - .1 Occupational Health and Safety Act, 1993, S.S. - Updated 2012.

1.2 SAFETY PLAN

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

1.3 RESPONSIBILITY

- .1 The "Prime Contractor" according applicable local jurisdiction, is responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.
- .3 Should any unforeseen or peculiar safety-related factor, hazard, or condition become evident during performance of Work, and follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Province having jurisdiction. Advise Owner Representative verbally and in writing.

1.4 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.
- .3 Submit electronic copies of Contractor's authorized representative's work site health and safety inspection reports weekly to Owner Representative.

- .4 Submit copies of reports or directions issued by Federal and Provincial health and safety inspectors.
- .5 Submit copies of incident and accident reports.
- .6 Submit WHMIS MSDS - Material Safety Data Sheets as specified.
- .7 Owner Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 10 working days after receipt of plan. Revise plan as appropriate and resubmit plan to Owner Representative within 5 working days after receipt of comments from Owner Representative.
- .8 Owner Representative's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.
- .9 Medical Surveillance: Where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Owner Representative.
- .10 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.

1.5 FILING OF NOTICE

- .1 File Notice of Project with authorities having jurisdiction prior to beginning of Work.
- .2 Install proper site separation and identification in order to maintain time and space at all times throughout life of project.

1.6 SAFETY ASSESSMENT

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

1.7 MEETINGS

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

1.8 REGULATORY REQUIREMENTS

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

1.9 COMPLIANCE REQUIREMENTS

- .1 Comply with Occupational Health and Safety Regulations, 1996.
- .2 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

1.10 UNFORESEEN HAZARDS

- .1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, advise Health and Safety Co-ordinator, follow

procedures in accordance with Acts and Regulations of Province having jurisdiction, and advise Owner Representative verbally and in writing.

1.11 HEALTH AND SAFETY CO-ORDINATOR

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

1.12 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 Owner Representative.

1.13 WHMIS

- .1 Ensure that products used in project comply with Workplace Hazardous Materials Information System (WHMIS) Regulations and Chemical Substances of the OH&S Act and Regulations regarding use, handling, labelling, storage, and disposal of hazardous materials.
- .2 Deliver copies of relevant Material Safety Data Sheets (MSDS) to job site and Owner Representative. MSDS to be acceptable to Labour Canada and Health and Welfare Canada for controlled products that will be used in performance of this work. Locate MSDS in accessible locations for workers and visitors throughout the site, bound and organized in binders.
- .3 Train workers required to use or to work in close proximity to controlled products in accordance with OH&S Act and Regulations.
- .4 Label controlled products at jobsite in accordance with OH&S and Regulations and WHMIS.
- .5 Provide appropriate emergency facilities as specified in the MSDS where workers might be exposed to contact with chemicals, including eye-wash facilities, emergency shower.
 - .1 Workers are to be trained in use of such emergency equipment.
- .6 Provide appropriate personal protective equipment as specified in the MSDS where workers are required to use controlled products.
 - .1 Properly fit workers for personal protective equipment
 - .2 Train workers in care, use, and maintenance of personal protective equipment.

- .7 No controlled products are to be brought on-site without prior approved MSDS.
- .8 MSDS are to remain on site at all times.

1.14 CORRECTION OF NON-COMPLIANCE

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

1.15 POWDER ACTUATED DEVICES

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

1.16 WORK STOPPAGE

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

1.17 FIRE PROTECTION

- .1 Comply with requirements of the local Fire Commissioner's Office.
- .2 Provide and maintain temporary fire protection equipment during performance of Work required by governing codes, regulations and bylaws.
- .3 Burning rubbish and construction waste materials is not permitted on site.
- .4 Maintain placed or installed fire resistive construction to protect the portions of the Work during construction.

END OF SECTION

Part 1 General

1.1 REFERENCES AND CODES

- .1 Perform Work in accordance with 2015 National Building Code of Canada (NBC) including amendments up to tender closing date, and other codes of provincial or local application; in case of conflict or discrepancy, more stringent requirements apply. The following governing standards are also to apply.
 - .1 Canadian Electrical Code, 2015.
 - .2 National Plumbing Code of Canada, 2015.
 - .3 National Fire Code of Canada, 2015.
- .2 Meet or exceed requirements of:
 - .1 Contract documents.
 - .2 Specified standards, codes and referenced documents.

1.2 HAZARDOUS MATERIAL DISCOVERY

- .1 Asbestos: Demolition of spray or trowel-applied asbestos is hazardous to health. Stop work immediately when material resembling spray or trowel-applied asbestos is encountered during demolition work. Notify Owner Representative.
- .2 PCB: Polychlorinated Biphenyl: Stop work immediately when material resembling Polychlorinated Biphenyl is encountered during demolition work. Notify Owner Representative.
- .3 Mould: Stop work immediately when material resembling mould is encountered during demolition work. Notify Owner Representative.

1.3 BUILDING SMOKING ENVIRONMENT

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

END OF SECTION

Part 1 General

1.1 INSPECTION

- .1 Allow Owner Representative access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work wherever it is in progress.
- .2 Give timely notice requesting inspection if Work is designated for special tests, inspections, or approvals whether by Owner Representative instructions, or by law of Place of Work.
- .3 If Contractor covers, or permits to be covered, Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.
- .4 Owner 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 Work and pay cost of examination and correction. If Work is found in accordance with Contract Documents, cost of examination and replacement will be borne by Owner Representative.

1.2 INDEPENDENT INSPECTION AGENCIES

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

1.3 ACCESS TO WORK

- .1 Allow inspection/testing agencies access to Work, off site manufacturing and fabrication plants.
- .2 Co-operate to provide reasonable facilities for such access.

1.4 PROCEDURES

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

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

1.5 REJECTED WORK

- .1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Owner Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .2 Make good other Contractor's work damaged by such removals or replacements promptly.
- .3 If, in opinion of Owner 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 Owner Representative.

1.6 REPORTS

- .1 Submit three hard copies and one electronic copy of inspection and test reports to Owner Representative.
- .2 Provide copies to subcontractor of work being inspected or tested and manufacturer or fabricator of material being inspected or tested.

1.7 TESTS AND MIX DESIGNS

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

1.8 MOCK-UPS

- .1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of Sections required to provide mock-ups.
- .2 Construct in locations acceptable to Owner Representative.
- .3 Prepare mock-ups for Owner Representative's 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, Owner Representative will assist in preparing schedule-fixing dates for preparation.

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

1.9 MILL TESTS

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

1.10 EQUIPMENT AND SYSTEMS

- .1 Submit adjustment and balancing reports for mechanical, electrical, and building equipment systems.
- .2 Refer to Section 01 91 31 – Commissioning Plan for definitive requirements.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

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

1.2 INSTALLATION AND REMOVAL

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

1.3 WATER SUPPLY

- .1 Owner Representative will provide continuous supply of potable water for construction use.
- .2 Arrange for connection with appropriate utility company and pay costs for installation, maintenance and removal.
- .3 Owner Representative will pay for utility charges at prevailing rates.

1.4 TEMPORARY HEATING AND VENTILATION

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

- .6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.
- .6 Permanent heating system of building, to be used when available. Be responsible for damage to heating system if use is permitted.
- .7 On completion of Work for which permanent heating system is used, replace filters.
- .8 Ensure Date of Substantial Performance and Warranties for heating system do not commence until entire system is in as near original condition as possible and is certified by Owner Representative.
- .9 Owner Representative will pay utility charges when temporary heat source is existing building equipment.
- .10 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
 - .1 Conform with applicable codes and standards.
 - .2 Enforce safe practices.
 - .3 Prevent abuse of services.
 - .4 Prevent damage to finishes.
 - .5 Vent direct-fired combustion units to outside.
- .11 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

1.5 TEMPORARY POWER AND LIGHT

- .1 Owner Representative will pay for temporary power during construction for temporary lighting and operating of power tools, to a maximum supply of 230 volts, 30 amps.
- .2 Arrange for connection with appropriate utility company. Pay costs for installation, maintenance, and removal.
- .3 Provide and maintain temporary lighting throughout project. Ensure level of illumination on all floors and stairs is not less than 162 lx.
- .4 Electrical power and lighting systems installed under this Contract may be used for construction requirements only with prior approval of Owner Representative, provided that guarantees are not affected. Make good damage to electrical system caused by use under this Contract. Replace lamps that have been used for more than 3 months.

1.6 FIRE PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA S269.2-M87 (R2003), Access Scaffolding for Construction Purposes.
 - .2 CAN/CSA Z321-96 (R2006), Signs and Symbols for the Workplace.

1.2 SUBMITTALS

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

1.3 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 Indicate use of supplemental or other staging area.
- .3 Provide construction facilities in order to execute work expeditiously.
- .4 Remove from site all such work after use.

1.4 SCAFFOLDING

- .1 Scaffolding in accordance with CSA S269.2.
- .2 Provide and maintain scaffolding, ramps, ladders, swing staging, platforms, temporary stairs.

1.5 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 and cranes to be operated by qualified operator.

1.6 SITE STORAGE/LOADING

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

1.7 CONSTRUCTION PARKING

- .1 Parking will be permitted on site in designated areas only, as instructed by Owner Representative.
- .2 Provide and maintain adequate access to project site.

- .3 Clean access routes where used by Contractor's equipment.

1.8 OFFICES

- .1 Provide on-site construction trailer for use by Contractor during execution of Work.
- .2 Provide marked and fully stocked first-aid case in a readily available location.

1.9 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.

1.10 CONSTRUCTION SIGNAGE

- .1 No construction advertisement signs, other than health and safety, warning and instructional signs, are permitted on site.
- .2 Signs and notices for safety and instruction; graphic symbols to CAN/CSA Z321.
- .3 Maintain approved signs and notices in good condition for duration of project, and dispose of off site on completion of project or earlier if directed by Owner Representative.

1.11 PROTECTION AND MAINTENANCE OF TRAFFIC

- .1 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by Owner Representative.
- .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 are to interfere as little as possible with public traffic.
- .5 Deliveries to the Site are restricted. Confirm acceptable routes with Owner Representative at Construction Start-Up Meeting.
- .6 Verify adequacy of existing roads and allowable load limit on these roads. Contractor is responsible for repair of damage to roads caused by construction operations.
- .7 Provide snow removal during period of Work.

1.12 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.

END OF SECTION

Part 1 General

1.1 INSTALLATION AND REMOVAL

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

1.2 GUARD RAILS AND BARRIERS

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

1.3 WEATHER ENCLOSURES

- .1 Provide weathertight closures and protection for exterior openings such as unfinished door and window openings, tops of shafts, and other openings in floors and roofs until they are permanently enclosed.
- .2 Erect enclosures to allow access for the installation of materials and to allow for work inside enclosure.
- .3 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.
- .4 Design enclosures to withstand wind pressure [and snow loading].
- .5 Ensure that upon final construction, and during construction, the work is executed to prevent the entry of water, snow and air infiltration into the interior of the building, and to accept the responsibility to correct any deficient work. Bring to the attention of the Owner Representative prior to construction any detail that may compromise weather tightness.
- .6 Provide weather enclosures or other means as necessary to protect foundation excavations to maintain soil bearing capacity.

1.4 DUST TIGHT BARRIERS

- .1 Provide dust tight barriers and screens or partitions to localize dust generating activities, and for protection of workers, finished areas of Work and public.
- .2 Maintain and relocate protection until such work is complete.
- .3 Coordinate location and security measures with Owner Representative on Site.

1.5 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.

1.6 PROTECTION OF APPLIED FINISHES

- .1 Provide protection for finished and partially finished surfaces and equipment during performance of Work.
- .2 Provide necessary screens, covers, and hoardings.
- .3 Confirm with Owner Representative locations and installation schedule three (3) days prior to installation.

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

1.7 PROTECTION OF SURROUNDING WORK

- .1 Provide protection for finished and partially finished Work from damage.
- .2 Provide necessary cover and protection.
- .3 Be responsible for damage incurred due to lack of or proper or appropriate protection.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Within text of each specifications section, reference may be made to reference standards. Conform to these reference standards, in whole or in part as specifically requested in specifications.
- .2 If there is question as to whether products or systems are in conformance with applicable standards, Owner Representative reserves right to have such products or systems tested to prove or disprove conformance.
- .3 Cost for such testing will be borne by Owner Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.

1.2 QUALITY OF PRODUCTS

- .1 Products, materials, equipment, and articles incorporated in Work are to be new, not damaged nor defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source, and quality of products provided.
- .2 Procurement policy is to acquire, in cost effective manner, items containing highest percentage of recycled and recovered materials practicable consistent with maintaining satisfactory levels of competition. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of work.
- .3 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- .4 Should disputes arise as to quality or fitness of products, decision rests strictly with Owner Representative based upon requirements of Contract Documents.
- .5 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .6 Permanent labels, trademarks, and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.3 AVAILABILITY

- .1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for items. If delays in supply of products are foreseeable, notify Owner Representative of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.
- .2 In event of failure to notify Owner Representative at commencement of Work, and should it subsequently appear that Work may be delayed for such reason,

Owner Representative reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

1.4 STORAGE, HANDLING, AND PROTECTION

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

1.5 TRANSPORTATION

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

1.6 MANUFACTURER'S INSTRUCTIONS

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

1.7 QUALITY OF WORK

- .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Owner 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. Owner 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 Owner Representative, whose decision is final.

1.8 CO-ORDINATION

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

1.9 CONCEALMENT

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

1.10 REMEDIAL WORK

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

1.11 LOCATION OF FIXTURES

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

END OF SECTION

Part 1 General

1.1 SUBMITTALS

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

1.2 PREPARATION

- .1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
- .2 After uncovering, inspect conditions affecting performance of Work.
- .3 Beginning of cutting or patching means acceptance of existing conditions.
- .4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.
- .5 Provide protection from elements for areas that are to be exposed by uncovering work; maintain excavations free of water.

1.3 EXECUTION

- .1 Execute cutting, fitting, and patching to complete Work.
- .2 Fit parts together, to integrate with other Work.
- .3 Uncover Work to install ill-timed Work.
- .4 Remove and replace defective and non-conforming Work.
- .5 Remove samples of installed Work for testing if requested.
- .6 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.

- .7 Execute Work by methods to avoid damage to other Work, and that will provide proper surfaces to receive patching and finishing.
- .8 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.
- .9 Restore work with new products in accordance with requirements of Contract Documents.
- .10 Fit Work to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .11 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with firestopping material in accordance with Section 07 84 00 – Firestopping, full thickness of the construction element.
- .12 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.
- .13 Conceal pipes, ducts, and wiring in floor, wall, and ceiling construction of finished areas except where indicated otherwise.

1.4 WASTE MANAGEMENT AND DISPOSAL

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

END OF SECTION

Part 1 General

1.1 PROJECT CLEANLINESS

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

1.2 FINAL CLEANING

- .1 When Work is Substantially Performed remove surplus products, tools, construction machinery, and equipment not required for performance of remaining Work.
- .2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- .3 Prior to final review remove surplus products, tools, construction machinery, and equipment.
- .4 Remove waste products and debris other than that caused by Owner or other Contractors.
- .5 Remove waste materials from site at regularly scheduled times or dispose of as directed by Owner Representative. Do not burn waste materials on site.

- .6 Arrange with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .7 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.
- .8 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, and floors.
- .9 Clean lighting reflectors, lenses, and other lighting surfaces.
- .10 Vacuum clean and dust building interiors, behind grilles and screens.
- .11 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.
- .12 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .13 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .14 Remove dirt and other disfiguration from exterior surfaces.
- .15 Clean and sweep roofs, gutters, areaways, and sunken wells.
- .16 Sweep and wash clean paved areas.
- .17 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.
- .18 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.

1.3 WASTE MANAGEMENT AND DISPOSAL

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

END OF SECTION

Part 1 General

1.1 DEFINITIONS

- .1 Materials Source Separation Program (MSSP): Consists of series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.
- .2 Waste Reduction Workplan (WRW): Written report that addresses opportunities for reduction, reuse, or recycling of materials. Refer to Schedule B. WRW is based on information acquired from WA (Schedule A).

1.2 DOCUMENTS

- .1 Maintain at job site, one copy of following documents:
 - .1 Waste Audit.
 - .2 Waste Reduction Workplan.
 - .3 Material Source Separation Plan.

1.3 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prepare and submit following prior to project start-up:
 - .1 Submit 2 copies of completed Waste Reduction Workplan (WRW).

1.4 WASTE AUDIT (WA)

- .1 Conduct WA prior to project start-up.
- .2 Prepare WA: Schedule A.
- .3 Record, on WA - Schedule A, extent to which materials or products used consist of recycled or reused materials or products.

1.5 WASTE REDUCTION WORKPLAN (WRW)

- .1 Prepare WRW prior to project start-up.
- .2 Structure WRW to prioritize actions and follow 3R's hierarchy, with Reduction as first priority, followed by Reuse, then Recycle.
- .3 Describe management of waste.
- .4 Post WRW or summary where workers at site can review content.

1.6 MATERIALS SOURCE SEPARATION PROGRAM (MSSP)

- .1 Prepare MSSP and have ready for use prior to project start-up.
- .2 Implement MSSP for waste generated on project in compliance with approved methods and as reviewed by Owner Representative.

- .3 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and recyclable materials.
- .4 Provide containers to deposit reusable and recyclable materials.
- .5 Locate containers in locations to facilitate deposit of materials without hindering daily operations.
- .6 Locate separated materials in areas that minimize material damage.
- .7 Collect, handle, store on-site, and transport off-site, salvaged materials in separate condition.
 - .1 Transport to users of material for recycling.
- .8 Collect, handle, store on-site, and transport off-site, salvaged materials in combined condition.
 - .1 Ship materials to site operating under Certificate of Approval.
 - .2 Materials must be immediately separated into required categories for reuse or recycling.

1.7 STORAGE, HANDLING AND PROTECTION

- .1 Store materials to be reused, recycled, and salvaged, in locations as directed by Owner Representative.
- .2 Unless specified otherwise, materials for removal become Contractor's property.
- .3 Protect, stockpile, store and catalogue salvaged items.
- .4 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.
- .5 Protect structural components not removed for demolition from movement or damage.
- .6 Support affected structures. If safety of building is endangered, cease operations and immediately notify Owner Representative.
- .7 Protect surface drainage, mechanical, and electrical from damage and blockage.
- .8 Separate and store materials produced during dismantling of structures in designated areas.
- .9 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.
 - .1 On-site source separation is recommended.
 - .2 Remove co-mingled materials to off-site processing facility for separation.
 - .3 Provide waybills for separated materials.

1.8 DISPOSAL OF WASTES

- .1 Do not bury rubbish or waste materials.

- .2 Do not dispose of waste, volatile materials, mineral spirits, oil, paint thinner into waterways, storm, or sanitary sewers.
- .3 Keep records of construction waste including:
 - .1 Number and size of bins.
 - .2 Waste type of each bin.
 - .3 Total tonnage generated.
 - .4 Tonnage reused or recycled.
 - .5 Reused or recycled waste destination.
- .4 Remove materials from deconstruction as deconstruction/disassembly Work progresses.
- .5 Prepare project summary to verify destination and quantities on a material-by-material basis as identified in pre-demolition material audit.

1.9 USE OF SITE AND FACILITIES

- .1 Execute work with least possible interference or disturbance to normal use of premises.
- .2 Provide temporary security measures approved by Owner Representative.

1.10 SCHEDULING

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

Part 2 Products

Not used.

Part 3 Execution

3.1 APPLICATION

- .1 Perform Work in compliance with WRW.
- .2 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.

3.2 CLEANING

- .1 Remove tools and waste materials on completion of Work, and leave work area in clean and orderly condition.
- .2 Clean-up work area as work progresses.
- .3 Source separate materials to be reused/recycled into specified sort areas.

3.3 WASTE AUDIT (WA)

.1 Schedule A - Waste Audit (WA):

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

3.4 WASTE REDUCTION WORKPLAN (WRW)

.1 Schedule B:

(1) Material Category	(2) Person(s) Respon- sible	(3) Total Quantity of Waste (unit)	(4) Reused Amount (units) Projected	Actual	(5) Recycled Amount (unit) Projected	Actual	(6) Material(s) Destina- tion
Wood and Plastics Material Description							
Chutes							
Warped Pallet Forms							
Plastic Packaging							
Card- board Packaging							
Other							
Doors and Windows Material Description							
Painted Frames							
Glass							
Wood							
Metal							
Other							

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE REQUIREMENTS

- .1 Acceptance of Work Procedures:
 - .1 Contractor's Inspection:
 - .1 Contractor: Conduct inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
 - .2 Notify Owner Representative, in writing, of satisfactory completion of Contractor's inspection; submit verification that corrections have been made.
 - .3 Request Owner Representative inspection.
 - .2 Owner Representative Inspection:
 - .1 Owner Representative and Contractor to inspect Work and identify defects and deficiencies.
 - .2 Contractor to correct Work as directed.
 - .3 Completion Tasks: Submit written certificates, in English, indicating that tasks have been performed as follows:
 - .1 Work: Completed and inspected for compliance with Contract Documents.
 - .2 Defects: Corrected and deficiencies completed.
 - .3 Equipment and systems: Tested, adjusted, balanced, and fully operational.
 - .4 Certificates required by Fire Commissioner, Utility companies: Submitted.
 - .5 Operation of systems: Demonstrated to designated personnel.
 - .6 Commissioning of mechanical systems: completed in accordance with 01 91 13 - General Commissioning (Cx) Requirements, and final Commissioning Report submitted to Owner Representative.
 - .7 Work: Complete and ready for final inspection.
 - .4 Final Inspection:
 - .1 When completion tasks are done, request final inspection of Work by Owner Representative and Contractor.
 - .2 When Work incomplete according to Owner Representative, complete outstanding items and request re-inspection.

1.2 FINAL CLEANING

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

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE REQUIREMENTS

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

1.2 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 Owner Representative, three print and three DVD final copies of operating and maintenance manuals in English and French. Confirm quantities of O&M manuals required with Owner Representative.
- .3 Provide spare parts, maintenance materials, and special tools of same quality and manufacture as products provided in Work.
- .4 Provide evidence, if requested, for type, source, and quality of products supplied.

1.3 FORMAT

- .1 Organize data as instructional manual.
- .2 Binders: Vinyl, hard covered, 3 'D' ring, with spine and face pockets.
 - .1 When multiple binders are used, correlate data into related consistent groupings.
- .3 Text: Manufacturer's printed data, or typewritten data.

1.4 CONTENTS – O&M MANUALS

- .1 Binder Cover and Binder Edge
 - .1 Include: Building Name, address, project name, project number (RCMP #), completed date.

- .2 Title Page
 - .1 O&M Manual for... Building name, address, date, general contractor information: name address, phone number.
 - .2 Consultant name address, phone number.
 - .3 Table of contents indicates each binder's contents.
- .3 Index and tabs
 - .1 Dividers with permanently marked tabs separate each section and sub section.
 - .2 Tab labels typed, not hand written.
 - .3 Main tab for each specification section.
- .4 Tab A: Signed Letter of Warranty, to include:
 - .1 Date.
 - .2 Project name.
 - .3 Project number (RCMP #).
 - .4 Building Location.
 - .5 Warranty start date and end, to be from date of substantial, declared by Consultant.
 - .6 Organization, names and phone numbers of persons to call for warranty services.
 - .7 All warranties to be included from all contractors in this section and extended warranties.
- .5 Tab B: Contact Information for all Subcontractors and Suppliers, including:
 - .1 Name, address, telephone number of manufacturer, installing contractor.
 - .2 24-hour number for emergency service for all equipment in this section identified by equipment.
- .6 Tab C: All Reports and Permits:
 - .1 TAB reports.
 - .2 Pre-functional tests.
 - .3 Start-up reports.
 - .4 Completed performance verification forms (found in the Tender Documents).
 - .5 Cabling verifications.
 - .6 ESA certification.
 - .7 TSSA certification.
 - .8 Fire alarm certification.
 - .9 Seismic certification.
 - .10 All permits, including electrical, building, plumbing.
- .7 Tab D: As-Built Drawings:
 - .1 Marked-up by contractor, changes marked in red to also be given to Consultant.

- .8 Tab E: Operation and Shutdown:
 - .1 Sequence of Operation-outline how the systems installed were designed to work.
 - .2 Accurate Sequence of Operation, with detailed instruction in proper sequence, for each mode of operation.
 - .3 Emergency Operation: Functions of equipment that can be operated while other functions disabled. Included only for alternate abnormal operations that can follow when there is a partial failure, malfunctioning of components, or other unusual condition.
 - .4 Shutdown Procedure: Instructions for stopping and securing the equipment after operation. If a particular sequence is required, step-by-step instructions given in that order.
- .9 Tab F: CMMS Data Sheets:
 - .1 All equipment that is to be deleted, removed, added, or replaced is to have a CMMS inventory sheet completed and included in the O&M Manual.
- .10 Tab G: Shop Drawings:
 - .1 Copy of all reviewed "by the Consultant" shop drawings.
- .11 Tab H: Maintenance
 - .1 Copy of specific service and maintenance manuals.
 - .2 Preventative and corrective maintenance, with service procedures and schedules.
 - .3 Schedule for preventive maintenance in a printed format and electronic format compatible with Owner's system.
 - .4 Recommended frequency of performance for each preventive maintenance task, cleaning, inspection and scheduled overhauls or reconditioning.
 - .5 Cleaning: Instructions and schedules for all routine cleaning and inspection recommended, including recommended cleaners and lubricants.
 - .6 Inspection: Periodic inspection of equipment required for operation, cleaning or other reasons, with items to be inspected indicated and inspection criteria given for motors, controls, filters, and any other maintenance items.
 - .7 Instructions for minor repairs or adjustments required for preventive maintenance routines.
 - .8 Listing of any special tools required to service or maintain the equipment.
- .12 Last Tab: Miscellaneous Items
 - .1 Health and Safety submittals including: site specific hazard assessment, safety manual TOC and company safety policy, MSDS sheets (if applicable) signed site orientations for worker, copy of first aid certificate, copy of emergency plan and muster location.
 - .2 Special requirements for equipment, not to be used for reports.

1.5 AS-BUILT DOCUMENTS AND SAMPLES

- .1 Maintain, in addition to requirements in General Conditions, at site for Owner 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 as-built documents and samples in field office apart from documents used for construction.
 - .1 Provide files, racks, and secure storage.
- .3 Label as-built documents and file in accordance with Section number listings in List of Contents of this Project Manual.
 - .1 Label each document "AS-BUILT DOCUMENTS" in neat, large, printed letters.
- .4 Maintain as-built documents in clean, dry and legible condition.
 - .1 Do not use as-built documents for construction purposes.
- .5 Keep as-built documents and samples available for inspection by Owner Representative.
- .6 Record as-built information on drawings and in designated copy of Project Manual provided by Owner Representative.
- .7 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.
- .8 Maintain information during construction on project site drawings and accurately record deviations of newly installed or existing works from Contract documents.
- .9 Use red felt tip marking pens for recording information.
- .10 Mark on one set of prints and at completion of project and prior to final inspection; neatly transfer notations to second set.
- .11 Ensure but do not limit recording of following information on as-built drawings:
 - .1 Locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of structure.
 - .2 Changes made by Change Order.
 - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
 - .4 Field changes of dimension and detail.
 - .5 Details not on original Contract Drawings.
 - .6 References to related shop drawings and modifications.

- .12 Incorporate as-built information into CAD drawings.
- .13 Submit as-built drawings to Owner Representative.
 - .1 Provide in electronic form as CAD .dwg format, on CD or DVD.
- .14 Specifications: Mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and change orders.

1.6 RECORD DOCUMENTS

- .1 Prior to Substantial Performance of the Work, provide on CD or DVD the marked-up information from the as-built documents to a master set of drawing files provided by the Owner Representative:
- .2 Mark revised documents as "RECORD DOCUMENTS". Include all revisions.
- .3 Indicate changes on the electronic set of record drawings. Provide updated record drawings in .dwg format.
- .4 Submit completed record documents to Owner Representative on CD or DVD.

1.7 EQUIPMENT AND SYSTEMS

- .1 For each item of equipment and each system include description of unit or system, and component parts.
 - .1 Give function, normal operation characteristics and limiting conditions.
 - .2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.
 - .1 Include regulation, control, stopping, shut-down, and emergency instructions.
 - .2 Include summer, winter, and any special operating instructions.
- .5 Maintenance Requirements: Include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.

- .11 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include test and balancing reports.
- .15 Additional requirements: as specified in individual specification sections.

1.8 MATERIALS AND FINISHES

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

1.9 MAINTENANCE MATERIALS

- .1 Spare Parts:
 - .1 Provide spare parts, in quantities specified in individual specification sections.
 - .2 Provide items of same manufacture and quality as items in Work.
 - .3 Deliver to site; place and store.
 - .4 Receive and catalogue items.
 - .1 Submit inventory listing to Owner 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 Owner 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 Owner Representative.
 - .2 Include approved listings in Maintenance Manual.

1.10 DELIVERY, STORAGE, AND HANDLING

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

1.11 WARRANTIES AND BONDS

- .1 Develop warranty management plan to contain information relevant to Warranties.
- .2 Submit warranty management plan, 30 days before planned pre-warranty conference, to Owner Representative approval.
- .3 Warranty management plan to include required actions and documents to assure that Owner 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 Owner 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 Owner 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 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.
 - .3 Contractor's plans for attendance at 4 and 9 month post-construction warranty inspections.
 - .4 Procedure and status of tagging of equipment covered by extended warranties.
 - .5 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 Owner Representative to proceed with action against Contractor.

1.12 WARRANTY TAGS

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

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE REQUIREMENTS

- .1 Demonstrate operation and maintenance of equipment and systems to designated personnel two weeks prior to date of substantial performance.
- .2 Owner Representative: Provide list of personnel to receive instructions, and coordinate their attendance at agreed-upon times.
- .3 Preparation:
 - .1 Verify conditions for demonstration and instructions comply with requirements.
 - .2 Verify designated personnel are present.
 - .3 Ensure equipment has been inspected and put into operation in accordance with Section 01 91 13 – General Commissioning Requirements.
 - .4 Ensure testing, adjusting, and balancing have been performed in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements and equipment and systems are fully operational.
- .4 Demonstration and Instructions:
 - .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at agreed upon times, at the equipment location.
 - .2 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.
 - .3 Review contents of manual in detail to explain aspects of operation and maintenance.
 - .4 Prepare and insert additional data in operations and maintenance manuals when needed during instructions.
- .5 Time Allocated for Instructions: Ensure amount of time provided for instruction of each item of equipment or system is adequate for full orientation and training of designated personnel.

1.2 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to designated dates, for Owner Representative's approval.
- .3 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- .4 Give time and date of each demonstration, with list of persons present.
- .5 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

1.3 QUALITY ASSURANCE

- .1 When specified in individual Sections requiring manufacturer to provide authorized representative to demonstrate operation of equipment and systems:
 - .1 Instruct designated personnel.
 - .2 Provide written report that demonstration and instructions have been completed.

END OF SECTION

Part 1 General

1.1 REFERENCES

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

1.2 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit 20 days prior to start of demolition and removals Work.
- .3 Where required, submissions to be signed and sealed by a Professional Engineer licensed in the Province of Saskatchewan.
- .4 Shop Drawings:
 - .1 Drawings, diagrams or details indicating sequence of disassembly Work, supporting structures, and underpinning.
- .5 Hazardous Materials: provide description of Hazardous Materials and Notification of Filing with proper authorities prior to beginning of Work as required.
- .6 Demolition plan:
 - .1 Show schedule of selective demolition.
 - .2 Number and location of dumpsters.
 - .3 Anticipated frequency of tipping.
 - .4 Show impacts, interruptions, and delays to building operations.
- .7 Waste reduction: Submit progress reports and audits in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

1.3 QUALITY ASSURANCE

- .1 Convene pre-installation meeting one week prior to beginning work of this section to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with building subtrades.
- .2 Arrange for site visit with Owner Representative to examine existing site conditions adjacent to demolition work, prior to start of Work.
- .3 Hold project meetings every month.
 - .1 Ensure key personnel, site supervisor, project manager, subcontractor representatives attend.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Protect existing items designated to remain and items designated for salvage. In event of damage to such items, immediately replace or make repairs to approval of Owner Representative and at no cost to Owner Representative.
- .2 Remove and store materials to be salvaged, in manner to prevent damage.
- .3 Store and protect in accordance with requirements for maximum preservation of material.

1.5 SITE CONDITIONS

- .1 Perform operations, machine and equipment movements, deliveries and removals at time or times that will permit uninterrupted operations in and around structures, including parking, deliveries, and Site access and egress.
- .2 Take over structures to be demolished based on condition on date that Bids close.
- .3 In all circumstances, ensure that demolition work does not adversely affect adjacent water courses groundwater and wildlife, nor contribute to excess air and noise pollution.
- .4 Do not dispose, of waste or volatile materials such as mineral spirits, oil, petroleum based lubricants, or toxic cleaning solutions into watercourses, storm or sanitary sewers. Ensure proper disposal procedures are maintained throughout project.
- .5 Do not pump water containing suspended materials into watercourses, storm or sanitary sewers, or onto adjacent properties.
- .6 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authorities.
- .7 Protect trees, plants and foliage on site and adjacent properties where indicated.

Part 2 Products

Not used.

Part 3 Execution

3.1 GENERAL

- .1 Products requiring demolition become Contractor's property. Remove Products from Site daily, unless such Products are otherwise specified or indicated on Contract Drawings to be reused or handed over to Owner Representative.
- .2 Stockpiling of rubble, debris and surplus Products on Site will not be permitted.
- .3 Clean up rubble and debris resulting from Work promptly and dispose at end of day or place in waste disposal bins. Empty bins on regular basis.

3.2 EXAMINATION

- .1 Examine adjacent structures and other installations prior to commencement of demolition and removals Work.

3.3 PREPARATION

- .1 Inspect site with Owner Representative and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage, and items to remain.
- .2 Locate and protect utilities. Preserve active utilities traversing site in operating condition.
- .3 Notify and obtain approval of utility companies before starting demolition.
- .4 Disconnect electrical and telephone service lines in areas to be demolished. Post warning signs on electrical lines and equipment that remain energized to serve other areas during period of demolition. Disconnect electrical and telephone service lines in demolition areas to requirements of local authority having jurisdiction.
- .5 Disconnect and cap mechanical services in accordance with requirements of local authority having jurisdiction. Natural gas supply lines are to be removed by gas company or by qualified trade, in accordance with gas company instructions.
- .6 Erect and maintain dustproof partitions, seal off ducts as required to prevent spread of dust and fumes to other parts of the building. On completion, remove partitions and make good surfaces to match adjacent surfaces.

3.4 EXISTING CONDITIONS

- .1 Prior to start of demolition work, remove from site materials defined as contaminated or hazardous by authorities having jurisdiction, and dispose at designated disposal facilities.

3.5 PROTECTION

- .1 Prevent movement of or damage to adjacent structures, services and parts of existing structure to remain. Supply and install bracing and shoring as required. Make good damage caused by demolition, to acceptance of Owner Representative.
- .2 Protect adjacent structures and property against damage that might occur from falling debris or other causes. Repair or replace damage caused from Work of this Section to acceptance of Owner Representative.
- .3 Do not interfere with use of adjacent structures and Work areas. Maintain free, safe passage to and from adjacent structures and Work areas.
- .4 Take precautions to support affected structures. If safety of structure being demolished, adjacent structures or services are endangered, cease demolition operations and take necessary action to support endangered item. Immediately inform Owner Representative. Do not resume demolition until reasons for endangering have been determined and corrected and action taken to prevent further endangering.

- .5 If movement or settlement occurs, install additional bracing and shoring as necessary and make good any damage to acceptance of Owner Representative.
- .6 Prevent debris from blocking surface drainage system, mechanical and electrical systems which are required to remain in operation.
- .7 Pay attention to prevention of fire and elimination of fire hazards that would endanger Work or adjacent structures and premises.
- .8 Close off access to areas where demolition is proceeding by barricades and post warning signs.
- .9 Where required, supply, install and maintain barricades, guards, railings, lights, warning signs, security and other safety measures, and fully protect persons and property.
- .10 Do not proceed with demolition work when weather conditions constitute a hazard to workers and site.
- .11 Dust/Weather Protection:
 - .1 Prior to demolition Work proceeding in existing structures, temporarily enclose Work areas, access and supply and install dustproof partitions. Design partitions to prevent dust and dirt infiltration into adjoining areas.
 - .2 Prevent dust, dirt and material caused by demolition operations from entering operational areas.
 - .3 Adjust and relocate partitions as required for various operations of Work.
 - .4 Upon completion of Work, remove and dispose of partitions from Site.

3.6 DEMOLITION

- .1 Carry out demolition in accordance with the requirements of CSA S350.
- .2 Perform demolition with extreme care. Confine effects of demolition to those parts that are to be demolished.
- .3 Perform Work and prevent inconvenience to persons outside the demolition area.
- .4 Demolish parts of structure to permit construction of addition as indicated.
- .5 Perform Work to minimize dust.
- .6 Do not sell or burn materials on Site.
- .7 Remove existing equipment, services, and obstacles where required for refinishing or making good of existing surfaces, and replace as Work progresses.
- .8 Sprinkle exterior debris with water to prevent dust. Do not cause flooding, contaminated runoff or icing. Do not allow waste material, rubbish, and windblown debris to reach and contaminate adjacent properties.
- .9 Lower waste materials in a controlled manner; do not drop or throw materials from heights.
- .10 At end of day's Work, leave Work in safe condition with no part in danger of toppling or falling.
- .11 Drainage and Sewer System Protection:

- .1 Ensure that no dust, debris, nor slurry enters drainage and sewer system on Site.
- .2 Remove and dispose of debris and slurry promptly from Site.

3.7 REMOVAL OPERATIONS

- .1 Except where otherwise specified, all materials indicated or specified to be permanently removed from the Place of the Work shall become Contractor's property. Maximize salvage and recycling of such materials, consistent with proper economy and expeditious performance of the Work.
- .2 Remove items as indicated.
- .3 Do not disturb items designated to remain in place.
- .4 Removal from site: Interim removal of stockpiled material will be required by Owner Representative, if material is deemed to interfere with operations.

3.8 RESTORATION

- .1 Restore areas and existing works outside areas of demolition to match conditions of adjacent, undisturbed areas.
- .2 Employ soil treatments and procedures which are not harmful to health, are not injurious to plants, and do not endanger wildlife, adjacent water courses or ground water.

3.9 CLEAN UP

- .1 Upon completion of work, remove debris, trim surfaces, and leave work site clean.
- .2 Use cleaning solutions and procedures which are not harmful to health, are not injurious to plants, and do not endanger wildlife, adjacent water courses or ground water.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A307-14, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .2 Canadian Standards Association (CSA)
 - .1 CSA S16-09, Design of Steel Structures.
 - .2 CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding.
 - .3 CSA W59-13, Welded Steel Construction (Metal Arc Welding).
- .3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.2 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
- .3 Certifications: Submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.3 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products

2.1 MATERIALS

- .1 Steel pipe: To ASTM A53/A53M, Schedule 40.

- .2 Welding materials: To CSA W59.
- .3 Welding electrodes: To CSA W48 Series.
- .4 Bolts and anchor bolts: To ASTM A307.

2.2 FABRICATION

- .1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.
- .2 Use self-tapping shake-proof headed screws on items requiring assembly by screws or as indicated.
- .3 Where possible, fit and shop assemble work, ready for erection.
- .4 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

2.3 FINISHES

- .1 Galvanizing: Hot dipped galvanizing with zinc coating 600 g/m² to CAN/CSA G164.
- .2 Shop coat primer: To CISC/CPMA 2-75 or CAN/CGSB-1.105.

2.4 SHOP PAINTING

- .1 Apply one shop coat of primer to metal items, with exception of galvanized or concrete encased items.
- .2 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, and grease. Do not paint when temperature is lower than 7°C.

2.5 HANDRAILS

- .1 Steel pipe: 38 mm nominal outside diameter for handrails.
- .2 Fabricate handrails to support concentrated load of 90 kg applied at top of handrail.
- .3 Galvanize interior pipe railings after fabrication. Shop prime paint interior railings after fabrication.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify conditions of substrates are acceptable for metal fabrications installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.
 - .2 Inform Owner Representative of unacceptable conditions.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 ERECTION

- .1 Perform welding work in accordance with CSA W59 unless specified otherwise.
- .2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
- .3 Provide suitable means of anchorage acceptable to Owner Representative such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.
- .4 Exposed fastening devices to match finish and be compatible with material through which they pass.
- .5 Make field connections with bolts to CSA S16.
- .6 Touch-up rivets, welds, bolts, and burnt or scratched surfaces with primer after completion of installation.
- .7 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.

3.3 HANDRAILS

- .1 Install handrails as indicated.

3.4 CLEANING

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

3.5 PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM A123/A123M-13, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .2 ASTM A653/A653M-13, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction and amendment.
- .3 Canadian Standards Association (CSA)
 - .1 CSA B111-1974 (R2003), Wire Nails, Spikes and Staples.
 - .2 CSA O112.9-10 (R2014), Evaluation of Adhesives for Structural Wood Products (Exterior Exposure).
 - .3 CSA O121-08 (R2013), Douglas Fir Plywood.
 - .4 CSA O141-05 (R2014), Softwood Lumber.
 - .5 CSA O151-09 (R2014), Canadian Softwood Plywood.
 - .6 CSA O153-13, Poplar Plywood.
 - .7 CSA O325-07 (R2012), Construction Sheathing.
- .4 National Lumber Grades Authority (NLGA)
 - .1 NLGA Standard Grading Rules for Canadian Lumber (2014 edition).
- .5 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC S102-10, Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.2 QUALITY ASSURANCE

- .1 Lumber by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.
- .2 Plywood, particleboard, OSB, and wood based composite panels in accordance with CSA and ANSI standards.

1.3 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 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 wood from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 FRAMING STRUCTURAL AND PANEL MATERIALS

- .1 Lumber: Softwood, S4S, moisture content 19% (S-dry) or less in accordance with following standards:
 - .1 CSA O141.
 - .2 NLGA Standard Grading Rules for Canadian Lumber.
- .2 Furring, blocking, nailing strips, grounds, rough bucks, cants, curbs, fascia backing and sleepers:
 - .1 Use S2S or S4S materials.
 - .2 Board sizes: "Standard" or better grade.
 - .3 Dimension sizes: "Standard" light framing or better grade.
 - .4 Post and timbers sizes: "Standard" or better grade.
- .3 Plywood, OSB and wood based composite panels: CSA O325.
- .4 Douglas fir plywood (DFP): CSA O121, standard construction.
- .5 Canadian softwood plywood (CSP): CSA O151, standard construction.
- .6 Poplar plywood (PP): CSA O153, standard construction.
- .7 Treated wood products: To CSA O80 Series.
- .8 Fire retardant treated wood: To CAN/ULC S102.
 - .1 Flame spread: Maximum 25.
 - .2 Smoke developed: Maximum 25.

2.2 ACCESSORIES

- .1 Polyethylene film: To CAN/CGSB 51.34, Type 1, 0.15 mm thick.
- .2 Air seal: Closed cell polyurethane or polyethylene.
- .3 Sealants: In accordance with Section 07 92 00 - Joint Sealants.
- .4 General purpose adhesive: CSA O112.9.
- .5 Nails, spikes and staples: CSA B111.
- .6 Bolts: 12.5 mm diameter unless indicated otherwise, complete with nuts and washers.
- .7 Proprietary fasteners: Toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, recommended for purpose by manufacturer.

- .8 Joist hangers: Minimum 1 mm thick sheet steel, galvanized ZF001 coating designation.
- .9 Fasteners: Hot dipped galvanized steel to ASTM A123/A123M or ASTM A653/A653M for high humidity and treated wood locations, unfinished steel elsewhere.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify conditions of substrates are acceptable for product installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.
 - .2 Inform Owner Representative of unacceptable conditions.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 FURRING AND BLOCKING

- .1 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, audio-visual equipment mounting, electrical equipment mounting boards, architectural hardware, bathroom accessories, fire extinguisher brackets, and other work as required.
- .2 Install rough bucks, nailers, and linings to rough openings as required to provide backing for frames and other work.
- .3 Install wood cants, fascia backing, nailers, curbs, and other wood supports as required and secure using galvanized steel fasteners.
- .4 Install sleepers as indicated.

3.3 CLEANING

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

3.4 PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI A208.1-09, Particleboard.
 - .2 ANSI A208.2-09, Medium Density Fiberboard (MDF) for Interior Applications.
- .2 Architectural Woodwork Manufacturers Association of Canada (AWMAC) and Architectural Woodwork Institute (AWI)
 - .1 Architectural Woodwork Standards, 2nd Edition, 2014.
- .3 Builders Hardware Manufacturers Association (BHMA)
 - .1 ANSI/BHMA A156.9-2015, Cabinet Hardware.
 - .2 ANSI/BHMA A156.11-2014, Cabinet Locks.
- .4 Business and Institutional Furniture Manufacturers Association (BIFMA)
 - .1 BIFMA G1-2013, Ergonomics Guideline for Furniture Used in Office Work Spaces Designed for Computer Use.
- .5 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 71.20-M88, Adhesive, Contact, Brushable.
- .6 Canadian Standards Association (CSA)
 - .1 CSA B111-74 (R2003), Wire Nails, Spikes and Staples.
 - .2 CSA O112.10-08 (R2013), Evaluation of Adhesives for Structural Wood Products (Limited Moisture Exposure).
 - .3 CSA O141-05 (R2014), Softwood Lumber.
 - .4 CSA O151-09 (R2014), Canadian Softwood Plywood.
- .7 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .8 National Electrical Manufacturers Association (NEMA)
 - .1 ANSI/NEMA LD3-2005, High-Pressure Decorative Laminates (HPDL).
- .9 National Lumber Grades Authority (NLGA)
 - .1 Standard Grading Rules for Canadian Lumber, 2014.

1.2 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 architectural woodwork and include product characteristics, performance criteria, physical size, finish and limitations.

- .2 Submit WHMIS MSDS in accordance with Section 01 35 29 - Health and Safety Requirements.
- .3 Shop Drawings:
 - .1 Indicate details of construction, profiles, jointing, fastening, and other related details.
 - .1 Scales: profiles full size, details half full size.
 - .2 Indicate materials, thicknesses, finishes and hardware.
 - .3 Indicate locations of service outlets in casework, typical and special installation conditions, and connections, attachments, anchorage and location of exposed fastenings.
- .4 Samples:
 - .1 Submit duplicate manufacturer's samples of high-pressure decorative laminate for pattern and colour selection.
- .5 Certifications: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.3 QUALITY ASSURANCE

- .1 Lumber by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.
- .2 Plywood, particleboard, OSB, and wood based composite panels to CSA and NPA standards.

1.4 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 and address.
 - .1 Protect millwork against dampness and damage during and after delivery.
 - .2 Store millwork in ventilated areas, protected from extreme changes of temperature or humidity.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect architectural woodwork from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Softwood lumber: Unless specified otherwise, S4S, moisture content 19% or less in accordance with following standards:
 - .1 CSA O141.
 - .2 NLGA Standard Grading Rules for Canadian Lumber.
 - .3 AWMAC Custom grade, moisture content as specified.
- .2 Machine stress-rated lumber is acceptable for all purposes.
- .3 Canadian softwood plywood (CSP): To CSA O151, standard construction.
 - .1 Plywood resin to contain no added urea-formaldehyde.
- .4 Particleboard core: To NPA A208.1, Grade M2 or better.
 - .1 Thickness swelling: Maximum 5.5%.
 - .2 Modulus of rupture: Minimum 13.0 N/mm² (1885 psi).
- .5 MDF (medium density fibreboard) core: To NPA A208.2, Grade 130 or better.
 - .1 Modulus of rupture: Minimum 21.6 N/mm² (3130 psi).
 - .2 MDF resin to contain no added urea-formaldehyde.
- .6 Moisture-resistant MDF: To ANSI/NPA A208.2, Grade 155 MR50.
- .7 Chair rail: Maple species, 152 x 19 mm (6 x 3/4 inch) profile, eased edges.
- .8 High pressure decorative laminate (HPDL) for horizontal surfaces: To NEMA LD3, Horizontal Grade Standard (HGS), 1.2 ± 0.12 mm thick; colours and patterns as selected by Owner Representative.
- .9 HPDL for vertical surfaces: To NEMA LD3, Vertical Grade Standard (VGS), 0.7 mm ± 0.10 mm thick, colours and patterns as selected by Owner Representative.
- .10 Thermofused Melamine: To NEMA LD3, melamine, polyester, or foil resin impregnated paper thermally fused under pressure to an approved core.
 - .1 High wear resistant thermofused melamine: Equal or exceed 400 cycles (Minimum standard for HPL abrasion test).
- .11 Nails and staples: To CSA B111.
- .12 Wood screws: Stainless steel, type and size to suit application.
- .13 Sealant: In accordance with Section 07 92 00 - Joint Sealants.
- .14 Laminate adhesive:
 - .1 Adhesive: Contact adhesive to CAN/CGSB 71.20.

2.2 HARDWARE

- .1 General:
 - .1 Hardware: ANSI/BHMA A156.9.
 - .2 Finish: Brushed nickel or stainless steel, unless otherwise specified.

- .2 Hinges: European style hinges, minimum 110° opening.
- .3 Pulls: Metal, contemporary closed end bar pull.
 - .1 Mounting: 128 mm center-to-center screw attachment.
 - .2 Overall dimension: 170 mm long; 40 mm projection from mounting surface.
 - .3 Confirm proposed product with Owner Representative.
- .4 Catches: Type I – magnetic catch.
- .5 Adjustable shelf standards and supports: Vertical slotted shelf standard, type B04102.
- .6 Drawer slides: Full extension, side-mounted drawer slides with ball bearings, zinc coated steel, 30 kg (66 lb) load capacity, soft closing.
- .7 Cabinet Locks: ANSI/BHMA A156.11, Grade 1; keyed cylinder, two keys per lock, master keyed, steel with satin finish; complete with strike.
 - .1 Body: Die cast zinc.
 - .2 Cylinder: Solid brass, pin tumbler.
 - .3 Coordinate keying with Owner Representative.
- .8 Linear grilles: Extruded aluminum, clear anodized finish, with flange; blades running in long dimension of grille.
 - .1 Grille width: 100 mm (4 inches).
 - .2 Grille length: One piece, to suit installation.
 - .3 Core spacing: 6 mm (1/4 inch) on center.
 - .4 Blade angle: 0°.
- .9 Keyboard trays: To BIFMA G1, ergonomic style, powder-coated steel brackets with phenolic resin keyboard platform, slim profile, with palm support.
 - .1 Tilt adjustment range: 0 - 15°.
- .10 Closet rods: To ANSI/BHMA A156.9, heavy duty round steel tubing, polished chrome finish.
 - .1 Outside diameter: Minimum 27 mm (1-1/16 inch).
 - .2 Wall thickness: Minimum 2.2 mm (0.087 inch).
 - .3 Mounting brackets: Round, closed flange, three-screw attachment.
 - .1 Provide centre supports for closet rods longer than 1.5 m (5 feet).

2.3 MANUFACTURED UNITS

- .1 All work to AWMAC Custom grade.
- .2 Core: Particleboard or MDF.
- .3 Casework:
 - .1 Construction type: Frameless.
 - .2 Cabinet and door interface: Flush overlay.
 - .3 Exposed surfaces: HPDL.

- .4 Exposed interior surfaces: HPDL, to match exposed surfaces.
- .5 Semi-exposed surfaces: HPDL, to match exposed surfaces.
- .6 Edgeband: 3 mm PVC, colour matched to adjoining HPDL.
 - .1 Adjustable shelves: Apply edgeband to all four sides.
- .7 Ladder base: Canadian softwood plywood, 19 mm thick.
 - .1 Kitchenette: Mount 6 mm moisture-resistant MDF to front face of ladder base, HPDL finish.
- .4 Doors/drawers:
 - .1 Fronts: HPDL.
 - .2 Semi-exposed surfaces: HPDL.
 - .3 Concealed surfaces: Melamine.
 - .4 Edgeband: 3 mm PVC, colour as selected by Owner Representative.
- .5 Laminate countertops:
 - .1 Horizontal surfaces: HPDL.
 - .2 Backsplash: 100 mm high.
 - .3 Front edges: 3 mm PVC, colour as selected by Owner Representative.
- .6 Carrels:
 - .1 All surfaces: HPDL.
 - .2 Edges: 3 mm PVC, colour as selected by Owner Representative.

2.4 FABRICATION

- .1 Set nails and countersink screws apply plain wood filler to indentations, sand smooth and leave ready to receive finish.
- .2 Shop install cabinet hardware for doors, shelves, and drawers. Recess shelf standards unless noted otherwise.
- .3 Shelving to cabinetwork to be adjustable unless otherwise noted.
- .4 Provide cut-outs for plumbing fixtures, inserts, appliances, outlet boxes and other fixtures.
- .5 Shop assemble work for delivery to site in size easily handled and to ensure passage through building openings.
- .6 Obtain governing dimensions before fabricating items that are to accommodate or abut appliances, equipment and other materials.
- .7 Ensure adjacent parts of continuous laminate work match in colour and pattern.
- .8 Veneer laminate to core material in accordance with adhesive manufacturer's instructions. Ensure core and laminate profiles coincide to provide continuous support and bond over entire surface. Use continuous lengths up to 2400 mm. Keep joints 600 mm from sink cut-outs.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify conditions of substrates are acceptable for architectural woodwork installation in accordance with manufacturer's instructions.
 - .1 Visually inspect substrate.
 - .2 Inform Owner Representative of unacceptable conditions.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Perform architectural woodwork to Quality Standards of AWMAC.
- .2 Install prefinished millwork at locations shown on drawings.
 - .1 Position accurately, level, plumb, and straight.
- .3 Fasten and anchor millwork securely.
 - .1 Supply and install heavy duty fixture attachments for wall mounted cabinets.
- .4 Use draw bolts in countertop joints.
- .5 Scribe and cut as required to fit abutting walls and to fit properly into recesses and to accommodate piping, columns, fixtures, outlets or other projecting, intersecting or penetrating objects.
- .6 At junction of laminate counter and adjacent wall finish, apply small bead of silicone sealant in accordance with Section 07 92 00 - Joint Sealants.
- .7 Apply water resistant building paper over wood framing members in contact with masonry or cementitious construction.
- .8 Fit hardware accurately and securely in accordance with manufacturer's written instructions.

3.3 CLEANING

- .1 Progress Cleaning: Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Leave Work area clean at end of each day.
- .3 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
 - .1 Clean cabinet work outside surfaces, inside cupboards and drawers.
 - .2 Remove excess glue from surfaces.
- .4 Waste Management: Remove waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

3.4 PROTECTION

- .1 Protect cabinet work from damage until final inspection.

- .2 Protect installed products and components from damage during construction.
- .3 Repair damage to adjacent materials caused by architectural woodwork installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM C167-09, Standard Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations.
 - .2 ASTM C423-09a, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - .3 ASTM C518-10, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - .4 ASTM C1104/C1104M-13, Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.
 - .5 ASTM C1338-08, Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
 - .6 ASTM E413-04, Classification for Rating Sound Insulation.
- .2 Canadian Standards Association (CSA)
 - .1 CSA B111-1974 (R2003), Wire Nails, Spikes and Staples.
 - .2 CSA B149.1-10, Natural Gas and Propane Installation Code.
 - .3 CSA B149.2-10 (R2015), Propane Storage and Handling Code.
- .3 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC S102-07, Test for Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC S102.2-07, Test for Surface Burning Characteristics of Building Materials and Assemblies.
 - .3 CAN/ULC S107-03, Methods of Fire Tests of Roof Coverings.
 - .4 CAN/ULC S114-05, Test for Determination of Non-Combustibility in Building Materials.
 - .5 CAN/ULC S127-14, Standard Corner Wall Method of Test for Flammability Characteristics of Non-Melting Foam Plastic Building Materials.
 - .6 CAN/ULC S129-06, Standard Method of Test for Smoulder Resistance of Insulation (Basket Method).
 - .7 CAN/ULC S604-M91, Standard for Factory Built Type A Chimneys.
 - .8 CAN/ULC S702-09, Standard for Thermal Insulation, Mineral Fibre, for Buildings.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.2 SUBMITTALS

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

- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications, and data sheets.
 - .2 Submit WHMIS MSDS - Material Safety Data Sheets.
- .3 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions.
- .4 Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.3 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver materials in manufacturer's original containers clearly labeled with manufacturer's name, product identification, safety information, net weight of contents and expiration date.
- .2 Store material in a safe manner and where the temperatures are within range specified by manufacturer.
- .3 Remove empty containers from site daily.
- .4 Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.4 WASTE MANAGEMENT AND DISPOSAL

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

1.5 PROJECT CONDITIONS

- .1 Maintain environmental conditions of temperature, humidity, and ventilation within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.
- .2 Ventilate area to receive insulation to maintain safe working conditions.
- .3 Protect workers as recommended by standards and manufacturer's recommendations.
- .4 Protect adjacent surfaces, windows, equipment and site areas from damage of overspray.

Part 2 Products

2.1 BATT INSULATION

- .1 Batt insulation for interior partitions: To CAN/ULC S702, Type 1; semi-rigid mineral wool batt insulation.
 - .1 Non-combustibility (CAN/ULC S114): Pass.

- .2 Surface burning characteristics (CAN/ULC S102):
 - .1 Flame spread: 0.
 - .2 Smoke developed: 0.
- .3 Density (ASTM C167): 40 kg/m³.
- .4 Smoulder resistance (CAN/ULC S129): 0.09%.

2.2 BLANKET INSULATION

- .1 Acoustic blanket insulation: To ASTM C665, glass fibre blanket insulation with glass fibre mat surface on one side.
 - .1 Surface burning characteristics to CAN/ULC S102.2:
 - .1 Flame spread: 25 or less.
 - .2 Smoke developed: 50 or less.
 - .2 Colour: Black.
 - .3 Sound absorption coefficients: To ASTM C423:

Thickness (mm)	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	NRC
25	0.10	0.34	0.65	0.87	0.91	0.91	0.70
50	0.27	0.80	1.12	1.07	1.02	1.01	1.00

2.3 ACCESSORIES

- .1 Nails: To CSA B111, galvanized steel, length to suit insulation plus 25 mm.
- .2 Staples: 12 mm minimum leg.
- .3 Tape: As recommended by manufacturer.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.2 GENERAL

- .1 Install insulation after building substrate materials are dry.
- .2 Install insulation to maintain continuity of thermal protection to building elements and spaces.
- .3 Fit insulation tight around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows and other protrusions.
- .4 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures, and minimum 50 mm from sidewalls of CAN/ULC S604 type A chimneys and CSA B149.1 and CSA B149.2 type B and L vents.

- .5 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.
- .6 Offset both vertical and horizontal joints in multiple layer applications.
- .7 Do not enclose insulation until it has been inspected and approved by Owner Representative.

3.3 EXAMINATION

- .1 Examine substrates and immediately inform Owner Representative in writing of defects.
- .2 Verify substrates are firm, straight, smooth, dry, free of snow, ice or frost, and clean of dust and debris.
- .3 Verify acoustic and firestop sealants required at stud framing [concrete masonry unit wall] junctions with adjacent building components or at mechanical and electrical conduit and duct penetrations are installed.
- .4 Confirm mechanical, electrical and telecommunications service lines in walls, ceilings, and floors to be insulated have been inspected.

3.4 BATT INSULATION INSTALLATION

- .1 Install insulation to maintain continuity of thermal protection to building elements and spaces.
- .2 Install acoustic insulation where indicated to maintain sound attenuation of separation in building elements and spaces.
- .3 Place acoustic batts between studs ensuring friction fit, free of sags, folds, voids, or open joints that may let sound pass through.
- .4 Fit insulation closely around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.
- .5 Do not compress insulation excessively to fit voids.
- .6 Do not enclose insulation until it has been inspected and approved by Owner Representative.

3.5 BLANKET INSULATION INSTALLATION

- .1 Loose-lay blanket insulation above acoustic ceiling tile, install two layers.
- .2 Lay insulation to obtain tight joints between blankets.
- .3 Lap seams between blanket layers minimum 300 mm.

3.6 CLEANING

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM C612-10, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .2 ASTM E1966-07 (2011), Standard Test Method for Fire-Resistive Joint Systems.
 - .3 ASTM E2174-14 – Standard Practice for On-Site Inspection of Installed Firestops.
 - .4 ASTM G21-15, Determining Resistance of Synthetic Polymeric Materials to Fungi.
- .2 Firestop Contractors International Association (FCIA)
 - .1 FCIA Firestop Industry Manual of Practice, 5th Edition.
- .3 FM Global (FM)
 - .1 FM Approvals 4991 – Approval of Firestop Contractors.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .5 National Fire Protection Association (NFPA)
 - .1 NFPA 101 – Life Safety Code, 2009 Edition.
- .6 UL (formerly Underwriters Laboratories)
 - .1 UL 1479 – Standard for Fire Tests of Through-Penetration Firestops.
 - .2 UL 2079 – Standard for Tests for Fire Resistance of Building Joint Systems.
- .7 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC S101-07 – Standard Methods of Fire Endurance Tests of Building Construction and Materials.
 - .2 CAN/ULC S102-07 – Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
 - .3 CAN/ULC S115-05 - Fire Tests of Firestop Systems.

1.2 DEFINITIONS

- .1 Fire Stop Material: Device intended to close off opening or penetration during fire or materials that fill openings in wall or floor assembly where penetration is by cables, cable trays, conduits, ducts and pipes and poke-through termination devices, including electrical outlet boxes along with their means of support through wall or floor openings.

- .2 Single Component Fire Stop System: Fire stop material that has Listed Systems Design and is used individually without use of high temperature insulation or other materials to create fire stop system.
- .3 Multiple Component Fire Stop System: Exact group of fire stop materials that are identified within Listed Systems Design to create on site fire stop system.
- .4 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.

1.3 PERFORMANCE REQUIREMENTS

- .1 Materials, accessories, and application procedures: Listed by ULC, cUL, or tested in accordance with CAN/ULC S115 to comply with applicable building code requirements.
- .2 Firestopping materials: To CAN/ULC S101, to achieve fire rating as noted on Drawings and ULC Design Number shown.

1.4 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications, and datasheets. Include product characteristics, performance criteria, physical size, finish, and limitations.
 - .2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets.
- .3 Shop Drawings:
 - .1 Submit shop drawings to show location, proposed material, reinforcement, anchorage, fastenings, and method of installation.
 - .2 Ensure construction details accurately reflect actual job conditions.
- .4 System Design Listings, including illustrations from a qualified testing and inspection agency as applicable for each firestop configuration.
- .5 Samples:
 - .1 Submit duplicate 200 x 200 mm samples showing actual fire stop material proposed for project.
- .6 Quality Assurance Submittals: Submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Certificates: Signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Manufacturer's Instructions: Including special handling criteria, installation sequence, and cleaning procedures.

- .7 Project Record Documentation: Supply documentation for each single application addressed. Identify each penetration and joint location on entire project. Provide at completion of project.
 - .1 Include the following for through-penetrations:
 - .1 Sequential location number.
 - .2 Project name.
 - .3 Installation date.
 - .4 Detailed description of penetration location.
 - .5 Tested System or Engineered Judgment Number.
 - .6 Type of assembly penetrated.
 - .7 Detailed description of size and type of penetrating item.
 - .8 Size of opening.
 - .9 Number of sides of assemblies addressed.
 - .10 Hour rating achieved.
 - .11 Installer's name.
 - .2 Include the following for construction joints:
 - .1 Sequential location number.
 - .2 Project name.
 - .3 Installation date.
 - .4 Detailed description of construction joint location.
 - .5 Tested System or Engineered Judgment Number.
 - .6 Type of construction joint.
 - .7 Width of joint.
 - .8 Lineal footage of joint.
 - .9 Number of sides of assemblies addressed.
 - .10 Hour rating achieved.
 - .11 Installer's name.

1.5 QUALITY ASSURANCE

- .1 Single Source Responsibility: Obtain firestop systems for each type of penetration and construction situation from a single primary firestop systems manufacturer.
- .2 Regulatory Requirements:
 - .1 Conform to applicable code for fire resistance ratings and surface burning characteristics.
 - .2 Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.6 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 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, and ULC or cUL labels.
- .3 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .4 Replace defective or damaged materials with new.
- .5 Waste Management and Disposal:
 - .1 Remove waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.7 SITE CONDITIONS

- .1 Apply materials within temperature range recommended by manufacturer.
- .2 Maintain recommended temperature before, during, and for 72 hours after installation of materials.

1.8 SEQUENCING AND SCHEDULING

- .1 Schedule installation of cast-in-place firestop devices after completion of floor formwork, metal form deck, or composite deck, but before placement of concrete.
- .2 Schedule installation of drop-in firestop devices after placement of concrete but before installation of pipe penetration.
- .3 Schedule installation of other firestopping materials after completion of penetrating item installation, but prior to covering or concealing of openings.

Part 2 Products

2.1 MATERIALS

- .1 Fire stopping and smoke seal systems: In accordance with CAN/ULC S115.
 - .1 Asbestos-free materials and systems capable of maintaining effective barrier against flame, smoke, and gases in compliance with requirements of CAN/ULC S115 and not to exceed opening sizes for which they are intended.
 - .2 Ensure firestopping system components are fully compatible with each other, with substrates, and with items penetrating the firestopping.
 - .3 Mould and mildew resistance to ASTM G21: 0 (Zero).
- .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 Insulation: Mineral wool fibre semi-rigid insulation to ASTM C612 – Type IVA, UL 2079, and ASTM E1966; minimum density 64 kg/m³ (4 lbs/ft³).
- .10 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.
- .11 Sealants for vertical joints: Non-sagging.
- .12 Installation Accessories: Clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 EXAMINATION

- .1 Verify existing conditions before starting work.
- .2 Verify opening configurations, penetrating items, substrates, and other conditions affecting performance of firestopping are ready to receive the work of this Section.
- .3 Proceed with installation only when unsatisfactory conditions have been corrected.

3.3 PREPARATION

- .1 Ensure substrates and surfaces are clean, dry, and frost free.
- .2 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.
- .3 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.
- .4 Maintain insulation around pipes and ducts penetrating fire separation, without interruption to vapour barrier.
- .5 Mask and use drop cloths where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.4 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.

3.5 LABELLING

- .1 Provide and install identification labels for each individual penetration with firestopping.
 - .1 Install labels in readily visible location, on both sides of penetrated assembly, with permanently bonding adhesive.
 - .2 Label to include:
 - .1 Warning indicating that system is firestopping installation to be left undisturbed.
 - .2 Installing Contractor name and contact information.
 - .3 System designation of testing organization.
 - .4 Installation date.
 - .5 Manufacturer.

3.6 FIELD QUALITY CONTROL

- .1 Section 01 45 00: Quality Control.
- .2 Inspections: Notify Owner Representative when ready for inspection and prior to concealing or enclosing fire stopping materials and service penetration assemblies.

3.7 CLEANING

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Architectural Aluminum Manufacturers Association (AAMA)
 - .1 AAMA 812-04 (2012), Voluntary Practice for Assessment of Single Component Aerosol Expanding Polyurethane Foams for Sealing Rough Openings of Fenestration Installations.
- .2 ASTM International
 - .1 ASTM C719-14, Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants under Cyclic Movement (Hockman Cycle).
 - .2 ASTM C834-05, Standard Specification for Latex Sealants.
 - .3 ASTM C919-12, Standard Practice for Use of Sealants in Acoustical Applications.
 - .4 ASTM C920-05, Standard Specification for Elastomeric Joint Sealants.
 - .5 ASTM C1016-14, Determination of Water Absorption of Sealant Backing (Joint Filler) Material.
 - .6 ASTM C1184-05, Standard Specification for Structural Silicone Sealants.
 - .7 ASTM C1193-13, Standard Guide for Use of Sealants.
 - .8 ASTM C1311-02, Standard Specification for Solvent Release Sealants.
 - .9 ASTM C1330-02 (2013), Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants.
 - .10 ASTM C1401-14, Standard Guide for Structural Sealant Glazing.
 - .11 ASTM D1623-09, Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics.
 - .12 ASTM D5249-10(2016), Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints.
 - .13 ASTM E814-13a, Standard Test Method for Fire Tests of Penetration Firestop Systems.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 19.13-M87, Sealing Compound, One-component, Elastomeric, Chemical Curing.
 - .2 CGSB 19-GP-14M-1984, Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing.
 - .3 CAN/CGSB 19.17-M90, One-Component Acrylic Emulsion Base Sealing Compound.
 - .4 CAN/CGSB 19.21-M87, Sealing and Bedding Compound, Acoustical.
 - .5 CAN/CGSB 19.24-M90, Multi-component, Chemical Curing Sealing Compound.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.2 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. 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 WHMIS MSDS in accordance with Section 01 35 29 - 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.

1.3 CLOSEOUT SUBMITTALS

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

1.4 QUALITY ASSURANCE

- .1 Compatibility: Verify sealants used are compatible with their respective joint substrates.
- .2 Provide sealants with appropriate expansion and contraction properties for the joints being sealed.
- .3 Perform sealant application work to ASTM C1193.
- .4 Perform structural sealant application work to ASTM C1401.
- .5 Perform acoustic sealant application work to ASTM C919.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

1.6 SITE CONDITIONS

- .1 Ambient Conditions:
 - .1 Proceed with installation of joint sealants only when:
 - .1 Ambient and substrate temperature conditions are within limits permitted by joint sealant manufacturer or are above 4.4°C.
 - .2 Joint substrates are dry.
 - .3 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.
 - .2 Joint-Width Conditions:
 - .1 Proceed with installation of joint sealants only where joint widths are more than those allowed by joint sealant manufacturer for applications indicated.
 - .3 Joint-Substrate Conditions:
 - .1 Proceed with installation of joint sealants only after contaminants capable of interfering with adhesion are removed from joint substrates.

1.7 ENVIRONMENTAL REQUIREMENTS

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of Material Safety Data Sheets (MSDS) acceptable to Health Canada.
- .2 Owner Representative to arrange for ventilation system to be operated on maximum outdoor air and exhaust during installation of caulking and sealants.

Part 2 Products

2.1 SEALANT MATERIALS

- .1 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.
- .2 When low toxicity caulks are not possible, confine usage to areas that off gas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize off gas time.
- .3 Where sealants are qualified with primers use only these primers.
- .4 Air/vapour barrier sealant and adhesive: To ASTM C920, Type S, Grade NS, Class 35, single component, low odour, moisture cure, medium modulus, low VOC.

- .1 Adhesion to ASTM C719: $\pm 35\%$.
- .2 Ultimate Elongation: 450 - 550%.
- .3 Modulus, 100%: 275 - 345 kPa.
- .4 Shore A Hardness: 25 ± 5 .
- .5 Tensile Strength: 1034 – 1378 kPa.
- .6 Maximum VOC: 5 g/L.
- .5 Polyurethane Sealant: To CAN/CGSB 19.24, Type 2, Class B; and ASTM C920, Type M, Grade NS, Use NT, M, A and O; non-sag, multi component, chemical curing.
 - .1 Typical uses: Control joints in concrete floors (when no hard finish is specified), exterior joints, precast concrete panels, expansion joints, panel walls, perimeter windows.
- .6 Elastomeric Polyurethane Sealant: To CAN/CGSB 19.13, Type 2; and ASTM C920, Type S, Grade NS, Use NT, M, A and O; non-sag, single component, moisture curing hybrid polyurethane.
 - .1 Typical uses: Expansion and control joints, pre-cast concrete panel joints, perimeter caulking of windows and doors.
- .7 Spray foam sealant: Spray applied polyurethane, closed cell, low pressure build foam, complying with AAMA 812-04.
- .8 Latex Sealant: To CAN/CGSB 19.17; and ASTM C834; single component, acrylic latex or siliconized acrylic latex.
 - .1 Typical uses: General purpose, acoustic sealing, back bedding glazing compound, window frame perimeters.
- .9 Acoustic Sealant: To CAN/CGSB 19.21 and ASTM C919, acoustic grade, single component, non-hardening, non-skinning.
 - .1 Typical uses: Acoustic sealing of gypsum wall board partitions, sealing of interior polyethylene air/vapour barrier.
- .10 Acoustic and Smoke Sealant: To CAN/CGSB 19.21 and ASTM C919, acoustic grade, single component, non-hardening, non-skinning.
 - .1 Typical use: Acoustic and smoke sealing of gypsum wall board partitions.
- .11 Fire-Resistive Sealant: To ASTM E814, one part fire-stopping sealant.
 - .1 Typical uses: Penetrations in fire-rated floor and wall assemblies.
 - .2 Refer to Section 07 84 00 – Fire Stopping.
- .12 Silicone, one part: To CAN/CGSB 19.13; and ASTM C920, Type S, Grade NS; mildew resistant, single component, colour white unless otherwise specified.
 - .1 Typical uses: Around washroom fixtures, lavatories, janitor's sinks, and other wet areas.
- .13 Preformed compressible and non-compressible back-up materials:
 - .1 Polyethylene foam: Extruded closed cell round foam backer rod, to ASTM C1330 Type C, to ASTM D5249 Type 3.
 - .1 Compression recovery to ASTM D5249: Minimum 96%.
 - .2 Tensile strength to ASTM D1623: Minimum 200 kPa.

- .3 Water absorption to ASTM C1016 Procedure B: Maximum 0.03 g/cm³.
- .4 Size: oversize 30 to 50%.
- .2 Neoprene or butyl rubber:
 - .1 Round solid rod, Shore A hardness 70.
- .3 High density foam:
 - .1 Extruded closed cell polyvinyl chloride (PVC), extruded polyethylene, closed cell, Shore A hardness 20, tensile strength 140 to 200 kPa, extruded polyolefin foam, 32 kg/m³ density, or neoprene foam backer, size as recommended by manufacturer.
- .4 Bond breaker tape:
 - .1 Polyethylene bond breaker tape that will not bond to sealant.
- .14 Primer: As recommended by sealant manufacturer, where required, for adhesion of sealant to substrate.

2.2 JOINT CLEANER

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

Part 3 Execution

3.1 EXAMINATION

- .1 Verify conditions of substrates are acceptable for joint sealants installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.
 - .2 Inform Owner Representative of unacceptable conditions.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 SURFACE PREPARATION

- .1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.
- .2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter that may impair Work.
- .3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.
- .4 Ensure joint surfaces are dry and frost free.
- .5 Prepare surfaces in accordance with manufacturer's directions.

3.3 PRIMING

- .1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.
- .2 Prime joint substrates as recommended by sealant manufacturer immediately prior to caulking.

3.4 BACKUP MATERIAL

- .1 Apply bond breaker tape where required to manufacturer's instructions.
- .2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

3.5 MIXING

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

3.6 APPLICATION

- .1 Sealant:
 - .1 Mask edges of joint where irregular surface or sensitive joint border exists, to provide neat joint.
 - .2 Apply sealant in continuous beads.
 - .3 Apply sealant using gun with proper size nozzle.
 - .4 Use sufficient pressure to fill voids and joints solid.
 - .5 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.
 - .6 Tool exposed surfaces before skinning begins to give slightly concave shape.
 - .7 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.

3.7 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: Remove waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

3.8 PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM International (ASTM)
 - .1 ASTM A653/A653M-08, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
 - .2 CAN/CGSB 12.1-2017, Safety Glazing.
 - .3 CGSB 41-GP-19Ma-84, Rigid Vinyl Extrusions for Windows and Doors.
- .3 Canadian Standards Association (CSA)
 - .1 CAN/CSA A440.4-07, Window, Door, and Skylight Installation.
 - .2 CSA G40.20-04/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .3 CSA W59-13, Welded Steel Construction (Metal Arc Welding).
- .4 Canadian Steel Door Manufacturers' Association (CSDMA)
 - .1 CSDMA, Recommended Specifications for Commercial Steel Doors and Frame Products, 2006.
 - .2 CSDMA, Recommended Selection and Usage Guide for Commercial Steel Door and Frame Products, 2009.
- .5 National Fire Protection Association (NFPA)
 - .1 NFPA 80-2007, Standard for Fire Doors and Other Opening Protectives.
 - .2 NFPA 252-12, Fire Tests of Door Assemblies.
- .6 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN4-S104-M80, Standard Method for Fire Tests of Door Assemblies.
 - .2 CAN4-S105-M85, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN/ULC S104.
 - .3 CAN4-S106-M80, Fire Tests of Window and Glass Block Assemblies.
 - .4 CAN/ULC S704-03, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

1.2 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 Provide fire labelled frames for openings requiring fire protection ratings.
 - .2 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN4-S104 or NFPA 252 for ratings specified or indicated.

- .3 Steel fire rated borrowed light and window assemblies: Conform to CAN4-S106.

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings:
 - .1 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, glazing, arrangement of hardware, fire ratings, and finishes.
 - .2 Indicate each type of frame material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings, fire rating, and finishes.
 - .3 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver, handle, and store doors and frames at the job site in such manner as to prevent damage.
- .3 Store doors and frames under cover with doors stored in a vertical position on blocking, clear of floor, and with blocking between doors to permit air circulation.
- .4 Waste Management and Disposal: Remove waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 Hot dipped galvanized steel sheet: To ASTM A653/A653M, CS Type B.
 - .1 Galvanizing thickness: Z120 (G40).

2.2 DOOR CORE MATERIALS

- .1 Honeycomb construction for interior doors: Structural small cell, 24.5 mm maximum kraft paper 'honeycomb', density: 16.5 kg/m³ minimum, sanded to required thickness.

2.3 ADHESIVES

- .1 Honeycomb cores and steel components: heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.
- .2 Polyurethane cores: Heat resistant, epoxy resin based, low viscosity, contact cement.

- .3 Lock-seam doors: Fire resistant, resin reinforced polychloroprene, high viscosity, sealant/adhesive.

2.4 PAINT

- .1 Touch-up primer to CAN/CGSB 1.181.
- .2 Field paint steel doors and frames in accordance with Section 09 91 00 – Painting. Protect weatherstrips from paint. Provide final finish free of scratches or other blemishes.

2.5 ACCESSORIES

- .1 Door Hardware and Weatherstripping: Specified in Section 08 71 00.
- .2 Door silencers: Single stud rubber/neoprene type.
- .3 Metallic paste filler: To manufacturer's standard.
- .4 Fire labels: Metal riveted.
- .5 Sealant: Refer to Section 07 92 00 – Joint Sealing.
- .6 Frame filler and rough-in gap sealer: One component, low-expanding polyurethane foam.
- .7 Glazing Stops: Formed galvanized steel channel, minimum 16 mm high, accurately fitted, butted at corners and fastened to frame sections with counter-sunk, tamper proof sheet metal screws.
- .8 Glass: 6 mm laminated and wired glass to CAN/CGSB 12.1-2017.
- .9 Finish painting: Refer to Section 09 91 00 – Painting.

2.6 DOOR FABRICATION GENERAL

- .1 Doors: Swing type, flush, with provision for glass openings as indicated.
- .2 Form face sheets for exterior doors from 1.3 mm sheet steel with polyurethane core laminated under pressure to face sheets.
- .3 Form face sheets for interior doors from 1.3 mm sheet steel with honeycomb core laminated under pressure to face sheets.
- .4 Fabricate doors with longitudinal edges lock-seamed, adhesive assisted.
 - .1 Seams: Visible.
- .5 Blank, reinforce, drill doors and tap for mortised, templated hardware and electronic hardware.
- .6 Fabricate doors with semi-mortised bottom to accommodate flush mounting of automatic door bottoms, where scheduled.
- .7 Factory prepare holes 12.7 mm diameter and larger except mounting and through-bolt holes, on site, at time of hardware installation.
- .8 Reinforce doors where required, for surface mounted hardware.
- .9 Provide inverted, recessed, spot welded channels to top and bottom of interior doors.

- .10 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.
- .11 Provide fire labelled doors for those openings requiring fire protection ratings, as scheduled. Test such products in conformance with CAN/ULC S104 or NFPA 252 and list by nationally recognized agency having factory inspection service and construct as detailed in Follow-Up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.

2.7 FRAME FABRICATION GENERAL

- .1 Fabricate frames in accordance with CSDMA specifications.
- .2 Fabricate frames to profiles and maximum face sizes as indicated.
- .3 Exterior frames: 1.6 mm welded, thermally broken type construction.
- .4 Interior frames: 1.6 mm welded type construction.
- .5 Blank, reinforce, drill and tap frames for mortised, templated hardware, using templates provided by finish hardware supplier. Reinforce frames for surface mounted hardware.
- .6 Prepare frame for door silencers, 3 for single door, 2 at head for double door.
- .7 Conceal fastenings except where exposed fastenings are indicated.
- .8 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.

2.8 FRAME ANCHORAGE

- .1 Shim and anchor new doors in accordance with CAN/CSA A440.4.
- .2 Provide appropriate anchorage to floor and wall construction.
- .3 Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.
- .4 Provide 2 anchors for rebate opening heights up to 1520 mm and 1 additional anchor for each additional 760 mm of height or fraction thereof.

2.9 FRAMES: WELDED TYPE

- .1 Welding in accordance with CSA W59.
- .2 Accurately mitre or mechanically joint frame product and securely weld on inside of profile.
- .3 Cope accurately and securely weld butt joints of mullions, transom bars, centre rails, and sills.
- .4 Grind welded joints and corners to a flat plane, fill with metallic paste and sand to uniform smooth finish.
- .5 Securely attach floor anchors to inside of each jamb profile.
- .6 Weld in 2 temporary jamb spreaders per frame to maintain proper alignment during shipment.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION GENERAL

- .1 Install labelled steel fire rated doors and frames to NFPA 80 except where specified otherwise.
- .2 Install doors and frames to CSDMA Installation Guide.

3.3 FRAME INSTALLATION

- .1 Set frames plumb, square, level, and at correct elevation.
- .2 Secure anchorages and connections to adjacent construction.
- .3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.
- .4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.
- .5 Exterior door frames: Fill rough-in space and hollow behind frame with low-expanding spray foam polyurethane.
- .6 Caulk perimeter of frames between frame and adjacent material.
- .7 Maintain continuity of air barrier and vapour retarder.

3.4 DOOR INSTALLATION

- .1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 00 - Door Hardware.
- .2 Provide even margins between doors and jambs, and doors and finished floor as follows.
 - .1 Hinge side: 1.0 mm.
 - .2 Latchside and head: 1.5 mm.
 - .3 Finished floor: 13 mm.
- .3 Adjust operable parts for correct function.

3.5 FINISH REPAIRS

- .1 Touch up with primer finishes damaged during installation.
- .2 Fill exposed frame anchors and surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.

3.6 GLAZING

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Architectural Woodwork Manufacturers Association of Canada (AWMAC)
 - .1 Architectural Woodwork Standards, Edition 2, 2014.
- .2 Canadian Standards Association (CSA)
 - .1 CAN/CSA O132.2 Series-90 (R1998), Wood Flush Doors.
 - .2 CAN/CSA O132.5-M1992 (R1998), Stile and Rail Wood Doors.
- .3 National Fire Protection Association (NFPA)
 - .1 NFPA 80-2007, Standard for Fire Doors and Other Opening Protectives.
 - .2 NFPA 252-2012, Fire Tests of Door Assemblies.
- .4 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN4-S104-M80, Fire Tests of Door Assemblies.
 - .2 CAN4-S105-M85, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN/ULC S104.

1.2 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications, data sheets and installation instructions. Include door core materials, thickness, construction.
 - .2 Submit WHMIS Material Safety Data Sheets. Indicate VOC content for door materials and adhesives.
- .3 Shop Drawings:
 - .1 Indicate door types and cut-outs for lights, sizes, core construction, transom panel construction, locations, swings, undercuts, hardware locations and preparation requirements, blocking for hardware in mineral core doors, fire ratings, finishes, glass, and other pertinent data.
- .4 Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.3 QUALITY ASSURANCE

- .1 Perform work to custom grade in accordance with requirements of AWMAC Architectural Woodwork Standards.

1.4 REGULATORY REQUIREMENTS

- .1 Wood fire rated doors:

- .1 Provide doors tested in compliance with CAN4-S104 or NFPA 252.
- .2 Provide doors with ULC or ITS/Warnock Hersey label.
- .2 Installed Fire Rated Door Assembly: Conform to NFPA 80 for fire rated class as indicated.
- .3 Provide fire-rated wood doors with either ULC or ITS/Warnock Hersey label, and of the construction standard to the door manufacturer and conform to the requirements of manufacturer's labelling agency.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, protect, and handle products in compliance with AWMAC Architectural Woodwork Standards, and with manufacturer's recommendations.
- .2 Arrange for delivery after work causing abnormal humidity has been completed.
- .3 Accept doors on site in manufacturer's packaging. Inspect for damage.
- .4 Storage and Protection:
 - .1 Protect doors from dampness.
 - .2 Store doors in well ventilated room, off floor, in accordance with manufacturer's recommendations.
 - .3 Protect doors from scratches, handling marks, and other damage.
 - .4 Store doors away from direct sunlight.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove waste material in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 Ensure products contain no added urea formaldehyde resins and adhesives.

2.2 FIRE RATED WOOD DOORS

- .1 Tested in accordance with CAN4-S104 or NFPA 252 to achieve rating as scheduled.
- .2 Solid core: To CAN/CSA O132.2, stile and rail frame, 5-ply construction.
 - .1 Core for 45 minute rated doors: Mineral, or structural composite lumber.
- .3 Stiles and rails: Manufacturer's standard, conforming to requirements of manufacturer's labelling agency.
- .4 Face panels for opaque finish: MDO.
- .5 Edges: Square.
- .6 Adhesive: Type II (water resistant) for interior doors.

2.3 NON-RATED WOOD FLUSH DOORS

- .1 Manufacture doors to ANSI/WDMA I.S. 1a-11 Heavy Duty performance level.
- .2 Solid core: To CAN/CSA O132.2, stile and rail frame, 5-ply construction.
 - .1 Particleboard or structural composite lumber.
- .3 Face panels for opaque finish: MDO.
- .4 Edges: Square.
- .5 Adhesive: Type II (water resistant) for interior doors.

2.4 GLAZING

- .1 Glass: Refer to Section 08 80 50 – Glazing.

2.5 FINISH

- .1 Paint doors and frames in accordance with Section 09 91 00 – Painting.

2.6 FABRICATION

- .1 Prepare doors for glazing. Provide glazing stops with mitred corners.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.2 INSTALLATION

- .1 Unwrap and protect doors in accordance with CAN/CSA O132.2 Series.
- .2 Install labelled fire rated doors to NFPA 80.
- .3 Install doors and hardware in accordance with manufacturer's printed instructions and CAN/CSA O132.2 Series.
- .4 Adjust hardware for correct function.
- .5 Install glazing in accordance with Section 08 80 50 - Glazing.
- .6 Install stops.

3.3 ADJUSTMENT

- .1 Re-adjust doors and hardware just prior to completion of building to function freely and properly.

3.4 CLEANING

- .1 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.

- .2 Remove traces of primer and caulking; clean doors and frames.
- .3 Clean glass and glazing materials with approved non-abrasive cleaner.
- .4 On completion of installation, remove surplus materials, rubbish, tools, and equipment barriers.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM B221/B221M-14, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-12.1-M90, Tempered or Laminated Safety Glass.
 - .2 CAN/CGSB-12.8-97, Insulating Glass Units.
 - .3 CAN/CGSB 12.20-M89, Structural Design of Glass for Buildings.
- .3 Canadian Standards Association (CSA)
 - .1 AAMA/WDMA/CSA 101/I.S.2/A440-11, NAFS – North American Fenestration Standard/Specification for Windows, Doors, and Skylights.

1.2 PERFORMANCE REQUIREMENTS

- .1 Aluminum Framed Entrance System: To AAMA/WDMA/CSA 101/I.S.2/A440, supplemented as follows:
 - .1 Thermally broken aluminum frames meeting specified performance and design requirements are acceptable.
 - .2 Entrance system average thermal resistance: U-Value \leq 1.0.
 - .3 Deflection limit of framing members; L/175.
- .2 Provide anchorage capable of withstanding wind load, design in accordance with National Building Code.
- .3 Design to accommodate expansion and contraction within service temperature range of -35°C to 35°C.
- .4 Allow for movement within system.
- .5 Allow for movement between system and perimeter framing components or substrate.
- .6 Doors: Ratings to CSA A440-00.
 - .1 Air infiltration rating: A3.
 - .2 Water tightness rating: B3.
 - .3 Wind load resistance: C5.
- .7 Glazing: Size glass thickness and glass unit dimensions to limits in accordance with CAN/CGSB-12.20.

1.3 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for aluminum framed entrances; include product characteristics, performance criteria, physical size, finishes, and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Saskatchewan.
 - .2 Indicate materials and details in full size scale, showing entrance system dimensions, elevations, sections, details, attachments to other work, and installation details.
 - .1 Interior trim and exterior junctions with adjacent construction.
 - .2 Junctions between combination units.
 - .3 Core thicknesses of components.
 - .4 Type and location of exposed finishes, method of anchorage, number of anchors, supports, reinforcement, and accessories.
 - .5 Each type of door system including location.
 - .6 Arrangement of reinforcing for hardware and joints.
 - .7 Arrangement of hardware and required clearances.
 - .8 Location of caulking.
 - .9 Include thermal resistance value of aluminum framed entrance system.
- .4 Test and Evaluation Reports:
 - .1 Submit test reports from approved independent testing laboratories, certifying compliance with specifications, for:
 - .1 Air tightness.
 - .2 Water tightness.
 - .3 Wind load resistance.
 - .4 Condensation resistance.
- .5 Certifications: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
 - .1 Apply temporary protective coating to finished surfaces. Remove coating after installation. Use coatings that are easily removed and residue-free.
 - .2 Leave protective covering in place until final cleaning of building.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect doors and frames from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Aluminum extrusions: ASTM B221: AA 6063-T5 or 6063-T6.
- .2 Reinforcing Members: Aluminum, stainless steel, or nickel/chrome-plated steel complying; provide sufficient strength to meet performance specified.

2.2 GLASS

- .1 Glass: Insulated glazing units to CAN/CGSB 12.8, double pane unit, certified by IGMA.
 - .1 Glass: To CAN/CGSB 12.1, tempered, minimum 6 mm each light.
 - .2 Inert gas fill: Argon.
- .2 Glazing materials:
 - .1 Setting blocks: To suit glazing method, glass light weight and area, silicone, Shore A hardness 80-90 durometer.
 - .2 Glazing tape and splines: Manufacturer's standard, compatible with framing material.

2.3 ACCESSORIES

- .1 Fasteners: Aluminum, nonmagnetic stainless steel, or other materials to be non-corrosive and compatible with framing members, trim hardware, anchors, and other components.
- .2 Thermal break: PVC.
- .3 Isolation coating: Cold-applied, asphalt-mastic paint, asbestos free, 0.76 mm (30 mil) per coat.

- .4 Sealant: For sealants required within fabricated entrance system, provide permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.

2.4 FINISHES

- .1 Aluminum: Clear anodizing.

2.5 FABRICATION

- .1 Fabricate in accordance with AAMA/WDMA/CSA 101/I.S.2/A440, supplemented as follows:
 - .1 Make profiles sharp, straight, and free of defects or deformations.
 - .2 Accurately fit joints; make joints flush, hairline, and weatherproof.
 - .3 Reinforce mechanically-joined corners to produce sturdy frames.
 - .4 Provide structural steel reinforcement as required.
 - .5 Provide means to drain water passing joints, condensation within framing members, and moisture migrating within system, to exterior.
 - .6 Provide thermal isolation of glazing from framing members.
 - .7 Accommodate for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - .8 Conceal fasteners, anchors, and connection devices from view to greatest extent possible.
- .2 Mortise, reinforce, drill and tap doors, frames and reinforcements to receive hardware.
- .3 Glazing stops: interlocking snap-in type for dry glazing. Exterior stops: tamperproof type.
 - .1 Provide for field replacement of glazing.
- .4 Supply thermally broken doors and frames for exterior.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify conditions of substrates are acceptable for entrance system installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.
 - .2 Inform Owner Representative of unacceptable conditions.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Manufacturer's Instructions: Comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 Install frame system level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.
- .3 Install system and components to drain condensation, water penetrating joints, and moisture migrating within system to exterior.
- .4 Make allowances for deflection of structure to ensure that structural loads are not transmitted to frames.
- .5 Install door and hardware in accordance with hardware templates and manufacturer's instructions.
- .6 Adjust door components to ensure smooth operation.
- .7 Install glazing in accordance with AAMA/WDMA/CSA 101/I.S.2/A440.
- .8 Seal joints to provide weathertight seal at outside and air/vapour seal at inside.
- .9 Isolate aluminum from direct contact with dissimilar metals, concrete and masonry.
- .10 Apply sealant in accordance with Section 07 92 00 - Joint Sealants. Conceal sealant within framing except where exposed use is permitted by Departmental Representative.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Perform cleaning of components in accordance with AAMA.
 - .3 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.
 - .4 Clean aluminum with damp rag and approved non-abrasive cleaner.
 - .5 Remove traces of primer, caulking, epoxy and filler materials; clean doors and frames.
 - .6 Clean glass and glazing materials with approved non-abrasive cleaner.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: Remove waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

3.4 PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA)
 - .1 ANSI A117.1-2009, Standard for Accessible and Usable Buildings.
 - .2 ANSI/BHMA A156.1-2013, American National Standard for Butts and Hinges.
 - .3 ANSI/BHMA A156.4-2013, Door Controls - Closers.
 - .4 ANSI/BHMA A156.6-2010, Architectural Door Trim.
 - .5 ANSI/BHMA A156.13-2012, Mortise Locks.
 - .6 ANSI/BHMA A156.21-2014, Thresholds.
 - .7 ANSI/BHMA A156.22-2012, Door Gasketing and Edge Seal Systems.
 - .8 ANSI/BHMA A156.31-2013, Electric Strikes and Frame Mounted Actuators.
- .2 ASTM International
 - .1 ASTM E283-04 (2012), Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
 - .2 ASTM F1577-05 (2012), Standard Test Methods for Detention Locks for Swinging Doors.
- .3 Canadian Standards Association (CSA)
 - .1 CSA B651-12 – Accessible Design for the Built Environment.
- .4 Canadian Steel Door and Frame Manufacturers' Association (CSDMA)
 - .1 CSDMA Recommended Dimensional Standards for Commercial Steel Doors and Frames - 2009.
- .5 National Fire Protection Association (NFPA)
 - .1 NFPA (Fire) 80 - Standard for Fire Doors and Other Opening Protectives, 2007 edition.
 - .2 NFPA 105-2013, Smoke Door Assemblies and Other Opening Protectives.
 - .3 NFPA (Fire) 252 - Fire Tests of Door Assemblies, 2012 edition.
- .6 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC S104-M80, Fire Tests of Door Assemblies.

1.2 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for door hardware and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Samples:
 - .1 Submit for review and acceptance of each unit.
 - .2 Samples will be returned for inclusion into work.
 - .3 Identify each sample by label indicating applicable specification paragraph number, brand name and number, finish and hardware package number.
 - .4 After approval samples will be returned for incorporation in Work.
- .4 Hardware List:
 - .1 Submit contract hardware list.
 - .2 Indicate specified hardware, including make, model, material, function, size, finish and other pertinent information.
- .5 Manufacturer's Instructions: Submit manufacturer's installation instructions.
- .6 Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
- .7 Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.3 CLOSEOUT SUBMITTALS

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

1.4 QUALITY ASSURANCE

- .1 Regulatory Requirements:
 - .1 Hardware for doors in fire separations and exit doors certified by a Canadian Certification Organization accredited by Standards Council of Canada.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Package items of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.
- .4 Storage and Handling Requirements:

- .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, well-ventilated area.
- .2 Store and protect door hardware from nicks, scratches, and blemishes.
- .3 Protect prefinished surfaces with wrapping or strippable coating.
- .4 Replace defective or damaged materials with new.

Part 2 Products

2.1 HARDWARE ITEMS

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

2.2 DOOR HARDWARE

- .1 Mortise locks and latches: To BHMA A156.13, series 1000 mortise lock, Grade 1 and Security Grade 1. Meets impact requirements of ASTM F1577.
 - .1 Case: Wrought steel, zinc dichromate plated, 3 mm thick.
 - .2 Latchbolt: Stainless steel, minimum 19 mm throw.
 - .3 Strikes: To ANSI A115.1.
 - .4 Lever: L-shaped, forged or cast.
 - .5 Escutcheons: As scheduled.
 - .6 Function: As scheduled.
- .2 Cylindrical lock: To BHMA A156.2, Series 4000, Grade 1 and ANSI A117.1; through-bolt style.
 - .1 Latchbolt: Minimum 13 mm throw.
 - .2 Levers: Solid cast.
 - .3 Roses: Heavy wrought.
 - .4 Strikes: Curved lip, 124 mm height, complete with wrought boxes.
 - .5 Cylinders: To BHMA A156.5, brass, 6-pin.
 - .6 Function: As scheduled.
- .3 Electric strikes: To BHMA A156.31, Grade 1; heavy duty stainless steel.
 - .1 Conforms to CAN4-S104 for fire doors.
 - .2 Static strength: 1133 kg (2500 lbs).
 - .3 Dynamic strength: 160 N-m (120 ft-lbs).
 - .4 UL 1034 – burglar resistant, suitable for outdoor use.
 - .5 Dual voltage: 12/24 VDC.
- .4 Exit device: To BHMA A156.3, Grade 1, heavy duty cast chassis, non-ferrous removable covers, metal end caps, maximum 3 inch projection.
- .5 Hinges: To BHMA A156.1, five-knuckle.
 - .1 Provide hinges with non-removable pins where scheduled.
 - .2 Provide pre-wired hinges where scheduled.
 - .3 Provide hinges with safety studs where scheduled.

- .4 Standard weight: 0.134 gauge steel.
- .5 Heavy weight: 0.180 gauge steel.
- .6 Door closers: To BHMA A156.4, Grade 1, rack and pinion operation, adjustable backcheck intensity.
 - .1 Arms: Heavy duty forged steel; standard and parallel, with compressions stops, as scheduled.
- .7 Door bottom: To ANSI/BHMA A156.21 and ASTM E283, aluminum case with movable sponge neoprene drop bar seal. Seal actuated by plunger contacting jamb.
- .8 Door sweep: To ANSI/BHMA A156.22, extruded aluminum retainer, alloy 6063-T6; with neoprene insert.
- .9 Wall stops: Brass, bronze, and stainless steel with rubber bumper, 63 mm diameter, 19 mm projection, concealed mounting.
 - .1 Bumper: Convex or concave as indicated in schedule.
- .10 Threshold: To ANSI/BHMA A156.21, saddle-style threshold, extruded tempered aluminum, alloy 6063-T6, fluted surface.
- .11 Flush bolts: To ANSI/BHMA A156.16; cast brass, 19 mm bolt throw, 19 mm backset.
 - .1 Dust proof strike: Brass; compatible with flush bolt; adjustable height, barrel 22 mm diameter x 51 mm depth.
- .12 Perimeter gasketing: To ANSI/BHMA A156.22 Category J, extruded tempered aluminum retainer, alloy 6063-T6; with black sponge silicone seal, heavy duty type; stainless steel fasteners.
- .13 Adhesive gasketing: Silicone extrusion, low closing force fin with stabilizer flange, and adhesive backing; meets NFPA 105.
 - .1 Air infiltration: 0.09 cfm/foot to ASTM E283.
- .14 Latch protector: Steel, minimum 12 gauge thickness, to encase electric strike keeper.
- .15 Architectural door trim: To BHMA A156.6.
 - .1 Door protection plates: Kick plate type 1.27 mm thick stainless steel, No. 4 finish.

2.3 FASTENINGS

- .1 Use only fasteners provided by manufacturer. Failure to comply may void warranties and applicable licensed labels.
- .2 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.
- .3 Exposed fastening devices to match finish of hardware.

- .4 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices, and install so pull can be secured through door from reverse side. Install push plate to cover fasteners.
- .5 Use fasteners compatible with material through which they pass.

2.4 KEYING

- .1 Refer to Door Hardware Schedule.
- .2 Contact Owner Representative for Keying Strategy.
- .3 Provide keys in duplicate for every lock.
- .4 Provide four master keys for each master key group.
- .5 Stamp keying code numbers on keys and cylinders.

Part 3 Execution

3.1 INSTALLATION

- .1 Manufacturer's Instructions: Comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 Supply door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.
- .3 Supply manufacturers' instructions for proper installation of each hardware component.
- .4 Install hardware to standard hardware location dimensions in accordance with CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction) and CSA B651.
- .5 Where doorstop contacts door pulls, mount stop to strike bottom of pull.
- .6 Use only manufacturer's supplied fasteners.
 - .1 Use of "quick" type fasteners, unless specifically supplied by manufacturer, is unacceptable.
- .7 Remove construction cores when directed by Owner Representative.
 - .1 Install permanent cores and ensure locks operate correctly.

3.2 ADJUSTING

- .1 Adjust door hardware, operators, closures and controls for optimum, smooth operating condition, safety and for weather tight closure.
- .2 Lubricate hardware, operating equipment and other moving parts.
- .3 Adjust door hardware to ensure tight fit at contact points with frames.

3.3 CLEANING

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

- .1 Leave Work area clean at end of each day.
 - .2 Clean hardware with damp rag and approved non-abrasive cleaner, and polish hardware in accordance with manufacturer's instructions.
 - .3 Remove protective material from hardware items where present.
 - .4 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .2 Waste Management: Remove waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

3.4 PROTECTION

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

3.5 SCHEDULE

Set: 1.0

3 Hinge (heavy weight)	T4A3386 NRP SSF 4-1/2" x 4-1/2"	US26D	MK
1 Rim Exit Device	AD8504 862	US32D	SA
1 Electric Strike	9600-LBM	630	HS
1 Conc Overhead Stop	6-X36	630	RF
1 Door Closer	281 OZ	EN	SA
1 Mounting Plate	281B	EN	SA
1 Threshold	171A		PE
1 Weatherstrip and Sweep	By Door Supplier		
1 Card Reader	By Security Division		
1 Power Supply	By Electrical/Security Division		

Set: 2.0

3 Hinge	TA2714 4-1/2" x 4"	US26D	MK
1 Passage Set	8215 LE1L	US26D	SA
1 Door Closer	1431 O	EN	SA
1 Kick Plate	K1050 10"	US32D	RO
1 Wall Stop	406	US32D	RO
1 Gasketing	S88BL		PE
1 Door Bottom	4131CRL		PE

Set: 3.0

3 Hinge	TA2714 4-1/2" x 4"	US26D	MK
1 Office Lock	8205 LE1L ("0" bitted LA cylinder)	US26D	SA
1 Wall Stop	406	US32D	RO
1 Gasketing	S88BL		PE
1 Door Bottom	4131CRL		PE

Set: 4.0

3 Hinge	TA2714 4-1/2" x 4"	US26D	MK
1 Classroom Lock	8237 LE1L	US26D	SA
1 Wall Stop	406	US32D	RO
1 Gasketing	S88BL		PE
1 Door Bottom	4131CRL		PE

Set: 5.0

1 Passage Lock	10U15 LL	US26D	SA
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Remove existing lock, return to
Owner Representative

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI Z97.1-2015, Safety Glazing Materials Used in Buildings – Safety Performance Specifications and Methods of Test.
- .2 ASTM International
 - .1 ASTM C542-05 (2011), Standard Specification for Lock-Strip Gaskets.
 - .2 ASTM D2240-05 (2010), Standard Test Method for Rubber Property - Durometer Hardness.
 - .3 ASTM F1233-08 (2013), Standard Test Method for Security Glazing Materials and Systems.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 12.1-2017, Safety Glazing.
 - .2 CAN/CGSB 12.8-97, Insulating Glass Units.
- .4 Glass Association of North American (GANA)
 - .1 GANA Glazing Manual – current edition.
 - .2 GANA Laminated Glazing Reference Manual - 2009.
- .5 United States Consumer Product Safety Commission (CPSC)
 - .1 CPSC 16CFR1201 – Safety Standard for Architectural Glazing Materials.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Hold project meetings bi-weekly.
- .2 Ensure key personnel, site supervisor, project manager, and subcontractor representatives attend.
- .3 Owner Representative will submit written notification of change to meeting schedule established upon contract award 24 hours prior to scheduled meeting.

1.3 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for glass, sealants, and glazing accessories; include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Show layout, profiles, and product components, including anchorage, accessories, finishes, colours, patterns.

- .2 Include detailed plans, elevations, details of framing members, sealants, fasteners, anchors, thicknesses.
- .4 Samples:
 - .1 Submit duplicate 200 x 200 mm size samples of each type of glass proposed for installation.
- .5 Certificates: Submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.4 CLOSEOUT SUBMITTALS

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

1.5 QUALITY ASSURANCE

- .1 Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .2 Mock-ups:
 - .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.
 - .2 Construct mock-up to include glass and glazing.
 - .3 Mock-up will be used:
 - .1 To judge quality of work, substrate preparation, operation of equipment and material application.
 - .4 Locate where directed by Owner Representative.
 - .5 Allow 24 hours for inspection of mock-up before proceeding with work.
 - .6 Reviewed mock-up may remain as part of finished work.

1.6 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 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 glazing and frames from nicks, scratches, and blemishes.
 - .3 Protect prefinished aluminum surfaces with strippable coating.
 - .4 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Glass for non-rated interior doors: To CAN/CGSB 12.1, 6 mm thick.
 - .1 Type 2-tempered.
 - .2 Class B-float.
 - .3 Category 11.
 - .4 Edge treatment.
- .2 Glass for fire-rated interior doors: To CAN/CGSB 12.1, laminated wired glass, 6 mm thick.
 - .1 Fire rating: UL classified and labelled.
 - .2 Impact safety rating: ANSI Z97.1 and CPSC 16CFR1201 CAT I and II.
 - .3 Provide glazing tapes recommended by wired glass manufacturer for compliant fire-rated installation.
- .3 Glass for side lights, transoms, and exterior doors: To CAN/CGSB 12.8, dual glazed unit.
 - .1 Panes: 6 mm tempered glass to CAN/CGSB 12.1.
 - .2 Spacer width: To suit installation and acoustic requirements.

2.2 ACCESSORIES

- .1 Glazing films: Single layered decorative film products, applied to interior glass surfaces.
 - .1 Removable release liner.
 - .2 Pressure sensitive adhesive.
 - .3 Pattern: As selected by Owner Representative from manufacturer's full range.
 - .4 Glazing Film Accessories:
 - .1 General: Provide products complying with requirements of glazing film manufacturer for application indicated.
 - .2 Cleaners, Primers, and Sealers: Types recommended by glazing film manufacturer.
- .2 Setting blocks: Neoprene, 80-90 Shore A durometer hardness to ASTM D2240, to suit glazing method, glass light weight and area.
- .3 Spacer shims: Neoprene, 50-60 Shore A durometer hardness to ASTM D2240, 75 mm long x one half height of glazing stop x thickness to suit application. Self-adhesive on one face.
- .4 Glazing tape: Preformed butyl compound with integral resilient tube spacer, 10-15 Shore A durometer hardness to ASTM D2240; coiled on release paper; widths as required for application, black colour.
- .5 Glazing splines: Resilient polyvinyl chloride or silicone, extruded shape to suit glazing channel retaining slot, colour as selected by Owner Representative.

- .6 Lock-strip gaskets: To ASTM C542.
- .7 Sealant: In accordance with Section 07 92 00 - Joint Sealants.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify conditions of substrates are acceptable for glazing installation in accordance with manufacturer's written instructions.
 - .1 Verify openings for glazing are correctly sized and within tolerance.
 - .2 Verify surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.
 - .3 Visually inspect substrate.
 - .4 Inform Owner Representative of unacceptable conditions.
 - .5 Proceed with installation only after unacceptable conditions have been remedied.

3.2 PREPARATION

- .1 Clean contact surfaces with solvent and wipe dry.
- .2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- .3 Prime surfaces scheduled to receive sealant.

3.3 INSTALLATION: INTERIOR - DRY METHOD (TAPE AND TAPE)

- .1 Perform work in accordance with GANA Glazing Manual and GANA Laminated Glazing Reference Manual for glazing installation methods.
- .2 Cut glazing tape to length and set against permanent stops, projecting 1.6 mm above sight line. Butt-joint tape edges, seal joints with butyl sealant.
- .3 Place setting blocks at 1/4 points, with edge block maximum 150 mm from corners.
- .4 Set glass unit on setting blocks; apply pressure against fixed stop for full contact.
- .5 Place glazing tape on free perimeter of glazing in same manner described.
- .6 Install removable stop without displacement of tape. Apply pressure on tape for full continuous contact.
- .7 Knife trim protruding tape.

3.4 CLEANING

- .1 Progress Cleaning: Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .1 Remove traces of primer, caulking.
 - .2 Remove glazing materials from finish surfaces.

- .3 Remove labels.
- .4 Clean glass using approved non-abrasive cleaner in accordance with manufacturer's instructions.
- .2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .2 Waste Management: Remove waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

3.5 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 After installation, mark each light with an "X" by using removable plastic tape or paste.
- .3 Repair damage to adjacent materials caused by glazing installation.

END OF SECTION

NO.	ROOM NAME	FLOOR	BASE	CEILING		WALL								NOTES
						NORTH		EAST		SOUTH		WEST		
						Material	Mat.	Material	Fin.	Material	Fin.	Material	Fin.	
101	Vestibule	RSF	RB	EX	PT	EX	-	EX	-	EX	-	EX	-	
102	Training	RSF	RB	EX	PT	EX/GWB	PT	EX	PT	EX	PT	EX	PT	
103	Custodial Closet	RSF	RB	EX	PT	EX	PT	EX	PT	EX	PT	EX	PT	
104	Machine Room	EX	EX	EX	-	EX	-	EX	-	EX	-	EX	-	
105	Reading	RSF	RB	EX	PT	EX	PT	EX	PT	EX	PT	EX	PT	
105A	Kitchenette	RSF	RB	EX	PT	EX	PT	-	-	-	-	EX	PT	
106	Coats	RSF	RB	EX	PT	EX	PT	EX	PT	-	-	EX	PT	
107	Women's WC	EX	EX	EX	-	EX	-	EX	-	EX	-	EX	-	
108	Men's WC	EX	EX	EX	-	EX	-	EX	-	EX	-	EX	-	
109	Library	CPT	RB	EX	PT	EX/GWB	PT	EX	PT	EX/GWB	PT	GWB	PT	
110	Office	CPT	RB	EX	PT	EX	PT	GWB	PT	GWB	PT	EX	PT	
111	Office	CPT	RB	EX	PT	GWB	PT	GWB	PT	GWB	PT	EX	PT	
112	Office	CPT	RB	EX	PT	GWB	PT	GWB	PT	EX	PT	EX	PT	1
ST1	Stair	RSF/CPT	RB	EX	PT	EX	PT	EX	PT	EX	PT	EX	PT	2
ST2	Stair	RSF/CPT	RB	EX	PT	EX	PT	EX	PT	EX	PT	EX	PT	2
Lift 1	Lift	EX	EX	EX	-	EX	-	EX	-	EX	-	EX	-	
201	Carrels	CPT	RB	ACT	-	EX	PT	EX	PT	EX	PT	EX	PT	
202	Copy	RSF	RB	ACT	-	GWB	PT	EX	PT	EX	PT	EX	PT	
203	Storage	CPT	RB	EX	-	EX	-	EX	-	EX	-	EX	-	
204	Storage	EX	EX	EX	-	EX	-	EX	-	EX	-	EX	-	
205A	Meeting Room	CPT	RB	ACT	-	EX	PT	EX	PT	EX	PT	EX	PT	
205B	Meeting Room	CPT	RB	ACT	-	EX	PT	EX	PT	EX	PT	EX	PT	
206	Quiet Room	CPT	RB	ACT	-	EX	PT	EX	PT	EX	PT	EX	PT	
207	Storage	EX	EX	EX	-	EX	-	EX	-	EX	-	EX	-	
208	Quiet Room	CPT	RB	ACT	-	EX	PT	EX	PT	EX	PT	EX	PT	
209	Storage	EX	EX	EX	-	EX	-	EX	-	EX	-	EX	-	
210	Storage	EX	EX	EX	-	EX	-	EX	-	EX	-	EX	-	

LEGEND

ACT Acoustic Ceiling Tile
CPT Carpet Tile
EX Existing
GWB Gypsum Wall Board
PT Paint
RSF Resilient Sheet Flooring

NOTES

1. Window film to be applied to vestibule glazing.
2. Carpet tile on second floor landing only.

Part 1 General

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM C475/C475M-15, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
 - .2 ASTM C557-03 (2009)e1, Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.
 - .3 ASTM C645-14, Non-Structural Steel Framing Members.
 - .4 ASTM C754-11, Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
 - .5 ASTM C840-13, Standard Specification for Application and Finishing of Gypsum Board.
 - .6 ASTM C954-11, 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.
 - .7 ASTM C1002-07, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
 - .8 ASTM C1047-14a, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
 - .9 ASTM C1396/C1396M-14, Standard Specification for Gypsum Wallboard.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .3 Gypsum Association (GA)
 - .1 GA-214-15, Recommended Levels of Finish for Gypsum Board, Glass Mat, and Fiber-Reinforced Gypsum Panels.
 - .2 GA-216-13, Application and Finishing of Gypsum Panel Products.
- .4 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC S102-10, Standard Method of Fire Endurance Tests of Building Construction and Materials.

1.2 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; include product characteristics, performance criteria, physical size, finish, and limitations.

1.3 REGULATORY REQUIREMENTS

- .1 Conform to applicable code for fire rated assemblies in conjunction with Section 09 22 16 as follows:
 - .1 Fire resistance classifications to CAN/ULC S102.
 - .2 Fire rated Design Assembly No. as listed on Drawings.

1.4 MOCK-UPS

- .1 Construct mock-up in accordance with Section 01 45 00 - Quality Control.
- .2 Construct wall assembly, full height by 1200 mm wide, illustrating materials installation and interface.
- .3 Locate where directed.
- .4 Accepted mock-up may remain as part of finished work.
- .5 Allow for review of mock-up by Owner Representative before proceeding with gypsum wall partition Work.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Deliver materials to site in original packaging, labelled with manufacturer's name and identification.
- .3 Storage and Handling Requirements:
 - .1 Store gypsum board assemblies materials level off ground and indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect gypsum board assemblies from nicks, scratches, and blemishes.
 - .3 Protect from weather, elements and damage from construction operations.
 - .4 Handle gypsum boards to prevent damage to edges, ends or surfaces.
 - .5 Replace defective or damaged materials with new.

1.6 AMBIENT CONDITIONS

- .1 Maintain temperature 10°C minimum, 21°C maximum for 48 hours prior to and during application of gypsum boards and joint treatment, and for 48 hours minimum after completion of joint treatment.
- .2 Apply board and joint treatment to dry, frost-free surfaces.
- .3 Ventilate building spaces as required to remove excess moisture that would prevent drying of joint treatment material immediately after its application.

Part 2 Products

2.1 MATERIALS

- .1 Standard gypsum board: ASTM C1396/C1396M, regular and Type X, thickness as shown on Drawings, 1200 mm wide x maximum practical length, ends square cut, edges square.
- .2 Carrying Channels: Cold rolled steel to ASTM C645, galvanized.
- .3 Tie Wire: To ASTM C754.
- .4 Hangers: To ASTM C754, galvanized.
- .5 Drywall furring channels: 0.5 mm core thickness galvanized steel channels for screw attachment of gypsum board.
- .6 Resilient channels: To ASTM C645, 0.58 mm (22 mil) thick steel, G40, with integral pre-punched attachment flange, screw attached.
 - .1 Furring channel is not acceptable in place of resilient channel.
- .7 Steel drill screws: ASTM C1002.
- .8 Stud adhesive: ASTM C557.
- .9 Laminating compound: As recommended by manufacturer, asbestos-free.
- .10 Casing beads, corner beads, control joints and edge trim: to ASTM C1047, metal, zinc-coated by hot-dip process, 0.5 mm base thickness, perforated flanges, one piece length per location.
- .11 Plenum barrier: Purpose made, bonded acoustical cotton, mineral wool fibre, or fibreglass, adhered to foil backing; 25 mm minimum thickness; to ASTM E84, Class A, flame spread ≤ 5 , smoke developed ≤ 35 .
- .12 Sealants: In accordance with Section 07 92 00 - Joint Sealants.
- .13 Polyethylene: CAN/CGSB 51.34, Type 2.
- .14 Joint tape: ASTM C475, 52 mm wide fibre paper tape.
- .15 Joint compound: ASTM C475, asbestos-free.

2.2 FRAMING MATERIALS

- .1 Studs and Tracks: As specified in Section 09 22 16.
- .2 Furring, framing, and accessories: ASTM C645.
- .3 Anchorage to substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application, and to rigidly secure materials in place.
 - .1 Tie wire: To ASTM C754.
 - .2 Hangers: To ASTM C754, galvanized.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify conditions of substrates are acceptable for installation of gypsum board assemblies in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.
 - .2 Inform Owner Representative of unacceptable conditions.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 ERECTION

- .1 Apply and finish gypsum board to ASTM C840 or GA-216 except where specified otherwise.
- .2 Frame with furring channels: perimeter of openings for access panels, light fixtures, diffusers, grilles.
- .3 Furr for gypsum board faced vertical bulkheads within and at termination of ceilings.
- .4 Furr above suspended ceilings for gypsum board fire and sound stops, and to form plenum areas as indicated.
- .5 Install wall furring for gypsum board wall finishes to ASTM C840, except where specified otherwise.
- .6 Install furring as required for fire resistance ratings indicated.
- .7 Furr openings and around built-in equipment, cabinets, and access panels on four sides. Extend furring into reveals. Check clearances with equipment suppliers.
- .8 Furr duct shafts, beams, columns, pipes and exposed services where indicated.
- .9 Erect drywall resilient furring transversely across studs, spaced maximum 600 mm on centre and not more than 150 mm from ceiling/wall juncture. Secure to each support with drywall screws.
- .10 Install 150 mm continuous strip of 12.7 mm gypsum board along base of partitions where resilient furring installed.

3.3 APPLICATION

- .1 Apply gypsum board after bucks, anchors, blocking, sound attenuation, electrical work, and mechanical work have been approved.
- .2 Apply single layer standard gypsum board in most economical direction, with ends and edges occurring over firm bearing.
- .3 Double layer gypsum board:
 - .1 Base layer application:
 - .1 Apply gypsum board with long dimension parallel to studs.

- .2 Position board with abutting edges located in centre of stud flanges.
- .3 Stagger joints on opposite sides of partition so that joints occur on different studs.
- .4 Screw-fasten base layer gypsum board to steel studs with 25 mm screws.
- .2 Face layer application:
 - .1 Apply gypsum board with long dimension parallel to studs.
 - .2 Position board with abutting edges located in centre of stud flanges.
 - .3 Stagger joints from base layer joints, and on opposite sides of the partition.
 - .4 Screw-fasten face layer to steel studs with screws that are minimum 10 mm longer than the total thickness of the material being attached to the studs.
- .4 Install fire rated gypsum board in accordance with applicable ULC design number.
- .5 Apply board using stud adhesive on furring or framing, laminating adhesive on base layer of gypsum board.
- .6 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.
- .7 Install gypsum board with face side out.
- .8 Do not install damaged or damp boards.
- .9 Locate edge or end joints over supports. Stagger vertical joints over different studs on opposite sides of wall.

3.4 INSTALLATION - GENERAL

- .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.
- .2 Install casing beads around perimeter of suspended ceilings.
- .3 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.
- .4 Splice corners and intersections together and secure to each member with 3 screws.
- .5 Install access doors to electrical and mechanical fixtures as specified in their respective sections.
 - .1 Rigidly secure frames to furring or framing systems.
- .6 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.

- .7 Place corner beads at external corners.
 - .1 Use longest practical length.
 - .2 Place edge trim where gypsum board abuts dissimilar materials [and as indicated].
- .8 Finish gypsum board walls and ceilings to following levels in accordance with GA-214:
 - .1 Concealed areas - Level 1: embed tape for joints and interior angles in joint compound. Surfaces to be free of excess joint compound; tool marks and ridges are acceptable.
 - .2 Exposed areas - Level 4: embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; surfaces smooth and free of tool marks and ridges.
- .9 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.
- .10 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board, to be invisible after surface finish is completed.
- .11 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.
- .12 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.
- .13 Treat cut edges and holes in moisture resistant gypsum board with sealant.

3.5 ACOUSTIC ACCESSORIES INSTALLATION

- .1 Install resilient channels at maximum 600 mm on centre. Locate joints over framing members.
- .2 Place acoustic insulation in partitions tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind partitions, and tight to items passing through partitions.
- .3 Apply 12 mm diameter bead of acoustic sealant continuously around periphery of each face of partition to seal gypsum board/structure junction where partitions abut fixed building components. Seal full perimeter of cut-outs around electrical boxes, and ducts in partitions where perimeter sealed with acoustic sealant.
- .4 Apply two 12 mm beads of acoustic sealant to bottoms of floor tracks and tops of ceiling tracks.

3.6 CEILING INSTALLATION

- .1 Install to ASTM C754 or GA-216.
- .2 Erect hangers and runner channels for suspended gypsum board ceilings to ASTM C840 except where specified otherwise.
- .3 Install ceiling framing independent of walls, columns, and above ceiling work.

- .4 Install ceiling boards in direction that will minimize number of end-butt joints. Stagger end joints at least 250 mm.
- .5 Support light fixtures by providing additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.
- .6 Install work level, to tolerance of 1:1200.
- .7 Coordinate location of hangers with other work.
- .8 Reinforce openings in ceiling suspension system that interrupt main carrying channels or furring channels, with lateral channel bracing. Extend bracing minimum 600 mm past each end of openings.
- .9 Laterally brace entire suspension system.

3.7 TOLERANCES

- .1 Maximum variation of finished gypsum board surface from true flatness: 3 mm in 3 m, in any direction.

3.8 CLEANING

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

3.9 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by installation of gypsum board assemblies.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM C645-14, Standard Specification for Nonstructural Steel Framing Members.
 - .2 ASTM C754-11, Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 1.181-99, Ready-Mixed Zinc-Rich Coating.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.2 SUBMITTALS

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

1.3 QUALITY ASSURANCE

- .1 Certificates: Submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.4 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 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 metal framing from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Non-load bearing channel stud framing: To ASTM C645, stud size as shown on drawings, roll formed from hot dipped galvanized steel sheet, for screw attachment of gypsum board.
 - .1 Base steel thickness unless otherwise indicated in drawings:

- .1 General wall construction: Minimum 0.46 mm (25 gauge).
- .2 For attachment of cement board and abuse resistant gypsum board: Minimum 0.91 mm (20 gauge).
- .3 Single studs at jambs: Minimum 0.91 mm (20 gauge).
- .2 Knock-out service holes at 460 mm centres.
- .3 Floor and ceiling tracks: In widths to suit stud sizes, 32 mm flange height.
- .2 Metal channel stiffener: 1.4 mm (16 gauge) thick cold rolled steel, coated with rust inhibitive coating.
- .3 Acoustical sealant: In accordance with Section 07 92 00 - Joint Sealants.
- .4 Insulating strip: Rubberized, moisture resistant 3 mm thick foam strip, 12 mm (1/2 inch) wide, with adhesive on one face, lengths as required.
- .5 Touch-up primer for galvanized surfaces: CAN/CGSB 1.181.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify that conditions of substrate are acceptable for non-structural metal framing application in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.
 - .2 Inform Owner Representative of unacceptable conditions.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 ERECTION

- .1 Align partition tracks at floor and ceiling and secure at maximum 600 mm on centre.
- .2 Install damp proof course under stud shoe tracks of partitions on slabs on grade.
- .3 Place studs vertically at 400 mm on centre and not more than 50 mm from abutting walls, and at each side of openings and corners.
 - .1 Position studs in tracks at floor and ceiling. Cross brace steel studs as required to provide rigid installation to manufacturer's instructions.
- .4 Erect metal studding to tolerance of 1:1000.
- .5 Attach studs to bottom track using screws.
- .6 Co-ordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.
- .7 Co-ordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other Sections.
- .8 Provide two studs extending from floor to ceiling at each side of openings wider than stud centres specified.

- .1 Secure studs together, 50 mm apart using column clips or other approved means of fastening placed alongside frame anchor clips.
- .9 Install heavy gauge single jamb studs at openings.
- .10 Erect track at head of door/window openings and sills of sidelight/window openings to accommodate intermediate studs.
 - .1 Secure track to studs at each end, in accordance with manufacturer's instructions.
 - .2 Install intermediate studs above and below openings in same manner and spacing as wall studs.
- .11 Frame openings and around built-in equipment, cabinets, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.
- .12 Provide blocking for attachment of fixtures behind lavatory basins, toilet and bathroom accessories, and other fixtures including grab bars and towel rails. Refer to Section 06 10 00 – Rough Carpentry.
- .13 Install steel studs or furring channel between studs for attaching electrical and other boxes.
- .14 Extend partitions to ceiling height except where noted otherwise on drawings.
- .15 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs.
 - .1 Use double track slip joint.
- .16 Install continuous insulating strips to isolate studs from uninsulated surfaces.
- .17 Install two continuous 12 mm wide beads of acoustical sealant under studs and tracks around perimeter of sound control partitions.

3.3 CLEANING

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

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by non-structural metal framing application.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM A641/A641M-09a (2014) – Standard Specification for Zinc-Coated/Galvanized Carbon Steel Wire.
 - .2 ASTM C423-09a, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - .3 ASTM C635/C635M-13a, Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.
 - .4 ASTM C636/C636M-13, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
 - .5 ASTM E1110-06 (2011), Standard Classification for Determination of Articulation Class.
 - .6 ASTM E1111-07, Standard Test Method for Measuring the Interzone Attenuation of Open Office Components.
 - .7 ASTM E1264-14, Standard Classification for Acoustical Ceiling Products.
 - .8 ASTM E1414/E1414M-11ae1 - Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum.
 - .9 ASTM E1477-98a (2013) - Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-92.1-M89, Sound Absorptive Prefabricated Acoustical Units.
- .3 Canadian Standards Association (CSA)
 - .1 CSA B111-1974 (R2003), Wire Nails, Spikes and Staples.
- .4 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
 - .2 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 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC S102-10, Surface Burning Characteristics of Building Materials and Assemblies.

1.2 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:

- .1 Submit manufacturer's printed product literature, specifications, and data sheets.
- .2 Submit WHMIS MSDS for products used on project.
- .3 Samples:
 - .1 Samples: Submit duplicate manufacturer samples illustrating material and finish of acoustic units.
 - .2 Samples: Submit two (2) samples of suspension system, 300 mm (12 inches) long.
- .4 Installation Data: Provide manufacturer's special installation requirements.
- .5 Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.3 QUALITY ASSURANCE

- .1 Regulatory Requirements:
 - .1 Fire-resistance rated floor/ceiling and roof/ceiling assembly: certified by Canadian Certification Organization accredited by Standards Council of Canada.
- .2 Mock-up:
 - .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.
 - .2 Construct mock-up 10 m² minimum of acoustical panel ceiling including one inside corner.
 - .3 Construct mock-up where directed.
 - .4 Allow for review of mock-up by Owner Representative before proceeding with ceiling work.
 - .5 Accepted mock-up will demonstrate minimum standard for this work. Mock-up may remain as part of the finished work.
- .3 Extra Stock Materials:
 - .1 Provide extra materials of acoustic units in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Provide acoustical units amounting to 2% of gross installed ceiling area for each pattern and type required for project.
 - .3 Ensure extra materials are from same production run as installed materials.
 - .4 Clearly identify each type of acoustic unit, including colour and texture.
 - .5 Deliver to Owner Representative, upon completion of the work of this section.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver acoustical ceiling units to project site in unopened manufacturer's packaging. Store in enclosed space and protect from damage.

- .2 Protect on-site stored or installed absorptive material from moisture damage.
- .3 Store extra materials required for maintenance, where directed by Owner Representative.

1.5 ENVIRONMENTAL REQUIREMENTS

- .1 Permit wet work to dry before beginning installation.
- .2 Maintain uniform minimum temperature of 15°C and humidity of 20% before and during installation.
- .3 Store materials in work area 48 hours prior to installation.

Part 2 Products

2.1 MATERIALS

- .1 Acoustic Ceiling Tile Suspension System:
 - .1 Non-fire Rated Grid: ASTM C635/C635M, intermediate duty cold rolled steel with hot dipped galvanized coating; components die cut and interlocking.
 - .2 Fire Rated Grid: ASTM C635/C635M, intermediate duty cold rolled steel with hot dipped galvanized coating; listed by ULC/UL for use in fire-rated assembly; components die cut and interlocking.
 - .3 Grid Materials: Commercial quality cold rolled steel with galvanized coating.
 - .4 Edge Profile: Tee.
 - .5 Grid Finish: Painted white.
- .2 Acoustic units for suspended ceiling system: To CAN/CGSB 92.1 and ASTM E1264, Type XII, Form 2, Pattern E.
 - .1 Fire Class A.
 - .2 Substrate composition: Fibreglass. Texture: Fine.
 - .4 Fire ratings to CAN/ULC S102:
 - .1 Flame spread: Maximum 25.
 - .2 Smoke developed: Maximum 50.
 - .5 Noise Reduction Coefficient (NRC) to ASTM C423: Minimum 0.90.
 - .6 Articulation Class (AC) to ASTM E1110 and ASTM E1111: Minimum 190.
 - .7 Light Reflectance (LR) range to ASTM E1477: 0.90.
 - .8 Edge type: Square.
 - .9 Colour: White.
 - .10 Size: 610 x 610 mm (24 x 24 inches).
 - .11 Thickness: 25 mm (1 inch).
 - .12 Surface coverings: Factory-applied latex paint.
- .3 Adhesive: Low VOC type recommended by acoustic unit manufacturer.

- .4 Staples, nails and screws: To CSA B111 non-corrosive finish as recommended by acoustic unit manufacturer.
- .5 Hold down clips: Purpose made clips to secure tile to suspension system, approved for use in fire-rated systems.
- .6 Adhesives and mounting accessories as recommended by manufacturer.
- .7 Attachment devices: Size for five times design load indicated in ASTM C635/C635M, Table 1, Direct Hung, unless otherwise indicated.
- .8 Wire for hangers and ties: To ASTM A641/A641M, Class 1 zinc coating, soft annealed, with yield stress load at least 3 times design load, but not less than 12 gauge.
- .9 Touch-Up Paint: Type and colour to match acoustic and grid units.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify conditions of substrates are acceptable for acoustical ceiling tile and track installation in accordance with manufacturer's written instructions.
- .2 Ensure following work is completed before installation of ceilings begins.
 - .1 Plastering, gypsum board finishing, and painting: completed and dry.
 - .2 Mechanical, electrical, other work above ceiling: completed.
 - .3 Heating, ventilating and air-conditioning systems: installed and operating.
 - .4 Layout light fixture and sprinkler head penetrations at centre of panel width.
 - .5 Plan HVAC inlets and outlets to occur within centre of panel system or provide for equal distance on each side parallel to length of panels.
- .3 Do not install acoustical panels until work above ceiling has been reviewed by Owner Representative.
- .4 Verify layout of hangers will not interfere with other work.
- .5 Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans.

3.2 INSTALLATION

- .1 Manufacturer's Instructions: Comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 Co-ordinate ceiling work to accommodate components of other sections, such as light fixtures, diffusers, speakers, sprinkler heads, to be built into acoustical ceiling components.
- .3 Installation: To ASTM C636/C636M except where specified otherwise.
- .4 In fire rated ceiling systems, secure lay-in panels with hold-down clips and protect over light fixtures, diffusers, air return grilles and other appurtenances according to Certification Organizations design requirements.

- .5 Completed suspension system to support superimposed loads, such as lighting fixtures, diffusers, grilles and speakers. Provide additional suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of each light fixtures and diffusers.
- .6 Finished ceiling system to be square with adjoining walls and level within 1:1000.
- .7 Expansion joints: As recommended by manufacturer.
- .8 Install acoustical units as indicated in reflected ceiling plan.
- .9 Scribe acoustic units to fit adjacent work. Butt joints tight, terminate edges with moulding.
- .10 Site finish cut tile edges with touch-up paint.

3.3 APPLICATION

- .1 Install acoustic units to clean, dry and firm substrate.
- .2 Install acoustical units as indicated in reflected ceiling plan.
- .3 Scribe acoustic units to fit adjacent work. Butt joints tight, terminate edges with moulding.

3.4 INTERFACE WITH OTHER WORK

- .1 Co-ordinate ceiling work to accommodate components of other sections, such as light fixtures, diffusers, speakers, sprinkler heads, to be built into acoustical ceiling components.

3.5 CLEANING

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

3.6 PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM D412-06ae2, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension.
 - .2 ASTM D2047-11, Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine.
 - .3 ASTM D2240-05 (2010), Standard Test Method for Rubber Property—Durometer Hardness.
 - .4 ASTM D3389-10, Standard Test Method for Coated Fabrics Abrasion Resistance (Rotary Platform Abrader).
 - .5 ASTM E648-10e1, Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
 - .6 ASTM E1155-14/E1155M-14, Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers.
 - .7 ASTM F970-07 (2011), Standard Test Method for Static Load Limit.
 - .8 ASTM F1303-04 (2014), Standard Specification for Sheet Vinyl Floor Covering with Backing.
 - .9 ASTM F2169-12, Standard Specification for Resilient Stair Treads.
- .2 Canadian Standards Association (CSA)
 - .1 CSA B651-12, Accessible Design for the Built Environment.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .4 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC S102.2-10, Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies.

1.2 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for tile adhesive, subfloor patching compound. Include product characteristics, performance criteria, physical size, finish, and limitations.
 - .2 Submit WHMIS MSDS in accordance with Section 01 35 29 – Health and Safety Requirements.
- .3 Samples:
 - .1 Submit duplicate 300 x 300 mm pieces of sheet safety floor material, in proposed colours and patterns.

- .2 Submit duplicate 50 mm pieces of base, demonstrating profiles and colours.
- .3 Submit duplicate 50 mm sections of rubber stair tread, full width, demonstrating finish of tread and colours.
- .4 Submit duplicate 50 mm pieces of transition strip in proposed colours and finish.
- .4 Shop Drawings: Indicate:
 - .1 Seam layout.
 - .2 Cut-outs: Show locations where cut-outs are required.
 - .3 Edgings: Show location of edge mouldings.
- .5 Closeout Submittals:
 - .1 Provide maintenance data for resilient flooring for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.3 MOCK-UPS

- .1 Construct mock-up in accordance with Section 01 45 00 - Quality Control.
- .2 Install safety flooring mock-up, minimum 3000 x 3000 mm, in location designated by Owner Representative; illustrate selected materials, colour schemes, pattern, texture, direction of installation, finish fit to walls and doorways, seam finish, and quality of work.
- .3 Locate where directed.
- .4 Allow for inspection of mock-up by Owner Representative before proceeding with safety flooring installation.
- .5 Accepted mock-up may remain as part of finished work.

1.4 DELIVERY, STORAGE, AND HANDLING

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

1.5 AMBIENT CONDITIONS

- .1 Maintain air temperature and structural base temperature at flooring installation area above 20°C for 48 hours before, during, and 48 hours after installation.

1.6 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide extra materials of resilient sheet flooring in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Provide 10 m² of sheet flooring material as installed in project, for maintenance use.
 - .3 Provide extra materials in one piece, and from same production run as installed materials.
 - .4 Identify each roll of safety flooring.

- .5 Deliver to Owner Representative, upon completion of the work of this section.
- .6 Store where directed by Owner Representative.

Part 2 Products

2.1 MATERIALS

- .1 Safety flooring: To ASTM F1303, Type 2, Grade 1; sheet vinyl with aluminum oxide and coloured quartz grains.
 - .1 Surface: Silicon carbide grains.
 - .2 Backing: Polyester and cellulose scrim with glass fibre reinforcement.
 - .3 Thickness: 2 mm.
 - .4 Static coefficient of friction (ASTM D2047): Minimum values:
 - .1 Dry 0.78.
 - .2 Wet 0.80.
 - .5 Static load limit (ASTM F970): 1000 psi.
 - .6 Fire performance (CAN/ULC S102.2):
 - .1 Flame spread: 75.
 - .2 Smoke developed: 120.
 - .7 Colour: As selected by Owner Representative.
 - .8 Welding rod for seams: As provided by flooring manufacturer, to match colour of sheet material.
- .2 Resilient base: To ASTM F1861, continuous, top set.
 - .1 Type: Rubber.
 - .2 Thickness: 3.2 mm.
 - .3 Height: 101.6 mm.
 - .4 Lengths: cut lengths minimum 2400 mm.
 - .5 Profile:
 - .1 Cove with toe: For resilient floor.
 - .2 Straight (toeless): For carpeted floor.
 - .6 Colour: As selected by Owner Representative.
- .3 Transition Mouldings and Reducer Strips: Homogeneous PVC with additives and colourants.
 - .1 Hardness to ASTM D2240: Minimum 85 Shore A.
 - .2 Abrasion resistance to ASTM D3389: 0.22 mg/cycle.
 - .3 Slip resistance: To meet ASTM D2047.
 - .4 Changes in level to comply with accessibility requirements of CSA B651:
 - .1 0 to 6 mm vertical rise: Vertical transition strip permitted.
 - .2 7 to 13 mm vertical rise: Bevelled transition, not to exceed 1:2 ratio for rise:run.

- .3 Over 13 mm vertical rise: Bevelled transition, not to exceed 1:12 ratio for rise:run.
- .5 Provide adhesive as recommended by transition strip manufacturer.
- .6 Height: To be determined from flooring materials being transitioned.
- .7 Exposed width: 16 mm (5/8 inch).
- .4 Resilient stair tread: To ASTM F2169, synthetic rubber, square nosed, integral riser, and 50 mm (2 inch) wide contrasting colour grit tape insert.
 - .1 Length: As required to cover full width of stair.
 - .2 Tread pattern: Raised round disc.
 - .3 Tensile strength (ASTM D412): 8.2 MPa (1200 psi).
 - .4 Hardness (ASTM D2240): Minimum 85 Shore A.
 - .5 Abrasion resistance (ASTM D3389): < 1 g weight loss.
 - .6 Slip resistance (ASTM D2047): Minimum 0.8 SCOF.
 - .7 Fire resistance (ASTM E648): Class 1.
 - .8 Flammability (CAN/ULC S102.2):
 - .1 Flame spread: ≤ 300 .
 - .2 Smoke developed: ≤ 500 .
 - .9 Colours for tread and contrasting grit tape: As selected by Owner Representative.
- .5 Primers and adhesives: Types recommended by resilient flooring manufacturer for specific material on applicable substrate, above, on or below grade.
- .6 Sub-floor filler and leveller: Self-levelling cementitious compound capable of bonding to properly prepared substrate surfaces.
 - .1 Compressive strength: Minimum 36.5 MPa (5300 psi) at 28 days.
 - .2 Capable of being walked on without damage after 3 hours.
 - .3 Capable of being coated after 24 hours at 21°C.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 EXAMINATION

- .1 Verify conditions of substrates are acceptable for product installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.
 - .2 Inform Owner Representative of unacceptable conditions.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.3 PREPARATION

- .1 Remove existing resilient flooring.
- .2 Remove or treat old adhesives to prevent residual, old flooring adhesives from bleeding through to new flooring and/or interfering with the bonding of new adhesives.
- .3 Clean floor and apply filler; trowel and float to leave smooth, flat hard surface. Prohibit traffic until filler cured and dry.
- .4 Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with sub-floor filler.
- .5 Prime and seal plywood sub-floor to resilient flooring manufacturer's printed instructions.

3.4 APPLICATION: FLOORING

- .1 Provide high ventilation rate, with maximum outside air, during installation, and for 48 to 72 hours after installation. If possible, vent directly to outside. Do not let contaminated air recirculate through district or whole building air distribution system. Maintain extra ventilation for at least one month following building occupation.
- .2 Apply adhesive uniformly using recommended trowel. Do not spread more adhesive than can be covered by flooring before initial set takes place.
- .3 Lay flooring with seams parallel to building lines to produce a minimum number of seams. Border widths minimum 1/3 width of full material.
- .4 Double cut sheet joints heat weld according to manufacturer's printed instructions.
- .5 As installation progresses, and after installation, roll flooring with 45 kg minimum roller to ensure full adhesion.
- .6 Cut flooring around fixed objects.
- .7 Install flooring in pan type floor access covers. Maintain floor pattern.
- .8 Continue flooring over areas that will be under built-in furniture.
- .9 Continue flooring through areas to receive movable type partitions without interrupting floor pattern.
- .10 Terminate flooring at centreline of door in openings where adjacent floor finish or colour is dissimilar.

3.5 APPLICATION: STAIR TREADS

- .1 Scribe and trim treads to ensure proper fit to substrate.
- .2 Dry-lay treads to confirm proper sizing and fit prior, to application of adhesive.
- .3 Trim treads to within 1/16 inch of riser and stringer to allow for expansion.
- .4 Do not overlap nosing over riser material.

- .5 Apply adequate amount of epoxy caulking nose filler to fill void between internal angle of stair tread and external edge of stair surface to ensure adhesion of nosing to substrate.
- .6 Bond tread and nosing directly to step surface, with adhesive recommended by manufacturer.
- .7 Roll treads with hand roller after installation to ensure proper bonding.

3.6 APPLICATION: BASE

- .1 Clean substrate.
- .2 Install resilient base in lengths as long as practicable, without gaps at seams, and with tops of adjacent pieces aligned.
- .3 Do not stretch resilient base during installation.
- .4 Mitre base neatly at corners.
- .5 Set base against wall and floor surfaces tightly by using 3 kg hand roller.
- .6 Install base straight and level, with base in continuous contact with horizontal and vertical substrates.
- .7 Scribe and fit to door frames and other obstructions. Use pre-moulded end pieces at flush door frames.

3.7 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Waste Management and Disposal: Remove waste material in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Remove excess adhesive from floor, base, and wall surfaces without damage.
- .4 Clean, seal and wax floor and base surface to flooring manufacturer's printed instructions.

3.8 PROTECTION

- .1 Protect new floors from time of final set of adhesive until final inspection.
- .2 Prohibit traffic on floor for 48 hours after installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Association of Textile Chemists and Colorists (AATCC)
 - .1 AATCC Test Method 134-2011, Electrostatic Propensity of Carpets.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 4.129-93, Carpets for Commercial Use.
- .3 Carpet and Rug Institute (CRI)
 - .1 CRI Carpet Installation Standard 2011.
 - .2 CRI Green Label Plus Indoor Air Quality Testing Program.
- .4 National Floor Covering Association of Canada (NFCA)
 - .1 Floor Covering Reference Manual, latest edition.
- .5 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC S102.2-10, Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies.

1.2 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 carpet tile, adhesive, subfloor patching compound; include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS MSDS for products used in the project.
- .3 Shop Drawings: Indicate:
 - .1 Tile installation orientation.
 - .2 Cut-outs: Show locations where cut-outs are required.
 - .3 Edgings: Show location of edge mouldings and edge bindings.
- .4 Samples:
 - .1 Submit duplicate samples of each type of carpet tile specified.
- .5 Certificates: Submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .6 Manufacturer's Instructions: Submit manufacturer's installation and storage instructions.

1.3 CLOSEOUT SUBMITTALS

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

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra stock materials: Deliver extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Section 01 78 00 - Closeout Submittals.
 - .1 Quantity: Provide minimum 3% of actual installed area of carpet.

1.5 QUALITY ASSURANCE

- .1 Use material from single dye lot.

1.6 MOCK-UPS

- .1 Construct mock-up in accordance with Section 01 45 00 - Quality Control.
- .2 Install carpet tile mock-up, minimum 8 x 8 tiles, in area designated by Owner Representative; illustrate selected materials, colour schemes, pattern, texture, direction of installation, finish fit to walls and doorways, and seam finish.
- .3 Locate where directed.
- .4 Allow for photographic inspection of mock-up by Owner Representative before proceeding with carpet tile installation.
- .5 Accepted mock-up may remain as part of finished work.

1.7 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 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store materials protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
 - .3 Store and protect carpet tile and adhesive in original containers or wrapping with manufacturer's seals and labels intact.
 - .4 Store and protect carpet tile and accessories in location as directed by Owner Representative.
 - .5 Store carpet and adhesive at minimum temperature of 18°C and relative humidity of maximum 65% for minimum 48 hours before installation.
 - .6 Prevent damage to materials during handling and storage. Keep materials under cover and free from dampness.

- .7 Safety: Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.
- .8 Replace defective or damaged materials with new.

1.8 SITE CONDITIONS

- .1 Install carpet after space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete.

Part 2 Products

2.1 PERFORMANCE

- .1 CPT-1
 - .1 Pile Surface Appearance: Multi-level pattern loop.
 - .2 Pile fibre: Nylon 6, minimum 18 denier per filament.
 - .3 Tile size: 610 x 610 mm (24 x 24 inches).
 - .4 Flammability (ASTM E648): Class I.
 - .5 Dyeing method: 100% solution dyed.
 - .6 Primary backing: Non-woven synthetic.
 - .7 Secondary backing: Thermoplastic polyolefin with fibreglass reinforcement.
 - .8 Pile weight: Minimum 542 g/m².
 - .9 Machine gauge: 47.2 rows/10 cm.
 - .10 Density: Minimum 9.23 kilotex.
 - .11 Stitch count: Minimum 34 stitches/10 cm.
 - .12 Pile height: 2.34 mm.
 - .13 Total thickness: 5.8 mm.
 - .14 Stain resistance treatment: Manufacturer's standard.
 - .15 Electrostatic propensity: Maximum 3.5 kV to AATCC 134.
 - .16 Air quality: To CCI/CRI Green Label Plus requirements.
 - .17 Acceptable product: Shaw Contract.
 - .1 Style: Diffuse 59575.
 - .2 Colour: Flutter 75761.

2.2 ACCESSORIES

- .1 Adhesive film tabs: Polyethylene film tabs with pressure sensitive adhesive, as recommended by carpet manufacturer.
- .2 Base: Refer to Section 09 65 16 – Resilient Flooring.
- .3 Transition Mouldings: Refer to Section 09 65 16 – Resilient Flooring.
- .4 Sub-floor filler and leveller: Self-levelling cementitious compound capable of bonding to properly prepared substrate surfaces.

- .1 Compressive strength: Minimum 20.6 MPa (3000 psi) at 28 days.
- .2 Capable of being walked on without damage after 3 hours.
- .3 Capable of being coated after 24 hours at 21°C.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify conditions of substrates are acceptable for carpet tile installation in accordance with adhesive manufacturer's written instructions.
 - .1 Inform Owner Representative of unacceptable conditions.
 - .2 Proceed with installation only after unacceptable conditions have been remedied.

3.2 PREPARATION

- .1 Surface Preparation: Prepare surface in accordance with manufacturer's written recommendations and co-ordinate with Section 01 71 00 - Examination and Preparation.
 - .1 Prepare floor surfaces in accordance with CRI Carpet Installation Standard.
- .2 Tile Carpeting Preparation: Pre-condition carpeting following manufacturer's written instructions.

3.3 INSTALLATION

- .1 Install carpet tiles in accordance with manufacturer's written instructions, and CRI Carpet Installation Standard.
- .2 Co-ordinate tile carpeting work with work of other trades, for proper time and sequence to avoid construction delays.
- .3 Install carpet tile after finishing work is completed but before demountable office partitions and telephone and electrical pedestal outlets are installed.
- .4 Snugly join carpet tiles in completed installation.
 - .1 Measure distance covered by 11 carpet tiles (10 joints) and ensure distance complies with manufacturer specifications.
 - .2 Do not trap yarn between carpet tiles.
- .5 Ensure finished installation presents smooth wearing surface free from conspicuous seams, burring and other faults.
- .6 Ensure colour, pattern and texture match within visual areas.
- .7 Scribe tiles around architectural, mechanical, electrical, and telephone outlets, and furniture fitments, around perimeter of rooms into recesses, and around projections.
- .8 Extend carpet tiles into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

- .9 Install carpet tiles smooth and free from bubbles, puckers, and other defects.
- .10 Protect exposed carpet tile edges at transition to other flooring materials with suitable transition strips.

3.4 CLEANING

- .1 Progress Cleaning: Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
 - .1 Vacuum carpets clean immediately after completion of installation, using commercial machine with face-beater element.
- .2 Waste Management: Remove waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

3.5 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Prohibit traffic on carpet for period of 24 hours minimum after installation and until adhesive is cured.
- .3 Repair damage to adjacent materials caused by tile carpeting installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .2 Environmental Protection Agency (EPA)
 - .1 EPA Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24 - [1995], (for Surface Coatings).
- .3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .4 Master Painters Institute (MPI)
 - .1 MPI Architectural Painting Specifications Manual, 2014.
 - .2 MPI Maintenance Repainting Manual, 2015.
 - .3 MPI Approved Products List, 2016.
- .5 National Fire Code of Canada 2015.
- .6 Society for Protective Coatings (SSPC)
 - .1 SSPC Painting Manual, Volume Two, 8th Edition, Systems and Specifications Manual.
- .7 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.2 SCHEDULING

- .1 Submit work schedule for various stages of painting to Owner Representative for review. Submit schedule minimum of 48 hours in advance of proposed operations.
- .2 Obtain written authorization from Owner Representative for changes in work schedule.
- .3 Schedule painting operations to prevent disruption of occupants.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit product data and instructions for each paint and coating product to be used.
 - .2 Submit product data for the use and application of paint thinner.

- .3 Submit Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) for products used in the project. Indicate VOCs during application and curing.
- .3 Samples:
 - .1 Submit full range colour sample chips to indicate where colour availability is restricted.
 - .2 Submit duplicate 200 x 300 mm sample panels of each paint with specified paint or coating in colours, gloss/sheen, and textures required, to MPI Architectural Painting Specification Manual standards and submitted on following substrate materials:
 - .1 3 mm plate steel for finishes over metal surfaces.
 - .2 13 mm gypsum board for finishes over gypsum board and other smooth surfaces.
 - .3 10 mm hardboard for opaque finishes over wood surfaces.
 - .3 Retain reviewed samples on-site to demonstrate acceptable standard of quality for appropriate on-site surface.
 - .4 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .5 Manufacturer's Instructions:
 - .1 Submit manufacturer's application instructions.
 - .6 Closeout Submittals: Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals include following:
 - .1 Product name, type and use.
 - .2 Manufacturer's product number.
 - .3 Colour numbers.

1.4 MOCK-UPS

- .1 Mock-ups: Apply mock-ups of each paint system indicated, in each colour and finish selected, to verify preliminary selections made under sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.
 - .2 Owner Representative will select surfaces to represent surfaces and conditions for application of each paint system specified.
 - .1 Vertical and Horizontal Surfaces: Provide samples of at least 9 m² (100 ft²).
 - .2 Other Items: Owner Representative will designate items or areas required.
 - .3 Apply mock-up samples after permanent lighting and other environmental services have been activated.
 - .4 Final approval of colour selections will be based on mock-ups.

- .1 If preliminary colour selections are not approved, apply additional mock-ups of additional colours selected by Owner Representative at no added cost to contract.
- .5 Approved mock-up may remain as part of finished work.

1.5 MAINTENANCE

- .1 Extra Materials:
 - .1 Deliver to extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Section 01 78 00 - Closeout Submittals.
 - .2 Quantity: provide one – 4 litre can of each type and colour of primer and finish coating. Identify colour and paint type in relation to established colour schedule and finish system.
 - .3 Delivery, storage and protection: comply with Owner Representative requirements for delivery and storage of extra materials.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Packing, Shipping, Handling and Unloading:
 - .1 Pack, ship, handle, and unload materials in accordance with Section 01 61 00 - Common Product Requirements and manufacturer's written instructions.
- .2 Acceptance at Site:
 - .1 Identify products and materials with labels indicating:
 - .1 Manufacturer's name and address.
 - .2 Type of paint or coating.
 - .3 Compliance with applicable standard.
 - .4 Colour number in accordance with established colour schedule.
- .3 Remove damaged, opened and rejected materials from site.
- .4 Storage and Protection:
 - .1 Provide and maintain dry, temperature controlled, secure storage.
 - .2 Store materials and supplies away from heat generating devices.
 - .3 Store materials and equipment in well-ventilated area within temperature range 7°C to 30°C.
- .5 Store temperature sensitive products above minimum temperature as recommended by manufacturer.
- .6 Keep areas used for storage, cleaning and preparation clean and orderly. After completion of operations, return areas to clean condition.
- .7 Remove paint materials from storage only in quantities required for same day use.
- .8 Fire Safety Requirements:
 - .1 Provide one 9 kg dry chemical fire extinguisher adjacent to storage area.

- .2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site daily.
- .3 Handle, store, use and dispose of flammable and combustible materials in accordance with National Fire Code of Canada requirements.
- .9 Waste Management and Disposal:
 - .1 Remove waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .2 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional, and Municipal regulations.
 - .3 Ensure emptied containers are sealed and stored safely.
 - .4 Dispose unused paint and coating materials at official hazardous material collections site.
 - .5 Paint, stain and wood preservative finishes and related materials (thinners, and solvents) are regarded as hazardous products and are subject to regulations for disposal. Information on these controls can be obtained from Provincial Ministries of Environment and Regional levels of Government.
 - .6 Material that cannot be reused is to be treated as hazardous waste and disposed in an appropriate manner.
 - .7 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.
 - .8 To reduce the amounts of contaminants entering waterways, sanitary/storm drain systems or into ground follow these procedures:
 - .1 Retain cleaning water for water-based materials to allow sediments to be filtered out.
 - .2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.
 - .3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.
 - .4 Dispose of contaminants in approved legal manner in accordance with hazardous waste regulations.
 - .5 Empty paint cans are to be dry prior to disposal or recycling where available.
 - .9 Set aside and protect surplus and uncontaminated finish materials. Turn over to Owner Representative for maintenance purposes.

1.7 SITE CONDITIONS

- .1 Heating, Ventilation and Lighting:
 - .1 Coordinate use of existing ventilation system with Owner Representative and ensure its operation during and after application of paint as required.

- .2 Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.
- .3 Provide minimum lighting level of 323 Lux on surfaces to be painted.
- .2 Temperature, Humidity and Substrate Moisture Content Levels:
 - .1 Unless pre-approved with written approval by Specifying body and product manufacturer, perform no painting when:
 - .1 Ambient air and substrate temperatures are below 10°C.
 - .2 Substrate temperature is above 32°C, unless paint is specifically formulated for application at high temperatures.
 - .3 Substrate and ambient air temperatures are not expected to fall within MPI or paint manufacturer's prescribed limits.
 - .4 Ensure that conditions are within specified limits during drying or curing process, until newly applied coating can itself withstand 'normal' adverse environmental factors.
 - .2 Perform painting work when maximum moisture content of the substrate is below:
 - .1 15% for wood.
 - .2 12% for plaster and gypsum board.
 - .3 Surface and Environmental Conditions:
 - .1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
 - .2 Apply paint to adequately prepared surfaces and to surfaces within moisture limits.
 - .3 Apply paint when previous coat of paint is dry or adequately cured.
 - .4 Additional interior application requirements:
 - .1 Apply paint finishes when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.
 - .2 Apply paint in occupied facilities during silent hours only. Schedule operations to approval of Owner Representative such that painted surfaces will have dried and cured sufficiently before occupants are affected.

Part 2 Products

2.1 MATERIALS

- .1 Paint materials listed in the MPI Approved Products List (APL) are acceptable for use on this project.
- .2 Provide paint materials for paint systems from single manufacturer.

- .3 Conform to latest MPI requirements for painting work, including preparation and priming.
- .4 Materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, etc.) in accordance with MPI Architectural Painting Specification Manual "Approved Product" listing.
- .5 Linseed oil, shellac, and turpentine: Highest quality product from approved manufacturer listed in MPI Architectural Painting Specification Manual, compatible with other coating materials as required.

2.2 COLOURS

- .1 Selection of colours to be from manufacturer's full range of colours.
- .2 Second coat in three-coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.

2.3 MIXING AND TINTING

- .1 Perform colour-tinting operations prior to delivery of paint to site. Obtain written approval from Owner Representative for tinting of painting materials.
- .2 Mix paste, powder or catalyzed paint mixes in accordance with manufacturer's written instructions.
- .3 Use and add thinner in accordance with paint manufacturer's recommendations. Do not use kerosene or similar organic solvents to thin water-based paints.
- .4 Thin paint for spraying in accordance with paint manufacturer's instructions.
- .5 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

2.4 GLOSS/SHEEN RATINGS

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

	Gloss @ 60 degrees	Sheen @ 85 degrees
Gloss Level 1 - Matte 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	

- .2 Gloss level ratings of painted surfaces as indicated.

2.5 INTERIOR PAINTING

- .1 Galvanized metal: Doors and door frames, handrails:
 - .1 INT 5.3M – High performance architectural latex, G5 finish.
 - .1 Coat 1: Water based primer, MPI #134.
 - .2 Coats 2 and 3: HIPAC latex, MPI #141.
 - .2 Gypsum wallboard, include access panels:
 - .1 INT 9.2A - Latex.
 - .1 Walls: G3 finish.
 - .1 Coat 1: Latex primer/sealer, MPI #50.
 - .2 Coats 2 and 3: HIPAC latex, MPI #52.
 - .2 Ceilings: G1 finish.
 - .1 Coat 1: Latex primer/sealer, MPI #50.
 - .2 Coats 2 and 3: HIPAC latex, MPI #53.
 - .3 Dressed lumber: Doors and door frames.
 - .1 INT 6.3A – High performance architectural latex over latex primer, G5 finish.
 - .1 Coat 1: Latex primer, MPI #39.
 - .2 Coats 2 and 3: HIPAC latex, MPI #141.
 - .4 Electrical backboards.
 - .1 INT 6.4PP – Fire retardant coating, pigmented, waterborne, MPI #64.
 - .1 Apply in accordance with manufacturer's instructions. Apply to all six sides of plywood electrical backboards.

2.6 INTERIOR REPAINTING

- .1 Galvanized metal: High contact/high traffic areas (doors, frames).
 - .1 RIN 5.3J – High performance architectural latex, G5 finish.
 - .1 Coat 1: Touch-up, MPI #141.
 - .2 Coats 2 and 3: HIPAC latex, MPI #141.
- .2 Gypsum wallboard:
 - .1 RIN 9.2A – Latex.
 - .1 Walls: G3 finish.
 - .1 Coat 1: Touch-up, MPI #52.
 - .2 Coats 2 and 3: HIPAC latex, MPI #52.
 - .2 Ceilings: G1 finish.
 - .1 Coat 1: Touch-up, MPI #53.
 - .2 Coats 2 and 3: HIPAC latex, MPI #53.
- .3 Dressed lumber: Trim carpentry, doors and door frames.

- .1 RIN 6.3T – High performance architectural latex over latex primer, semi-gloss finish.
 - .1 Coat 1:
 - .1 Touch-up: Latex primer, MPI #141.
 - .2 Spot prime or full prime: Latex primer, MPI #39.
 - .2 Coats 2 and 3: HIPAC latex, MPI #141.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 GENERAL

- .1 Perform preparation and operations for painting in accordance with MPI Architectural Painting Specifications Manual except where specified otherwise.
- .2 Apply paint materials in accordance with paint manufacturer's written application instructions.

3.3 EXAMINATION

- .1 Prior to commencing work, examine site conditions and existing substrates to be painted and repainted. Report to Owner Representative damages, defects, or unsatisfactory or unfavourable conditions or surfaces that will adversely affect this work.
- .2 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test". Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.
- .3 Do not commence until such adverse conditions and defects have been corrected and surfaces and conditions are acceptable to Painting Subcontractor and Inspection Agency.
- .4 Assess degree of surface deterioration for areas to be repainted, using MPI identifiers and assessment criteria indicated in MPI Repainting Manual. MPI DSD ratings and descriptions are as follows:

Condition	Description
DSD-0	Sound Surface (includes visual (aesthetic) defects that do not affect film's protective properties).
DSD-1	Slightly Deteriorated Surface (indicating fading; gloss reduction, slight surface contamination, minor pin holes, scratches).
DSD-2	Moderately Deteriorated Surface (small areas of peeling, flaking, slight cracking, and staining).
DSD-3	Severely Deteriorated Surface (heavy peeling, flaking, cracking, checking, scratches, scuffs, abrasion, small holes and gouges).

DSD-4	Substrate Damage (repair or replacement of surface required).
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- .5 Where an assessed degree of surface degradation of DSD-1 to DSD-3 before preparation of surfaces for repainting is revealed to be DSD-4 after preparation, repair or replacement of such unforeseen defects discovered are to be corrected, as mutually agreed, before repainting is started.
- .6 Maximum moisture content as follows:
 - .1 Gypsum board, stucco, and plaster: 12%.
 - .2 Wood: 15%.

3.4 PREPARATION

- .1 Protection:
 - .1 Protect existing building surfaces and adjacent structures from paint splatters, markings, and other damage by suitable non-staining covers or masking. If damaged, clean and restore surfaces as directed by Owner Representative.
 - .2 Protect items that are permanently attached such as fire labels on doors and frames.
 - .3 Protect factory finished products and equipment.
 - .4 Protect passing pedestrians, building occupants, and public in and about the building.
- .2 Surface Preparation:
 - .1 Remove electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Identify and store items in secure location and re-installed after painting is completed.
 - .2 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.
 - .3 Place "WET PAINT" signs in occupied areas as painting operations progress. Signs to be acceptable to Owner Representative.
- .3 Clean and prepare surfaces in accordance with MPI Architectural Painting Specification Manual and Maintenance Repainting Manual requirements. Refer to MPI Manual for specific requirements and as follows:
 - .1 Remove dust, dirt, and other surface debris by vacuuming and wiping with dry, clean cloths.
 - .2 Wash surfaces with a biodegradable detergent, bleach where applicable, and clean warm water, using stiff bristle brush to remove dirt, oil, and other surface contaminants.
 - .3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.
 - .4 Allow surfaces to drain completely and allow to dry thoroughly.
 - .5 Prepare surfaces for water-based painting, water-based cleaners should be used in place of organic solvents.
 - .6 Use trigger operated spray nozzles for water hoses.

- .7 Many water-based paints cannot be removed with water once dried. Minimize use of mineral spirits or organic solvents to clean up water-based paints.
- .4 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements. Remove traces of blast products from surfaces, pockets and corners to be painted by brushing with clean brushes and vacuum cleaning.
- .5 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pre-treatment as soon as possible after cleaning and before deterioration occurs.
- .6 Touch up of shop primers with primer as specified.
- .7 Do not apply paint until prepared surfaces are acceptable to Owner Representative.
- .8 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.

3.5 APPLICATION

- .1 Method of application to be as approved by Owner Representative. Apply paint by brush and roller. Conform to manufacturer's application instructions unless specified otherwise.
- .2 Brush and Roller Application:
 - .1 Apply paint in uniform layer using brush and/or roller type suitable for application.
 - .2 Work paint into cracks, crevices and corners.
 - .3 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.
 - .4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces free of roller tracking and heavy stipple.
 - .5 Remove runs, sags and brush marks from finished work and repaint.
- .3 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access.
- .4 Apply coats of paint continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.
- .5 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time as recommended by manufacturer.
- .6 Sand and dust between coats to remove visible defects.
- .7 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as tops of interior cupboards and cabinets and projecting ledges.
- .8 Repaint top, bottom, and vertical edges of doors to be repainted.

- .9 Finish closets and alcoves as specified for adjoining rooms.
- .10 Finish top, bottom, edges and cut-outs of doors after fitting as specified for door surfaces.

3.6 MECHANICAL/ELECTRICAL EQUIPMENT

- .1 Paint finished area exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as indicated.
- .2 Other unfinished areas: Leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.
- .3 Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.
- .4 Do not paint over nameplates.
- .5 Paint inside of ductwork where visible behind grilles, registers and diffusers with primer and one coat of matt black paint.
- .6 Paint disconnect switches for fire alarm system and exit light systems in red enamel.
- .7 Paint natural gas piping yellow.
- .8 Do not paint interior transformers and substation equipment.

3.7 FIELD QUALITY CONTROL

- .1 Standard of Acceptance:
 - .1 Walls: No defects visible from 1000 mm at 90 degrees to surface.
 - .2 Ceilings: No defects visible from floor at 45 degrees to surface when viewed using final lighting source.
 - .3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.
- .2 Advise Owner Representative when surfaces and applied coating is ready for inspection. Do not proceed with subsequent coats until previous coat has been approved.
- .3 Cooperate with inspection firm and provide access to areas of work.
- .4 Retain purchase orders, invoices and other documents to prove conformance with noted MPI requirements when requested by Owner Representative.

3.8 RESTORATION

- .1 Clean and re-install hardware items removed before undertaken painting operations.
- .2 Remove protective coverings and warning signs as soon as practical after operations cease.

- .3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.
- .4 Protect freshly completed surfaces from paint droppings and dust to approval of Owner Representative. Avoid scuffing newly applied paint.
- .5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by Owner Representative.

END OF SECTION

Part 1 General

1.1 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 datasheets; include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS MSDS - Material Safety Data Sheets.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Saskatchewan, for track type, track installation detail, track assembly, stationary tie down detail, rubber bumpers, drive upright detail, handle detail, crank, carriage detail including splice, and accessories.
 - .2 Indicate dimensions, layout, number of bays, number of shelves, number and size of drawers and bins, number of dividers, system of bracing against tipping and anchoring devices.
- .4 Quality Assurance Submittals: Submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Design Data:
 - .1 Submit floor loading calculations including floor loading diagram.
 - .2 Provide installation details.
 - .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.
- .5 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.2 DELIVERY, STORAGE AND HANDLING

- .1 Store shipped materials on site only after arrival of installation crew.
- .2 Installation personnel to arrange delivery of components on site as required to avoid storing components on site.
- .3 Waste Management and Disposal: Remove waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 DESIGN REQUIREMENTS

- .1 Compact Storage System: Storage units mounted on track-guided carriages. Access to individual aisles attained by manually moving units in the system.
- .2 System configuration: As indicated.
- .3 Track/Rail system: Design track to carry minimum 1490 kg per linear metre (1000 lbs per linear foot) of carriage.
- .4 Carriage: Gear reduction to allow carriage to move with 2.25 kg (5 lb) of force at turn handle.
- .5 Shelving:
 - .1 Four post, wedge-locking design, consisting of uprights, shelves, and shelf supports.
 - .2 Holes on exposed surfaces of assembled shelves are not permitted.
 - .3 Shelves and backs: flush with outside post.
 - .4 Provide sheet metal gables and back between each bay of shelves to prevent tampering.
 - .5 Design individual shelves to support uniform load of 59 kg/m (40 lbs/ft) of span, maximum deflection 1/140.
 - .6 Adjustment: provide with vertical adjustment of shelves in 38 mm increments.

2.2 FABRICATION

- .1 Materials and construction: Fabricate with cold-rolled steel, with bends sharp and true, without dents, oil-canning, buckling, or other surface irregularities.
 - .1 Fabricate units free of sharp edges, burrs, and projecting hardware.
- .2 Uprights: Formed from steel sheet, with keyhole slots on inner wall to accommodate shelves.
 - .1 Provide sheet steel panels for uprights at end of units.
 - .2 Vertical adjustment increment: 38 mm (1-1/2 inch).
- .3 Rail: Steel, AISI Type 1035 or 1045.
 - .1 Contact surface; Minimum 16 mm (5/8 inch) wide.
 - .2 Rail configuration: Permit attachment to top of structural floor system with provision for leveling rails to compensate for variations in floor surface level.
 - .3 Design rail connections to provide horizontal and vertical continuity between rail sections, to gradually transfer concentrated wheel point load to and from adjoining rail sections. Butt joints are not permitted.
- .4 Carriages: Welded or bolted steel construction, designed to recess and interlock into carriages minimum 19 mm (3/4 inch).
 - .1 Provide each carriage with two wheels per rail.

- .5 Wheels:
 - .1 Load capacity: Minimum 1455 kg (3200 lbs) per wheel.
 - .2 Size: Minimum outside diameter 125 mm (5 inches).
 - .3 Guides: Minimum 2 locations.
- .6 Drive system: Chain drive, with control wheel mounted to accessible ends of shelf units, complete with handle.
 - .1 Provide integral chain tensioning device to mechanical assist mechanism.
 - .2 Bearings: Permanently lubricated.
- .7 Drive / Guide System:
 - .1 Design: Provide drive system that prevents carriage whipping, binding, and excessive wheel/rail wear under normal operation.
 - .1 If line shafts are used, all wheels on one side of carriage shall drive.
 - .2 If synchronized drives are used, a minimum of one wheel assembly driving both sides of carriage at center location required. Drive shaft shall exhibit no play or looseness over the entire length of that assembly.
 - .2 Shafts: Solid steel rod or tube.
 - .3 Shaft Connections: Secured couplings.
 - .4 Bearing Surfaces: Rotating load bearing members with ball or roller bearings. Provide shafts with pillow block or flanged self-aligning type bearings.
- .8 End panels: Cold rolled steel, minimum 24 gauge, matched to existing mobile storage shelving.
- .9 Shelving: Formed of cold rolled steel with flanges on all sides and formed angles for end supports.
 - .1 Fabricate shelves with slots for file dividers.
 - .2 Front and back flanges: Form with return hems, flush with outside faces of posts.

2.3 FINISH

- .1 Finish metal shelving with electrostatically applied powder coat paint.
 - .1 Colour: As selected by Owner Representative from manufacturer's standard range.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install metal storage shelving in accordance with reviewed layout, installation and start-up instructions.
- .2 Level track anchor and grout between track and floor.
- .3 Install components in place, plumb, straight and level.
- .4 Installation Tolerances:
 - .1 Maximum Variation from True Level Within Any Module: 2.4 mm (3/32 inch).
 - .2 Maximum Variation Between Adjacent (Parallel) Rails: 1.6 mm (1/16 inch), perpendicular to rail direction.
 - .3 Maximum Variation in Height: 0.8 mm (1/32 inch), measured along any 3.05 m (10 foot) rail length.
- .5 Brace, secure, and anchor components in place.
- .6 Install shelving at uniform, equal height spacing, unless instructed otherwise.
- .7 Make good finished surfaces damaged during shipment or installation.

3.3 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

Part 1 General

1.1 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: Submit manufacturer's printed product literature and data sheets for horizontal louvre blinds; include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings: Indicate dimensions in relation to window jambs, operator details, anchorage details, hardware and accessories details.
- .4 Samples: Submit duplicate samples of manufacturer's standard colours for selection by Owner Representative.

1.2 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 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect horizontal louvre blinds from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS AND FABRICATION

- .1 Slats: 25 mm (1 inch) wide x 0.2 mm (0.008 inch) thickness, with rounded corners, and rough edges removed.
 - .1 Aluminum alloy, spring-tempered.
 - .2 Colour and finish: As selected by Owner Representative.
- .2 Ladders:
 - .1 Braided polyester yarn designed for full tilting action while retaining same level and position of each slat.
- .3 Headrails:
 - .1 One piece corrosion-resistant steel channel with rolled edges, formed to provide sufficient strength to support blind without sagging, twisting or distorting.
 - .2 Metal minimum 0.50 mm thick.

- .4 Bottom rails:
 - .1 Lock seam tubular steel section.
 - .2 Bottom rail end caps: Colour to match slats.
- .5 Installation brackets: end and centre type, complete with safety locking caps to secure headrail and valance.
- .6 Pulleys: designed to permit ease of operation with minimum wear to cord.
- .7 Valance: Same material colour and finish as slats.
- .8 Tilters: Fully enclosed and lubricated, positively locked to drum to prevent slippage and ensure accurate timing.
 - .1 Use anti-friction materials for worm and gear.
- .9 Lift cords: 2 mm diameter, with end tassels.
- .10 Cord locks: designed to provide smooth operation with feature to prevent accidental dropping of blinds.
- .11 Ladder cap: designed to provide sufficient retention when snapped onto bottom rail to hold ladders in proper position.
- .12 Tilter controls: Wand type, minimum 8 mm diameter.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify conditions of substrates and surfaces to receive horizontal louvre blinds are acceptable for product installation in accordance with manufacturer's instructions, prior to horizontal louvre blinds installation.
 - .1 Visually inspect substrate.
 - .2 Inform Owner Representative of unacceptable conditions.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Install blinds at exterior windows at locations indicated.
- .2 Include centre brackets where necessary to prevent deflection of headrail.
- .3 Adjust to provide for operation without binding.
- .4 Use non-corrosive metal fasteners for installation, concealed in final assembly.

3.3 ADJUSTING

- .1 Adjust horizontal louvre blinds components for correct function and operation in accordance with manufacturer's written instructions.
- .2 Lubricate moving parts to operate smoothly and fit accurately.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: Remove waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

3.5 PROTECTION

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

END OF SECTION

Part 1 General

1.1 PERFORMANCE REQUIREMENTS

- .1 Installed roller shade systems: Free from sagging, rippling, curling, cupping, twisting, and telescoping.
- .2 Window coverings required to be consistent with existing building standards. Confirm product details and selections with Owner Representative before beginning fabrication.

1.2 SUBMITTALS

- .1 Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature and data sheets for roller shades. Include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Shop Drawings:
 - .1 Indicate dimensions in relation to window jambs, operator details, top rail, conditions between adjacent blinds, corner conditions, head anchorage details, hardware and accessories details.
- .4 Samples:
 - .1 Submit duplicate samples of manufacturer's standard colours and textures for confirmation by Owner Representative.
 - .1 Submit fascia samples, minimum 100 mm long.
 - .2 Submit samples of shade fabrics, minimum size 100 x 100 mm, showing colour, finish, and texture.

1.3 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 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, in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect roller shades from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS AND FABRICATION

- .1 Heavy-duty manual chain-operated horizontal roller shade systems.
 - .1 Roller tube: Extruded aluminum with internal ribs, alloy 6063-T5 or 6063-T6; same width as shade band; diameter sufficient to bear weight of shade fabric without deflection.
 - .1 Idler end cap: Spring loaded for ease of roller removal.
 - .2 Brackets: Nickel plated cold rolled steel, for single or double roller tube installations as required.
 - .1 Mounting: Confirm on site with Owner Representative.
 - .3 Bottom bar: External mount, round.
 - .4 Fascia: Extruded aluminum, finish as selected by Owner Representative from manufacturer's standard range.
 - .5 Operating chain: #10 nickel plated steel or stainless steel bead chain.
 - .6 Sizes: As determined by field measurement.
- .2 Fabrics:
 - .1 Sunshade fabric: PVC coated fibreglass, openness factor 1%. Colour: Black or charcoal.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify conditions of substrates and surfaces to receive roller shades are acceptable for product installation in accordance with manufacturer's instructions.
 - .1 Visually inspect substrate.
 - .2 Inform Owner Representative of unacceptable conditions.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Install roller shades in accordance with manufacturer's instructions.
- .2 Install roller shades level and true.
- .3 Use non-corrosive metal fasteners for installation, concealed in final assembly.

3.3 ADJUSTING

- .1 Adjust shade components for correct function and operation in accordance with manufacturer's written instructions.
- .2 Adjust to provide for quiet operation without binding.
- .3 Adjust shade and shade cloth to hang flat without waves, folds, or distortion.
- .4 Lubricate moving parts to operate smoothly and fit accurately.

3.4 TOLERANCES

- .1 Maximum variation of gap at window opening perimeter: 6 mm per 2.4 m of shade height.

3.5 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 Clean exposed surfaces and edges/ends, including metal and shade cloth, using non-abrasive materials and methods recommended by manufacturer. Remove and replace work that cannot be satisfactorily cleaned.
- .4 Waste Management: Remove waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

3.6 PROTECTION

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

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 Conform to the requirements of Division 1, which applies to and forms part of all sections of the work.
- .2 Conform to all the requirements to comply with the Green Globe Standard. Refer to Section 01 33 29.
- .3 The Specification is divided into Sections which are not intended to identify contractual limits between Subcontractors nor between the Contractor and his Subcontractors. The requirements of any one Section apply to all Sections. Refer to other Divisions and Sections to ensure a complete and operational system.
- .4 Provide mechanical components and accessories which may not be specifically shown on the Drawings or stipulated in the Specifications, but are required to ensure complete and operational systems

1.2 INTENT

- .1 Mention in the Specifications or indication on the Drawings of equipment, materials, operation and methods, requires provision of the quality noted, the quantity required, and the systems complete in every respect.
- .2 The Specifications are an integral part of the accompanying Drawings. Any item or subject omitted from one or the other, but which is either mentioned or reasonably implied, shall be considered as properly and sufficiently specified.
- .3 Be completely responsible for the acceptable condition and operation of all systems, equipment and components forming part of the installation or directly associated with it. Promptly replace defective material, equipment and part of equipment and repair related damages.

1.3 SECTIONS AFFECTED

- .1 These instructions apply to and form a part of all Mechanical Sections.

1.4 REGULATIONS

- .1 Work shall be performed in accordance with codes, rules, regulations, by-laws and requirements of the authorities having jurisdiction.
- .2 The plumbing and drainage systems shall comply with regulations respecting plumbing made under the National Building Code except as modified by rules, regulations and by-laws of authorities having jurisdiction.
- .3 Natural gas systems shall be in accordance with the Gas Protection Act and Natural Gas and Propane Installation Code CSA B149.1-15.
- .4 These specifications are supplementary to the requirements above.

- .5 Drawings and specifications should not conflict with the above regulations but where there are apparent discrepancies the Contractor shall notify the Departmental Representative.

1.5 PERMITS, FEES INSPECTION

- .1 Obtain all permits, make submissions, pay all fees and arrange for all inspections required for the work of this Division.

1.6 DRAWINGS, CHANGES AND INSTALLATION

- .1 The Drawings shall be considered to show the general character and scope of the work and not the exact details of the installation. The installation shall be complete with all accessories required for a complete and operational installation.
- .2 The location, arrangement and connection of equipment and material as shown on the Drawings represents a close approximation to the intent and requirements of the work. The right is reserved by the Departmental Representative. To make reasonable changes required to accommodate conditions arising during the progress of the work, at no extra cost to the Owner.
- .3 In order to show more clearly the arrangement of the work, plans and sections do not show every valve, thermometer, pressure gauge or other system accessory. Refer to the Mechanical Standard Details and to the Specifications to determine the requirements.
- .4 Equipment installed by this Division shall installed in accordance with the manufacturer's installation requirements. In the event of conflicts between the Drawings or Specifications and the manufacturer's installation requirements, the Contractor shall notify the Departmental Representative.
- .5 Certain Details indicated on the Drawings are general in nature and specific labelled detail references to each and every occurrence of use are not indicated, however, such details shall be applicable to every occurrence.
- .6 All piping and ductwork in finished areas shall be concealed in ceiling spaces and shafts or chased into walls. No exposed piping or ductwork shall be installed in such areas unless specifically reviewed and accepted by the Departmental Representative. No piping shall be concealed in outside walls.
- .7 Vent pipes, exhaust hoods or other mechanical equipment mounted on the roof, or housing for such equipment shall not be closer to the edge of the roof than a distance equal to the height of the pipe, hood or equipment, unless specifically reviewed and accepted by the Departmental Representative.
- .8 The location and size of existing services shown on the Drawings are based on the best available information. The actual location of existing services shall be verified in the field before work is commenced. Particular attention shall be paid to buried services.
- .9 Changes and modifications necessary to ensure co-ordination and to avoid interference and conflicts with other Trades, or to accommodate existing conditions, shall be made at no extra cost to the Departmental Representative.

- .10 Leave areas clear of piping and ducts where space is indicated as reserved for future equipment and equipment for other Trades.
- .11 Adequate space and provisions shall be left for removal of coils and servicing of equipment, with minimum inconvenience to the operation of systems.
- .12 Where equipment is shown to be 'roughed-in only' obtain accurate information from the Departmental Representative before proceeding with the work.
- .13 Before fabricating ductwork or piping for installation, make certain that such items can be installed as shown on the Drawings without interfering with the structure or the work of other Trades. Any problems that cannot be solved in agreement with the other Trades affected, shall be submitted for decision. If ductwork or piping is prefabricated prior to the investigation and reaching of a solution to possible interference problems, necessary changes in such prefabricated items shall be made at no extra cost to the Owner.
- .14 Location of diffusers, grilles registers, thermostats, sprinklers and all other equipment shown on plans is diagrammatic. Layout of each device in finished areas is critical in terms of symmetry and location. Refer to Architectural Drawings and to site instructions in all regards. Any work not installed in the correct location (at the sole discretion of the Departmental Representative) shall be remedied by this Contractor at his expense. This Contractor is responsible for mark-out of his work, fully co-ordinated with all other trades, in sufficient time for review by Departmental Representative prior to rough-in. All mechanical and sprinkler services shall be located precisely.
- .15 Prepare dimensioned layouts of each room prior to rough-in for review by the Departmental Representative. Do not proceed with any work until the Departmental Representative has reviewed the layout.

1.7 INSTALLATION, INTERFERENCE AND SETTING DRAWINGS

- .1 Installation, interference and setting Drawings dimensioned and to scale, shall be submitted for review by the Departmental Representative, as may be required or requested by the Departmental Representative to make clear the work intended or to show its relation to adjacent work or to the work of other trades. When an alternative piece of equipment is to be substituted for equipment shown, Drawings of the area involved shall be prepared by this Division. Three copies of such Drawings shall be submitted for review, of which one will be retained by the Departmental Representative.
- .2 Installation working Drawings to 1:50 scale for mechanical rooms showing plan and sections of the plant, services, bases, curbs, drains, motor terminals, shall be prepared by this Division.
- .3 Interference Drawings are required for shafts, ceiling spaces, typical floors and wherever there is possible conflict with the positioning of mechanical equipment, piping or ductwork and architectural or structural features or the work of other trades.
- .4 The design of the structural framing of the mechanical rooms and pipe spaces and major pipe run supports has been based on assumed loadings supplied

during the design phase. Well ahead of the construction of the affected areas, prepare and submit Drawings for review by the Departmental Representative showing the layout and weights of all finally selected mechanical equipment including details of concrete pads, concentrated pipe loads and point reactions of the equipment onto the structure.

- .5 This Division shall prepare sleeving Drawings indicating the size and locations of openings required in concrete floor slabs, roof slabs/decks and walls for piping, ductwork and equipment. In case of failure to provide information in time (i.e. before the concrete is poured) any extras incurred shall be at the expense of this Division.
- .6 Work shall not proceed in areas involved until after final review of such Drawings has been obtained.

1.8 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for all equipment.
- .3 Shop drawings:
 - .1 Drawings to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
 - .2 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, including ASHRAE 90.1 and the Model National Energy Code of Canada for Buildings.
 - .3 In addition to transmittal letter referred to in Section 01 33 00: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

1.9 CLOSEOUT SUBMITTALS

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

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- .2 Operation and Maintenance Data: submit operation and maintenance data for all equipment.
 - .1 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
 - .2 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 Colour coding chart.
 - .3 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
 - .4 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93.
 - .5 Approvals:
 - .1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
 - .2 Make changes as required and re-submit as directed by Departmental Representative.
 - .6 Additional data:

- .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 Site records:
 - .1 Departmental Representative will provide 1 set of reproducible mechanical drawings. Provide sets of prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .2 Transfer information weekly to reproducible, revising reproducible 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.

1.10 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00.
- .2 Furnish spare parts as follows:
 - .1 One set of packing for each pump.
 - .2 One casing joint gasket for each size pump.
 - .3 One head gasket set for each heat exchanger.
 - .4 One glass for each gauge glass.

- .5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.11 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions and with Section 01 61 00.
- .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 all equipment 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: as specified in Construction Waste Management Plan in accordance with Section 01 74 20.

Part 2 Products

2.1 MATERIALS

- .1 HVAC&R Equipment:
 - .1 Refrigerant:
 - .1 HCFC based refrigerant.
 - .2 HFC based refrigerant.
 - .2 Metering Equipment

Part 3 Execution

3.1 CO-OPERATION WITH DEPARTMENTAL REPRESENTATIVES

- .1 To assist in the successful execution of the project, the Contractor shall receive a job report that summarizes the expectations of the Departmental Representative and the Contractor. This document covers topics such as progress billings breakdowns, shop drawing requirements, change order pricing breakdowns, the commissioning process, installation drawings, the specifications, as-builts and O+M manuals, along with a number of other items. This job report is intended to

reiterate and elaborate on key items of the Contract Documents and is not intended to impose new requirements.

- .2 At the appropriate time during construction the Contractor shall submit the applicable documentation listed in the Mechanical/Electrical Unfinished Building Occupancy Checklist. The list shall be issued by the Departmental Representative during the course of the project; however, a sample checklist can be provided at any time upon request. The checklist shall be completed by the Contractor when the information required for occupancy is submitted. The Departmental Representative shall review the information and checklist and shall identify when the information is complete. The Departmental Representative's general review letter (required for building occupancy) shall only be issued when all the information requested in the checklist is submitted by the Contractor and deemed to be complete by the Departmental Representative.

3.2 CO-OPERATION WITH OTHER DIVISIONS

- .1 Particular attention must be paid to the proximity of electrical conduit and cable to mechanical piping and equipment.
- .2 Pipes transporting hot fluids shall be installed at least 150 mm (6 in.) away from pipes carrying cold fluids, unless approval from the Departmental Representative is obtained to install services closer than 150 mm (6 in.).
- .3 Electrical conduits shall not touch or be supported from piping or ductwork.
- .4 Each Section shall confine itself to installing all materials in the spaces shown without encroaching upon space for materials installed under other Sections or Divisions. Where the space allocated to another Section or Division is encroached upon, the materials shall be relocated to their proper space allocation in such a manner to complete the work using space allocated to the various Sections and Divisions. Relocation of materials and work involved shall be paid for by the Section responsible for the encroachment at no extra cost to the Owner.
- .5 Supply all items to be built in ample time for rapid progress of the work. Schedule and proceed with work as required to satisfy the construction schedule.
- .6 The Contractor shall confirm the available voltage for all single phase and three phase motors or other similar electrically driven equipment with the Electrical Division prior to ordering the equipment. Any discrepancy between the requirements identified within the Contract Documents and those of the Electrical Division shall be reported to the Departmental Representative and the equipment shall be adjusted to suit the appropriate power requirements. Failure to perform this coordination prior to ordering of the motors or equipment shall result in correction at no additional cost to the Owner.

3.3 TEMPORARY USE OF EQUIPMENT

- .1 Where the mechanical systems are operated during construction, the Contractor shall maintain the system and equipment in proper operating condition.

- .2 Prior to application for substantial performance of the work as certified by the Departmental Representative, the systems and equipment shall be returned to the initial new condition by replacing used air filters with new air filters, cleaning the air side of all coils in the air handling systems, replacing used belts in belt drives with new belts, lubricating all bearings according to manufacturer's factory standards and adjusting the thermostatic control system according to specifications and/or to suit the Owner.

3.4 PROVISION FOR FUTURE EXPANSION

- .1 Where piping, ductwork and equipment is indicated for use in future expansion of the building, the Contractor shall leave sufficient clear space and shall install the piping, ductwork and equipment in such manner that connections to the future building expansion can be made without dismantling existing piping, ductwork and equipment and without removing existing floors, walls and ceilings.

3.5 HOUSEKEEPING PADS, CURBS AND SUPPORT PIERS

- .1 Housekeeping pads, curbs and support piers under all floor mounted mechanical equipment and around all floor penetrations for pipes and ducts shall be provided by Division 03. This Division shall coordinate all sizes and locations for housekeeping pads and curbs. Provide dimensioned drawings for review by the Departmental Representative. All housekeeping pads shall be minimum 100 mm (4 in.) high unless detailed otherwise. Refer to the Drawings and Details for additional information.

3.6 SYSTEM CLEANING

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

3.7 FIELD QUALITY CONTROL

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

3.8 DEMONSTRATION

- .1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

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

3.9 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 21 05 01

1.2 REFERENCE STANDARDS

.1 ASTM International

.1 ASTM A126-04(2014), Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.

.2 American Water Works Association (AWWA)

.1 AWWA C702-15, Standard for Cold Water Meters-Compound Type.

.3 CSA International

.1 CAN/CSA-B64 Series-11(R2016), Backflow Preventers and Vacuum Breakers.

.2 CSA B79-08(R2013), Commercial and Residential Drains and Cleanouts.

.3 CAN/CSA-B356-10(R2015), Water Pressure Reducing Valves for Domestic Water Supply Systems.

.4 Efficiency Valuation Organization (EVO)

.1 International Performance Measurement and Verification Protocol (IPMVP).

.1 IPMVP 2007 Version.

.5 National Research Council Canada (NRC)

.1 National Plumbing Code of Canada 2015 (NPC).

.6 Plumbing and Drainage Institute (PDI)

.1 PDI-G101-R2010, Testing and Rating Procedure for Grease Interceptors with Appendix of Installation and Maintenance.

.2 PDI-WH201-R2010, Water Hammer Arresters Standard.

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Pre-installation Meetings:

.1 Convene pre-installation meeting 1 week prior to beginning on-site installation in accordance with Section 01 31 19 Project Meetings to:

.1 Verify project requirements.

.2 Review installation and substrate conditions.

- .3 Co-ordination with other building construction subtrades.
- .4 Review manufacturer's written installation instructions and warranty requirements.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for plumbing products and include product characteristics, performance criteria, physical size, finish and limitations.
- .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 Manufacturers' Field Reports: manufacturers' field reports specified.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00.
- .2 Operation and Maintenance Data: submit operation and maintenance data for plumbing specialties and accessories for incorporation into manual.
 - .1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.
 - .2 Details of operation, servicing and maintenance.
 - .3 Recommended spare parts list.

1.6 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 FLOOR DRAINS

- .1 Floor Drains and Trench Drains: to CSA B79.
- .2 Type 1: finished areas; cast iron body, round, adjustable head, 127mm diameter, 6.35mm thick nickel bronze strainer, integral seepage pan, and clamping collar, trap primer connection.
- .3 Type 2: non-finished areas; cast iron body, drainage flange, adjustable nominal 200 mm dia. heavy-duty strainer.
- .4 Type 3: combination funnel floor drain; cast iron body with integral seepage pan, clamping collar, minimum nominal 127 mm dia. 6.35mm thick Nickel bronze strainer, full opening for funnel and nominal 75 mm x 225 mm oval funnel. .
- .5 Type 4: planters; cast-iron body with integral seepage pan, clamping collar, nickel-bronze adjustable head strainer, vandal-proof dome and standpipe, stainless steel screen.
- .6 Type 5: finished areas, tile; cast iron body, square, adjustable head, 127mm x 127mm, 6.35mm thick nickel bronze strainer, integral seepage pan, and clamping collar, trap primer connection.

2.2 ROOF DRAINS

- .1 Type 1: controlled flow; coated cast iron body, large sump, wide non-crimping flange, vandal proof aluminum or ductile iron mushroom dome strainer, extension frame to suit thickness of insulation, sump receiver, under-deck clamps and flashing clamp with integral gravel stop. flow control weir assembly, cast iron dome.
- .2 Type 2: parapet or scupper drain; cast iron body with bronze strainer/grate and flashing clamp.

2.3 CLEANOUTS

- .1 Cleanout Plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.
- .2 Access Covers:
 - .1 Wall Access: face or wall type, round polished nickel bronze square cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.
 - .2 Floor Access: round cast iron body and frame with adjustable secured nickel bronze top and:
 - .1 Plugs: bolted bronze with neoprene gasket.
 - .2 Cover for Unfinished Concrete Floors: nickel bronze frame round cast iron, gasket, vandal-proof screws.

- .3 Cover for Terrazzo Finish: polished nickel bronze with recessed cover for filling with terrazzo, vandal-proof locking screws.
- .4 Cover for Tile and Linoleum Floors: polished nickel bronze with recessed cover for linoleum or tile infill, complete with vandal-proof locking screws.
- .5 Cover for Carpeted Floors: polished nickel bronze with deep flange cover for carpet infill, complete with carpet retainer vandal-proof locking screws.

2.4 NON-FREEZE WALL HYDRANTS

- .1 Recessed type with integral vacuum breaker, NPS $\frac{3}{4}$ hose outlet, removable operating key. Chrome plated finish.

2.5 WATER HAMMER ARRESTORS

- .1 Stainless steel, bellows type: to PDI-WH201.

2.6 BACK FLOW PREVENTERS

- .1 Preventers: to CAN/CSA-B64 Series 11, application double check valve assembly reduced pressure principle type.

2.7 VACUUM BREAKERS

- .1 Breakers: to CAN/CSA-B64 Series 11, vacuum breaker atmospheric, laboratory faucet intermediate.

2.8 PRESSURE REGULATORS

- .1 Capacity: as indicated.
 - .1 Inlet pressure: as indicated.
 - .2 Outlet pressure: as indicated.
- .2 Up to NPS 1-1/2 bronze bodies, screwed: to ASTM B62.
- .3 NPS 2 and over, semi-steel bodies, Class 125, flanged: to ASTM A126, Class B.
- .4 Semi-steel spring chambers with bronze trim.

2.9 BACKWATER VALVES

- .1 Coated extra heavy cast iron body with bronze seat, revolving bronze flapper and threaded cover.
- .2 Access:
 - .1 Surface access.
 - .2 Access pipe with cover: maximum 300mm depth.

.3 Steel housing with gasketed steel cover.

.4 Concrete access pit with cover, as indicated.

2.10 HOSE BIBBS AND SEDIMENT FAUCETS

.1 Bronze construction complete with integral back flow preventer, hose thread spout, replaceable composition disc, and chrome plated in finished areas.

2.11 WATER MAKE-UP ASSEMBLY

.1 Complete with backflow preventer pressure gauge on inlet and outlet, pressure reducing valve to CAN/CSA-B356, pressure relief valve on low pressure side and gate valves on inlet and outlet.

2.12 WATER METERS

.1 Compound type to AWWA C702.

.2 Capacity: as indicated.

.3 Accessories: remote readout device.

2.13 TRAP SEAL PRIMERS

.1 Brass, with integral vacuum breaker, NPS 1/2 solder ends, NPS drip line connection.

.2 Electronic, automatic with integral ball valve. Pre-piped with copper manifold and distribution system suitable for number of drains

.3 Electrical components to require a single point power connection at 120V. Unit shall include a manual override switch and 24 hour timer with relay and adjustable delay. All components shall be factory assembled and installed into a coated steel box with access door for recessed installation.

2.14 STRAINERS

.1 860kPa, Y type with 20 mesh, monel, bronze or stainless steel removable screen.

.2 NPS 2 and under, bronze body, screwed ends, with brass cap.

.3 NPS 2 1/2 and over, cast iron body, flanged ends, with bolted cap.

2.15 OIL INTERCEPTOR

.1 Under sink Oil interceptors shall have steel body, internal baffles with epoxy coated finish. Cover shall be scoriated steel or cast aluminum and shall be bolted and gasketed to the body for a tight fit. A flow control fitting shall be included with the unit to limit flow to the maximum allowable.

.2 Flow rate shall be equal to the connecting sink flow rate.

.3 Unit shall be complete with oil draw-off.

- .4 Unit shall be suitable for floor installation beneath sink as shown

2.16 ACID DILUTION DEVICES

- .1 Neutralizing tank and Interceptor
- .1 180 gallon neutralizing tank 1220mm (48") dia. 2440 (96") high
 - .2 610mm (24") dia x 1220mm (48") high interceptor c/w 16" dia x 32" high removable sediment basket
 - .3 Tank and Fittings fabricated from black carbon pigmented U.V. stabilized polyethylene
 - .4 Plain end polyethylene inlet, outlet and vent connections
 - .5 EDPM cover and inspection port gaskets. Fastening hardware: 304 SS rated to 44.8 kPa (15 ft head).
 - .6 12.7mm ½"FIP for primer connection complete with plug
 - .7 Extension to suit inlet invert
 - .8 pH monitor c/w hi/low alarm, pH probe, 6m (20') coaxial cable, 120V auxiliary power for remote alarm and connection to building automation system.
 - .9 304mm (12") dia. Flush mounted inspection port
 - .10 200mm thick probe port
 - .11 25mm thick heavy duty polyethylene top, flush with floor frame assembly and encapsulated receiving nuts
 - .12 3mm thick non-skid aluminum cover.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install in accordance with National Plumbing Code of Canada (NPC), local authority having jurisdiction, Ontario Building code.
- .2 Install in accordance with manufacturer's instructions and as specified.

3.3 CLEANOUTS

- .1 Install cleanouts at base of soil and waste stacks, and rainwater leaders, at locations required code, and as indicated.

.2 Bring cleanouts to wall or finished floor unless serviceable from below floor.

.3 Building drain cleanout and stack base cleanouts: line size to maximum NPS 4.

3.4 NON-FREEZE WALL HYDRANTS

.1 Install 600mm above finished grade in locations indicated.

3.5 WATER HAMMER ARRESTORS

.1 Install on branch supplies to fixtures or group of fixtures.

3.6 BACK FLOW PREVENTERS

.1 Install in accordance with CAN/CSA-B64 Series-11, where indicated and elsewhere as required by code. Back-flow preventers shall be installed for any connection to potable water systems in which backflow may occur, including

.1 Connections to wall hydrants

.2 connections to hose bibs

.3 Water Make-up Assemblies.

.2 Pipe discharge to terminate over nearest drain or service sink.

3.7 BACKWATER VALVES

.1 Install where indicated

.2 Install in access pit as indicated.

3.8 HOSE BIBBS AND SEDIMENT FAUCETS

.1 Install at bottom of risers, at low points to drain systems, and as indicated.

3.9 TRAP SEAL PRIMERS

.1 Provide electronic automatic trap seal primer systems with 12 mm connection complete with integral ball valve, backflow preventer and vacuum breaker. Pre-pipe unit with a copper manifold and distribution system suitable for the number of drains served. Electrical components to require a single point power connection at 120V. Unit shall include a manual override switch and 24 hour timer with relay and adjustable delay. All components shall be factory assembled and installed into a coated steel box with access door for recessed, or surface mounted installation as shown.

.2 Install for floor drains and elsewhere, as indicated.

.3 Install soft copper tubing to floor drain.

.4 Provide a running trap and cleanout for each pit drain.

3.10 STRAINERS

- .1 Install with sufficient room to remove basket for maintenance.

3.11 WATER METERS

- .1 Install water metre provided by local water authority.
- .2 Install water metre as indicated.

3.12 WATER MAKE-UP ASSEMBLY

- .1 Install on valved bypass.
- .2 Pipe discharge from relief valve to nearest floor drain.

3.13 START-UP

- .1 Timing: start-up only after:
 - .1 Pressure tests have been completed.
 - .2 Disinfection procedures have been completed.
 - .3 Certificate of static completion has been issued.
 - .4 Water treatment systems operational.
- .2 Provide continuous supervision during start-up.

3.14 TESTING AND ADJUSTING

- .1 General:
 - .1 Test and adjust plumbing specialties and accessories in accordance with Section 01 91 13: General Requirements, supplemented as specified.
- .2 Timing:
 - .1 After start-up deficiencies rectified.
 - .2 After certificate of completion has been issued by authority having jurisdiction.
- .3 Application tolerances:
 - .1 Pressure at fixtures: +/- 70 kPa.
 - .2 Flow rate at fixtures: +/- 20%.
- .4 Adjustments:
 - .1 Verify that flow rate and pressure meet design criteria.

- .2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.
- .5 Floor drains:
 - .1 Verify operation of trap seal primer.
 - .2 Prime, using trap primer. Adjust flow rate to suit site conditions.
 - .3 Check operations of flushing features.
 - .4 Check security, accessibility, removability of strainer.
 - .5 Clean out baskets.
- .6 Vacuum breakers, backflow preventers, backwater valves:
 - .1 Test tightness, accessibility for O&M of cover and of valve.
 - .2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.
 - .3 Verify visibility of discharge from open ports.
- .7 Roof drains:
 - .1 Check location at low points in roof.
 - .2 Check security, removability of dome.
 - .3 Adjust weirs to suit actual roof slopes, meet requirements of design.
 - .4 Clean out sumps.
 - .5 Verify provisions for movement of roof systems.
- .8 Access doors:
 - .1 Verify size and location relative to items to be accessed.
- .9 Cleanouts:
 - .1 Verify covers are gas-tight, secure, yet readily removable.
- .10 Water hammer arrestors:
 - .1 Verify proper installation of correct type of water hammer arrester.
- .11 Wall, ground hydrants:
 - .1 Verify complete drainage, freeze protection.
 - .2 Verify operation of vacuum breakers.
- .12 Pressure regulators, PRV assemblies:
 - .1 Adjust settings to suit locations, flow rates, pressure conditions.

- .13 Strainers:
 - .1 Clean out repeatedly until clear.
 - .2 Verify accessibility of cleanout plug and basket.
 - .3 Verify that cleanout plug does not leak.

- .14 Hose bibbs, sediment faucets:
 - .1 Verify that flow and pressure meet design criteria.
 - .2 Check for leaks, replace compression washer if required.

- .15 Hydronic system water Make-up Assembly:
 - .1 Verify flow, pressure, and connection.

- .16 Water meters:
 - .1 Verify location and accessibility.
 - .2 Test metre reading accuracy.

- .17 Soap Dispensing Systems:
 - .1 Verify location and reach.
 - .2 Check for leaks.

3.15 CLOSEOUT ACTIVITIES

- .1 Training: provide training in accordance with Section 01 79 00: Training of O&M Personnel, supplemented as specified.

3.16 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Waste Management: in accordance with Section 01 74 20

3.17 PROTECTION

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

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 21 05 01

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA B45 Series-02(R2013), Plumbing Fixtures.
 - .2 CSA B125.3-12, Plumbing Fittings.
 - .3 CSA B651-12(R2017), Accessible Design for the Built Environment.
- .2 National Research Council Canada (NRC)
 - .1 National Building Code of Canada 2015(NBC).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data in accordance with Section 01 78 00.
- .2 Include:
 - .1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.
 - .2 Details of operation, servicing, maintenance.
 - .3 List of recommended spare parts.

1.5 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 MANUFACTURED UNITS

- .1 Fixtures: manufacture in accordance with CAN/CSA B45 series.
- .2 Trim, fittings: manufacture in accordance with CAN/CSA B125.
- .3 Exposed plumbing brass to be chrome plated.
- .4 Number, locations: architectural drawings to govern.
- .5 Fixtures to be product of one manufacturer.
- .6 Trim to be product of one manufacturer.
- .7 Stainless steel counter top sinks.
 - .1 S-1: Single compartment, under counter mount, non-ledge back:
 - .1 From 1.0 mm thick type 302 stainless steel, self-rimming, undercoated, clamps. Overall sizes: 520 x 315 x 160mm.
 - .2 Trim: chrome plated brass, with gooseneck swing spout, pull down spray head, aerator, single lever handle, washerless controls, accessories to limit maximum flow rate to 5.7litres/minute at 413 kPa, spray fitting.
 - .3 Bottle Filler: Laminar water stream with 5.7L/Min at 414 kPa, One hole mount, 360 degree spout rotation, Provide PEX supply line connection. Water supply is started and stopped via touching faucet. Finish: Chrome

Part 3 Execution

3.1 APPLICATION

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

3.2 INSTALLATION

- .1 Mounting heights:
 - .1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified.
 - .2 Wall-hung fixtures: as indicated, measured from finished floor.
 - .3 Physically handicapped: to comply with most stringent of either NBC or CAN/CSA B651.

3.3 ADJUSTING

- .1 Conform to water conservation requirements specified this section.
- .2 Adjustments:

- .1 Adjust water flow rate to design flow rates.
- .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
- .3 Checks:
 - .1 Aerators: operation, cleanliness.
 - .2 Vacuum breakers, backflow preventers: operation under all conditions.
 - .3 Wash fountains: operation of flow-actuating devices.
- .4 Thermostatic controls:
 - .1 Verify temperature settings, operation of control, limit and safety controls.

3.4 CLEANING

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

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 21 05 01

1.2 REFERENCE STANDARDS

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA B139-09 Series-15, Installation Code for Oil Burning Equipment.
- .3 Green Seal Environmental Standards (GSES)
 - .1 Standard GS-11-2015, Edition 3.2, 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-A2016, Architectural Coatings.
 - .2 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions and 01 61 00.
- .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 20.

Part 2 Products

2.1 MATERIAL

- .1 Paint: zinc-rich to CAN/CGSB-1.181.
- .2 Sealants: in accordance with Section 07 92 00.
- .3 Fire Stopping: in accordance with Section 07 84 00.

Part 3 Execution

3.1 APPLICATION

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

3.2 CONNECTIONS TO EQUIPMENT

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

3.3 CLEARANCES

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

3.4 DRAINS

- .1 Install piping with grade in direction of flow except as indicated.
- .2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.
- .3 Pipe each drain valve discharge separately to above floor drain.
 - .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.

3.5 AIR VENTS

- .1 Install automatic air vents at high points as per CSA B139.

- .2 Install isolating valve at each automatic air valve.
- .3 Install drain piping to approved location and terminate where discharge is visible.

3.6 DIELECTRIC COUPLINGS

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

3.7 PIPEWORK INSTALLATION

- .1 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 gate 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 ball valves for glycol service.
- .10 Use chain operators on valves NPS 2 1/2 and larger where installed more than 2400mm above floor in Mechanical Rooms.
- .16 Check Valves:
 - .1 Install silent check valves in vertical pipes with downward flow, and as indicated.
 - .2 Install swing check valves in horizontal lines, on discharge of pumps, and as indicated.

3.8 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.

3.9 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.
- .2 Uninsulated unheated pipes not subject to movement: no special preparation.
- .3 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe movement without damaging fires topping material or installation.
- .4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

3.11 FLUSHING OUT OF PIPING SYSTEMS

- .1 Flush system in accordance with Section 23 08 02
- .2 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 CLEANING

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

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 21 05 01

1.2 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B1.20.1-2013, Pipe Threads, General Purpose (Inch).
 - .2 ASME B16.18-2012, Cast Copper Alloy Solder Joint Pressure Fittings.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

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

1.5 MAINTENANCE MATERIAL SUBMITTALS

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

1.6 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: in accordance with Section 01 74 20.

Part 2 Products

2.1 MATERIALS

- .1 Valves:
 - .1 Except for specialty valves, to be single manufacturer.
 - .2 Products to have CRN registration numbers.
- .2 End Connections:
 - .1 Connection into adjacent piping/tubing:
 - .1 Steel pipe systems: screwed ends to ASME B1.20.1.
 - .2 Copper tube systems: grooved or solder ends to ASME B16.18.
- .3 Lockshield Keys:
 - .1 Where lockshield valves are specified, provide 10 keys of each size: malleable iron cadmium plated.
- .4 Gate Valves:
 - .1 NPS 2 and under
 - .1 860 kPa (125 psi) WSP or 1380 kPa (200 psi) non-shock WOG with bronze body, rising stem screwed.
- .5 Globe Valves:
 - .1 NPS 2 and under
 - .1 860 kPa (125 psi) WSP or 1380 kPa (200 psi) non-shock WOG with bronze body, solder ends or with screwed to solder adapter and composition disc for water service.
- .6 Check Valves:
 - .1 NPS 2 and under
 - .1 860 kPa (125 psi) WSP or 1380 kPa (200 psi) non-shock WOG with bronze body, swing check, solder or threaded ends.

- .7 Silent Check Valves:
 - .1 Non-slam check valves downstream from pumps, ANSI Class 150, 1032 kPa (150 psi) WSP pressure rating, dual flapper design with 316 stainless steel body and stainless steel check, renewable disc and resilient seat for flanged installation.
- .8 Ball Valves NPS 2 and smaller:
 - .1 bronze body or forged brass 4137 kPa (600 psi) WOG, virgin Teflon seat, TFE stem packing and thrust washer, 1/4 turn open-closed operation with solid ball.
- .9 Butterfly Valves:
 - .1 NPS 3 and under
 - .1 bubble-tight service up to 2065 kPa (300 psi) with bronze body
 - .2 NPS 4 and over
 - .1 bubble-tight service up to 2065 kPa (300 psi), with bronze body.

Part 3 Execution

3.1 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.
- .4 Butterfly valves may be used in lieu of gate valves in size 65 mm (2-1/2 in.) and over in systems 1380 kPa (200 psi) and less. Where specifically shown on drawings, butterfly valves must be used. Install between 860 kPa (125 psi) flanges.
 - .1 Valves shall have iron body, one piece or split alloy steel shaft, top and bottom bearings, bronze disc or iron disc with stainless steel trim and resilient elastomer replaceable seat with integral reinforcing ring or keyed to body.
 - .2 Body shall have threaded lugs.
 - .3 Valve shall have bubble tight shut-off to 1035 kPa (150 psi) pressure in either direction when the piping and connecting flange is removed from one side of the valve.
 - .4 Valves 100 mm (4 in.) and smaller shall have lever operator with lock.
 - .5 Valves larger than 100 mm (4 in.) shall have worm gear manual operator with indication of valve opening.

3.2 CLEANING

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

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 01

1.2 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B31.1-16, Power Piping.
- .2 ASTM International
 - .1 ASTM A125-1996(2013)e1, Standard Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A307-14e1, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A563-15, Standard Specification for Carbon and Alloy Steel Nuts.
- .3 Factory Mutual (FM)
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP-58-2009, Pipe Hangers and Supports - Materials, Design and Manufacture.
- .5 National Research Council Canada (NRC)
 - .1 National Plumbing Code of Canada 2015(NPC).
- .6 Underwriter's Laboratories of Canada (ULC)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit shop drawings for:
 - .1 Bases, hangers and supports.
 - .2 Connections to equipment and structure.
 - .3 Structural assemblies.
- .4 Certificates:

.1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Manufacturers' Instructions:

.1 Provide manufacturer's installation instructions.

1.4 CLOSEOUT SUBMITTALS

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

1.5 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: in accordance with Section 01 74 20. .

Part 2 Products

2.1 SYSTEM DESCRIPTION

.1 Design Requirements:

.1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.

.2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP-58.

.3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.

.4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.

.5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP-58.

2.2 GENERAL

.1 Piping and equipment shall be complete with all necessary supports and hangers required for a safe and workmanlike installation.

.2 Hangers, supports, anchors, guides, and restraints shall be selected to withstand all static and dynamic loading conditions which act upon the piping system and

associated equipment. Prepare detailed shop drawings showing all anchors and guides for all systems with the potential for thermal expansion/contraction and/or loads due to weight or thrust. The drawings shall bear the signed seal of a Professional Engineer licensed to practice in the appropriate discipline and place of work. The drawings shall include all details of construction, static and dynamic forces at points of attachment, etc. necessary for review and acceptance by the Departmental Representative. Make adjustments as necessary to satisfy the requirements of the Departmental Representative. No anchor points shall be permitted without reviewed shop drawings and, where installed prior to review, shall be removed and replaced to the satisfaction of the Departmental Representative.

- .3 Fabricate hangers, supports and sway braces in accordance with MSS SP-58 and ANSI B31.1.
- .4 Use components for intended design purpose only. Do not use for rigging or erection purposes.
- .5 All hangers, supports, brackets and other devices installed exterior to the building shall be galvanized to prevent failure from environmental corrosion. If galvanized components cannot be used submit samples of proposed substitute for review prior to installation.

2.3 PIPE HANGERS

- .1 Finishes:
 - .1 Pipe hangers and supports: galvanized after manufacture.
 - .2 Ensure steel hangers in contact with copper piping are epoxy coated or copper plated.
- .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 carbon steel retaining clip.
 - .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, MSS SP-58.
- .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, to MSS SP69.
 - .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.
- .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 6mm minimum greater than rod diameter.
- .2 Concrete inserts: wedge shaped body with knockout protector plate to MSS SP-58.
- .5 Hanger rods: threaded rod material to MSS SP58:
 - .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 22mm or 28mm rod.
- .6 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.
- .7 Adjustable clevis: material to MSS SP-58, 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.
- .8 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP-58.
- .9 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.
 - .1 Finishes for steel pipework: galvanized.
 - .2 Finishes for copper, glass, brass or aluminum pipework: galvanized, with formed portion plastic coated.
- .10 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

2.4 RISER CLAMPS

- .1 Steel or cast iron pipe: galvanized carbon steel to MSS SP-58, type 42.
- .2 Copper pipe: carbon steel copper plated to MSS SP-58, type 42.
- .3 Bolts: to ASTM A307.
- .4 Nuts: to ASTM A563.

2.5 INSULATION PROTECTION SHIELDS

- .1 Insulated cold piping:

- .1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP-58, 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-58.

2.6 CONSTANT SUPPORT SPRING HANGERS

- .1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR).
- .2 Load adjustability: 10% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.
- .3 Provide upper and lower factory set travel stops.
- .4 Provide load adjustment scale for field adjustments.
- .5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.
- .6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.7 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 2springs in series in single casing.
- .3 Variable spring hanger complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.
- .4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.8 EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 12 23. Submit calculations with shop drawings.

2.9 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

- .1 Provide templates to ensure accurate location of anchor bolts.

2.10 HOUSE-KEEPING PADS

- .1 Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 50mm larger than equipment; chamfer pad edges.
- .2 Concrete: to Section 03 30 00.

2.11 OTHER EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports from structural grade steel meeting requirements of Section 05 12 23.
- .2 Submit structural calculations with shop drawings.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Pipe hangers shall be capable of supporting the pipe in all conditions of operation. They shall allow free expansion and contraction of the piping, and prevent undue stress to building structural components.
- .2 Suspending one hanger from another shall not be permitted.
- .3 Install in accordance with:
 - .1 Manufacturer's instructions and recommendations.
- .4 Vibration Control Devices:
 - .1 Install on piping systems at pumps, boilers, chillers, cooling towers, and as indicated.
- .5 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.
- .6 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .7 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .8 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.
- .9 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.
- .10 For special equipment supports refer to equipment sections. Where no support method is identified secure wall mounted equipment to metal framing or masonry, with steel toggle or expansion fasteners, machine screws or sheet metal screws as applicable. Plastic, fibre or soft metal inserts shall not be acceptable. Wall mounted equipment shall not exceed 45.5 Kg (100 lbs) in weight or 250mm (10") in depth unless reviewed or detailed by the Engineer's Representative. Where framing does not permit direct attachment, provide metal strut sub-framing or minimum 19mm (3/4 in.) fire retardant treated plywood backboards, unpainted, attached to the framing. Provide attachments for backboards at 600mm (24 in.) on centres with no less than 4 attachments.

3.3 HANGER SPACING

- .1 Plumbing piping: to National Plumbing Code of Canada (NPC) or Ontario Building Code, whichever is more stringent.
- .2 Fire protection: to Ontario 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 300mm 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-58.

3.4 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.5 HORIZONTAL MOVEMENT

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
- .2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 FINAL ADJUSTMENT

- .1 Adjust hangers and supports:
 - .1 Ensure that rod is vertical under operating conditions.
 - .2 Equalize loads.
- .2 Adjustable clevis:
 - .1 Tighten hanger load nut securely to ensure proper hanger performance.
 - .2 Tighten upper nut after adjustment.
- .3 C-clamps:
 - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
 - .1 Hammer jaw firmly against underside of beam.

3.7 FIELD QUALITY CONTROL

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

- .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.8 CLEANING

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

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 21 05 01

1.2 REFERENCE STANDARDS

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

- .2 National Fire Protection Association (NFPA)

.1 NFPA 13-2016, Standard for the Installation of Sprinkler Systems.

- .3 National Research Council Canada (NRC)

.1 National Building Code of Canada 2015(NBC).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00. Include product characteristics, performance criteria, and limitations.

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

.1 Provide system shop drawings complete with performance and product data.

- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00.

.1 Instructions: submit manufacturer's installation instructions.

1.4 PERFORMANCE REQUIREMENTS

- .1 Adequately isolate all equipment to maintain acceptable noise levels in the occupied area of the building as specified below. Take noise measurements over the complete audible frequency range in each of the occupied zones under, above and beside Mechanical Equipment Rooms, and where indicated by the Departmental Representative. Noise levels due to mechanical equipment, ductwork, grilles, registers, terminal devices, diffusers, etc, shall not exceed sound pressure levels in all 8 octave bands corresponding to the NC levels per ASHRAE handbook as indicated.

AREAS	N.C. LEVELS
General Offices	35
Meeting Rooms	35
Duct distribution system	35
Storage Rooms	40

Entrance Halls	40
Laboratories	50
Outdoors	45 dBA

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: in accordance with Section 01 74 20.

Part 2 Products

2.1 GENERAL

- .1 Size and shape of bases type and performance of vibration isolation as indicated.
- .2 All equipment provided for vibration isolation or noise control shall be new and manufactured specifically for the purpose intended.
- .3 Provide silencers in accordance with the Silencer Schedule.
- .4 Type EP (Elastomeric Pad)
 - .1 Type EP shall be 8mm thick ribbed or waffle neoprene pads. Isolator pads shall be selected for less than 80% maximum rated load.
 - .2 If the isolator is bolted to the structure, a neoprene vibration isolation washer and sleeve shall be installed under the bolt head between the steel washer and the base plate.
- .5 Type MEP
 - .1 Type MEP shall consist of two 8mm thick ribbed or waffle neoprene pads bonded to each side of a 16-gauge stainless or galvanized steel shim plate. Isolator pads shall be selected for less than 80% maximum rated load.
 - .2 If the isolator is bolted to the structure, a neoprene vibration isolation washer and sleeve shall be installed under the bolt head between the steel washer and the base plate.
- .6 Type DDNM (Double Deflection Neoprene Mounts)
 - .1 Type DDNM shall be laterally stable, double deflecting, molded neoprene isolators. All metal surfaces shall be covered with neoprene. The top and bottom surfaces shall be ribbed and bolt holes shall be provided in

- the base. The mounts shall have leveling bolts rigidly secured to the equipment.
- .2 DDNM mounts shall be selected for a static deflection of 9.5mm unless specified otherwise.
- .7 Type DDNH (Double Deflection Neoprene Hangers)
- .1 Type DDNH shall consist of a molded neoprene isolating element in a steel hanger box. A neoprene sleeve shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel. The diameter of the clear hole in the hanger box shall be at least 19mm larger than the diameter of the hanger rod and permit the hanger rod to swing through a 30 degree arc. When installed the hanger box shall be allowed to rotate through a full 360 degrees without encountering an obstruction.
 - .2 Unless otherwise specified the static deflection of DDNH hangers shall be 8mm.
- .8 Type SPNM (Spring and Neoprene Mounts)
- .1 Type SPNM shall have a free standing and laterally stable steel spring without any housing, and two type WP isolation pads sandwiching a 16 gauge stainless or galvanized steel separator plate shall be bonded to the isolator base plate. Springs shall be designed so that the ratio of the horizontal to vertical spring constant is between one and two. The spring diameter shall not be less than 80% of the compressed height of the spring at rated load. Loaded springs shall have a minimum additional travel to solid equal to 50% of the specified static deflection.
 - .2 Unless otherwise specified the minimum static deflection of SPNM isolators under actual load conditions for equipment mounted on grade slabs shall be 25 mm (1 in.), and 50 mm (2 in.) for equipment mounted above grade level.
 - .3 Unless otherwise specified, isolators need not be bolted to the floor for indoor installations. If base plates are bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 602/660 or as approved) shall be installed under the bolt head between the steel washer and the base plate.
- .9 Type SPH (Spring Hangers)
- .1 Type SPH shall consist of a steel spring and welded steel housing. Spring diameter and hanger box hole shall be large enough to permit the hanger rod to swing through a 30 degree arc. A neoprene sleeve shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel hanger. The diameter of the clear hole in the hanger box shall be at least 19 mm (3/4 in.) larger than the diameter of the hanger rod. When installed, the spring element shall not be cocked, and the hanger box shall be allowed to

- rotate through a full 360 degree arc without encountering any obstructions.
- .2 Unless otherwise specified, the static deflection of SPH hangers under actual load conditions shall be 50 mm (2 in.).
- .10 Type SPNH (Spring and Neoprene Hangers)
- .1 Type SPNH shall be as above with the addition of a neoprene element in series with the spring. The neoprene element shall have a deflection of not less than 9mm with a strain not exceeding 15%. Unless otherwise specified, the static deflection of SPNH hangers under actual load conditions shall be 50 mm (2 in.).
- .11 Type CSNM (Constrained Spring and Neoprene Mounts)
- .1 Type CSNM shall be a spring and neoprene mount that incorporates a housing which contains unrestrained stable springs with built-in leveling device and resilient vertical limit stops to prevent spring elongation when partial load is removed and limits the movement of equipment when it is subjected to wind loading.
- .2 A minimum clearance of 25 mm (1 in.) shall be maintained around the restraining bolts and between the housing and the spring so as not to interfere with the spring operation. Limit stops shall provide minimum 6 mm (1/4 in.) clearance under normal operation, and a neoprene washer shall be installed beneath the bolt head/washer used to restrain the isolator.
- .3 For Installations subject to wind load, provide tapped hole in top and bottom plates for bolting to equipment and the roof or supporting structure with a neoprene sleeve.
- .4 Provide minimum 6mm thick neoprene acoustical base pad on the underside of the mount unless designated otherwise.
- .5 Mount shall be capable of supporting equipment at a fixed elevation during equipment erection. Installed and operating heights shall be identical.
- .6 Unless specified otherwise, the minimum static deflection for Type CSNM mounts under actual load conditions shall be 50 mm (2 in.).
- .12 Type SB (Steel Base)
- .1 Type SB inertia base which shall be a structural steel base frame with clearance holes located to correspond to the mounting bolt holes of the equipment mounted on the base. Fan bases shall have built-in motor slide rails, and shall be reinforced as necessary to withstand belt pull without drive misalignment or base distortion.
- .2 The bases shall be constructed with deep angle steel sections with a minimum vertical angle leg of 100 mm (4 in.) for motors of 7.5 hp or less,

- 125 mm (5 in.) for motors between 7.5 hp and 20 hp, and 150 mm (6 in.) for motors over 20 hp.
- .3 Structural steel base frames shall be prime-painted (galvanized).
- .13 Type CB (Concrete Base)
- .1 Type CB inertia base shall have an integral rectangular structural steel form to which concrete is poured.
- .2 Perimeter members shall be beams of depth equal to 10% of the longest span of the base, but not more than 300 mm (12 in.) or less than 150 mm (6 in.) deep. Forms shall include motor slide base and all reinforcing steel. Where anchor bolt locations fall in concrete, the reinforcing steel shall include drilled members with sleeves welded below the steel to accept the anchor bolts. Height saving steel brackets shall be used in all mounting locations.
- .3 When the concrete base is T-shaped, isolators shall be located under the projections as well as under the main body in order to prevent cantilever distortion.
- .4 Inertia bases for pumps shall be of sufficient size to accommodate supports for pipe elbows at pump suction and discharge connections.
- .5 Height saving brackets or welded steel pockets shall be incorporated to ensure a 50 mm (2 in.) minimum clearance under each inertia base.
- .6 The weight of each inertia base shall be sufficient to lower the centre of gravity to or below the isolator support plane.
- .7 The structural perimeter frame, mounting templates, height saving brackets, and spring system shall be provided as an assembly by the vibration control vendor.
- .8 Structural perimeter frames shall be prime-painted (galvanized).
- .14 All spring mounts shall be complete with levelling devices 6 mm (1/4 in.) thick ribbed neoprene sound pads and completely colour coded stable springs.
- .15 Where steel spring isolation systems are described in the specifications, the mounting assemblies shall utilize bare springs with the spring diameter not less than 80% of the loaded operating height of the spring. Each spring isolator shall be designed and installed so that the ends of the spring remain parallel during and after spring installation.
- .16 All isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer, and must be linear over a deflection range of not less than 50% above the design deflection.
- .17 All vibration isolators shall have either known undeflected heights of calibration markings to that, after adjustment, verified, thus determining that the load is

within the proper range of the device and that the correct degree of vibration isolation is being provided according to design.

- .18 All mounts installed outdoors or exposed to high humidity conditions shall have two coats of rust resisting paint and springs shall be cadmium plated and neoprene coated. Nuts and bolts shall be cadmium plated. All metal parts of mountings (except springs and hardware) shall be hot dip galvanized.
- .19 Grout: Non-shrink, self-levelling grout having ability to withstand thermal, vibratory and impact stresses.
- .20 Acoustic Sealant: Non-hardening, non-skinning permanently flexible, to CAN/CGSB-19.21-M87.

2.2 INTERNAL ACOUSTIC DUCT LINING

- .1 Duct lining shall have a minimum density of 24 kg/m³ (1.5 lbs/ft³).
- .2 Duct liner shall comply with the requirements of NFPA 90A and the "Duct Liner Materials Standard" of the Thermal Insulation Manufacturer's Association.
- .3 Sizes shown on the Drawing are free area dimensions (after the installation of duct liner). Duct liner shall be a minimum of 25 mm (1 in.) unless shown otherwise.
- .4 All acoustical duct lining shall incorporate means to prevent fiber entrainment in the air stream.
- .5 The following ductwork shall be internally lined:
 - .1 All return air transfer ductwork.
 - .2 All ductwork specifically identified on the Drawings.

2.3 ACOUSTICAL DUCT AND PIPE LAGGING

- .1 The barrier shall be constructed of a 2 mm (1/16 in.) thick barium sulphate loaded limp vinyl sheet bonded to a thin layer of reinforced aluminum foil on one side. The barrier shall have a nominal density of 4.8 kg/m³ (1 lbs/ft³) and shall have a minimum STC rating of 28.
- .2 The barrier shall have a minimum thermal conductivity "K" value of 0.29 and a rated service temperature range of -40 Deg. C. (-40 Deg. F.) to 105 Deg. C. (220 Deg. F.).
- .3 The barrier shall have a Flame Spread Index of no more than 25 and a Smoke Development Index of no more than 50 when tested for Surface Burning Characteristics per ASTM E84.
- .4 The decoupling layer shall be a combination of 25 mm (1 in.) or 50 mm (2 in.) as shown, fibreglass batting, non woven porous scrim-coated glass cloth, quilted together in a matrix of diamond stitch pattern which encapsulates the glass fibres. The composite material shall be fabricated to include a nominal 152 mm

(6 in.) wide barrier overlap tab extending beyond the quilted fibreglass to facilitate a leak-tight seal around field joints.

2.4 SILENCERS

- .1 Factory-Built Silencers shall be completely pre-fabricated of incombustible materials and shall have a minimum insertion loss and a maximum air pressure drop as shown in Silencer Schedule. Submitted silencer performance shall be according to ASTM E477-06a "Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers"
- .2 Media filled silencers shall contain acoustic media type as indicated on the Silencer Schedule, either acoustic quality, shot free glass fibre insulation with long, resilient fibres bonded with a thermosetting resin, or 100% natural cotton fibres treated with an EPA registered, non-toxic borate solution, "flash dried" to provide resistance to mould, mildew and fungi. Media shall not cause or accelerate corrosion of aluminum or steel. Glass fibre, and rockwool will not be permitted as a substitute for cotton fibre media.
- .3 Acoustic media in media filled silencers shall have density as required to provide specified performance, packed under 15 percent compression and protected from air erosion by perforated sheet metal, gauge as specified below.
- .4 Acoustic media filled silencers with internal air velocities above 22.9 m/s (4500 fpm) shall have acoustic media wrapped with glass fibre cloth for additional erosion protection. Where indicated on the Silencer Schedule silencers shall have acoustic media wrapped in Tedlar film liner to help prevent shedding, erosion and impregnation of the acoustic media.
- .5 No-media silencers shall contain no absorptive media of any kind. Attenuation shall be achieved with controlled impedance membranes and broadly tuned resonators.
- .6 Silencer materials, including acoustic media and Tedlar film, shall have the following combustion ratings when tested in accordance with ASTM E84-17: maximum Flamespread Classification 25, maximum Smoke Development Rating 50.
- .7 Rectangular type silencers for duct systems operating less than 4 in. WG and designated as Class 1 on the Silencer Schedule shall be constructed with a minimum 22 gauge (0.78 mm) lock formed galvanized steel outer casing and 26 gauge (0.47 mm) galvanized perforated steel liner.
- .8 Rectangular type silencers for duct systems operating greater than 4 in. WG and less than 8 in. WG and designated as Class 2 on the Silencer Schedule shall be constructed with a minimum 18 gauge (1.18 mm) Pittsburgh lock formed galvanized steel outer casing and 22 gauge (0.78 mm) galvanized perforated steel liner.
- .9 Rectangular type elbow silencers shall have minimum Class 2 construction, 18 gauge (1.18 mm) Pittsburgh lock formed galvanized steel outer casing and 22 gauge (0.78 mm) galvanized perforated steel liner, unless indicated as Class 3

on the Silencer Schedule. All acoustical splitters shall be internally radiused and aerodynamically designed for efficient turning of the air. Half and full splitters are required as necessary to achieve the scheduled insertion loss. All elbow silencers with a turning cross-section dimension greater than 1200 mm (48 in.) shall have at least two half splitters and one full splitter.

- .10 Silencers shall be complete with high transmission loss (HTL) casing where indicated on the silencer schedule. HTL walls shall consist of media, airspace, mass and outer protective metal skin as required to obtain specified room noise criteria. Standard acoustic panels will not be accepted as HTL walls. Where requested by the Engineer's Representative, provide breakout noise calculations for each air handling and fan system with silencer submittal to insure compliance with the room noise criteria. Breakout noise calculations shall be based on the sound power levels of the specified equipment and calculation methods in accordance with ASHRAE HVAC Applications handbook.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Obtain one copy of all Shop Drawings of equipment to be isolated showing weights, shaft centres and all dimensions.
- .2 On system start-up, inspect the complete installation and provide a report in writing.
- .3 Furnish concrete bases, including concrete fill, on springs or other vibration isolation materials for mechanical isolation.
- .4 All floor mounted equipment shall be erected on concrete housekeeping pads, with thickness as identified, over the complete floor area of the equipment, unless shown or specified otherwise. Wherever vibration eliminating devices and/or concrete inertia pads are specified, these items shall be mounted on concrete housekeeping pads.
- .5 Furnish and install neoprene mounting sleeves for hold-down bolts to prevent any metal to metal contact.
- .6 All equipment shall be provided with lateral restraining isolators as required to limit horizontal motion to 6mm maximum, under all operating conditions. Lateral restraining isolators shall have the same static deflection as equipment being isolated.
- .7 Unless otherwise indicated, all equipment mounted on vibration isolators shall have a minimum operating clearance of 50 mm (2 in.) between the bottom of the

equipment or inertia base (and height-saving bracket) and the concrete housekeeping pad (or bolt heads) beneath the equipment. The clearance shall be checked by the Contractor to ensure that no material has been left to short-circuit the vibration isolators. There shall be a minimum 100 mm (4 in.) clearance between isolated equipment and the walls, ceiling, floors, columns and any other equipment not installed on vibration isolators.

- .8 Piping, ductwork, conduit or mechanical equipment shall be supported from building structure, not hung from or supported on other equipment, pipes, or ductwork.
- .9 Equipment connected to water or other fluid piping shall be erected on isolators or isolated foundations at correct operating heights prior to connection of piping, and blocked-up with temporary shims to final operating height. When the system is assembled and fluid is added, the isolators shall be adjusted to allow removal of the shims.
- .10 All mechanical equipment not specifically identified in this Section that contains rotating or vibrating elements, and any associated electrical apparatus installed by this Division that contains transformers or inductors shall be installed on Type DDNM, MEP, or EP isolators as appropriate.
- .11 All wiring connections to mechanical equipment on isolators shall be made with a minimum long flexible conduit installed in a slack "U" shape.
- .12 Elastomeric isolators that will be exposed to temperatures below 0 deg. C. (32 deg. F.) shall be fabricated from natural rubber instead of neoprene.
- .13 Springs shall be designed and installed so that ends of springs remain parallel and all springs installed with adjustment bolts.
- .14 Springs shall be sized to be non-resonant with equipment forcing frequencies or support structure natural frequencies.
- .15 Fans and air handling units shall be levelled with fans operating before the flexible connectors are attached.
- .16 All fan bases and isolators shall be sized so that thrust restraints (which would act against turning moment caused by static pressure) are not required.

3.3 EQUIPMENT ISOLATION

- .1 Ceiling Suspended Centrifugal Fans, and axial flow fans shall be mounted on Type SPNH spring isolators. Static deflection of the isolators shall be 50 mm (2 in.) unless shown otherwise on the Vibration and Isolation Schedule. Fans shall be suspended from above only if expressly noted as such on the Drawings and Schedules. Thrust restraint shall be by pre-compressed springs.
 - .1 If the fan to be suspended is not furnished with integral structural frame and external mounting lugs of suitable strength and rigidity, install approved structural base with lugs in the field.

- .2 Fans in packaged or custom air handling units shall be mounted on a Type SB base with Type SPNM isolators. The static deflection shall not be less than 50 mm (2 in.) under actual load conditions.
- .1 Structural steel floor supports shall be located beneath the spring isolators and shall be equivalent to the structural perimeter frame of the air handling unit.
- .3 Base mounted pumps 3.73 kW (5 hp) and larger except where located on slab-on-grade. Mount each pump with motor on a Type CB inertia base. Minimum base thickness shall be:
- | | |
|--|-----------------|
| Pumps up to 3.73 kW (5 hp) | 150 mm (6 in.) |
| Pumps 5.6 kW (7-1/2 hp) to 18.7 kW (25 hp) | 250 mm (10 in.) |
| Pumps 22.4 kW (30 hp) to 44.8 kW (60 hp) | 300 mm (12 in.) |
| Pumps 56.0 kW (75 hp) to 93.3 kW (125 hp) | 400 mm (16 in.) |
| Pumps 112 kW (150 hp) and larger | 600 mm (24 in.) |
- .1 Base for horizontally split pumps shall include supports for base elbows for the discharge and suction connections. Vertically split pumps shall include support for base elbow for suction connection. Bolt and grout base elbows to the pump base.
- .2 Mount the base on Type SPNM isolators. Where the base is 'T' shaped or other than rectangular, locate the isolators under the projections as well as the main body of the base.
- .3 Pour bases on roofing felt and elevate a minimum of 50 mm (2 in.) with mounting adjustment bolts after the pumps are grouted to the base.
- .4 No damping or snubbing materials shall be used. Spring deflection shall be as specified in the Vibration Isolation Schedule, but in no case less than 25 mm (1 in.) and all mountings shall have 6 mm (1/4 in.) thick neoprene vibration isolation pads at the bottom.
- .4 Vertical in-line pumps floor mounted 6.5 kW (10 hp) and larger except where located on slab-on-grade bolt and grout each elbow support to a Type CB inertia base. The minimum base thickness shall be:
- | | |
|---|-----------------|
| Pumps 6.5 kW (10 hp) to 18.7 kW (25 hp) | 200 mm (8 in.) |
| Pumps 22.4 kW (30 hp) to 74.6 kW (100 hp) | 250 mm (10 in.) |
| Pumps 93.3 kW (125 hp) and larger | 300 mm (12 in.) |
- .1 Mount the base on Type SPNM isolators.
- .2 Pour bases on roofing felt and elevate a minimum of 50 mm (2 in.) with mounting adjustment bolts after the pump elbows are grouted to the base.
- .3 No damping or snubbing materials shall be used. Spring deflection shall be as specified in the Vibration Isolation Schedule, but in no case less

than 25 mm (1 in.) and all mountings shall have 6 mm (1/4 in.) thick neoprene vibration isolation pads at the bottom.

- .5 Vertical in-line pumps floor mounted 4.9 kW (7-1/2 hp) and smaller and 6.5 kW (10 hp) and larger where located on slab-on-grade, shall be supported on Type MEP isolation. Refer to Mechanical Standard Details.
- .6 Vertical in-line pumps ceiling hung shall be supported by Type SPNH spring isolators. Refer to Mechanical Standard Details.
- .7 Floor mounted air compressors shall be bolted and grouted to Type CB inertia base supported by Type SPNM isolators. Spring deflection shall be 50 mm (2 in.) minimum. Resilient pipe hangers shall be as specified for piping in Mechanical Rooms.
- .8 Refrigeration machines and boilers shall be mounted on a Type SB base with CSNM isolators. Spring deflection shall be 50 mm (2 in.) minimum. If the equipment is suitable and an additional steel base is not required, the equipment can be mounted directly on the isolators.
- .9 Expansion tanks, dearators, heat exchangers and water heaters without pumps or motors which are floor mounted shall be supported on Type MEP isolators. Suspended units shall be supported by Type DDNH isolators. Where piping on isolators is connected to these units, the connection shall be made with a neoprene flexible connector.
- .10 Cooling tower shall be mounted on a Type SB base supported by CSNM isolators. Spring deflection shall be 50 mm (2 in.) minimum. If the equipment is suitable and an additional steel base is not required, the equipment can be mounted directly on the isolators.
- .11 Suspend all piping in Mechanical Rooms on Type SPH or SPNH isolators as required. Where piping is supported from the floor, weld brackets to the piping and support on Type SPNM isolators. Isolators do not replace constant support hangers or mounts.
- .12 The first isolator both upstream and downstream of equipment on springs shall have a static deflection of 1.5 times the deflection of the vibration isolated equipment to a maximum of 50 mm (2 in.). All other piping supports shall have a static deflection of 25 mm (1 in.) minimum.
- .13 Where a pipe connects to multiple pieces of equipment in the Mechanical Room the pipe isolators for the entire run shall be chosen to suit the connected equipment of the greatest static deflection.
- .14 Piping that is connected only to equipment installed on neoprene isolators shall be either supported from the floor by Type DDNM isolators or suspended from the structure on Type DDNH isolators within the Mechanical Equipment Rooms.
- .15 Flexible piping connectors shall be installed to connect piping of diameter 50 mm (2 in.) or greater to reciprocating or rotating equipment.

- .16 Piping attached to either coil sections separated from the fan sections of air handling units by flexible connections, or to air handling units with internal isolators meeting the requirements of these specifications is exempt from these requirements and is not considered connected to vibrating equipment.
- .17 No rigid connections between equipment and the building structure shall be made that degrades the specified noise and vibration control system.
- .18 Any conflicts with other trades which result in rigid contact with the equipment or piping due to inadequate space or other unforeseen conditions should be brought to the Departmental Representative's attention prior to installation. If not brought to the attention of the Departmental Representative prior to installation corrective work necessitated by conflicts shall be at the Contractor's expense.
- .19 Locate isolation hangers with the housing a minimum of 50 mm (2 in.) below but as close as possible to the structure. Where isolator hangers would be concealed by a non-accessible acoustical sub-ceiling, install the hangers immediately below the sub-ceiling for access.
- .20 Except as noted elsewhere in this specification, outside the Mechanical Room all HVAC, compressed air, and domestic hot and cold water pipes with an inner diameter less than or equal to 50 mm (2 in.) shall be isolated from the structure with sponge neoprene, felt or glass /mineral fibre sleeves between the pipe and pipe clamp or with Type WP pads between the clamp and the structure. When compressed, the sleeve shall be not less than 3 mm (1/8 in.) in thickness.
- .21 All piping outside the Mechanical Room with inner diameter greater than 50 mm (2 in.) shall be supported on Type SPNM isolators or suspended by Type SPNH isolators. Where piping is ganged on a trapeze the piping shall rest on the trapeze, which shall be isolated from the structure by the appropriate isolators. Neoprene pipe riser guides shall be used where lateral restraint is required.
- .22 Any pipe crossing an acoustical joint shall have a twin-sphere neoprene flexible connector at the joint, with the exception of piping associated with fire protection, natural gas and compressed gases, and shall be suspended by Type SPNH isolators as follows:
 - .1 Pipes with inner diameters less than 50 mm (2 in.) shall be suspended by Type DDNH isolators for a minimum distance of 6m on each side of the joint.
 - .2 Pipes with an inner diameter of 50 mm (2 in.) or greater shall be suspended on Type SPNH isolators for a minimum distance of 6m on the non-isolated structure and for the entire pipe length on the isolated structure.
- .23 Where pipes rise in a vertical chase and are supported from a structure with type SPNH or DDNH isolators and require lateral bracing, neoprene riser guides shall be mounted around the pipe to limit lateral movement and to prevent direct contact with the supporting structure.
- .24 Ducts shall be connected to fans, fan casings and fan plenums by means of flexible connectors. Flexible connectors shall be installed to prevent metal-to-

metal contact across flexible connection. Flexible duct connectors shall not be used outside the Mechanical Room unless expressly shown on the Drawings.

- .25 After installation, manufacturer shall verify that the vibration isolation systems are installed and operating properly, and shall submit a certificate so stating. Verify that the isolators are adjusted, with springs perpendicular to bases or housings, adjustment bolts are tightened up on equipment mountings, and hangers are not cocked.

3.4 SILENCERS

- .1 Where silencers are to be installed in stainless steel or aluminum ductwork, the silencer shall be all stainless steel or aluminum construction to match the ductwork gauges used.
- .2 Silencers for all variable air volume boxes, and fan powered variable volume boxes shall be as scheduled in the Silencer Schedule. Refer to Drawings for specific number required. The Silencer Schedule only indicates type. Receive from VAV box manufacturer dimension and sound data. Adjust silencers as required to match box discharge size. Adjust silencer as required to ensure insertion loss necessary to meet the room noise criteria.
- .3 Silencers shall have outside dimensions that match the connecting duct size unless indicated otherwise.
- .4 Submittals shall include certified test data on dynamic insertion loss, self-noise power levels, and pressure drop for reverse or forward flow. Silencer performance must have been substantiated by laboratory testing according to ASTM E477-06a and so certified when submitted for approval. The aero-acoustic laboratory must be NVLAP accredited for the ASTM E477-06a test standard. A copy of the accreditation certificate must be included with the submittals. Data from non-NVLAP accredited test facilities will not be accepted. Shop Drawings submitted without proper certifications will be rejected.
- .5 The certification of the pressure drop, insertion loss and generated noise data shall be based upon tests of the same silencer for all measurements.
- .6 For specific silencers indicated on the Silencer Schedule, the manufacturer shall provide acoustic analysis for approval showing that this silencer will reduce mechanical fan noise to acceptable levels in the occupied space. Use sound power levels of actual equipment to be installed on project. Analysis shall include breakout noise calculations.

3.5 ACOUSTICAL LINING OF DUCTS

- .1 Ducts, except where noted otherwise, shall be acoustically lined internally, from the fan connection to the terminal. Both supply and return systems shall be lined unless otherwise specified. Exhaust ducts shall be internally lined where shown on the Drawings to reduce sound transmission.
- .2 Other ductwork shall be acoustically lined where shown on the Drawings.

- .3 Acoustical duct lining shall be 50 mm (2 in.) thick in ducts within Mechanical Rooms, in plenums, and where expressly shown on the Drawings. Acoustical duct lining shall be 25 mm (1 in.) thick in all other internally lined sheet metal ducts, unless otherwise specified or shown on the Drawings.
- .4 The acoustical liner shall be fixed to the duct with a minimum of 50% coverage of a fire-resistant adhesive. Where the duct width exceeds 300 mm (12 in.) or the height 600 mm (24 in.), the liner shall be additionally secured with mechanical fastening on maximum 450 mm (18 in.) centers on all sides. Mechanical fasteners that pierce the duct are unacceptable. All ends of the liner shall be coated with a fire resistant cementing material to prevent delamination, leakage or erosion. All joints shall be firmly butted and ends coated with an adhesive to ensure that the lining is smooth across all joints.
- .5 Where acoustical duct lining is installed, the dimensions of the sheet metal shall be increased to include the thickness of the lining material. Dimensions shown on the Mechanical Drawings are the clear internal dimensions after the liner has been installed.

3.6 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.
 - .2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:
 - .1 After delivery and storage of Products.
 - .2 After preparatory work is complete but before installation commences.
 - .3 Twice during the installation, at 25% and 60% completion stages.
 - .4 Upon completion of installation.
 - .3 Submit manufacturer's reports to Departmental Representative within 3 days of manufacturer representative's review.
 - .4 Make adjustments and corrections in accordance with written report.
- .2 Inspection and Certification:
 - .1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC systems after start up and TAB of systems to Section 23 05 93.
 - .2 Provide Departmental Representative with notice 24 hours in advance of commencement of tests.

- .3 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations (including sound curves).
- .4 Submit complete report of test results including sound curves.

3.7 CLEANING

- .1 Proceed in accordance with Section 01 74 11.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 21 05 01

1.2 QUALIFICATIONS OF TAB PERSONNEL

- .1 Submit names of personnel to perform TAB to Departmental Representative within 90 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-1-2017, 7th Edition.
 - .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) 1780, HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-2002.
- .4 Recommendations and suggested practices contained in the TAB Standard: mandatory.
- .5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
- .6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.
- .7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
 - .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
 - .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.3 PURPOSE OF TAB

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads
- .2 Adjust and regulate 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.

1.4 EXCEPTIONS

- .1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.

1.5 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.

1.6 PRE-TAB REVIEW

- .1 Review Contract Documents before project construction is started confirm in writing to Departmental Representative adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to Departmental Representative in writing proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.7 START-UP

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified elsewhere in Division 23.

1.8 OPERATION OF SYSTEMS DURING TAB

- .1 Operate systems for length of time required for TAB and as required by Departmental Representative for verification of TAB reports.

1.9 START OF TAB

- .1 Notify Departmental Representative 7 days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:

- .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 10%, minus 0%.
 - .2 Other HVAC systems: plus 5%, minus 5%.
 - .3 Hydronic systems: plus or minus 10%.

1.11 ACCURACY TOLERANCES

- .1 Measured values accurate to within plus or minus 2% of actual values.

1.12 INSTRUMENTS

- .1 Prior to TAB, submit to Departmental Representative 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 report for clarity. Hand written reports will not be accepted.
- .2 TAB report to show results in SI and IP 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, English 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 30% of reported results.
- .3 Number and location of verified results as directed by Departmental Representative.

- .4 Pay costs to repeat TAB as required to satisfaction of Departmental Representative.

1.17 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, ASHRAE, or SMACNA.
- .2 The following systems shall be tested and balanced:
 - .1 Air conditioning, ventilation and heating systems
 - .2 Miscellaneous ventilation or exhaust systems
 - .3 Air distribution (supply, return and exhaust)
 - .4 Miscellaneous systems on emergency power
 - .5 Refrigeration piping
 - .6 Split A/C units and condensers
 - .7 Chillers and chilled water distribution
 - .8 Boilers and heating systems
 - .9 Water treatment systems
 - .10 Life safety and fire protection systems
 - .11 Plumbing systems
 - .12 All process piping including gas, air nitrogen and vacuum
- .3 Qualifications: personnel performing TAB qualified and current member in good standing of AABC or NEBB.
- .4 Quality assurance: perform TAB under direction of supervisor qualified to standards of NEBB or AABC.
- .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 Duct traverse readings shall be taken through the access ports provided. Where no access ports have been provided new holes shall be made as required. These holes shall be resealed after final readings with sheet metal cover plates and sealant. Duct tape is not acceptable.
- .2 Where insulation is damaged it shall be repaired including the vapour barrier in an approved manner. Duct tape is not acceptable.
- .3 In all cases where measurements show failure to comply with the Drawings and Specifications, the Contractor shall change fan sheaves, etc., as required, and new TAB measurements shall be made.
- .4 Following final acceptance of the certified reports by the Departmental Representative, permanently mark the settings of all valves, dampers, splitters and other adjustable devices so that balance set position can be restored if disturbed at any time. Do not mark such devices until after final acceptance.
- .5 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.
- .6 Building pressure conditions:
 - .1 Adjust HVAC systems, equipment, controls to ensure building has overall positive pressure condition.
- .7 Zone pressure differences:
 - .1 Adjust HVAC systems, equipment, controls to establish indicated air pressure differentials, with systems in every possible combinations of normal operating modes.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 21 05 01

1.2 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.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00.
- .2 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties. Include pressure test information and results as follows:
 - .1 Submit proposed report form and test report format to Departmental Representative for approval at least three months before proposed date of first series of tests. Do not start tests until approval received in writing from Departmental Representative.
 - .2 Prepare report of results and submit to Departmental Representative within 24 hours of completion of tests. Include:
 - .1 Schematic of entire system.
 - .2 Schematic of section under test showing test site.
 - .3 Required and achieved static pressures.
 - .4 Orifice differential pressure at test sites.
 - .5 Permissible and actual leakage flow rate (L/s) for test sites.
 - .6 Witnessed certification of results.
 - .3 Include test reports in final TAB report.
 - .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .5 Instructions: submit manufacturer's installation instructions.
 - .6 Manufacturer's field reports specified.

1.4 QUALITY ASSURANCE

- .1 Pre-Installation Meetings:
 - .1 Convene pre-installation meeting one week prior to beginning work of this Section.
 - .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.

Part 2 Products

2.1 TEST INSTRUMENTS

- .1 Test apparatus to include:
 - .1 Fan capable of producing required static pressure.
 - .2 Duct section with calibrated orifice plate mounted and accurately located pressure taps.
 - .3 Flow measuring instrument compatible with the orifice plate.
 - .4 Calibration curves for orifice plates used.
 - .5 Flexible duct for connecting to ductwork under test.
 - .6 Smoke bombs for visual inspections.
- .2 Test apparatus: accurate to within +/- 3% of flow rate and pressure.
- .3 Submit details of test instruments to be used to Departmental Representative at least three months before anticipated start date.
- .4 Test instruments: calibrated and certificate of calibration deposited with Departmental Representative no more than 28 days before start of tests.
- .5 Re-calibrated every six months thereafter.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 TEST PROCEDURES

- .1 Test for leakage in accordance with all SMACNA Manuals and Standards, all ductwork except downstream of variable air volume boxes or other pressure reducing devices. Seal ducts at all equipment connections.

- .2 Lengths of ducts to be tested consistent with capacity of test equipment.
- .3 Section of duct to be tested to include:
 - .1 Fittings, branch ducts, tap-ins.
- .4 Repeat tests until specified pressures are attained. Bear costs for repairs and repetition to tests.
- .5 Base partial system leakage calculations on SMACNA HVAC Air Duct Leakage Test Manual.
- .6 Seal leaks that can be heard or felt, regardless of their contribution to total leakage.

3.3 SITE TOLERANCES

- .1 System leakage tolerances specified are stated as percentage of total flow rate handled by system. Pro-rate specified system leakage tolerances. Leakage for sections of duct systems: not to exceed total allowable leakage.
- .2 Leakage tests on following systems not to exceed specified leakage rates.
 - .1 Small duct systems up to 250 Pa: leakage 2%.
 - .2 VAV box and duct on downstream side of VAV box: leakage 2%.
 - .3 Large low pressure duct systems up to 500 Pa: leakage 2%.
 - .4 HP duct systems up to 1000 Pa pressure classification, including upstream side of VAV boxes: leakage 1.
- .3 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

3.4 TESTING

- .1 Test ducts before installation of insulation or other forms of concealment.
- .2 Test after seals have cured.
- .3 Test when ambient temperature will not affect effectiveness of seals, and gaskets.
- .4 Flexible connections to VAV boxes.

3.5 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services.
 - .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.

- .2 Manufacturer's Field Services: provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits, to review Work, at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of the Work, after cleaning is carried out.
- .4 Obtain reports, within 3 days of review, and submit, immediately, to Departmental Representative.
- .2 Performance Verification:
 - .1 Departmental Representative to witness tests and to verify reported results.
 - .2 To be certified by same TAB agency approved by Departmental Representative to undertake TAB on this project.

3.6 CLEANING

- .1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 21 05 01

1.2 REFERENCE STANDARDS

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ASHRAE 90.1-16, 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 B209M-14, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.

.2 ASTM C335/335M-17, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.3 ASTM C411-17, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C449-07(2013), Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C533-2017, Calcium Silicate Block and Pipe Thermal Insulation.

.6 ASTM C547-2017, Mineral Fiber Pipe Insulation.

.7 ASTM C795-08(2013), Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.8 ASTM C921-10(2015), Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.4 Department of Justice Canada (Jus)

.1 Canadian Environmental Assessment Act (CEAA), 1999, 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.
- .7 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-10, Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701-11, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .3 CAN/ULC-S702-14, Thermal Insulation, Mineral Fibre, for Buildings
 - .4 CAN/ULC-S702.2-15, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.3 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - will mean "not concealed" as specified.
- .2 TIAC:
 - .1 CRF: Code Rectangular Finish.
 - .2 CPF: Code Piping Finish.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00.
- .3 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00.
- .4 Samples:
 - .1 Submit samples in accordance with Section 01 33 00.

- .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.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

- .1 Qualifications:
- .2 Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00.
 - .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 20.

Part 2 Products

2.1 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC-S102.
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.2 INSULATION

- .1 Mineral fibre specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335/C335M.
- .3 TIAC Code A-1: rigid moulded mineral fibre with factory applied all-service jacket.
 - .1 Mineral fibre: to CAN/ULC-S702.
 - .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.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/ULC-S702.
- .5 TIAC Code C-2: mineral fibre blanket faced with factory applied vapour retarder jacket.
 - .1 Mineral fibre: to CAN/ULC-S702.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/ULC-S702.
- .6 TIAC Code A-6: flexible unicellular tubular elastomer.
 - .1 Insulation: 13mm, exterior piping covered with vapour retarder jacket.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 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: 50mm thick to ASTM C533.
 - .2 Joints: Staggered
 - .3 Jacket: Aluminum
 - .4 Design to permit periodic removal and re-installation.

2.3 INSULATION SECUREMENT

- .1 Tape: self-adhesive, aluminum, reinforced, 50mm wide minimum.
- .2 Contact adhesive: quick setting.

- .3 Canvas adhesive: washable.
- .4 Tie wire: 1.5mm diameter stainless steel.
- .5 Bands: stainless steel, 19mm wide, 0.5mm thick.

2.4 CEMENT

- .1 Thermal insulating and finishing cement:
 - .1 As recommended by insulation manufacturer

2.5 VAPOUR RETARDER LAP ADHESIVE

- .1 Water based, fire retardant type, compatible with insulation.

2.6 INDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.

2.7 OUTDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: fibrous glass, untreated 305 g/m².

2.8 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: white.
 - .3 Minimum service temperatures: -20 degrees C.
 - .4 Maximum service temperature: 65 degrees C.
 - .5 Moisture vapour transmission: 0.02 perm.
 - .6 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.
 - .7 Special requirements:
 - .1 Outdoor: UV rated material at least 0.5 mm thick.
- .2 ABS Plastic:
 - .1 One-piece moulded type and sheet with pre-formed shapes as required.

- .2 Colours: white
- .3 Minimum service temperatures: -40 degrees C.
- .4 Maximum service temperature: 82 degrees C.
- .5 Moisture vapour transmission: 0.012 perm.
- .6 Thickness: 0.75mm.
- .7 Fastenings:
 - .1 Solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.
- .8 Locations:
 - .1 For outdoor use ONLY.
- .3 Canvas:
 - .1 220 gm/m2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
 - .2 Lagging adhesive: compatible with insulation.
- .4 Aluminum:
 - .1 To ASTM B209.
 - .2 Thickness: 0.50mm sheet.
 - .3 Finish: stucco embossed.
 - .4 Joining: longitudinal and circumferential slip joints with 50mm laps.
 - .5 Fittings: 0.5mm thick die-shaped fitting covers with factory-attached protective liner.
 - .6 Metal jacket banding and mechanical seals: stainless steel, 19mm wide, 0.5mm thick at 300mm spacing.

2.9 WEATHERPROOF CAULKING FOR JACKETS INSTALLED OUTDOORS

- .1 Caulking to: Section 07 90 00.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PRE-INSTALLATION REQUIREMENT

- .1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.
- .2 Surfaces clean, dry, free from foreign material.

3.3 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with 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.
- .6 Terminate insulation on pipes passing through fire rated walls or floors, and fit tight to the fire stop material.
- .7 Irregular shaped objects such as strainers, pipe system filters, cyclone separators, blowdown valves and other accessories requiring servicing, on insulated piping, shall be insulated with removable caps or sections. All edges shall be sealed between pipe and vapour barrier and held in place with stainless steel straps. Finish all insulation smooth, making the outline of pipe insulation a true circular and concentric shape. Shape the outline of fitted insulation to blend with adjacent covering.
- .8 On cold water service valves, water meters, drain valves, vent connections, thermometer wells, pressure gauges and other irregular shaped objects, apply flexible elastomeric sheet insulation, thickness to suit service, cut and mitre as necessary, and attach with adhesive and stainless steel banding. Bond and seal edges of insulation to the adjacent surfaces, provide vapour retarder.

3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

- .1 Application: at expansion joints, valves, primary flow measuring elements, flanges and unions at equipment.

- .2 Design: to permit periodic removal and replacement without damage to adjacent insulation.
- .3 Insulation:
 - .1 Insulation, fastenings and finishes: same as system.
 - .2 Jacket: provide material as required for temperature of system: PVC, aluminum, high temperature fabric, ABS.

3.5 INSTALLATION OF ELASTOMERIC INSULATION

- .1 Insulation to remain dry. Overlaps to manufacturer's instructions. Ensure tight joints.
- .2 Provide vapour retarder as recommended by manufacturer.

3.6 PIPING INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code: A-1.
 - .1 Securements: 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 bands at 300mm on centre.
 - .2 Protection: sheet steel shields at each hanger or support
 - .3 Seals: VR lap seal adhesive, VR lagging adhesive.
 - .4 Installation: TIAC Code: 1501-C.
- .4 TIAC Code: A-6.
 - .1 Securements: Adhesive applied to both joining surfaces
 - .2 Seals: lap seal adhesive, lagging adhesive.
- .5 TIAC Code: C-2 with all service jacket.
 - .1 Securements: 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 Securements: 0.045mm SS tie wire 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.

Application	Temp degrees C	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)		
Run out	to 1	1 1/4 to 2	2 1/2 to 4	5 to 6	8 & over
Steam	up to 175	[A-1]	38	50	65
Condensate Return	60 - 94	[A-1]	25	38	38
Hot Water Heating	60 - 94	[A-1]	25	38	38
Hot Water Heating	up to 59	[A-1]	25	25	25
Glycol Heating	60 - 94	[A-1]	25	38	38
Glycol Heating	up to 59	[A-1]	25	25	25
Domestic HWS	[A-1]	25	25	25	38
Chilled Water	4 - 13	[A-3]	25	25	25
Chilled Glycol	below 4	[A-3]	25	25	38
Chilled Water Pump Casing	[A-3]	25	25	25	25
First 4500mm of sprinkler main	[A-3]	25	25	25	25
Condenser Water	[A-3]	25	25	25	25
Refrigerated Drinking Water	[A-3]	25	25	25	25
Domestic CWS	[A-3]	25	25	25	25
Refrigerant [suction] [liquid] [hot gas]	4 - 13	[A-6]	25	25	25
Refrigerant [hot gas] [liquid] [suction]	below 4	[A-6]	25	25	38
RWL and RWP	[C-2]	25	25	25	25
Cooling Coil cond. drain	[C-2]	25	25	25	25
Diesel generator exhaust system	[A-2]	38	65	65	75

- .8 Finishes:

- .1 Exposed indoors: PVC jacket.
- .2 Exposed in mechanical rooms: PVC or aluminum jacket.
- .3 Concealed, indoors: canvas.
- .4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.
- .5 Outdoors: water-proof ABS or aluminum jacket.
- .6 Finish attachments: SS bands at 150mm on centre. Seals: closed.
- .7 Installation: to appropriate TIAC code CRF/1 through CPF/5.
- .9 Drainage piping:
 - .1 Cover cast iron bell and spigot drainage pipe 75 mm (3 in.) and smaller with 12 mm (1/2 in.) preformed glass fibre pipe insulation, and finish with vapour barrier jacket. Cover the bell and spigot joint with a 12 mm (1/2 in.) thick flexible elastomeric insulation band that overlaps the fibreglass insulation 300 mm (12 in.) beyond joint in each direction. Seal band to the fibreglass insulation. Apply 25 mm (1 in.) thick insulation for all larger pipes.
 - .2 Storm Drainage piping to be insulated:
 - .1 Roof drain sump
 - .2 All horizontal or sloping storm piping
 - .3 All elbows connecting the horizontal storm drainage piping to the vertical leaders
 - .4 Where the roof drain is less than 3000 mm (10 ft.) from the vertical leader, insulate the first 3000 mm (10 ft.) of pipe closest to the roof drain and the exposed portion of the roof drain.
 - .3 Sanitary drainage piping to be insulated:
 - .1 Sanitary drainage pipes from urinals
 - .2 Direct and indirect drains from drinking fountains
 - .3 Floor drains from air conditioning apparatus
 - .4 Carrying chilled condensate to closest branch or main.
 - .5 All piping passing through high humidity area
 - .6 Sanitary drainage pipe from barrier free lavatories
- .10 Electrically Traced Piping
 - .1 Insulated for the entire length of the piping. Insulation type shall be as specified for the service being traced. For services not specifically

designated insulate as specified for heating water. The minimum thickness of insulation shall be:

- .1 25 mm (1 in.) for up to 150 mm (6 in.) pipe
- .2 38 mm (1-1/2 in.) for 200 mm (8 in.) pipe
- .3 250 mm (10 in.), 50 mm (2 in.) for pipes larger than 250 mm (10 in.) in size.

Thickness of insulation over fittings, valves and other appurtenances shall match the pipe insulation.

3.7 CLEANING

- .1 Proceed in accordance with Section 01 74 11.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 21 05 01

1.2 REFERENCE STANDARDS

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM E202-12, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

1.3 CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS

- .1 In accordance with Section 23 08 02.

1.4 HYDRONIC SYSTEMS - PERFORMANCE VERIFICATION (PV)

- .1 Perform hydronic systems performance verification after cleaning is completed and system is in full operation.
- .2 When systems are operational, perform following tests:
 - .1 Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of 48 hours to demonstrate compliance with design criteria.
 - .2 Verify performance of hydronic system circulating pumps as specified, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.
 - .1 Pump operation.
 - .2 Boiler and/or chiller operation.
 - .3 Pressure bypass open/closed.
 - .4 Control pressure failure.
 - .5 Maximum heating demand.
 - .6 Maximum cooling demand.
 - .7 Boiler and/or chiller failure.
 - .8 Cooling tower (and/or industrial fluid cooler) fan failure.
 - .9 Outdoor reset. Re-check heat exchanger output supply temperature at 100% and 50% reset, maximum water temperature.

1.5 HYDRONIC SYSTEM CAPACITY TEST

- .1 Perform hydronic system capacity tests after:

-
- .1 TAB has been completed
 - .2 Verification of operating, limit, safety controls.
 - .3 Verification of primary and secondary pump flow rates.
 - .4 Verification of accuracy of temperature and pressure sensors and gauges.
 - .2 Calculate system capacity at test conditions.
 - .3 Using manufacturer's published data and calculated capacity at test conditions, extrapolate system capacity at design conditions.
 - .4 When capacity test is completed, return controls and equipment status to normal operating conditions.
 - .5 Submit sample of system water to approved testing agency to determine if chemical treatment is correct. Include cost.
 - .6 Heating system capacity test:
 - .1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:
 - .1 Increasing OA flow rates through heating coils (in this case, monitor heating coil discharge temperatures to ensure that coils are not subjected to freezing conditions) or
 - .2 Reducing space temperature by turning off heating system for sufficient period of time before starting testing.
 - .2 Test procedures:
 - .1 Open fully heat exchanger, heating coil and radiation control valves.
 - .2 With boilers on full firing and hot water heating supply temperature stabilized, record flow rates and supply and return temperatures simultaneously.
 - .3 Conduct flue gas analysis test on boilers at full load and at low fire conditions.
 - .7 Chilled water system capacity test:
 - .1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:
 - .1 Adding heat from building heating system or;
 - .2 Raising space temperature by turning off cooling and air systems for sufficient period of time before starting testing and pre-heating building to summer design space temperature (occupied) or above. Set OAD and RAD for minimum outside air if OAT is near

outside design temperature or to maximum recirculation if RAT is greater than OAT. RAT to be at least 23 degrees C minimum.

- .2 Test procedures:
 - .1 Open fully cooling coil control valves.
 - .2 Set thermostats on associated AHU's for maximum cooling.
 - .3 Set AHU's for design maximum air flow rates.
 - .4 Set load or demand limiters on chillers to 100%.
 - .5 After system has stabilized, record chilled water, and condenser water flow rates and supply and return temperatures simultaneously.

1.6 CONDENSER WATER AND HUMIDIFICATION SYSTEMS

- .1 In addition to procedures specified above, perform following:
 - .1 Add chemicals once per week as required.
 - .2 Perform TAB as specified Section 23 05 93.
 - .3 Set up and adjust drip feeders, timer controls, pump strokes as required to maintain required chemical feed rates.
 - .4 Inject inhibitor into cooling tower sump.

1.7 GLYCOL SYSTEMS

- .1 Test to prove concentration will prevent freezing to minus 40degrees C Test inhibitor strength and include in procedural report. Refer to ASTM E202.

1.8 STEAM SYSTEMS

- .1 Performance verification:
 - .1 When systems are operational, perform relevant tests of steam and condensate return piping systems as specified under hydronic systems.
 - .2 Verify operation of components of steam system including:
 - .1 Steam traps by:
 - .1 Measuring temperature of condensate return and/or
 - .2 Using audio-sensing devices.
 - .3 Use of other approved methods.
 - .2 Flash tanks.
 - .3 Thermostatic vents.

- .3 Verify performance of condensation units, including:
 - .1 Pump capacity at design temperature.
 - .2 Controls.
- .4 Verify performance of condensate return system to ensure return of maximum quantity of condensate return water at with minimum temperature drop.
- .5 Adjust piping system as required to eliminate water hammer.
- .2 Monitor system continuously until acceptance for proper operation of components including steam traps, thermostatic vents, flash tanks and condensate pumping units.

1.9 GASEOUS FUEL SYSTEMS

- .1 Operation tests:
 - .1 Measure gas pressure at gas metre outlet and at burner manifold.
 - .2 Verify details of temperature and pressure compensation at meter.
 - .3 Verify settings, operation, venting of high and low pressure cut-outs, alarms.
 - .4 Check terminals of vents for gas pressure regulators.

1.10 POTABLE WATER SYSTEMS

- .1 When cleaning is completed and system filled:
 - .1 Verify performance of equipment and systems as specified elsewhere in Division 23.
 - .2 Check for proper operation of water hammer arrestors. Run oneoutlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or recharge air chambers. Repeat for each outlet and flush valve.
 - .3 Confirm water quality consistent with supply standards, verifying that no residuals remain resulting from flushing and/or cleaning.

1.11 WET AND DRY PIPE SPRINKLER SYSTEM, STANDPIPE AND HOSE SYSTEMS

- .1 Cleaning, testing, start-up, performance verification of equipment, systems, components, and devices is specified elsewhere in Division 23.
- .2 Verification of controls, detection devices, alarm devices is specified Division 26.
- .3 Demonstrate that fire hose will reach to most remote location regardless of partitions, and obstructions.

- .4 Verify operation of interlocks between HVAC systems and fire alarm systems.

1.12 SANITARY AND STORM DRAINAGE SYSTEMS

- .1 Buried systems: perform tests prior to back-filling. Perform hydraulic tests to verify grades and freedom from obstructions.
- .2 Ensure that traps are fully and permanently primed.
- .3 Ensure that fixtures are properly anchored, connected to system.
- .4 Operate flush valves, tank and operate each fixture to verify drainage and no leakage.
- .5 Cleanouts: refer to Section 22 42 00.
- .6 Roof drains:
 - .1 Refer to Section 22 42 00.
 - .2 Remove caps as required.

1.13 REPORTS

- .1 Provide reports for all tests.

1.14 TRAINING

- .1 In accordance with Section 01 91 13: Training of O&M Personnel.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

1. General

1.1. WORK INCLUDED

- 1.1.1. Provide all labour, materials, products, equipment and services to supply, install, test and commission Building Automation System (BAS) with Direct Digital Control (DDC) for building mechanical and electrical systems and interface with other microprocessor based building subsystems as indicated on drawings and described herein.
- 1.1.2. Conform to Section 23 09 23.00 - SEQUENCE OF OPERATION FOR BAS.

1.2. RELATED SECTIONS

1.3. PROJECT SCOPE PHASE 1

- 1.3.1. Supply and install new controls for by-pass boxes and perimeter heating control valves to tie into existing RCMP Resource Centre controls system.
- 1.3.2. Coordinate with the Owner and communications service provider for any network setup requirements and the activation of required ports on existing network switches and any requirements for additional network switches.
- 1.3.3. Disconnect and remove all existing control system components as required for a fully functioning control system.
- 1.3.4. All functionality of the existing BAS to remain and/or to be improved by the new BAS as per this specification.

1.4. SYSTEM OUTLINE

1.4.1. General

- .1 The documentation contained in this section and other contract documents pertaining to Building Automation System (BAS) is schematic in nature. The contractor shall provide all required hardware and software necessary to implement the functions shown or implied in the contract documents.
- .2 Control system to consist of high-speed, peer-to-peer network of microprocessor based DDC controllers and web-based operator interface.
- .3 Each system, building floor plan and control device shall be displayed through point-and-click graphics.
- .4 Web based server with network interface card shall gather data from this system and generate web pages that can be accessed through web browser on any PC connected to the network.
- .5 Operators shall access the system through web browser and browser interface to perform normal operator functions.
- .6 BAS shall provide support for smart phones & portable devices via one or more of the current common standards: Apple iOS (iPhone, iPad), Android Open Source Project (Droid devices), Windows Mobile Devices.
- .7 BAS to operate on building LAN communication infrastructure.

1.4.2. Functional Principals

- .1 BAS to control mechanical and electrical equipment as specified in CONTROL SEQUENCES, SCHEMATICS AND EQUIPMENT SCHEDULES.
- .2 System architecture to be modular permitting expansion of application software, system peripherals and field hardware.

- .3 Each controller to operate independently by performing its own specified control, alarm management, operator I/O and historical data collection receiving information from input field devices and controlling output field devices to perform the control sequences.
- .4 DDC controller may control more than one system provided that points associated with those systems are connected to that same controller.
- .5 DDC controllers to be configured so that main inputs and outputs from any control loop are located in that same controller. Global points used for control loop reset such as outdoor air temperature are exempt from this requirement.
- .6 DDC controllers to be capable of operating with local closed loop programming, independent from the server if communication is interrupted.
- .7 Where PID control loops are called for in the sequences, they are to be implemented within the controller.
- .8 BAS server shall perform global control programs and data consolidation and storage, communicating and obtaining data from all controllers and transmitting instructions to all controllers.
- .9 The supplied system must incorporate the ability to access all data including graphics, reports and alarm detection using standard Web Browsers without requiring proprietary operator interface and configuration programs. An Open Data Base Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on a supplier-installed server for all database access. Systems requiring proprietary database and user interface programs shall not be acceptable.

1.5. APPROVED SUPPLIERS AND MANUFACTURERS

Approved Suppliers and Manufacturer Product Lines			
Supplier	Manufacturer Product Line	Address/Location	Contact
DMA	Honeywell		Jared Hilderman (306) 525 9705
HVAC Sales	Honeywell		Heath Hrapstead (306) 721 7980

1.6. CODES AND STANDARDS

- 1.6.1. Comply with rules and regulations of codes and ordinances of local, provincial, and federal authorities; such codes and ordinances, when more restrictive, take precedence over the Contract Documents.
- 1.6.2. Provide products listed and classified by the testing firm acceptable to the authority having jurisdiction as suitable for the purpose indicated and specified.

1.7. STANDARD OF EQUIPMENT

- 1.7.1. Use only new products and software that manufacturer is currently stocking and selling for use in new installations.
- 1.7.2. Do not use this installation as product test site unless explicitly approved in writing.
- 1.7.3. Spare parts, software and technical support to be available for at least ten years after acceptance is certified.

1.8. OPEN PROTOCOL STANDARD

- 1.8.1. Intention of this specification is to provide an integrated, open protocol BAS, either BACnet as defined by ANSI/ASHRAE standard 135-2012 or LONWorks as defined by ANSI/CEA standard 709.1.

- 1.8.2. BACnet devices on the lower tier network to support all BACnet functional groups, standard application services and standard object types necessary, but not limited to provide reading and writing functionality of all analog and binary inputs and outputs and change-of-value initiation and reporting between BACnet devices on the network.
- 1.8.3. All BACnet devices to be BTL tested. Provide Protocol Implementation Conformance Statement (PICS) for all BACnet devices.
- 1.8.4. LON devices shall utilize Standard Network Variable Types (SNVTs) as defined by LonMark International and shall have all the functionality for network variable binding.
- 1.8.5. LON devices shall implement LonMark device profiles as appropriate and be LonMark certified. All devices shall be provided with a LonWorks Network Services (LNS) plug-in configuration utility. If LNS plug-in is not available for a device, all device resource files, XIF files, and points list shall be provided.

1.9. SYSTEM COMMUNICATION ARCHITECTURE

- 1.9.1. BAS shall use communication architecture consisting of at least two tiers. Each tier will utilize local area networks with totally open protocols based on industry leading standards.
- 1.9.2. The first tier of the BAS network (level 1) shall be based on Ethernet (ISO 8802-3/IEEE 802-3) communications, providing a high-speed local area network for reliable peer-to-peer communications. Future connected systems shall have compatibility specifications to provide communication with the first tier LAN. The operator workstations shall also be supported on the high speed LAN level 1. Communication speed on first tier network shall be at rate of 10Mbps or higher.
- 1.9.3. Coordinate with the Owner and communication service provider for required number of IP addresses, required number and location of Ethernet ports and subnets; identification of Internet socket port number requirements for external communication through Owner firewall.
- 1.9.4. The lower tiers of the BAS network shall be based on LON or BACnet networks which provide the interconnection of DDC Controllers. Communication speed on lower tier network shall be at rate of 76Kbps or higher. Connection to first tier network shall be provided on every floor of the building.
- 1.9.5. DDC controllers shall have communication port for temporary connection to laptop computer or operator interface device to allow downloads, uploads and other commissioning and troubleshooting operations.
- 1.9.6. Plugging a portable operator interface into any DDC controller shall allow access to any other DDC controller on the BAS.

1.10. EQUIPMENT SUPPLIED FOR INSTALLATION UNDER OTHER SECTIONS

- 1.10.1. Automatic control valves except otherwise noted.
- 1.10.2. Temperature sensor wells.
- 1.10.3. Terminal unit controllers including transformers. Ship to terminal unit manufacturer's facility for factory installation.
- 1.10.4. Motorized dampers except otherwise noted. Verify damper sizes and connection type with sheet metal contractor prior to ordering.

1.11. BAS PERFORMANCE

- 1.11.1. Graphic Display: Display the selected graphic representation at Operator Interfaces with current point object data at a minimum rate of twenty points in ten seconds.
- 1.11.2. Graphic Refresh: Update the selected graphic representation at Operator Interfaces with current point object data at a minimum rate of twenty points in ten seconds.

- 1.11.3. Data Scan: Update point object data at controllers and Operator Interfaces with current point object data at a minimum rate of once every ten seconds.
- 1.11.4. Binary Object Command: Controlled device will react within five seconds of an operator initiated command on a binary point object.
- 1.11.5. Analog Object Command: Controlled device will start to react within five seconds of an operator initiated command on an analog point object.
- 1.11.6. Alarmed Object Display: Alarm will annunciate visually and audibly at Operator Interfaces within five seconds on local area networks and within forty-five seconds on wide-area networks from the time the object entered the alarmed state.
- 1.11.7. Program Execution Rate: Provide ability to execute programs at a minimum rate of once every five seconds. Provide execution rates suitable for processes controlled.
- 1.11.8. PID Execution Rate: Provide adjustable execution rates for proportional-integral-derivative (PID) loops; update the controlled variable and command the controlled device at this same rate. Provide execution rates suitable for processes controlled.
- 1.11.9. Display and Report Accuracy: Provide minimum accuracy for point object data displayed at Operator Interfaces, reported to printers, reported to data files to Table 1: Display and Report Accuracy.

Table 1: Display and Report Accuracy.	
Point Object	Accuracy
Room Air Temperature	+/-0.2 deg. C (+/-0.36 deg. F) from actual
Duct Air Temperature	+/-0.2 deg. C (+/-0.36 deg. F) from actual
Outside Air Temperature	+/-0.2 deg. C (+/-0.36 deg. F) from actual
Dew Point Temperature	+/-1.5 deg. C (+/-2.7 deg. F) from actual
Water Temperature	+/-0.2 deg. C (+/-0.36 deg. F) from actual
Relative Humidity	+/-2 % of actual for 20% to 80% RH at 25 deg. C (77 deg.F)
Water Flow	+/-1.2 % of actual for 3.0 to 30.0 ft/s
Air Flow, Terminal Unit	+/-5.0 % of actual
Air Flow, Fan Bell and Duct	+/-5.0 % of actual
Air Flow, Pressurized Space	+/-3.0 % of actual
Air Pressure, Duct	+/-0.45 % of scale length
Air Pressure, Room	+/-0.45 % of scale length
Fluid Pressure (other than air)	+/-0.45 % of scale length (see Note 1)
Electrical (current, voltage, power)	+/-1.2 % of actual (see Note 2)
Carbon Monoxide	+/-3.2 % of actual
Carbon Dioxide	+/-3.2 % of actual
Note 1: For both absolute and differential pressure.	
Note 2: Does not include utility grade meters.	

- 1.11.10. Control Tolerance: Maintain controlled variable to control tolerance from set point to Table 2: Control Tolerance.

Table 2: Control Tolerance.		
Controlled Variable	Range	Control Tolerance from Set Point

Room Temperature		+/-0.6 deg. C (+/-1.1 deg. F)
Duct Temperature		+/-0.6 deg. C (+/-1.1 deg. F)
Humidity		+/-5 % RH
Air Flow		+/-1.0 % of scale length
Air Pressure	0-1500 Pa (0-6 in. w.g.)	+/-1.0 % of scale length
	-25 to 25 Pa (-0.1 to 0.1 in. w.g.)	+/- 10.0 % of scale length
Fluid Pressure (other than air)		+/- 1.0 % of scale length

1.12. SUBMITTALS

1.12.1. Product Data and Shop Drawings:

- .1 Within 30 days of award of contract, before start of construction, submit completely engineered and coordinated shop drawing package.
- .2 To Division 1 - Submittals in printed format and as amended below.
- .3 Provide drawing files on CD.
- .4 Riser Diagrams: Indicate: communication wire paths and connections to network devices; power wire and ground wire connections to Operator Interfaces and network devices; wire types and port types with manufacturer's model numbers; communication protocol and communication speed for network segments; power panel and breaker designations; wire terminal designations; addresses for network devices; room designations.
- .5 Provide required number of IP addresses, required number and location of Ethernet ports and subnets; identification of Internet socket port number requirements for external communication through Owner firewall.
- .6 Submit floor plan drawing indicating the coverage of CO and NO2 sensors.
- .7 Specifications and Instructions: Indicate: dimensions, capacities, electrical characteristics, mechanical characteristics, environmental characteristics, performance characteristics, finishes. Circle model number for products provided or furnished. General catalogue sheets are not acceptable. Provide installation instructions.
- .8 System Flow Diagrams: Indicate: control devices, control device designation, control device range, control device fail-safe position, point object type, point object name, point object address. Indicate flow directions for gases and liquids relevant to the controlled process. Indicate hardwired interlocks between control devices and equipment. Indicate the location of field control devices.
- .9 Products Schedule: Indicate: product designation, product name, product manufacturer, product model number, product data sheet reference number, quantities. Provide quantities required under the Work.
- .10 Valve Schedule: Indicate: system designation, service, medium, quantity, reference drawing, valve type, pipe configuration, fail position, pipe size, valve body size, valve design flow, valve design pressure drop, actual valve pressure drop, design Cv, valve Cv, design close-off, valve close-off, control type, control signal, connection type, valve model number.
- .11 Damper Schedule: Indicate: system designation, control device designation, duct dimensions, blade width, blade type, damper model number, calculated torque, actuator torque, actuator model number, actuator quantity, actuator fail-safe position, provisions for edge and blade seals, actuator mounting configuration.
- .12 Room Schedule: Indicate: controller object name, controller address, controller model number, application designation, room designation, VAV air volume set points, sensor model numbers.

- .13 Cabinet Layouts: Interior: Indicate: orientation of contents including controllers, transformers, cable trays, terminal strips, relays, control devices, labels. Exterior: Indicate: orientation of gauges, displays, switches, labels.
 - .14 Wire Details: Indicate: connections between control devices, controllers and equipment; connections to sources of power and grounds; control device designations, control device terminal designations, control device location; equipment terminal designations; cabinet terminal strip designations; wire designations. For control devices shown on multiple drawings, indicate the control device with the same designation on all drawings. Differentiate between manufacturer installed wire and field installed wire.
 - .15 Sequence of Operation: Provide a complete description of operation to Section 23 09 23.00 - SEQUENCE OF OPERATION FOR BAS. Provide description of operation for interlocks that directly connect to the Work. Indicate references to the system flow diagram by control device designation or point object name.
 - .16 Points Schedule: Indicate: input points, output points and virtual points for each controller. Indicate: point object address, point object name, point object description, point object alarm limits. List points in ascending order based on point object address.
- 1.12.2. Samples:
- .1 Provide with submittal under Part 1: Product Data and Shop Drawings for approval by the Owner and/or Consultant:
 - .1 Graphic Representations: Conceptual layouts in printed format of images and point objects for systems under Part 3: Execution, Operator Interface. Indicate or explain which other graphic representations are directly accessed.
 - .1 Typical terminal unit floor plan graphic that shows conditions on occupied floor.
 - .2 Typical equipment room floor graphic.
 - .3 Typical graphic for each system and terminal unit.
 - .4 Typical navigation menu. DELETE FOR STAND-ALONE SYSTEM.
 - .5 One sample graphic for each equipment type.
 - .6 One sample graphic for chilled water system.
 - .7 One sample graphic for hot water system.
 - .2 Test Forms: In printed format for test forms under Part 3: Execution, Testing and Commissioning.
 - .3 Products: As specified under Part 3: Execution, Control Devices.
- 1.12.3. Work Schedule:
- .1 Provide a schedule of the Work within four weeks of contract award. Indicate: intended sequence of tasks, start dates, task durations, delivery dates for material and equipment requiring long lead times, restraints on work by other trades or situations.
 - .2 Provide monthly updated Work Schedule indicating percentage complete and revisions to expected delivery dates.
- 1.12.4. Values Schedule:
- .1 Provide a schedule of separate system prices that comprises the price of the Work of this Section within four weeks of contract award. In addition to the system price, indicate material and labour prices separately for the system. Indicate each mechanical and electrical system as a separate price. Indicate terminal unit systems of the same type on a floor as a separate system price for the respective floor. Include the price for communication networks and power networks allocated proportionately to the separate system prices. Indicate the Operator Interfaces as a separate system price. Include all costs associated with the work of the system in the separate system price.
 - .2 The Values Schedule provides the basis for progress payments.

1.12.5. Project Record Documents:

- .1 Operation and Maintenance Manuals:
 - .1 Provide two copies in printed format for review by the Consultant at least ten weeks before the projected substantial completion date.
 - .2 Provide three copies of corrected manuals in printed format and three copies on CD within three weeks following completion of Acceptance Test under Part 3: Execution. Provide manuals in hard cover three-ring binders with index page and indexing tab per section.
 - .3 Sections:
 - .1 Contact Information: Provide names, addresses, 24-hour telephone numbers of service representatives and installing subcontractors.
 - .2 Operation: Provide Owner operating manuals for Operator Interfaces, Controller Resident Software, DDC Controllers, Advanced Application Controllers, Specific Application Controllers, control devices, compressed air system. For Custom Application Programs (Algorithms) Editor, provide a reference manual for the language syntax that describes each function.
 - .3 Engineering, Installation and Maintenance: Provide manuals for design and installation of point objects, controllers, control devices. Provide instructions for calibrating, troubleshooting and replacing controllers and control devices.
 - .4 Software: Provide complete original issue media and release notes for Operator Interfaces.
 - .5 Preventive Maintenance Procedures: Provide for Operator Interfaces, controllers, control devices. Provide a schedule of tasks; indicate dates for inspection, maintenance and calibration; indicate the pages in the engineering, installation and maintenance manuals that list the procedures.
 - .6 Replacement Parts List: Indicate: manufacturer name, manufacturer model number, supplier name, supplier address, supplier telephone number.
 - .7 Certificates: Provide original issue certificates for installation, maintenance and calibration.
 - .8 Test Forms: Provide copies of test forms completed under Part 3: Execution, Testing and Commissioning.
 - .9 Provide certificate of pressure test under Part 3: Execution, Control Air Tubing. DELETE CERTIFICATE OF PRESSURE TEST IF PNEUMATIC CONTROLLERS ARE NOT PROVIDED OR A TEST OF EXISTING CONTROL AIR TUBING IS NOT REQUIRED UNDER THE WORK.
 - .10 Provide licenses, guarantees and warranty documents for products and systems.
- .2 As-built Product Data and Shop Drawings:
 - .1 Provide three copies in printed format and three copies on CD for approval by the Consultant within three weeks following the successful completion of Acceptance Test under Part 3: Execution.
 - .2 Provide drawing files on CD.
 - .3 Points Schedule: For points schedule generated under Part 1: Submittals, Product Data and Shop Drawings, indicate operating conditions for point object data; list point objects by system designation and alphabetically by point object name.
 - .4 Time-of-Day (TOD) Schedules: Indicate: objects assigned to the TOD Schedule, Occupied Mode times.

- .3 As-built Floor Plans:
 - .1 Maintain on the project site as-built conditions on one full-size set of Contract Drawings, referred to as Marked-up Drawings; indicate on these drawings as-built locations for: control devices, cabinets, network devices with network address, communication networks by type and address, connection points to communication networks for Operator Interfaces, power networks, conduit paths, junction boxes, Operator Interfaces.
 - .2 Submit three copies of Marked-up Drawings to Consultant for review within three weeks following successful completion of Acceptance Test under Part 3: Execution. Revise Contract Drawings to match the approved Marked-up Drawings; revise using AUTOCAD Release 12 or higher format and submit three copies as full-size in printed format and three copies of drawing files on CD.
- .4 Software Backup:
 - .1 Provide with As-built Product Data and Shop Drawings.
 - .2 Provide three copies of complete BAS databases on CD.
- 1.12.6. Training Manuals:
 - .1 Provide a course outline, and one copy in printed format of training manuals provided under Part 3: Execution, Instruction and Training at least six weeks prior to the first class. Modify the course outline and training materials to suit Owner's requirements and as requested by the Consultant.

1.13. WARRANTY

- 1.13.1. Warrant the Work free from defects for a period of 12 months and in accordance with the General Conditions and as amended below.
- 1.13.2. Warranty start date will be the date the Work is accepted under Part 3: Execution, Acceptance Test.
- 1.13.3. Provide a single warranty start date even when the Owner has received beneficial use prior to acceptance of the Work. For Work split into multiple contracts or for a multi-phase contract, provide a separate warranty start date and period for each contract or phase.
- 1.13.4. Adjust, repair or replace defects and failures in the Work at no additional cost during the warranty period and without reduction in service to the Owner. Provide warranty service during normal business hours and within 24 hours of the Owner's request for service.
- 1.13.5. Provide warranty service by factory trained service representatives of the Supplier.
- 1.13.6. Replace Operator Interface software, Controller Resident Software, controller firmware and database files with revisions that correct deficiencies or defects during the warranty period at no charge to the Owner. Notify the Owner of changes and schedule the installation. Update Operation and Maintenance Manuals with firmware release notes.
- 1.13.7. Prior to testing date under Part 3: Execution, Acceptance Test, update firmware in controllers to latest revisions at no additional cost to the Owner; update Operation and Maintenance Manuals with firmware release notes.
- 1.13.8. During the Warranty period check the tuning of each control loop once during heating season and once during cooling season; notify the Owner when this work is to occur. Forward to the Consultant documentation indicating observations and adjustments made.
- 1.13.9. Warrant products that are reconditioned under the Work to the same requirements as new products.

1.14. BAS MAINTENANCE AND SERVICE

- 1.14.1. Provide full BAS maintenance and service for one year after the warranty expires.

- 1.14.2. Assign a fully trained BAS service technician to perform all contract activities as described below with one backup person.
- 1.14.3. Service to include but not to be limited to: full day site visit once a week to perform system maintenance and service work that is not urgent, including preparation of the visit report.
- 1.14.4. Scheduled preventive maintenance inspections will provide those services required to maintain the system at maximum performance and reliability levels and may include, but not be limited to the following: analyze, adjust, calibrate all sensors, diagnostic LEDs, printers, power supplies, work stations, controllers, input/output points, communication cabling, transmitters, transducers, damper and valve actuators, instrumentation and accessories directly pertaining to the Building Automation System.
- 1.14.5. Conduct inspections and thorough preventive maintenance routine on each piece of covered equipment. In addition, make tests and adjustments to ensure efficient and reliable operation of other major components.
- 1.14.6. Check and confirm control system sequence of operation to insure optimum system efficiency and economy. Monitor the operation of all systems connected to BAS and optimize the operation of those systems for better comfort and energy savings over the duration of operation and service contract.
- 1.14.7. Prepare a report on system operation once a month.
- 1.14.8. A log of each loop tested and each control sequence verified shall be reviewed with the Owner.
- 1.14.9. As part of the service, provide 24/7 contact number for service calls. Maximum response time to be 4 hours.
- 1.14.10. Provide a price for a one-year service agreement based on the above requirements to come in to effect upon the completion of the warranty period. Show this price as separate line item: Service Agreement.
- 1.14.11. Not included in the contract is the following: any customer initiated changes and additions to the system.

1.15. OWNERSHIP OF PROPRIETARY MATERIAL

- 1.15.1. Software and documentation supplied and generated under the Work or required for ongoing system operation, maintenance and modification becomes the property of the Owner, including and not limited to graphic files, database files, Custom Application Programs, Project Record Documents, Training Manuals.
- 1.15.2. Licensing to permit an unlimited number of users to access the system without additional fees.
- 1.15.3. As of last day of the warranty period, all software to be upgraded to most current recommended version of manufacturer's release.

2. Products

2.1. MATERIALS

- 2.1.1. Existing Products: To Part 3: Execution, Existing Products.
- 2.1.2. New Products: Non-beta versions currently under manufacture and have been applied in similar installations for a minimum period of one year.
- 2.1.3. Revisions: Latest available revision for Operator Software, Controller Resident Software and controller firmware at start of Warranty.
- 2.1.4. Replacement Parts: Readily available and not scheduled for discontinuation at time of Total Project Completion.

- 2.1.5. Expansion: Expandable through additional inputs and outputs and to card access, security, fire alarm, lighting control systems and other building systems.
- 2.2. 3RD PARTY MANUFACTURER INTERFACE:**
- .1 3rd party manufacturer controllers included but not limited to chillers, boilers, variable frequency drives, power monitoring, medical gasses to be based on the open system communication (LON or BACnet) for seamless integration with BAS. Include network connection from BAS to 3rd party manufacturer controllers.
 - .2 If 3rd party manufacturer controllers are based on different open system standard than BAS, it is the responsibility of BAS contractor to provide the appropriate interface for integration of that 3rd party manufacturer controller to BAS.
 - .3 If open system controllers are not available, include all appropriate hardware equipment and software to allow bi-directional data communication between the BAS and 3rd party manufacturers' control panels.
- 2.3. CONTROLLER RESIDENT SOFTWARE**
- 2.3.1. The software resides in Building Controllers and Advanced Application Controllers and is edited by means of the Operator Interface.
- 2.3.2. Security:
- .1 Definition: Multiple operators are assigned access levels, and independent user login names and passwords are configurable.
 - .2 Processing: Automatically log off operator after an adjustable period of inactivity.
- 2.3.3. Alarms and Events:
- .1 Definition: Alarm limits, alarm limit differentials, states and reactions shall be adjustable.
 - .2 Processing: Alarm and event messages are independently configured to route to network devices. Enable and disable alarms and events manually by the operator and automatically through Custom Application Programs.
- 2.3.4. Trends:
- .1 Definition: Create, delete and modify trends. Title blocks, legends, sampling interval and start and stop time shall be configurable.
 - .2 Storage: Store trend data to controller RAM memory. Trend data is retrieved by the Operator Interface.
 - .3 Samples:
 - .1 Analog Point Objects: Store instantaneous point object data at every point object change of value (COV) for the analog type or at time intervals of fifteen minutes.
 - .1 Temperature COV: 2.0 Deg. C (3.6 Deg. F).
 - .2 Relative Humidity COV: 5 % RH.
 - .3 Other Analog COV: 5 % of scale length.
 - .2 Binary Point Objects: Store instantaneous point object data at every point object change of value.
- 2.3.5. Time-of-Day (TOD) Schedules:
- .1 Definition: Create, delete and modify TOD Schedules. Assign objects to TOD Schedules based on function and location.
- 2.3.6. Custom Application Programs (Algorithms):
- .1 Definition: Create, delete and modify programs and program statements.
 - .2 Syntax Capabilities:
 - .1 Analog and binary point objects.

- .2 Conditional statements (IF, THEN, ELSE, ELSE IF) using compound Boolean relations (AND, OR and NOT) and comparisons (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL).
 - .3 Floating-point arithmetic using operators for addition, subtraction, division, multiplication and square root; absolute value and minimum/maximum value arithmetic functions.
 - .4 Predefined objects representing date, time of day, day of week, month of year and elapsed time.
 - .5 Create, delete and modify custom function blocks.
- 2.3.7. Maintenance Messages: Display at Operator Workstations. Indicate equipment name and maintenance required based on equipment run time, starts, and calendar date limits.
- 2.3.8. PID Control: PID (proportional-integral-derivative), PI and P algorithms for direct acting and reverse acting. Analog output is time-varying. Output control device is adjustable by the operator. Set point and gains are adjustable.
- 2.3.9. Optimal Start/Stop: Delay equipment start-up to latest possible time which will allow building space to reach target conditions by occupancy time. Advance shut-down of equipment to earliest possible time and maintain space target conditions until the end of occupancy time.
- 2.3.10. Enthalpy Economizer Control: Control outside, return and exhaust dampers based on inside and outside enthalpy comparisons.
- 2.3.11. Electrical Demand Management: Manage electrical demand by monitoring power consumption. If consumption exceeds operator adjustable level system to be capable of adjusting set-points, de-energizing low priority equipment and taking other pre-programmed actions as described in SEQUENCES OF OPERATION.
- 2.3.12. Chiller Optimization: sequence chillers and other chilled water plant equipment and reset chilled water and condenser water control set points, to provide cooling at minimum cost.
- 2.3.13. Load Reset: use the zone with the greatest load to reset the set-point of heating or cooling source.
- 2.3.14. Morning Warm-Up: compare outside and space temperatures and if outside air temperature is less than desired space temperature, run the system before occupancy with fully closed outside dampers until space temperature is satisfied.
- 2.3.15. Night Cool Down: compare outside and space temperatures and if outside air temperature is less than desired space temperature, run the system during unoccupied hours with outside dampers fully opened until space temperature is satisfied.
- 2.3.16. Equipment Sequencing: Sequence equipment with lead - leg, duty - standby and priority assignment based upon runtime or operator command as described in SEQUENCES OF OPERATION.
- 2.3.17. Staged Starts: Operator selectable time delays between starts for equipment on power restoration or scheduled start.
- 2.3.18. Anti-Short Cycling: Minimum on and minimum off times for equipment.
- 2.3.19. Dead-band Switch: Cycle a binary point object based on controlled point object and set point for direct acting and reverse acting. Differentials are adjustable.
- 2.3.20. Equipment Run Time Totalization: Accumulated run time expressed in unit hours and operator adjustable high runtime alarms.

2.4. DDC CONTROLLERS

2.4.1. General

- .1 Input/Output Interface:
 - .1 Analog Inputs:

- .1 Signal: 4 to 20 mA, 0 to 10 VDC, thermistor, RTD.
 - .2 Binary Inputs:
 - .1 Detect dry contact closure.
 - .2 Wetting Current: Supplied by the controller.
 - .3 Pulsed Inputs:
 - .1 Detect pulse of dry contact closure.
 - .2 Pulse Frequency: Compatible with input device.
 - .3 Wetting Current: Supplied by the controller.
 - .4 Analog Outputs:
 - .1 Signal: 4 to 20 mA, 0 to 10 VDC. Provide range and zero adjustment.
 - .2 Accuracy Rating: +/- 1% of scale length.
 - .5 Binary Outputs:
 - .1 Triac: Rated for 0.5 A at 24 VAC
 - .2 Relay: NO or NC configuration, rated for 3 A at 24 VAC
 - .3 Provide secondary relay for higher loads.
 - .6 Minimum Spare I/O Capacity: Controllers to have minimum 20% spare capacity or at least one of each type of I/O available on the controller. This does not apply to Application Specific Controllers.
- .2 Controllers that perform scheduling operations to have on board real-time clock.
 - .3 Controllers to continue to provide control functions in event of network communication failure.
 - .4 Controllers to be swappable without disconnecting the wiring.
 - .5 Immunity to Power: Rated for 90% to 110% of nominal voltage.
- 2.4.2. Building Controllers (BC):
- .1 Independent, networked, microprocessor-based for all internetwork control strategies.
 - .2 Reside on Ethernet Level 1 BAS network.
 - .3 Manage connected input and output control devices; transmit real and virtual point object data to distributed controllers and Operator Interfaces and provide global strategy and direction.
 - .4 Continuous monitoring of processor, memory and communication circuits; assume a predetermined failure mode for abnormal conditions; assume a failsafe operating mode for failed communication with objects.
 - .5 Communicates to card access, security, fire alarm, lighting control systems.
 - .6 Service communication port for communication with Portable Operator Terminals.
 - .7 Memory: Nonvolatile EEPROM for firmware. Seventy-two hours battery backed memory for object database and custom application programs.
 - .8 Each BC to support firmware upgrades without need to replace hardware.
 - .9 Environment: Suitable for anticipated ambient conditions.
 - .10 Serviceability: LEDs for power, communication and processor status.
- 2.4.3. Advanced Application Controllers (AAC):
- .1 Independent, networked, microprocessor-based.
 - .2 Reside on lower tier BAS network (BACNet or LON).
 - .3 Manage connected input and output control devices; transmit real and virtual point object data to distributed controllers and Operator Interfaces.

- .4 Continuous monitoring of processor, memory and communication circuits; assume a predetermined failure mode for abnormal conditions; assume a failsafe operating mode for failed communication with objects.
- .5 Service communication port for communication with Portable Operator Terminals.
- .6 Memory: Nonvolatile EEPROM for firmware. Seventy-two hours of battery backed memory for object database and custom application programs.
- .7 Each AAC to support firmware upgrades without need to replace hardware.
- .8 Environment: Suitable for anticipated ambient conditions.
- .9 Serviceability: LEDs for power, communication and processor status.

2.4.4. Application Specific Controllers (ASC):

- .1 Microprocessor-based networked. Non-adjustable programs with operator adjustable settings for customized operation within equipment design limits.
- .2 Reside on lower tier BAS network (BACNet or LON).
- .3 Service communication port for communication with Portable Operator Terminals.
- .4 Memory: Nonvolatile EEPROM memory for firmware and program data.
- .5 Environment: Suitable for anticipated ambient conditions.
- .6 Serviceability: LEDs for power, communication and processor status.

2.5. CONTROL DEVICES

2.5.1. Motorized Control Dampers:

- .1 Sizing:
 - .1 Dimensions: As indicated. Maximum damper section size: 1200 mm x 1500 mm (48 in. x 60 in.). For dampers larger than the section maximum, use an assembly of multiple, equally sized sections.
 - .2 Two-position: Parallel blade.
 - .3 Modulating: Opposed blade. Parallel blade dampers may be used for return air and bypass applications.
- .2 Frame: 125 mm x 25 mm x 3 mm (5 in. x 1 in. x 0.125 in.) 6063T5 extruded aluminum with mounting flanges on both sides.
- .3 Blades: Airfoil shape, 6063T5 extruded aluminum, maximum 150 mm (6 in.) depth.
- .4 Seals:
 - .1 Blade Edge: Extruded thermoplastic rubber (TPR) suitable for -58 deg. C to 135 deg. C (-72 deg. F to 275 deg. F), mechanically locked in place and easily replaceable in the field.
 - .2 Blade Jamb: Spring-loaded stainless steel.
- .5 Bearings: Molded synthetic.
- .6 Linkage: Corrosion resistant steel and concealed in the frame.
- .7 Drive Shaft: Corrosion resistant steel of square or hexagon shape.
- .8 Axle: Corrosion resistant steel.
- .9 Leakage: Maximum 0.35 L/s/sq m (8 CFM/sq ft) at 1.0 kPa (4 in. w.g.) of differential pressure across fully closed damper when tested to AMCA Standard 511.
- .10 Make and Model: Ruskin CD-50 or equivalent.

2.5.2. Actuators For Dampers, Electronic:

- .1 Control Signal: Compatible with BC, AAC and ASC.
- .2 Floating control signal is acceptable only for VAV damper application.

- .3 Operating Time: Maximum 120 seconds throughout the full rotation.
- .4 Angle of Rotation: Adjustable between 0° to 90°.
- .5 Stall protection: Mechanical or electronic.
- .6 Actuators shall have electronic overload protection or digital rotation sensing circuitry to prevent actuator damage throughout the entire rotation.
- .7 Failsafe: Non-spring return for VAV terminals; spring return for other applications. Spring return to normal position within 15 seconds.
- .8 Manual Override: Crank type. External gear release for non-spring return actuators.
- .9 Position Indicator: Reversible for clockwise or counter-clockwise rotation; set the 0 degrees mark to the failsafe position.
- .10 Torque: To damper manufacturer's requirements to provide complete compression of seals between frame and blades and for smooth control.
- .11 Provide UL555S listed damper actuators for all dampers used in smoke control.

2.5.3. Control Valves:

- .1 Characteristics, materials and pressure ratings suitable for the application; refer to schedules.
- .2 Flow Characteristic:
 - .1 Water:

Two-way: Equal percentage.

Three-way: A Port: Equal percentage. B Port: Linear or modified linear.

- .2 Steam: Linear.
- .3 Sizing Water Valves:
 - .1 Two-position: Line size with full ports.
 - .2 Two-way Modulating: Non Radiation: Pressure drop equal to the pressure drop through the coil or 27 kPa (4 psi), whichever is greater. Radiation: Pressure drop equal to 7 kPa (1 psi).
 - .3 Three-way Modulating: Non Radiation: Pressure drop equal to the pressure drop through the coil or 27 kPa (4 psi), whichever is greater. Radiation: Pressure drop equal to 7 kPa (1 psi).
 - .4 Butterfly Valves:
 - .1 Type: High-performance (HPBV).
 - .2 Make and Model: Dezurik BHP or equivalent.
 - .3 Tee-fitting: Provide for three-way application; with motor mounting bracket and linkage hardware.
 - .5 Valves 12 mm (1/2 in.) through 50 mm (2 in.):
 - .1 Screwed ANSI Class 250 bronze body.
 - .6 Valves 62 mm (2-1/2 in.) and Larger:
 - .1 Water temperature less than 121 deg. C (250 deg. F) at 1035 kPa (150 psi) or less than 93.2 deg. C (200 deg. F) at 1139 kPa (165 psi): Flanged ANSI Class 125 cast iron body.
 - .2 Water temperature greater than 121 deg. C (250 deg. F) at 1035 kPa (150 psi) or greater than 93.9 deg. C (200 deg. F) at 1138 kPa (165 psi): Flanged ANSI Class 250 cast iron body or ANSI Class 300 cast steel body.
- .4 Sizing Steam Valves:
 - .1 Two-position: Pressure drop equal to 10% to 20% of inlet pressure.

- .2 Modulating: Pressure drop equal to 50% of inlet pressure.
 - .5 Leakage: ANSI Class IV.
 - .6 Materials:
 - .1 Stems: Stainless steel.
 - .2 Plugs and Seats: Brass or steel.
 - .3 Packing: PTFE for steam.
 - .7 Rangeability: 40:1 minimum.
- 2.5.4. Pressure Independent Control Valves:
- .1 Factory fabricated of type, body material, and pressure class based on maximum pressure and temperature rating of the piping system, unless otherwise indicated.
 - .2 Calibrated Balancing Valves and Automatic Flow-Control Valves shall not be required on devices where pressure independent control valves are installed.
 - .3 The control valves shall accurately control the flow from 0 to 100% full rated flow with an equal percentage flow characteristic.
 - .4 Each control valve shall be individually flow tested and factory verified to deviate no more than $\pm 5\%$ through the operating pressure range. A calibrated performance tag shall be provided with each valve (optional for $\frac{1}{2}$ " [15mm]) listing the measured flow rate in 10° rotation increments.
 - .5 Valve bodies 2" [50mm] and smaller shall be brass. Valve bodies 3" [80mm] thru 8" [200mm] shall be ductile iron. All internal parts shall be brass, carbon steel, stainless steel or Teflon[®]. Plastic internal parts are not acceptable
 - .6 Control valve rangeability shall be 100:1 minimum.
 - .7 The manufacturer shall warrant all components for a period of 5 years from the date of production.
 - .8 The actuator shall be the same manufacturer as the valve, integrally mounted to the valve at the factory, or shall be provided with universal mounting plate to allow installation of actuators meeting system electrical and valve torque requirements.
- 2.5.5. Actuators for Control Valves, Electronic:
- .1 Control Signal: Compatible with BC, AAC and ASC.
 - .2 Floating control signal is not acceptable.
 - .3 Operating Time: Maximum 120 seconds throughout the full rotation.
 - .4 Mounting: Corrosion resistant hardware.
 - .5 Stall Protection: Electronic overload or digital rotation sensing.
 - .6 Failsafe: Non-spring return for radiation and terminal reheat coils; spring return for others. Spring returns to normal position within 15 seconds.
 - .7 Manual Override: Crank type. External gear release for non-spring return actuators.
 - .8 Position Indicator: Provide. Indicate valve open and closed positions.
 - .9 Close-off Pressure:
 - .1 Water:
 - .1 Two-way: 150% of total system head.
 - .2 Three-way: 300% of the pressure differential between ports A and B at design flow, or 100% of total system head.
 - .2 Steam: 150% of inlet pressure.
- 2.5.6. Electric Relays:
- .1 Type: General purpose; enclosed coil; diodes provided for inductive switched loads; override button; LED "energized" indicator; plug-in type base.

- .2 Contact rating, configuration and coil voltage suitable for application.
- .3 Regulatory: UL listed.
- 2.5.7. Damper End Switches:
 - .1 Type: Lever operated activated by blade position.
 - .2 Electrical Contacts: Rated for 10 A resistive, 6 FLA at 120 VAC.
 - .3 Regulatory: UL listed.
- 2.5.8. Low Limit Electromechanical Thermostat:
 - .1 Type: Vapour Pressure; minimum 6000 mm (20 ft.) of capillary; actuated by any 300 mm (12 in.) of capillary element; manual reset upon activation.
 - .2 Electrical Contacts: Double-pole double-throw (DPDT), snap-acting; rated for 10 A resistive, 6 FLA at 120 VAC.
 - .3 Adjustable Set Point: Range: -1 deg. C to 13 deg. C (30 deg. F to 55 deg. F) and set to 1.67 deg. C (35 deg. F).
 - .4 Regulatory: UL listed.
- 2.5.9. High Limit Electromechanical Thermostat:
 - .1 Type: Bimetallic sensing; manual reset upon activation.
 - .2 Mounting: Air stream.
 - .3 Electrical Contacts: Single-pole single-throw (SPST), normally closed, snap-acting; rated for 10 A resistive, 6 FLA at 120 VAC.
 - .4 Adjustable Set Point: Range: 38 deg. C to 66 deg. C (100 deg. F to 150 deg. F) and set to 57 deg. C (135 deg. F).
- 2.5.10. Electromechanical Thermostat:
 - .1 Wall Mount:
 - .1 Provide samples of covers to Part 1: Submittals, Samples.
 - .2 Low Voltage:
 - .1 Type: 24 VAC, bimetal-operated, mercury-switch; adjustable or fixed anticipation heater; vented ABS plastic concealed cover.
 - .2 Set Point: Range: 13 deg. C to 30 deg. C (55 deg. F to 85 deg. F); 1 deg. C (2 deg. F) maximum differential.
 - .3 Line Voltage:
 - .1 Type: Bimetal-actuated open contact, or bellow-actuated enclosed snap-switch type, or equivalent solid state type; anticipation heater; vented metal concealed cover.
 - .2 Electrical Contacts: Rated for 10 A resistive, 6 A FLA at 120 VAC.
 - .3 Set Point: Range: 13 deg. C to 30 deg. C (55 deg. F to 85 deg. F); 1 deg. C (2 deg. F) maximum differential.
 - .4 Regulatory: UL listed.
- 2.5.11. Digital Thermostat:
 - .1 Digital thermostats shall be 7-day programmable digital type suited for the application.
 - .2 Standalone terminal units shall utilize a digital thermostat where shown on drawings.
 - .3 Digital thermostat shall have user selectable engineering units (F or C) and set point adjustment.
 - .4 Digital thermostat shall support automatic daylight savings time switchover.
 - .5 Digital thermostat shall support automatic and manual heat/cool changeover when applicable.

- .6 Digital thermostat shall support temporary set point adjustment with automatic return to normal operation.
- 2.5.12. Temperature Sensors:
 - .1 General Requirements:
 - .1 Temperature sensors shall be of the resistance type, two-wire 1000 ohm nickel RTD, two-wire 1000 ohm platinum RTD or two-wire 10,000 ohm thermistor.
 - .2 Space Temperature Sensors:
 - .1 For installation throughout the facility unless otherwise noted.
 - .3 Space Temperature Sensors With Adjustable Set-Point, Override and Display:
 - .1 Key pad or slider for temperature set-point adjustment.
 - .2 LED display.
 - .3 Timed override request push button with LED status for activation of after-hours operation.
 - .4 For installation only where indicated on drawings, controls diagrams or sequences of operations.
 - .4 Covers for Wall Mount Sensors:
 - .1 Overrides: Exposed set point adjustment and override button.
 - .2 Communication Port: For communication between Portable Operator Terminals and ASC controllers.
 - .5 Averaging Temperature Sensors:
 - .1 Minimum 1.5 m (5 ft) of capillary per 1 sq m (10 sq ft) of duct cross-section.
 - .2 Provide multiple sensors where single averaging element is unable to be positioned to provide complete duct or plenum traverse.
 - .6 Outside Air Temperature Sensors:
 - .1 Outside air temperature sensors shall be designed to withstand the environmental conditions to which they will be exposed.
 - .2 The sensors shall be provided with a solar shield.
 - .3 Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.
 - .7 Duct Temperature Sensors:
 - .1 Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
 - .2 Probe length shall be no less than 1/3 of the duct width or diameter.
 - .3 For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.
 - .8 Thermowells:
 - .1 Brass or Type 316 stainless steel suitable for the application.
 - .2 Heat transfer compound compatible with sensing element.
- 2.5.13. Guards for Sensors and Thermostats:
 - .1 Materials: Heavy gauge steel.
- 2.5.14. Pressure Sensors:
 - .1 General:
 - .1 Sensing Element:
 - .1 Type: Capacitance sensing.
 - .2 Materials: Suitable for continuous contact with measured medium.

- .2 Transmitter:
 - .1 Range: Not to exceed two times the operating pressure.
 - .2 Signal: 4 to 20 mA or 0-10 VDC; with zero and span adjustment.
 - .3 Accuracy Rating: +/- 1.0 % of full scale.
 - .4 Response Time: Maximum 0.5 seconds.
- .3 Isolation Valve: Between process connection and sensor.
- .4 Capable of withstanding 100% overpressure without damage
- .2 Air Static Pressure Sensors:
 - .1 Sensing Element:
 - .1 Type: Capacitance sensing with pitot tube sensing tips screwed securely to duct.

2.6. WIRE AND CONDUIT

- 2.6.1. Conduit: Electrical metallic tubing EMT with compression type fittings in dry locations; cold rolled steel zinc coated or zinc coated rigid steel with threaded fittings in wet locations or where exposed to weather.
- 2.6.2. Outlet boxes: Dry locations: sheradized or galvanized drawn steel 100 mm (4 in.) square or octagon with suitable raised cover; Exposed to Weather: threaded hub cast aluminum boxes with gasket plate.
- 2.6.3. Junction boxes: Sized according to number, size and position of entering raceway; type: suitable for the environment.
- 2.6.4. Wire:
 - .1 Network: Per controls manufacturer recommendations.
 - .2 Analog Input, Output: Stranded 18 gauge copper twisted shielded.
 - .3 Binary Input, Output: 18 gauge, minimum insulation rating of 600 volts.
 - .4 Class 2: FT-6 without conduit in ceiling plenums; FT-4 in conduit for all other cases.

3. Execution

3.1. GENERAL WORKMANSHIP

- 3.1.1. Install all controllers, cabinets, control devices and power supplies in readily accessible locations providing adequate ambient conditions for its specified application and to the Canadian Electrical Code.
- 3.1.2. Install products to manufacturer's installation instructions.
- 3.1.3. Install parallel to building walls and floors unless indicated or specified or required by manufacturer's installation instructions.
- 3.1.4. Mechanical contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.

3.2. COORDINATION

- 3.2.1. Submittals: To Part 1: General, Submittals.
- 3.2.2. Integrate and coordinate work under this section to controls and control devices provided or installed by others.

- 3.2.3. Each supplier of control product to configure, program, start-up and commission that product to satisfy requirements of Sequence of Operation regardless of where within contract documents product is described or specified.
- 3.2.4. Resolve compatibility issues between control product provided under this section and those provided under other sections or divisions of this specification.

3.3. WIRING AND CONDUIT

- 3.3.1. Wire shall be neatly tie wrapped to conduit mounted to the building structure but must be installed at right angles or parallel to the building. Loose wiring shall only be allowed over a distance of 1500 mm (5 ft.) but must not pass over lighting fixtures.
- 3.3.2. Wiring in Equipment Room, between floors, or between concrete walls shall be installed in conduit. Exposed wiring will not be accepted. Conduit shall be installed at right angles or parallel to the building walls.
- 3.3.3. Should it become necessary to splice field wiring it shall be soldered. If soldering is not possible, approved B type crimp connectors are an acceptable alternative. Wire nuts and Marr connections are not acceptable. Provide a 500 mm (20 in.) loop length at all splices.
- 3.3.4. Conceal conduit within finished shafts, ceilings, and walls as required. Install exposed conduit parallel with or at right angles to the building walls.
- 3.3.5. Plug or cap unused conduit openings and stubs with compatible fittings.
- 3.3.6. Route all conduit to clear beams, plates, footings and structural members except through column footings and grade beams.
- 3.3.7. Provide watertight seals at penetrations through outside foundation walls.
- 3.3.8. Support conduit 25 mm (1 in.) and smaller to the building with one-hole non-perforated malleable iron or steel pipe straps. Suspend conduits larger than 1 in. on pipe racks with splitting hangers and rods.
- 3.3.9. Maintain caps on conduit openings throughout construction.
- 3.3.10. Where conduit is attached to vibrating or rotating equipment, install and anchor flexible metal conduit with a minimum length of 450 mm (18 in.) and a maximum length of 900 mm (36 in.) in such a manner that vibration and equipment noise will not be transmitted to the rigid conduit.
- 3.3.11. Where exposed to weather or in damp or wet locations, provide waterproof flexible conduit.
- 3.3.12. Fill conduit to maximum of 60% of its capacity. Provide a pull rope within the conduit when the installation is complete. Bend conduit to a radius of greater than 3 times the conduit diameter to a maximum of three 1/4 bends permitted between pull boxes.
- 3.3.13. Wire within cabinets shall be installed in a plastic tray with a cover. Terminate wires to field-removable, modular terminal strips.
- 3.3.14. All field sensors shall be provided with a flexible conduit connection minimum length of 450mm (18 in.) and an enclosure for the electrical connections.

3.4. POWER WIRING

- 3.4.1. Power for section 23 09 00.00 - Building Automation System (BAS) shall be provided under Electrical Division 26 at 120 VAC 60 Hz single phase and shall terminate in junction boxes installed where shown on electrical and mechanical drawings. Wiring and conduit from these boxes to control devices being electrically powered to be provided by section 23 09 00.00 - Building Automation System (BAS).
- 3.4.2. Where power for equipment is fed from MCC, 120 VAC power for Section 23 09 00.00 - Building Automation System (BAS) shall also be fed from the MCC from the 120 VAC section. Wiring and conduit from the MCC to control devices being electrically powered to be provided by section 23 09 00.00 - Building Automation System (BAS).

3.5. COMMUNICATION WIRING

- 3.5.1. Install communication wiring per controls manufacturer recommendations as to type of wire used and segment lengths.
- 3.5.2. Install communication wiring in conduit and raceways separated from other wiring.
- 3.5.3. Verify entire network's integrity following cable installation using appropriate tests for each cable.
- 3.5.4. Each run of communication wiring to be continuous length without splices.

3.6. OPERATOR INTERFACE

- 3.6.1. Operator Software:
 - .1 Security: Set up operators with independent user login name and password and assign access levels to Owner's requirements.
 - .2 Reports: Configure the following reports:
 - .1 List of objects and point object data that are in alarm state sorted by priority in descending order then by point object name in ascending order.
 - .2 List of disabled point objects sorted by point object name in ascending order.
 - .3 List of TOD Schedules: Indicate: objects assigned to the TOD Schedule, Occupied Mode times.
- 3.6.2. Graphics: Generate graphic representations for systems under Section 23 09 23.00 - SEQUENCE OF OPERATION FOR BAS and as follows:
 - .1 Building elevation in three dimensions; indicate: floors and mechanical rooms.
 - .2 Floor plans: Indicate: Equipment rooms; point object data for temperature, humidity and pressure. Directly access graphic representation for terminal systems.
 - .3 Equipment Rooms: Indicate locations for systems.
 - .4 Systems: Indicate: Equipment, service connections, point object data, set points, reset schedules. Highlight point objects under operator command.
 - .5 Graphic representations link to and display graphic representations for associated systems.

3.7. CABINETS

- 3.7.1. Install rigidly to wall or to an independent frame installed to the floor slab. Installation to duct, equipment and locations subject to vibration is not accepted.
- 3.7.2. Cabinets for ASC controllers: Install to terminal equipment. Installation to duct, equipment and locations subject to vibration that could affect controller operation or calibration of control device is not accepted.
- 3.7.3. Coordinate cabinet locations with other trades and general contractor.

3.8. CONTROL DEVICES

- 3.8.1. Provide or furnish control devices as indicated on the drawings and to the requirements of this Section and to execute sequence of operation under Section 23 09 23.00 - SEQUENCE OF OPERATION FOR BAS.
- 3.8.2. Motor Operated Dampers:
 - .1 Furnish motor operated dampers for installation under Section 23 31.13.00 - DUCTWORK AND SPECIALTIES. Provide supervision on site during installation.
 - .2 Install in areas maintained above freezing.

- 3.8.3. Actuators for Dampers, Electronic:
 - .1 Mounting: Direct coupled to drive shaft or jackshaft using a V bolt design.
- 3.8.4. Control Valves:
 - .1 Furnish control valves for installation under Section 22 11 13.00 - PIPE, VALVES AND FITTINGS (EXCEPT PLUMBING). Provide supervision on site during installation.
- 3.8.5. Actuators for Control Valves, Electronic:
 - .1 Factory install or field install actuator to valve body.
- 3.8.6. Low Limit Electromechanical Thermostat:
 - .1 Install hardwire interlocked to supply fan starter for respective system.
 - .2 Provide according to Section 23 09 23.00 - SEQUENCE OF OPERATION FOR BAS.
 - .3 Shut down the fan when duct temperature is equal to or less than 1.67 deg. C (35 deg. F).
 - .4 Install to adequately cover potential areas of low level stratification. Provide one low-limit thermostat for each 2.8 sq M (25 sq ft) of duct cross section. Mount sensing element on plastic clips.
- 3.8.7. High Limit Electromechanical Thermostat:
 - .1 Install hardwire interlocked to fan starters for respective system.
 - .2 Shut down the fans when duct temperature is equal to or greater than 51.7 deg. C (125 deg. F).
 - .3 Provide one high-limit thermostat for each 3.7 sq M (40 sq ft) of duct cross section.
- 3.8.8. Electromechanical Thermostats and Temperature Sensors:
 - .1 Furnish sensing wells for installation under Section 22 11 13.00 - PIPE, VALVES AND FITTINGS (EXCEPT PLUMBING). Provide supervision on site during installation.
 - .2 Samples: Provide for wall mount type to Part 1: Submittals, Samples.
 - .3 Wall Mount Type:
 - .1 Cover Colour: White.
 - .2 Install to furred-in columns and permanent walls on concealed junction boxes supported by wall framing or surface mount 1.2 m (4 ft) above finished floor. Installation to mobile and temporary partitions is not acceptable.
 - .3 Installation to exposed architectural concrete columns and walls is not acceptable, unless otherwise indicated or specified. For installation to concrete, set conduit in place before pouring of concrete.
 - .4 Single Point Type, Duct:
 - .1 Provide sufficient contact with process fluid to measure average conditions.
 - .2 Apply pipe sealing compound to plug thread.
 - .5 Single Point Type, Pipe:
 - .1 Provide sufficient contact with process fluid to measure average conditions.
 - .2 Install with heat conducting fluid in wells.
 - .6 Outdoor Type:
 - .1 Install to north side of building away from sources of heat such as lamps and exhaust vents; to greater than 1500 mm (5 ft) above horizontal surfaces.
 - .2 Where indicated or specified for installation in outside air intake, locate so as not to be affected by exhaust air flow or reverse flow.
 - .3 Provide solar shield. Install shield to open downward.
 - .4 Seal interior of conduit at penetration through exterior wall.

- 3.8.9. Guards for Thermostats and Temperature Sensors:
- .1 Provide for wall mount sensors and thermostats where indicated on the drawings.
 - .2 Samples: Provide to Part 1: Submittals, Samples.
- 3.8.10. Air Static Pressure Sensors:
- .1 Duct Mount: Pipe the high-pressure tap to the duct using a pitot tube.
 - .2 Building Static: Pipe the low-pressure port of the pressure sensor to the static pressure port located on the outside of the building and install with a shielded static air probe to reduce pressure fluctuations caused by wind.
 - .3 The piping to the pressure ports on all pressure transducers shall contain a capped test port located adjacent to the transducer.
- 3.8.11. Wet/Wet Differential Pressure Sensors:
- .1 Differential pressure sensors shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines.
- 3.8.12. Relative Humidity Sensors:
- .1 Install to requirements for Electric Thermostats and Temperature Sensors.
- 3.8.13. AC Current Sensors and Transducers:
- .1 Install in motor starter cabinet.
- 3.8.14. CO Sensors:
- .1 Mount the sensor 4-6 feet from the floor.
 - .2 Provide sufficient number of sensors for full coverage of the monitored area.
- 3.8.15. NO2 Sensors:
- .1 Use two sensors per zone, mount one of the sensors 1 foot from the floor and the other 1 foot from the ceiling.
 - .2 Provide sufficient number of sensors for full coverage of the monitored area.
- 3.8.16. Water Flow Meters:
- .1 The installing contractor is responsible for providing suitable mating flanges and any required reducer/expander.
- 3.8.17. Gas Meter Connection:
- .1 This contractor shall provide connection from BAS to standard output of a gas meter transducer provided by local authorities.
- 3.8.18. Air Flow Sensors, Fan Bell Mouth:
- .1 Coordinate installation of air flow sensors to inlet of fans with fan manufacturer.
- 3.8.19. Air Flow Sensors, Duct Mount:
- .1 Furnish duct mount air flow sensors for installation under Section 23 31 13.00 - DUCTWORK AND SPECIALTIES. Provide supervision on site during installation.

3.9. IDENTIFICATION

- 3.9.1. All wires shall be tagged at both ends. The tagging shall identify the device it is connected to. Use of the point object name is acceptable.
- 3.9.2. All wires passing through a junction box shall be tagged with the device identity or its termination point.
- 3.9.3. The junction boxes shall be tagged "BAS" with a sequential number suffix.
- 3.9.4. Label wires, control devices, controllers.

3.10. TESTING AND COMMISSIONING

- 3.10.1. Test and commission the BAS prior to the Demonstration and Acceptance Test.
- 3.10.2. Prepare test forms which shall identify each test. The forms shall be sub-divided into points, controllers, programs, loops, networks and graphics.
- 3.10.3. Device tests shall identify and confirm successful completion of the following:
 - .1 Device installation.
 - .2 Device identification.
 - .3 Device calibration.
 - .4 Device operation.
 - .5 Wiring to device, connection details and wire type.
 - .6 Validation of the device signal at the controller.
- 3.10.4. Controller tests shall identify and confirm successful completion of the following:
 - .1 Controller installation.
 - .2 Power source and grounding.
 - .3 Make, model and serial number, software revisions.
- 3.10.5. Software tests shall identify and confirm successful completion of the following:
 - .1 Custom application programs.
 - .2 Alarm reporting.
 - .3 Trending and reports.
 - .4 Energy management programs.
- 3.10.6. Loop tuning tests shall identify and confirm successful completion of the following:
 - .1 Loop input signal.
 - .2 Loop output signal.
 - .3 Set point adjustment.
 - .4 Device response.
 - .5 Control response.
- 3.10.7. Network communication tests shall identify and confirm successful completion of the following:
 - .1 Primary network communication function.
 - .2 Secondary network communication function.
 - .3 Alarm reporting function.
 - .4 Operator communication.
- 3.10.8. Dynamic graphics tests shall identify and confirm successful completion of the following:
 - .1 All graphics.
 - .2 All point objects per graphic.
 - .3 All set-points per graphic.

3.11. DEMONSTRATION

- 3.11.1. When all tests have been completed and the documentation completed, request a meeting with the Consultant and Owner. Provide at this meeting a demonstration that all systems on the BAS are operating. At the successful conclusion of this demonstration the Consultant will allow the Acceptance Test to begin.

- 3.11.2. At the discretion of the Consultant and Owner, demonstrate up to 10% of the tests described in Part 3: Execution, Testing and Commissioning and witnessed by the Consultant and Owner. Should any test fail then the BAS Contractor shall retest the failed components or functionality.

3.12. ACCEPTANCE TEST

- 3.12.1. When Testing and Commissioning and the Demonstration have been completed satisfactorily the Consultant will give approval for commencement of the Acceptance Test.
- 3.12.2. Notify the Owner in writing 2 weeks prior to the testing date.
- 3.12.3. Furnish a new operator's log book to building operators.
- 3.12.4. The Acceptance Test period shall be 21 days. Visit the site each morning, Monday to Friday, to review the BAS operation and the building operators log book which contains records of all problems experienced by the building operators, the point object name and value and time and date of failure, and time of return to service. During the first 14 days of the acceptance test, any operational failures due to malfunction of wiring, controllers or Operator Interfaces, shall designate a restart to testing for 21 days. Any failure of control devices shall be corrected and the acceptance test shall continue from the date the failure has been corrected. During the last 7 days of testing, no failures of any kind will be accepted, or the last 7 days shall be repeated.
- 3.12.5. The BAS shall not be accepted or considered substantially complete until the Acceptance Test is successfully completed.
- 3.12.6. At the successful completion of the Acceptance Test, provide a certificate of completion.

3.13. INSTRUCTION AND TRAINING

- 3.13.1. Provide three days of instruction during the BAS installation. This instruction shall include: identification of devices, power sources, conduit and wire installation, the operation of controlled devices and how they interface with the mechanical systems.
- 3.13.2. Provide an additional five days of instruction that shall cover the operation and maintenance of the BAS systems. The instruction shall be conducted in the building and video taped by the Owner. Submit training course outline for review by the Consultant before completion of the BAS and before instruction period commences. Instruction shall include:
- .1 Operation and maintenance of Operator Interfaces.
 - .2 Operation and maintenance of controllers.
 - .3 Custom Application Programming software.
 - .4 Point objects addressing and commanding.
 - .5 Custom reporting.
 - .6 Creating and modifying graphics.
 - .7 Data base modification, deletion and back-up and restore operations.
 - .8 System malfunction diagnostics and maintenance.
 - .9 Control devices, operation and maintenance.
- 3.13.3. Provide an additional three days of training that may be scheduled up to six months after BAS Acceptance. The Owner will advise the BAS Contractor of the training content required.
- 3.13.4. One day shall be 7.5 working hours excluding one hour lunch break.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 21 05 01.
- .2 Section 23 05 23.01.
- .3 Section 23 05 23.02.
- .4 Section 23 08 02.
- .5 Section 23 05 93

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - .1 ANSI/AWWA C111/A21.11-17, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .2 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.1-15, Grey Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - .2 ASME B16.3-16, Malleable Iron Threaded Fittings: Classes 150 and 300.
 - .3 ASME B16.5-17, Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard.
 - .4 ASME B16.9-12, Factory-Made Wrought Buttwelding Fittings.
 - .5 ASME B18.2.1-12, Square Hex, Heavy Hex and Askew Head Bolts and Hex, Heavy Hex, Hex Flange. Loded Head and Lag Screws (Inch Series).
 - .6 ASME B18.2.2-15, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).
- .3 ASTM International
 - .1 ASTM A47/A47M-99(2014), Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
 - .3 ASTM A181/A181M-14, Standard Specification for Carbon Steel Forgings, for General-Purpose Piping
 - .4 ASTM A536-84(2014), Standard Specification for Ductile Iron Castings.
 - .5 ASTM B61-15, Standard Specification for Steam or Valve Bronze Castings.

- .6 ASTM B62-17, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .7 ASTM E202-12, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.
- .4 CSA International
 - .1 CSA B242-15, Groove and Shoulder Type Mechanical Pipe Couplings.
 - .2 CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding.
- .5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS)
 - .1 MSS-SP-67-2017, Butterfly Valves.
 - .2 MSS-SP-70-2011, Grey Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS-SP-71-2011, Grey Iron Swing Check Valves Flanged and Threaded Ends.
 - .4 MSS-SP-80-2013, Bronze Gate, Globe, Angle and Check Valves.
 - .5 MSS-SP-85-2011, Grey Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for hydronic systems and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate on drawings:
 - .1 Components and accessories.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00.
- .2 Operation and Maintenance Data: submit operation and maintenance data for hydronic systems for incorporation into manual.
 - .1 Include special servicing requirements.

1.5 EXTRA STOCK MATERIALS

- .1 Supply spare parts as follows:
 - .1 Valve seats: 1 minimum for every ten valves, each size. Minimum one.

- .2 Discs: 1minimum for every ten valves, each size. Minimum one.
- .3 Stem packing: 1minimum for every ten valves, each size. Minimum one.
- .4 Valve handles: 2minimum of each size.
- .5 Gaskets for flanges: 1minimum for every ten flanges.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .2 Storage and Handling Requirements:
 - .1 Store materials in dry location, off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect hydronic systems from damage.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 PIPE

- .1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:
 - .1 To NPS 6: Schedule 40.
 - .2 NPS 8 and over, 10.
 - .3 NPS 12 and over, 10 mm wall thickness.

2.2 PIPE JOINTS

- .1 NPS 2 and under: screwed fittings.
- .2 NPS 2-1/2 and over: welding fittings and flanges to CSA W48.
- .3 Roll grooved: standard coupling to CSA B242.
- .4 Flanges: forged steel ASTM A181, 1035 kPa (150 psi) WSP, ANSI B16.1. Use only weld neck flanges with butterfly valves.
- .5 Orifice flanges: slip-on raised face, 2100 kPa.
- .6 Flange gaskets: to ANSI/AWWA C111/A21.11.
- .7 Pipe thread: taper.
 - .1 Bolts and nuts: square head machine with hexagonal nut, steel ASTM A307, ANSI B18.2.
- .8 Roll grooved coupling gaskets: type EPDM.

2.3 FITTINGS

- .1 Screwed fittings: malleable iron, to ASME B16.3, Class 150.
- .2 Pipe flanges and flanged fittings:
 - .1 Cast iron: to ASME B16.1, Class 125.
 - .2 Steel: to ASME B16.5.
- .3 Butt-welding fittings: steel, to ASME B16.9.
- .4 Unions: malleable iron, to ASME B16.3.
- .5 Fittings for roll grooved piping: ductile iron to ASTM A536.

2.4 VALVES

- .1 Connections:
 - .1 NPS 2 and smaller: screwed ends.
 - .2 NPS 2-1/2 and larger: flanged ends.
- .2 Gate valves: application: isolating equipment, control valves, pipelines:
 - .1 NPS 2 and under:
 - .1 Mechanical Rooms: Class 125, rising stem, splitwedge disc, as specified Section 23 05 23.01.
 - .2 Elsewhere: Class 125, non-rising stem, solidwedge disc, as specified Section 23 05 23.01.
 - .2 NPS 2-1/2 and over:
 - .1 Mechanical Rooms: rising stem, splitwedge disc, bronzetrim, as specified Section 23 05 23.02.
 - .1 Operators: manual.
 - .2 Elsewhere: non-rising stem, solidwedge disc, bronzetrim, as specified Section 23 05 23.02.
 - .1 Operators: Manual
- .3 Butterfly valves: application: isolating cells or section of multiple component equipment (i.e. multi-section coils, multi-cell cooling towers):
 - .1 NPS 2-1/2 and over: as specified Section 23 05 23.02.
- .4 Globe valves: to application: throttling, flow control, emergency bypass:
 - .1 NPS 2 and under:
 - .1 Mechanical Rooms: with PTFE disc, as specified Section 23 05 23.01.

- .2 Elsewhere: globe, with composition disc, as specified Section 23 05 23.01.
- .2 NPS 2-1/2 and over:
 - .1 With bronze disc, bronze trim, as specified Section 23 05 23.02.
- .5 Balancing, for TAB:
 - .1 Sizes: calibrated balancing valves, as specified this section.
 - .2 NPS 2 and under:
 - .1 Mechanical Rooms: globe, with plug disc as specified Section 23 05 23.01.
 - .2 Elsewhere: globe, with plug disc as specified Section 23 05 23.01.
- .6 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23.01.
- .7 Swing check valves:
 - .1 NPS 2 and under:
 - .1 Class 125, swing, with composition disc, as specified Section 23 05 23.01.
 - .2 NPS 2-1/2 and over:
 - .1 Flanged ends: as specified Section 23 05 23.02.
- .8 Silent check valves:
 - .1 NPS 2 and under:
 - .1 As specified Section 23 05 23.01.
 - .2 NPS 2-1/2 and over:
 - .1 Flanged ends: as specified Section 23 05 23.02.
- .9 Ball valves:
 - .1 NPS 2 and under: as specified Section 23 05 23.01.
- .10 Lubricated Plug Valves
 - .1 NPS 2-1/2 and over:
 - .1 As specified Section 23 05 23.02.

Part 3 Execution

3.1 PIPING AND VALVE INSTALLATION

- .1 Install pipework in accordance with Section 23 05 05.

- .2 For pipe 65 mm (2-1/2 in.) and larger, use flanges, and for smaller pipe, use unions at all valves and equipment.
- .3 Flare connections may be used on soft copper tubing where one end of the flare connection is an integral part of the equipment or valve.
- .4 Provide automatic air eliminators at all high points on piping mains for hot and chilled water systems. Where venting a horizontal pipe, grade pipe up in direction of flow with vent at high point. Provide gate valve at the float inlet. Pipe outlets to drain using copper pipe. Drain pipe shall be run such that its route is visible.
- .5 Provide manual air vents on all hot water heating units where air may be trapped. Use screw-driver operated vents of chrome plated brass. Vents shall be accessible without removing cover of heating unit.
- .6 Provide vacuum breakers on all equipment having modulating steam control valves and locate between valve and equipment, unless directed otherwise by equipment manufacturer.
- .7 Install drain valves at all low points for draining and locate where easily accessible. In order to achieve this, install remote from system where necessary, clearly marked. Typical marking similar to the following:
 - .1 Heating system.
 - .2 Danger, authorized personnel only.
- .8 Carefully ream threaded joints and join with compound on the male thread only. Re-tighten flanged connections after the installation has been brought up to its service. Following testing, apply insulation. Take care not to overstress the material during construction.
- .9 Pipe welding operations shall be performed by welders Provincial Certification for the class of piping to be welded. Ensure the internal opening of pipes and fittings are not restricted by superfluous material.
- .10 When welding or cutting with a torch, take precautions to prevent fire by maintaining fully charged 4.5 kg (10 lbs.) carbon dioxide extinguisher immediately adjacent to the operation. Protect wooden structure with fire retardant blankets.
- .11 Arrange piping to permit ease of equipment removal. Provide flanges or unions on all pipe connections to each piece of equipment.
- .12 Connect all multi-row water coils in counter flow.
- .13 Drains from packaged air handling unit drain pans shall be of same size as connection on unit. Provide traps on all drains and deep seal traps on both sides of the fan and coil sections.
- .14 Connect bases of all pumps with packed glands to drain with 12 mm (1/2 in.) O.D. copper tubing.

- .15 Provide on the discharge line of each spray pump, a 12 mm (1/2 in.) valved bleed-off. Connect to discharge line above sump water level and run to drain.
- .16 Provide strainers upstream of each pump suction, steam control valve and steam trap not preceded by a control valve, and where shown.
- .17 Provide butterfly valves where shown; these are permitted in lieu of gate valves in sizes 65 mm (2-1/2 in.) and larger.
- .18 Provide gate, globe and check valves in all piping systems as shown and as required for satisfactory operation and control of equipment. Provide shut-off valves wherever piping is connected to all equipment. Provide one flow balancing valve and one shut-off valve on water coils.
- .19 Provide for the expansion and Contraction of all pipes. Install with sufficient flexibility to prevent end-thrust and movements caused by thermal expansion or Contraction causing detrimental distortion or damage of connection equipment. Provide offsets between mains and equipment of sufficient length to safety absorb the expansion of the main.
- .20 Install all control devices, valves and any other appurtenances as directed by the controls and/or BAS trades.
- .21 Make connections between copper and steel with brass or bronze fittings.
- .22 Ball valves may be used in low temperature and/or pressure systems only in lieu of gate valves in 50 mm (2 in.) and smaller. Provide union downstream of ball valves for servicing if ball valve is not a three piece design.
- .23 For grooved piping ensure ends are clean and free from indentations, projections, and roll marks in the area from the pipe end to the groove for proper gasket sealing.
- .24 Install all grooved products as per manufacturers latest recommended instructions. The Contractor is responsible to establish training for proper pipe end preparation and assembly by the manufacturer.

3.2 CIRCUIT BALANCING VALVES

- .1 Install flow measuring stations and flow balancing valves as indicated.
- .2 Remove handwheel after installation and when TAB is complete.
- .3 Tape joints in prefabricated insulation on valves installed in chilled water mains.
- .4 Install flow balancing valves in sections of straight pipe as recommended by the manufacturer, but in no case with less than 10 pipe diameters upstream of the valve.
- .5 Install flow balancing valves in the following locations:
 - .1 at each heating, chilled or condenser water riser, or main floor branch.

- .2 each heating water and cooling water coils including unit heaters, fan coils and force flow heaters.
- .3 Each heat exchanger.
- .4 Each wall fin, radiant ceiling or similar heating device.
- .5 Each heat pump.
- .6 Each pump pressure differential line.
- .7 Each main building or secondary heating or cooling circuit.
- .8 And where shown.

3.3 CLEANING, FLUSHING AND START-UP

- .1 In accordance with Section 23 08 02.

3.4 TESTING

- .1 Test system in accordance with Section 21 05 01.
- .2 For glycol systems, retest with propylene glycol to ASTM E202, inhibited, for use in building system after cleaning. Repair leaking joints, fittings or valves.

3.5 BALANCING

- .1 Balance water systems to within plus or minus 5% of design output.
- .2 In accordance with Section 23 05 93 for applicable procedures.

3.6 GLYCOL CHARGING

- .1 Glycol make-up packages shall be provided for glycol water make-up. Each glycol make up package shall be for 1.8 gpm make-up at 50 psig with a 110v (1/3 hp) motor and 50 gallon polyethylene storage tank complete with hinged cover. Unit shall be complete with cut-off and (audible and visual) alarm in case of high pressure or low solution level. The pumping assembly shall be mounted in a sturdy steel frame, complete with legs to keep it off the floor. The package shall include a motor, a pump, a magnetic starter, a pressure tank, a priming valve, a PRV, a shut-off valve and a pressure gauge
- .2 Retest for concentration to ASTM E202 after cleaning.

3.7 PERFORMANCE VERIFICATION

- .1 In accordance with Section 23 08 01.

3.8 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Waste Management: in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.9 PROTECTION

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

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 21 05 01.

1.2 REFERENCE STANDARDS

- .1 ASME
 - .1 ASME Boiler and Pressure Vessel Code (BPVC), Section VIII-2017.
- .2 ASTM International
 - .1 ASTM A47/A47M-99(2014), Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A278/A278M-01(2015), Standard Specification for Grey Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (350 degrees C).
 - .3 ASTM A516/A516M-17, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
 - .4 ASTM A536-84(2014), Standard Specification for Ductile Iron Castings.
 - .5 ASTM B62-17, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .3 CSA Group
 - .1 CSA B51-14, Boiler, Pressure Vessel, and Pressure Piping Code.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for expansion tanks, air vents, separators, valves, and strainers and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with with manufacturer's written instructions.

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect hydronic specialties from damage.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 DIAPHRAGM TYPE EXPANSION TANK

- .1 Steel vertical pressurized diaphragm type expansion tank.
- .2 Size: As indicated in the Expansion Tank schedule
- .3 Diaphragm sealed in EPDM suitable for 115 degrees C operating temperature.
- .4 Working pressure: 860 kPa with ASME stamp and certification.
- .5 Air precharged to 84 kPa (initial fill pressure of system).
- .6 Base mount for vertical installation.
- .7 Supports: provide supports with hold down bolts and installation templates.
- .8 Renewable diaphragm.

2.2 AUTOMATIC AIR VENT

- .1 Standard float vent: brass body and NPS 1/8 connection and rated at 860 kPa working pressure.
- .2 Industrial float vent: cast iron body and NPS 1/2 connection and rated at 860 kPa working pressure.
- .3 Float: solid material suitable for 115 degrees C working temperature.

2.3 AIR SEPARATOR - BOILER MOUNTED

- .1 Complete with dip tube.
- .2 Working pressure: 860 kPa.

2.4 AIR SEPARATOR - EXPANSION TANK FITTING

- .1 Complete with adjustable vent tube and built-in manual vent valve.
- .2 Working pressure: 860 kPa.

2.5 AIR SEPARATOR - IN-LINE

- .1 Working pressure: 860 kPa.

- .2 Size: The vessel shell diameter three times the nominal inlet/outlet pipe diameter. The inlet and outlet connections must be of the same size.

2.6 COMBINATION SEPARATORS/STRAINERS

- .1 Steel, tested and stamped in accordance with ASME BPVC, for 860kPa operating pressure, with galvanized steel integral strainer with 5mm perforations, tangential inlet and outlet connections, and internal stainless steel air collector tube.

2.7 COMBINATION LOW PRESSURE RELIEF AND REDUCING VALVE

- .1 Adjustable pressure setting: 206kPa relief, 55to 172kPa reducing.
- .2 Low inlet pressure check valve.
- .3 Removable strainer.

2.8 PIPE LINE STRAINER

- .1 NPS 1/2 to 2: bronze body to ASTM B62, screwedconnections, Y pattern.
- .2 NPS 2 1/2 to 12: flanged, cast iron body to ASTM A278/A278M, Class 30connections.
- .3 NPS 2 to 12: T type with ductile iron body to ASTM A536, grooved ends.
- .4 Blowdown connection: NPS 1.
- .5 Screen: stainless steel with 1.19mm perforations.
- .6 Working pressure: 860kPa.

2.9 SUCTION DIFFUSER

- .1 Body: cast ironwith flanged connections.
- .2 Strainer: with built-in, disposable 1.19mm mesh, low pressure drop screen and NPS 1blowdown connection.
- .3 Permanent magnet particle trap.
- .4 Full length straightening vanes.
- .5 Pressure Grey tappings.
- .6 Adjustable support leg.

Part 3 Execution

3.1 APPLICATION

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

3.2 GENERAL

- .1 Run drain lines and blow off connections to terminate above nearest drain.
- .2 Maintain adequate clearance to permit service and maintenance.
- .3 Should deviations beyond allowable clearances arise, request and follow Departmental Representative's directive.
- .4 Check shop drawings for conformance of tappings for ancillaries and for equipment operating weights.

3.3 STRAINERS

- .1 Install in horizontal or down flow lines.
- .2 Ensure clearance for removal of basket.
- .3 Install ahead of each pump.
- .4 Install ahead of each automatic control valve, and as indicated.

3.4 AIR VENTS

- .1 Install at high points of systems.
- .2 Install gate valve on automatic air vent inlet. Run discharge to nearest drain.

3.5 EXPANSION TANKS

- .1 Adjust expansion tank pressure to suit design criteria.
- .2 Install lockshield type valve at inlet to tank.

3.6 PRESSURE SAFETY RELIEF VALVES

- .1 Run discharge pipe to terminate above nearest drain.

3.7 SUCTION DIFFUSERS

- .1 Install on inlet to pumps having suction size greater than 50.

3.8 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Waste Management: in accordance with Section 01 74 20.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 21 05 01.

1.2 REFERENCE STANDARDS

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition, 2005.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for air duct accessories and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate:
 - .1 Flexible connections.
 - .2 Duct access doors.
 - .3 Turning vanes.
 - .4 Instrument test ports.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00. Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect air duct accessories from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 GENERAL

- .1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 FLEXIBLE CONNECTIONS

- .1 Frame: galvanized sheet metal frame.
- .2 Material:
 - .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of 1.3kg/m².

2.3 ACCESS DOORS IN DUCTS

- .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- .2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .3 Gaskets: neoprene.
- .4 Hardware:
 - .1 Up to 300 x 300mm: two sash locks complete with safety chain.
 - .2 301 to 450mm: four sash locks complete with safety chain.
 - .3 451 to 1000mm: piano hinge and minimum two sash locks.
 - .4 Doors over 1000mm: piano hinge and two handles operable from both sides.
 - .5 Hold open devices.
 - .6 300 x 300 mm glass viewing panels.

2.4 TURNING VANES

- .1 Factory or shop fabricated single thickness to recommendations of SMACNA and as indicated.

2.5 INSTRUMENT TEST

- .1 1.6mm thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 28 mm minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.

2.6 SPIN-IN COLLARS

- .1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.
- .2 Sheet metal thickness to co-responding round duct standards.

Part 3 Execution

3.1 INSTALLATION

- .1 Flexible Connections:
 - .1 Install in following locations:
 - .1 Inlets and outlets to supply air units and fans.
 - .2 Inlets and outlets of exhaust and return air fans.
 - .3 As indicated.
 - .2 Length of connection: 100 mm.
 - .3 Minimum distance between metal parts when system in operation: 75 mm.
 - .4 Install in accordance with recommendations of SMACNA.
 - .5 When fan is running:
 - .1 Ducting on sides of flexible connection to be in alignment.
 - .2 Ensure slack material in flexible connection.
- .2 Access Doors and Viewing Panels:
 - .1 Size:
 - .1 Min 450mmx450mm
 - .2 As indicated.
 - .2 Locations:
 - .1 Fire and smoke dampers.
 - .2 Control dampers.
 - .3 Devices requiring maintenance.
 - .4 Required by code.
 - .5 Reheat coils.
 - .6 Elsewhere as indicated.
- .3 Instrument Test Ports:
 - .1 General:
 - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
 - .2 Locate to permit easy manipulation of instruments.

- .3 Install insulation port extensions as required.
- .4 Locations:
 - .1 For traverse readings:
 - .1 Ducted inlets to roof and wall exhausters.
 - .2 Inlets and outlets of other fan systems.
 - .3 Main and sub-main ducts.
 - .4 And as indicated.
 - .5 For temperature readings:
 - .1 At outside air intakes.
 - .2 In mixed air applications in locations as approved by Departmental Representative.
 - .3 At inlet and outlet of coils.
 - .4 Downstream of junctions of two converging air streams of different temperatures.
 - .5 And as indicated.
- .4 Turning Vanes:
 - .1 Install in accordance with recommendations of SMACNA and as indicated.

3.2 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Waste Management: in accordance with Section 01 74 20.

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 21 05 01.

1.2 REFERENCE STANDARDS

- .1 Sheet Metal and Air Conditioning National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-2013.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

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

1.5 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 dampers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 GENERAL

- .1 Manufacture to SMACNA standards.

2.2 SPLITTER DAMPERS

- .1 Fabricate from same material as duct but one sheet metal thickness heavier, with appropriate stiffening.

- .2 Doublethickness construction.
- .3 Control rod with locking device and position indicator.
- .4 Rod configuration to prevent end from entering duct.
- .5 Pivot: piano hinge.
- .6 Folded leading edge.

2.3 SINGLE BLADE DAMPERS

- .1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
- .2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm.
- .3 Locking quadrant with shaft extension to accommodate insulation thickness.
- .4 Inside and outside bronze or nylonend bearings.
- .5 Channel frame of same material as adjacent duct, complete with angle stop.

2.4 MULTI-BLADED DAMPERS

- .1 Factory manufactured of material compatible with duct.
- .2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.
- .3 Maximum blade height: 100mm.
- .4 Bearings: self-lubricating nylon or pin in bronze bushings.
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.

Part 3 Execution

3.1 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3 Locate balancing dampers in each branch duct, for supply, return and exhaust systems.
- .4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.
- .5 Dampers: vibration free.
- .6 Ensure damper operators are observable and accessible.

.7 Corrections and adjustments conducted by Departmental Representative.

3.2 CLEANING

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

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

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

.3 Waste Management:in accordance with Section 01 74 20.

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

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 21 05 01.

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM C423-17, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - .2 ASTM C916-14, Standard Specification for Adhesives for Duct Thermal Insulation.
 - .3 ASTM C1071-16, Standard specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
 - .4 ASTM C1338-14, Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
 - .5 ASTM G21-15, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 90A-18, Standard for the Installation of Air Conditioning and Ventilating Systems.
 - .2 NFPA 90B-18, Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
- .3 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
 - .1 SMACNA, HVAC Duct Construction Standards, Metal and Flexible, 3rd Edition -2005.
 - .2 SMACNA IAQ Guideline for Occupied Buildings Under Construction-2008.
- .4 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-11, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 DUCT LINER

- .1 General:
 - .1 Mineral Fibre duct liner: air surface coated mat facing.
 - .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50 when tested in accordance with CAN/ULC-S102.
 - .3 Recycled Content: with minimum 35 by weight recycled content.
 - .4 Fungi resistant
- .2 Flexible:
 - .1 Use on
 - .1 All return air transfer ductwork.
 - .2 All ductwork specifically identified on the Drawings.
 - .2 Duct liner shall comply with the requirements of NFPA 90A and the "Duct Liner Materials Standard" of the Thermal Insulation Manufacturer's Association.
 - .3 Sizes shown on the Drawing are free area dimensions (after the installation of duct liner). Duct liner shall be a minimum of 25 mm (1 in.) unless shown otherwise.

- .4 All acoustical duct lining shall incorporate means to prevent fiber entrainment in the air stream.
- .5 Fibrous glass blanket duct liner.
- .6 Density: 24 kg/m³ minimum.
- .7 Thermal resistance to be minimum 0.74 (m².degrees C)/W for 25 mm thickness when tested in accordance with ASTM C177, at 24 degrees C mean temperature.

2.2 ADHESIVE

- .1 Adhesive: to ASTM C916.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 29 degrees C to plus 93 degrees C.
- .3 Water-based fire retardant type.

2.3 FASTENERS

- .1 Weld pins 2.0mm diameter, length to suit thickness of insulation. Metal retaining clips, 32mm square.

2.4 JOINT TAPE

- .1 Poly-Vinyl treated open weave fiberglass membrane 50mm wide.

2.5 SEALER

- .1 Meet requirements of NFPA 90A.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 68 degrees C to plus 93 degrees C.

Part 3 Execution

3.1 GENERAL

- .1 Do work in accordance with SMACNA HVAC Duct Construction Standard except as specified otherwise.
- .2 Line inside of ducts where indicated.
- .3 Duct dimensions, as indicated, are clear inside duct lining.

3.2 DUCT LINER

- .1 Install in accordance with manufacturer's recommendations, and as follows:
 - .1 Fasten to interior sheet metal surface with 90% coverage of adhesive to ASTM C916.
 - .1 Exposed leading edges and transverse joints to be factory coated or coated with adhesive during fabrication.

- .2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 425 mm on centres to compress duct liner sufficiently to hold it firmly in place.
 - .1 Spacing of mechanical fasteners in accordance with SMACNA HVAC Duct Construction Standard.
- .2 In systems, where air velocities exceeds 20.3m/s, install galvanized sheet metal nosing to leading edges of duct liner.
- .3 Ducts, except where noted otherwise, shall be acoustically lined internally, from the fan connection to the terminal. Both supply and return systems shall be lined unless otherwise specified. Exhaust ducts shall be internally lined where shown on the Drawings to reduce sound transmission.
- .4 Other ductwork shall be acoustically lined where shown on the Drawings.
- .5 Acoustical duct lining shall be 50 mm (2 in.) thick in ducts within Mechanical Rooms, in plenums, and where expressly shown on the Drawings. Acoustical duct lining shall be 25 mm (1 in.) thick in all other internally lined sheet metal ducts, unless otherwise specified or shown on the Drawings.
- .6 The acoustical liner shall be fixed to the duct with a minimum of 50% coverage of a fire-resistant adhesive. Where the duct width exceeds 300 mm (12 in.) or the height 600 mm (24 in.), the liner shall be additionally secured with mechanical fastening on maximum 450 mm (18 in.) centers on all sides. Mechanical fasteners that pierce the duct are unacceptable. All ends of the liner shall be coated with a fire resistant cementing material to prevent delamination, leakage or erosion. All joints shall be firmly butted and ends coated with an adhesive to ensure that the lining is smooth across all joints.
- .7 Where acoustical duct lining is installed, the dimensions of the sheet metal shall be increased to include the thickness of the lining material. Dimensions shown on the Mechanical Drawings are the clear internal dimensions after the liner has been installed.

3.3 JOINTS

- .1 Seal butt joints, exposed edges, weld pin and clip penetrations and damaged areas of liner with joint tape and sealer. Install joint tape in accordance with manufacturer's written recommendations, and as follows:
 - .1 Bed tape in sealer.
 - .2 Apply 2coats of sealer over tape.
- .2 Replace damaged areas of liner at discretion of Departmental Representative.
- .3 Protect leading and trailing edges of duct sections with sheet metal nosing having 15mm overlap and fastened to duct.

3.4 CLEANING

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

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Waste Management:in accordance with Section 01 74 20.

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 21 05 01
- .2 Section 23 05 13.
- .3 Section 23 05 48.
- .4 Section 23 33 00

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)
 - .1 ANSI/AMCA 99-2016, Standards Handbook.
 - .2 ANSI/AMCA 210-2016 Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
 - .3 ANSI/AMCA 300-2014, Reverberant Room Method for Sound Testing of Fans.
 - .4 ANSI/AMCA 301-2014, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for HVAC fans and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Provide:
 - .1 Fan performance curves showing point of operation, kW, bhp and efficiency.
 - .2 Sound rating data at point of operation.
 - .2 Indicate:
 - .1 Motors, sheaves, bearings, shaft details
 - .2 Minimum performance achievable with variable speed controllers.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:

- .1 Submit in accordance with Section 01 78 00.
 - .1 Provide:
 - .1 Matched sets of belts.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:
 - .1 Bearings and seals.
 - .2 Addresses of suppliers.
 - .3 List of specialized tools necessary for adjusting, repairing or replacing.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect HVAC fans from damage.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.
 - .2 Capacity: flow rate, static pressure, bhp, efficiency, revolutions per minute, power, model, size, and sound power data as indicated on the fan schedule.
 - .3 Fans: statically and dynamically balanced, constructed in conformity with ANSI/AMCA 99.
 - .4 Sound ratings: comply with ANSI/AMCA 301, tested to ANSI/AMCA 300. Supply unit with ANSI/AMCA certified sound rating seal.
 - .5 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210. Supply unit with ANSI/AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

- .6 Classification for Spark Resistant Construction Conform to ANSI/AMCA 99.

2.2 FANS GENERAL

- .1 Motors:
 - .1 In accordance with Section 23 05 13 supplemented as specified herein.
 - .2 Motors for fans meet NEMA's Premium "Energy Efficiency Motor Program"
 - .3 For use with variable speed controllers.
 - .4 Sizes as indicated.
- .2 Belt drive motor shall have adjustable motor plate utilizing threaded studs for positive belt tensioning. Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower.
- .3 Accessories and hardware: matched sets of V-belt drives, adjustable motor bases, belt guards, coupling guards fan inlet and outlet safety screens as indicated and as specified in Section 23 05 13.
- .4 Factory primed before assembly in colour standard to manufacturer.
- .5 Scroll casing drains: as indicated.
- .6 Sizing shall be in accordance with the Fan Schedule.
- .7 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .8 Vibration isolation: to Section 23 05 48.
- .9 Flexible connections: to Section 23 33 00.

2.3 CENTRIFUGAL FANS

- .1 The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The scroll wrapper and side panels shall be steel. The entire fan housing shall have continuously welded seams for leak-proof operation. Bearing support shall be constructed of welded steel members.
- .2 All steel fan components shall be coated with an electrostatically applied, baked polyester powder coating or other equivalent protective coating.
- .3 Unless shown otherwise, fan wheels handling more than 472 L/s (1000 cfm) shall be of the non-overloading backward inclined centrifugal type. Wheel hub shall be keyed and securely attached to the fan shaft. The wheel and fan inlet shall be carefully matched and shall have precise running tolerances for maximum performance and operating efficiency. The assembled wheel shall be

- electronically balanced both statically and dynamically to balance grade G6.3 per ANSI S2.19.
- .4 Each fan shall be provided with fan sheave, motor sheave, matched V-belts and belt guard.
 - .1 Belt guard shall be OSHA compliant and completely cover the motor pulley and belt(s).
 - .2 Where motor is 7.5 kW (10 hp) or less, motor sheave shall be variable pitch.
 - .3 Where motor exceeds 7.5 kW (10 hp) motor sheave shall be variable pitch, to be replaced with a correctly sized fixed pitch sheave after balancing.
 - .4 All fans shall have arrangement 3 drive or arrangement 2 drive for smaller fans.
 - .5 Blower shaft shall be accurately turned and polished steel. Shaft shall be sized for a critical speed of at least 125% of the maximum RPM. The ends of fan shafts shall be centered depressions to allow for mechanical tachometer readings.
 - .6 All fans, without ducts or dampers on the inlet or outlet, including fans in plenums, shall have protective screens on the openings.
 - .7 Provide access doors on the fan scroll. Doors shall be hinged, in reinforced angle frames and provided with clamping devices. Minimum size shall be 450 mm x 350 mm (18 in. x 14 in.) or full width of fan scroll, if scroll is less than 450 mm (18 in.) wide.
 - .8 Provide drain connections as shown. Drains shall be minimum 25 mm (1 in.) pipe size, half coupling, welded into the bottom of the scroll with a square headed, threaded, brass plug. Drain shall be extended clear of fan scroll.
 - .9 Fans shall be suitable for operation with variable frequency drives where indicated in the Fan Schedule or as required to meet the requirements of Section 25 90 01.
 - .10 Bearings: split pillow-blockgrease lubricated ball or roller self-aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 200,000 hours. In addition, bearings on shafts 36.5 mm (1-7/16 in.) diameter and larger shall have grease nipple and grease relief valve. Permanently lubricated bearings are not acceptable.
 - .11 Variable volume control devices:
 - .1 Variable speed drives: refer to Section 21 05 15.

2.4 INDUCED DILUTION FANS (LABORATORY EXHAUST FANS)

- .1 Laboratory exhaust fans shall be mounted on custom unit enclosure complete with filters, heat recovery coil, bypass dampers, access panels.

- .2 Provide steel platform and steel hand railings minimum 1067mm high around exterior of each working surface that is 3.66m or more above ground, roof, or other supporting construction.
 - .1 Railings: minimum 32mm zinc-coated steel pipe with standard zinc-coated steel railing.
- .3 Provide straight-rung ladders of standard design, starting at rooflevel and extending as high as required to access fan platform.
 - .1 Stairways and ladders: hot-dip, zinc-coated steel.
 - .2 Equip ladders higher than 3.66m with safety cage.
- .4 Provide direct drive arrangement with impeller mounted directly to the motor shaft. Motor shall be isolated from the primary exhaust air stream, and shall be visible and accessible from the fan exterior for inspection and service.
- .5 Mixed flow impeller with combination axial/backward curved blades. Welded steel construction. Stationary discharge guide vane section. Non-stall and non-overloading characteristic with stable operation at any point on the fan curve.
- .6 Fan dynamic balance not to exceed 0.50 mil, peak-to-peak, at the blade pass area when operating at fan frequency. Isolation shall be limited to rubber-in-shear pad type isolator.
- .7 Fan assembly capable of being mounted on conventional roof curb without the need for guy wire supports.
- .8 Twin FRP discharge nozzle with passive third central stack capable of generating an aspiration effect. Steel entrainment windband provides secondary induction of outside air. Induction shall take place downstream of the fan impeller. Overall total mass discharge up to 270% of design flow rate.
- .9 Spark resistant construction per A.M.C.A. "C".
- .10 Fans shall be modular construction and capable of being assembled on the roof.
- .11 PTFE gaskets shall be provided at all companion flanged joints.
- .12 Fasteners shall be a combination of Type 316 stainless steel and Monel to prevent binding.
- .13 Bolted access door for impeller inspection on fan sized BS-005 and larger.
- .14 Internal drain system to prevent rainwater from entering building duct system.
- .15 Electric Motors: In accordance with requirements of Section 23 05 13, and in addition. TEFC Mill and Chemical duty; high efficiency type C-Face and foot mounted: 1:15 service factor, and L-50 bearing life of 200,000 hours. See Schedule for hp (wattage) ratings).
- .16 A N.E.M.A. 3R non-fused disconnect switch shall be provided, mounted and wired to the motor.

- .17 Coating: All steel and aluminum surfaces shall be prepared for coating by blasting or chemical etching. A two-coat system that is an electrostatically applied and baked, two-part corrosion-resistant polyester resin and zinc-rich epoxy primer.

2.5 IN-LINE CENTRIFUGAL FANS

- .1 Characteristics and construction: as for centrifugal fan wheels, with axial flow construction and beltdrive.
- .2 Provide AMCA arrangements 1 or 9 as indicated with stiffened flanges, smooth rounded inlets, and stationary guide vanes.

2.6 INLINE SPARK PROOF FANS

- .1 For use in exhausting the chemical storage rooms
- .2 Characteristics and construction: as for centrifugal fan wheels, with axial flow construction and beltdrive. Except as described below.
- .3 AMCA 99-0401 Type "A" Spark Resistant construction
- .4 All Aluminum construction for fan air stream components

Part 3 Execution

3.1 FAN INSTALLATION

- .1 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48, flexible electrical leads and flexible connections in accordance with Section 23 33 00
- .2 Provide sheaves and belts required for final air balance.
- .3 Bearings and extension tubes to be easily accessible. Where it is difficult to provide such access, provide extended lubrication lines. When such lines extend to pillow block bearings, provide a grease relief valve.
- .4 Align shafts, belt drive and motor, adjust belt tension, ensure all set screws are tight and check motor rotation before start-up.
- .5 Access doors and access panels to be easily accessible.

3.2 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Waste Management: in accordance with Section 01 74 20.

Part 1 General

1.1 REFERENCE STANDARDS

- .1 ASHRAE
 - .1 ASHRAE 70-2006 (RA2011) Method of Testing the Performance of Air Outlets and Air Inlets (ANSI approved)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for diffusers, registers and grilles and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate following:
 - .1 Capacity.
 - .2 Throw and terminal velocity.
 - .3 Noise criteria.
 - .4 Pressure drop.
 - .5 Neck velocity.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00.
 - .2 Include:
 - .1 Keys for volume control adjustment.
 - .2 Keys for air flow pattern adjustment.

1.4 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 in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

- .2 Store and protect diffuser, registers and grilles from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

2.2 GENERAL

- .1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.
- .2 Concealed manual volume control damper operators.
- .3 Colour: Standard, as directed by Departmental Representative.
- .4 Select all diffusers to provide uniform air coverage without overlap. Air velocity up to a height of 1800 mm (6 ft.) above the floor shall be 0.127 to 0.254 m/s (25 to 50 fpm).
- .5 Noise generated by diffusers shall be such that room sound pressure level does not exceed noise criteria 32 with an 8 db room attenuation, the sound power level reference to 10 to -12 power watts.
- .6 All volume and air pattern devices shall be fully adjustable from the face of the diffuser, register or grille.
- .7 In gypsum board or plaster ceiling applications, provide matching mounting frame. Finish shall be prime painted, off-white in plaster and gypsum board ceilings. .
- .8 Add additional unistrut as required to support diffusers as required.
- .9 In T-bar ceilings, manufacturer shall coordinate diffuser compatibility with t-bar ceiling specified by the architectural division. Colour shall match colour of ceiling tile in lay-in ceilings. Diffusers to suit ceiling grid as required imperial or metric.
- .10 Diffusers shall meet test requirements of ASHRAE 70, including air pattern and noise levels for air quantities from 10% to 110% of the required maximum air flow. Sound power tests shall be measured in accordance with ASHRAE 70 and NC ratings shall be determined using an 8 db room attenuation factor

2.3 MANUFACTURED UNITS

- .1 Grilles, registers and diffusers of same generic type, products of one manufacturer.

2.4 SUPPLY GRILLES AND REGISTERS

- .1 General: with opposed blade dampers.
- .2 All supply registers shown as type "D" shall be standard double deflection type with adjustable horizontal face bars and vertical rear bars. Frame shall be gasketed. Construction shall be aluminum with prime coat. Registers larger than listed sizes shall be shop fabricated in Sections such that the Sections will appear as one integral register when installed. The integral volume control damper shall be of the opposed blade type and shall be constructed of cold rolled steel. The damper shall be operable from the register face. The damper shall be coated or galvanized steel.
- .3 Sill and side wall registers as type "M" shall be linear extruded aluminum blades mechanically locked into a heavy extruded aluminum border. Grilles shall have fixed (15 degree) blades spaced 13mm on center. The border shall be complete with precise factory mitered corners. Blades shall run parallel to the long dimension of the grille.

2.5 RETURN AND EXHAUST GRILLES AND REGISTERS

- .1 Return registers shown as type "K" shall be standard return grilles with horizontal fixed bars set at approximately 45 deg. for wall returns and set straight for ceiling return. Key operated damper shall be mounted behind. General appearance, type of material and finish shall match the type B" supply register.
- .2 Transfer Grilles shown as type "J" shall be standard single deflection fixed blade type. Finish shall match wall.
- .3 Return grilles shown as type "E" shall be size as shown and shall be egg crate type with aluminum construction. Egg crate shall be 12 mm (1/2 in.) deep, formed of 12 mm (1/2 in.) wide aluminum strips on 12 mm (1/2 in.) centres. Strips shall be approximately 0.64 mm (0.025 in.) thick. Grilles shall be enclosed in a channel frame for inverted T-bar mounting or with a flanged frame for plaster or gypsum ceiling mounting. Colour shall match adjacent ceiling.

2.6 DIFFUSERS

- .1 General: volume control dampers with flow straightening devices and blank-off quadrants and gaskets.
- .2 All diffusers shown as type "P" shall be steel square plaque diffuser 600 mm x 600 mm (24 in. x 24 in.) face size and shall be square, coned metal. Diffusers shall consist of a precision formed back cone of one piece seamless construction which shall incorporate a round (or square) inlet collar of sufficient length for connecting rigid or flexible duct as shown. An inner plaque assembly shall be

incorporated that drops no more than 1/4" below the ceiling plane to assure proper air distribution performance. The inner plaque assembly shall be completely removable from the diffuser face to allow full access to any dampers or other ductwork components located near the diffuser neck.

.1 All diffusers shown as type "P1" shall be as specified above but with 300 mm x 300 mm face size for installation in ceiling specified by the architect.

.3 Diffusers shown as type "F_" shall be flush face radial flow diffusers. Diffuser shall be 600x600 (F1) or 1200x600(F2) as shown. Diffusers shall have aluminum frame and control blades and steel plenum and equalization baffle. Finish shall be white. Diffuser shall be suitable for mounting in Tbar ceiling.

2.7 CIRCULAR PIPE DIFFUSERS

.1 Basis of design for all type "C" diffusers:

.2 Circular pipe diffusers indicated in laboratory areas with no ceilings shall be pre-manufactured, high induction duct diffusers with integrated slots, engineered for each specific application.

.3 Manufacturers must provide documented design information including diffuser diameter, equipment pressure drops; sound power information; velocity and throw profiles; orifice or slot locations and suspension details. Equipment performance shall match or exceed scheduled design performance. Manufacturers must be able to provide room airflow simulation details using software, to illustrate compliance to the above noted items as scheduled.

.4 Diffusers shall be designed to operate under variable airflow conditions, in heating or cooling modes. Manufacturer must demonstrate an acceptable level of diffuser performance with airflow reductions down to 25%.

.5 The diffuser shall ensure a high rate of induction even in variable air volume applications, while maintaining an acceptable temperature differential in the discharge zone. This differential shall be calculated as the difference between the temperature of the room set point and the temperature of the air projected by the diffuser into an occupied zone, at a height of 1.8m above the finished floor.

.6 Diffuser capacities and lengths shall be as noted on the drawings with design and construction details as described below.

.7 All diffuser slots shall include a series of purpose built drum cylinders which accelerate and direct the airflow in an aerodynamic fashion, without creating turbulence or noise. The cylinders shall be manufactured of ABS and shall be white, black or grey. Departmental representative to approve colour sample prior to installation.

.8 Each drum cylinder shall be 100 mm long (4 inches) and shall be individually adjustable, capable of rotating up to 360°. Drum adjustment shall also control the air volume delivered to the space.

.9 Duct diffusers shall be manufactured of satin-finish steel.

- .10 Duct shall be coated outside with a baked polyester enamel paint, providing a smooth, easy-to-clean finish.
- .11 Diffusers shall be available in diameters ranging from 6 inches to 36 inches. Provide connections sleeves to join all sections and include an EPDM 65 DURO seal between all joined sections.
- .12 All duct diffusers shall be pre-balanced at the factory and shall not require balancing on-site. This shall be achieved by using dynamic flow balancing software to calculate the flow through each individual diffuser section, taking into account the geometry of the duct, the slot quantity and positions, and drum settings. The diffuser manufacturer must submit this calculation as part of the technical shop drawings. The actual air flow delivered through each diffuser shall be within $\pm 10\%$ of the design value. Use of remote balancing dampers will not be accepted.
- .13 Air velocity within the occupied zone must not exceed 30 fpm.

2.8 LINEAR DIFFUSERS

- .1 All diffusers shown as type "S1 or S2" shall linear supply diffusers of the sizes, configurations and mounting types required. Diffusers shall have (1 or 2) discharge slots respectively, 25 mm (1 in.) wide with extruded aluminum aerodynamically curved pattern controller for 180 degree air pattern control and airflow dampering if required. The diffuser border shall be heavy extruded aluminum construction with extruded aluminum spacers and (mitered end flanges, open ends, flush end caps or angle end caps). Narrow mounting flange. All diffusers shall have a removable concealed fixing device. Colour shall match architectural ceiling and diffuser face shall be pre-coated with a lacquer protective. Continuous length units shall be provided with factory assembled corner modules to suit drawings and on site conditions. Joiner strips shall be provided to align continuous slot assemblies.
 - .1 Return slots sections shall match supply and shall have return air sight baffles and mitred corners. Return linear grilles shall be specified as above and indicated as return on the drawings.
 - .2 Provide acoustically lined return air plenums for linear return air diffusers.
- .2 Linear slot diffusers shown as type "S3" in the main entry vestibule shall be high induction linear diffusers which are manufactured with an extruded aluminum housing, with profiles consisting of one or more slots, each 35 mm or 50 mm wide (as specified). Each slot shall house a set of eccentric drums. Diffusers shall be supplied with the support profile as detailed on the plans.
 - .1 Manufacturer must provide documented design information including diffuser diameter, equipment pressure drops; sound power information; velocity and throw profiles; slot locations and suspension details. Equipment performance shall match or exceed scheduled design performance. Manufacturers must be able to provide room airflow simulation details using software, to illustrate compliance to the above noted items as scheduled.

- .2 Diffusers shall be designed to operate under variable airflow conditions, in heating or cooling modes. Manufacturer must demonstrate an acceptable level of diffuser performance with airflow reductions down to 25%.
- .3 All diffuser slots shall include a series of purpose built drum cylinders which accelerate and direct the airflow in an aerodynamic fashion, without creating turbulence or noise. The cylinders shall be manufactured of ABS (which is UL94 tested, category V-0) and shall be available in white, black, or grey. Departmental Representative to approve colour sample prior to installation.
- .4 Each drum cylinder shall be 100 mm long [4 inches] and shall be individually adjustable, capable of rotating up to 360°. Drum adjustment shall also control the air volume delivered to the space.
- .5 Duct shall be coated outside with a baked polyester enamel paint, providing a smooth, easy-to-clean finish. Colour to be selected by the architect. Refer to the manufacturer's colour chart for options.
- .6 3 of every 4 drums shall be directed downwards to cover the windows below the diffuser. 1 of every 4 drums shall be directed at the windows to prevent condensation above the diffusers.

Part 3 Execution

3.1 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Refer to the architectural drawings for actual locations of diffusers, grilles and registers and install to suit these drawings. The mechanical drawings show intent and number of diffusers, grilles and registers required.
- .3 Provide transfer grilles in all finished spaces where air is transferred though a ceiling or partition.
- .4 For exposed ductwork installations, all connections to grilles shall be oversized and shall have in-turned flanges to meet the flange of the grilles and the duct. Out-turned or exposed flanges with screw mounting shall not be accepted.
- .5 For special mounting of diffusers, grilles and registers refer to Architectural Drawings.
- .6 Where rigid duct is connected to the diffuser, grille or register all devices used for flow pattern adjustment, flow balancing and flow equalizing shall be accessible from the face of the diffuser.
- .7 Install mounting frame tied into plaster and gypsum board ceilings to allow lay in type diffusers to rest on the frame.
- .8 Diffusers for installation in lay-in ceiling shall lay on inverted T-bars. Spacing as per Architectural Drawings

- .9 Contractor shall be responsible for mounting concealed flange linear diffusers in heated environment and following manufacturers' instructions.
- .10 Contractor shall caulk around edges of linear diffusers in installations with imperfect walls.
- .11 Pre-Manufactured Perforated ductwork
 - .1 Refer to installation diagrams for details on support and cylinder adjustment.
 - .2 Contractors must take precautions to ensure that airflow patterns through the diffuser are not turbulent. Provide straightening vanes if duct is mounted immediately downstream of an elbow.
 - .3 For exposed, uninsulated duct installations, installing contractor shall use wire duct hanger to hang the duct.
 - .4 Retain the services of a certified airflow balancer to balance and adjust the system, according to design specifications.

3.2 CLEANING

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

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA Group
 - .1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations.
 - .2 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.2 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.

1.3 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.
- .3 Shop drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Saskatchewan, Canada.
 - .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 coordinated 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 of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
 - .5 If changes are required, notify Consultant of these changes before they are made.
- .4 Certificates:
 - .1 Provide CSA certified material and equipment.
 - .2 Where CSA certified equipment is not available, submit such equipment to the 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 Consultant and Departmental Representative.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00- Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for all the electrical systems / devices.
 - .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.

1.5 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 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 labels for control items in English.

2.2 MATERIALS AND EQUIPMENT

- .1 Provide equipment and materials in accordance with Section 01 61 00- Common Product Requirements.
- .2 Equipment and materials shall be CSA certified. Where CSA certified products are not available, obtain special approval from the 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. The approval label shall be applied at the factory.

2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Control wiring and conduit: in accordance with Section 26 29 03- Control Devices except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections.

2.4 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.5 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment as follows:

.1 Nameplates: lamacoid 3mm thick plastic engraving sheet, black finish face, white core, mechanically attached with self-tapping screws, 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

- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording shall be approved by Consultant and Departmental Representative prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Identify equipment with Size 3 labels engraved "ASSET INVENTORY NO."
- .7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .8 Terminal cabinets and pull boxes: indicate system and voltage.

2.6 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

2.7 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 15m intervals.
- .3 Colours: 25mm wide prime colour and 20mm wide auxiliary colour.

Type	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green
Telephone	Green	

Other Communication Systems	Green	Blue
Fire Alarm	Red	
Other Security Systems	Red	Yellow

2.8 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.

Part 3 Execution

3.1 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

3.2 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.3 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with Section 26 05 32- Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000mm, and information is given before installation.
- .4 Locate light switches on latch side of doors.
 - .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

3.4 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
 - .1 Local switches: 1050mm.
 - .2 Wall receptacles:
 - .1 General: 400mm.
 - .2 Above top of continuous baseboard heater: 200mm.

- .3 Above top of counters or counter splash backs: 1050mm AFF.
- .3 Telephone and interphone outlets: 400mm.
- .4 Wall mounted telephone and interphone outlets: 1500mm.
- .5 Fire alarm manual stations: 1200mm.
- .6 Fire alarm horns / strobes: (match existing).
- .7 Card readers: 900mm.
- .8 Automatic Door Operators: 900mm.

3.5 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.6 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 (via Landlord fire alarm contractor).
- .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.

3.7 SYSTEM STARTUP

- .1 Instruct operating personnel in operation, care and maintenance of systems, system equipment and components.
- .2 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.

3.8 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.

Part 1 General

1.1 RE WORK INCLUDED

- .1 Section 26 05 00.00 – COMMON WORK RESULTS FOR ELECTRICAL.
- .2 Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

1.2 REFERENCE STANDARDS

- .1 CSA International
 - .1 CAN/CSA-C22.2 No.18-latest edition, Outlet Boxes, Conduit Boxes and Fittings.
 - .2 CAN/CSA-C22.2 No.65-latest edition, Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-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)

1.3 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.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00- Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials 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.

Part 2 Products

2.1 MATERIALS

- .1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper 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 and NEMA to consist of:
 - .1 Connector body and stud clamp for bar or copper.
 - .2 Clamp for stranded or round copper bar or conductors.
 - .3 Clamp for conductors.
 - .4 Stud clamp bolts.
 - .5 Bolts for copper bar.
 - .6 Sized for bars as indicated.
- .4 Clamps or connectors for TECK cable, mineral insulated cable, flexible conduit, non-metallic sheathed cable and armoured cable, as required to: CAN/CSA-C22.2 No.18.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for 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 of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Remove insulation carefully from ends of conductors 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 NEMA or EEMAC 1Y-2.

3.3 CLEANING

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

Part 1 General

1.1 WORK INCLUDED

- .1 Section 26 05 01.00 – COMMON WORK RESULTS FOR ELECTRICAL.
- .2 Section 26 05 04.00 – SUBMITTALS/SHOP DRAWINGS.

1.2 REFERENCE STANDARDS

- .1 CSA C22.2 No.0.3, Test Methods for Electrical Wires and Cables, latest edition.
- .2 CSA C22.2 No. 38, Thermoset-Insulated Wires and Cables, latest edition.
- .3 CSA-C22.2 No. 51, Armoured Cables, latest edition.
- .4 CSA C22.2 No. 75, Thermoplastic-Insulated Wires and Cables, latest edition.
- .5 CSA-C22.2 No. 96, Portable Power Cables, latest edition.
- .6 CSA-C22.2 No. 123, Metal Sheathed Cables, latest edition.
- .7 CSA-C22.2 No. 124, Mineral-Insulated Cable, latest edition.
- .8 CSA-C22.2 No. 131, Type TECK 90 Cable, latest edition.
- .9 CSA-C22.2 No. 174, Cables and Cable Glands for Use in Hazardous Locations, latest edition.
- .10 CAN/ULC S139, Standard Method of Fire Test for Evaluation of Integrity of Electrical Power, Data, and Optical Fibre Cables, latest edition.
- .11 UL 2196, Standard for Tests for Fire Resistive Cables, latest edition.
- .12 ASTM B800 - Standard Specification for 8000 Series Aluminium Alloy Wire for Electrical Purposes-Annealed and Intermediate Tempers, latest edition.

1.3 PRODUCT DATA

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

Part 2 Products

2.1 BUILDING WIRES

- .1 Conductors: stranded for 10AWG and larger. Minimum size: 12AWG.
- .2 Copper conductors: size as indicated, with 600V for 120V systems and 1000V for 600V systems insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE and RWU90 XLPE where required, Jacketed.
- .3 All circuits shall be complete with dedicated neutrals.

2.2 ARMOURED CABLES

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Type: ACWU90 jacket over armour and compliant to applicable Building Code classification for wet locations.
- .5 Connectors: anti short connectors.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00- Common Work Results for Electrical.
- .2 Perform with local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

- .1 Terminate cables in accordance with Section 26 05 20- Wire and Box Connectors - (0-1000 V).
- .2 Cable Colour Coding: to Section 26 05 00- Common Work Results for Electrical.
- .3 Conductor length for parallel feeders to be identical.
- .4 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .5 Wiring in walls: vertically from above or below to better facilitate future renovations.
 - .1 Concealed horizontal wiring in walls is not acceptable unless indicated on the drawings or permitted in writing by the Owner.
- .6 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.
- .7 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.
- .8 Provide a minimum of one bonding conductor for each three ungrounded conductors on all conduit and cable runs. Size bonding conductor to applicable tables of the Canadian Electrical Code. Provide separate bonding conductors for each ground fault circuit interrupter circuits. All bonding conductors to be copper and insulated with a green coloured insulation.
- .9 All equipment, junction boxes, pull boxes, liquid tight flex, etc. to be bonded to ground through bonding conductors.

- .10 Provide separate neutral conductor for each 120 volt circuit for all circuits feeding receptacles and power outlets.
- .11 All cable terminations to be compression type fittings for wire sizes greater than #8 AWG. All compression type fittings to be two-hole long barrel type with inspection / viewing window. Where mechanical screw type lugs are allowed by the Engineer's Representative, they will be suitable for quantity of parallel runs of wire that are to be terminated under.
- .12 Armoured Cable Type AC90 (BX) may only be used for individual drops from slab mounted junction box to recessed mounted light fixtures or where noted on the drawings where wiring is required to be installed within an existing wall. The maximum allowable distance of armoured cable is 3m. Contractor to receive written approval from the Engineer's Representative to run armoured cable further than 3m from junction box. Daisy changing of fixtures is only acceptable in dry wall ceilings. Wiring in conduit is to be brought to a junction box to allow for the transition to armoured cable. Armoured cable is not to be installed directly into electrical panels or run in walls for receptacles.
- .13 Branch circuit wiring to be upsized as follows to address voltage drop when:
 - .14 The entire length of the circuit wiring exceeds 25 m – branch wiring to be a minimum of No. 10 AWG.
 - .15 The entire length of the circuit wiring exceeds 40 m – branch wiring to be a minimum of No. 8 AWG.
 - .16 The entire length of the circuit wiring exceeds 60 m – branch wiring to be a minimum of No. 6 AWG.
- .17 Wire Splicing
 - .1 Splice up to and including No. 6 AWG with nylon insulated expandable spring type connectors.
 - .2 Splice larger conductors using compression type connectors wrapped in PVC insulation rated at the respective voltage.

3.3 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34- Conduits, Conduit Fastenings and Conduit Fittings.
 - .2 All conductors are to be colour coded. Provide colour tape at all terminations to identify all conductors in each run.

3.4 INSTALLATION OF ARMOURED CABLES

- .1 Group cables wherever possible on channels.

3.5 FIELD QUALITY CONTROL

- .1 Prior to energizing wires/cables, measure insulation resistance of each wire/cable. Ensure readings are acceptable per installation recommendations. Tabulate and submit for approval as a submittal.
- .2 All Wires and Cables to be tested on site as defined in Section 26 08 01.00 – TECHNICAL SERVICES DIVISION START-UP SERVICE and herein. Contractor to oversee all testing and correct any deficiencies noted.

3.6 INSTALLATION OF CONTROL CABLES

- .1 Install control cables in conduit.
- .2 Ground control cable shield.

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 Common Work Results for Electrical

1.2 REFERENCE STANDARDS

- .1 CSA Group
 - .1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations.
 - .2 CSA C22.2 No.41-13, Grounding and Bonding Equipment (Tri-National Standard, with NMX-J-590ANCE and UL 467).
 - .3 CSA C22.2 No.65-13, Wire connectors (Tri-National Standard, with UL 486A-486B NMX-J-543-ANCE).

1.3 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 connectors and terminations and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Certificates: obtain inspection certificate of compliance covering high voltage stress from Departmental Representative and include it with as-built drawings.

1.4 CLOSEOUT SUBMITTALS

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

1.5 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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 CONNECTORS AND TERMINATIONS

- .1 Copper compression connectors to CSA C22.2 No.65 as required sized for conductors.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for connectors and terminations installation in accordance with manufacturer's written instructions.
 - .1 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install stress cones, terminations, and splices in accordance with manufacturer's instructions.
- .2 Bond and ground as required to CSA C22.2No.41.

3.3 CLEANING

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

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 01– COMMON WORK RESULTS FOR ELECTRICAL

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data:
 - .1 Conduit and equipment provided under the Electrical division shall be complete with all necessary supports and hangers required for a safe and workmanlike installation.

1.3 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.

Part 2 Products

2.1 SUPPORT CHANNELS

- .1 U shape, size 41 x 41mm, 2.5mm thick, set in poured concrete walls and ceilings, suspended or surface mounted.

Part 3 Execution

3.1 INSTALLATION

- .1 Secure equipment to masonry, tile and plaster surfaces with lead anchors.
- .2 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .3 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.
- .4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .5 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole steel straps to secure surface conduits and cables 53 mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 53 mm.

- .3 Beam clamps to secure conduit to exposed steel work.
- .6 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
- .7 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .8 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .9 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .10 Do not use supports or equipment installed for other trades for conduit or cable support.
- .11 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

3.2 CLEANING

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

1.1 GENERAL

1.2 WORK INCLUDED

- .1 Section 26 05 01.00 – COMMON WORK RESULTS FOR ELECTRICAL.
- .2 Section 26 05 63.00 – ACCESS DOORS AND ACCESSIBILITY.

1.3 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-latest edition, Canadian Electrical Code, Part 1, latest edition.

1.4 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 stamped and signed by professional engineer registered or licensed in Ontario, Canada.

Part 2 Products

2.1 SPLITTERS

- .1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Terminations: main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
- .3 Spare Terminals: minimum three spare terminals or lugs on each connection or lug block sized less than 400 A.

2.2 JUNCTION AND PULL BOXES

- .1 Construction: welded steel enclosure.
- .2 Covers Flush Mounted: 25 mm minimum extension all around.
- .3 Covers Surface Mounted: screw-on flat covers.

2.3 CABINETS

- .1 Construction: welded sheet steel hinged door, handle, lock 2 keys, latch and catch

- .2 Type E Empty: surface return flange mounting.
- .3 Type T Terminal: surface return flange mounting containing sheet steel, 19 mm, fire resistant plywood backboard.

Part 3 Execution

3.1 SPLITTER INSTALLATION

- .1 Mount plumb, true and square to building lines.
- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.
- .3 Install terminal block as indicated in Type T cabinets.
- .4 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

3.3 IDENTIFICATION

- .1 Equipment Identification: to Section 26 05 00- Common Work Results for Electrical.
- .2 Identification Labels: size 2 indicating system name, voltage and phase.

Part 1 General

1.1 WORK INCLUDED

- .1 Section 26 05 01.00 – COMMON WORK RESULTS FOR ELECTRICAL.

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-latest edition, Canadian Electrical Code, Part 1,
- .2 National Building Code of Canada, latest edition.
- .3 CAN/ULC-S115, Fire Tests of Fire Stop Systems, latest edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00- Submittal Procedures.
- .2 Submit samples for floor box in accordance with Section 01 33 00- Submittal Procedures.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102mm square or larger outlet boxes as required.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347 V outlet boxes for 347 V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 GALVANIZED STEEL OUTLET BOXES

- .1 One-piece electro-galvanized construction.
- .2 Single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .3 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48mm.
- .4 102mm square or octagonal outlet boxes for lighting fixture outlets.
- .5 Extension and plaster rings for flush mounting devices in finished tile or plaster walls.

2.3 MASONRY BOXES

- .1 Electro-galvanized steel masonry and multi single gang boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 FLOOR BOXES

- .1 Concrete tight electro-galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brushed aluminum or brass faceplate. Device mounting plate to accommodate short or long ear single or duplex receptacles. Minimum depth: 73 mm for receptacles and communication outlets.
- .2 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 21 and 27 mm conduit. Minimum size: 73 mm deep.

2.6 CONDUIT BOXES

- .1 Cast FS or FD boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

2.7 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE

- .1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63 mm with two double clamps to take non-metallic sheathed cables.

2.8 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 35mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

2.9 SERVICE FITTINGS

- .1 'High tension' receptacle fitting made of 2 piece die-cast aluminum with brushed aluminum housing finish for 1 duplex receptacles. Bottom plate with two knockouts for centered or offset installation. 12 x 102 mm extension piece as indicated.
- .2 Pedestal type 'low tension' fitting made of 2 piece die cast aluminum with brushed aluminum housing finish to accommodate two amphenol jack connectors.

Part 3 Execution

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.
- .5 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .6 Identify systems for outlet boxes as required.
- .7 Non-combustible electrical outlet boxes that penetrate a fire separation or a membrane forming part of an assembly required to have a fire-resistance rating, do not require fire stops provided,
 - .1 they do not exceed:
 - .1 100 cm² each in area, AND
 - .2 an aggregate area of 650 cm² in any 9.3 m² of surface area, AND
 - .3 the annular space between the membrane and the box does not exceed 3 mm.
- .8 Where the conditions of clause 3.1.5 are not met, provide fire stops for the outlet boxes.
- .9 Opposing outlets on non-fire rated partition walls shall have a minimum 150 mm horizontal separation. Outlets shall not be mounted back to back.
- .10 Conform to the fire stopping requirements of the building code: unless provided with a fire stop in accordance with CAN/ULC-S115, "Fire Tests of Fire Stop Systems", electrical outlet boxes on opposite sides of a vertical fire separation required to have a fire-resistance rating shall be separated by a horizontal distance of not less than 600 mm, or be installed in adjacent stud cavities.

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 01.00 – COMMON WORK RESULTS FOR ELECTRICAL.
- .2 Section 26 05 31.00 – SPLITTERS, JUNCTION, PULL BOXES AND CABINETS
- .3 Section 26 05 32.00 – OUTLET BOXES, CONDUIT BOXES AND FITTINGS

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International) CAN/CSA C22.2 No. 18-latest edition, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
 - .1 CSA C22.2 No. 45-latest edition, Rigid Metal Conduit.
 - .2 CSA C22.2 No. 56-latest edition, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .3 CSA C22.2 No. 83-latest edition, Electrical Metallic Tubing.
 - .4 CSA C22.2 No. 211.2-latest edition, Rigid PVC (Unplasticized) Conduit.
 - .5 CAN/CSA C22.2 No. 227.3-latest edition, Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada.

1.3 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.
- .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.

Part 2 Products

2.1 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.

2.2 CONDUITS

- .1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded.
- .2 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.
- .3 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .4 Rigid pvc conduit: to CSA C22.2 No. 211.2.
- .5 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal or steel.

2.3 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits NPS 2 and smaller. Two hole steel straps for conduits larger than NPS 2.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1 m oc.
- .4 Hot dipped galvanized threaded rods, 6 mm dia. minimum, to support suspended channels.

2.4 CONDUIT FITTINGS

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Factory "ells" where 90 bends are required for 1" and larger conduits when a hydraulic bender is not used.
- .3 Connectors, and couplings for EMT conduit are to be set-screw steel type. Below the level of suspended ceilings, in a sprinklered environment, provide watertight fittings and "O" rings on all conduit runs and when conduit is terminated at any piece of electrical equipment.
- .4 Provide plastic bushings for all connectors, rigid nipples and rigid conduit 32mm or larger.

2.5 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 200 mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.6 FISH CORD

- .1 Fish cord to be made of polypropylene.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms or in unfinished areas. Conduits to have their own support system and are to be supported independently of the ceiling grid or ceiling support system.
- .3 Where vertically run conduit passes through a slab, Contractor to provide a 100mm high concrete pad with the pad extending 100mm on all sides of the conduit.
- .4 Use electrical metallic tubing (EMT) conduit except where specified otherwise.
- .5 Use epoxy coated conduit in corrosive areas.
- .6 Use rigid galvanized steel threaded conduit where conduit is subject to mechanical injury.
- .7 Use rigid PVC conduit underground or in corrosive areas and where indicated.
- .8 Use flexible metal conduit for connection to motors or vibrating equipment in dry areas, connection to recessed incandescent fixtures without a prewired outlet box, connection to surface or recessed fluorescent fixtures and work in movable metal partitions.
- .9 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations. Use only liquid tight fittings when using liquid tight flexible metal conduit. Liquid tight flexible metal conduit to have a jacket with an FT6 rating when used in plenums otherwise provide a minimum FT4 rating.
- .10 Use explosion proof flexible connection for connection to explosion proof motors.
- .11 Install conduit sealing fittings in hazardous areas. Fill with compound.
- .12 Minimum conduit size for lighting and power circuits: NPS 21mm, unless otherwise noted on the drawings.
- .13 Install EMT conduit from a raised floor branch circuit panel to outlet boxes located in sub floor.

- .14 Install EMT conduit from a raised floor branch circuit panel to junction box in sub-floor. Run flexible metal conduit from junction box to outlet boxes for equipment connections in sub-floor.
- .15 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .16 Mechanically bend steel conduit over 19 mm dia.
- .17 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .18 Install fish cord in empty conduits.
- .19 Run two 27mm spare conduits up to ceiling space and two 27mm spare conduits down to sub-floor space from each flush panel. Terminate these conduits in 152 x 152 x 102 mm junction boxes or in case of an exposed concrete slab, terminate each conduit in flush concrete or surface type box.
- .20 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .21 Dry conduits out before installing wire.
- .22 All cutting and patching of masonry/concrete floors, walls, and roof for electrical services shall be by this Division. Obtain approval from the Landlord and/or structural Engineer's Representative before cutting any structural walls or floors. Cutting and drilling shall only be at times allowed by the Landlord. Check and verify the location of existing mechanical and electrical services in walls and below the floor slab in all areas requiring core drilling and cutting. Protect all tenant areas where core drilling occurs. Carefully chip top and bottom of slab to expose rebar to minimize cutting of rebar when core drilling. Provide x-ray study before drilling or cutting where required by the Landlord and/or structural Engineer's Representative.
- .23 Provide sleeves for all new conduit passing through floor and roof slabs, beams, concrete walls and slab to slab partitions, etc.
- .24 Where cables and conduits pass through partitions and through floors that are not fire rated, provide an air-tight seal around the cables and conduits.
- .25 Where cables and conduits pass through floors and fire rated walls, pack space between conduit (or cable) and sleeve with an approved fire stop as specified in Section 26 05 01.00 – COMMON WORK RESULTS FOR ELECTRICAL.
- .26 Prior to installation of any wire or cable in the ducts, pull through each duct a flexible mandrel not less than 300 mm long and size for the internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign matter. Avoid disturbing or damaging ducts where concrete has not set completely. Notify the engineer's representative no less than 48 hours prior to the event, so that the engineer's representative may witness.

3.3

SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended or surface mounted channels.
- .5 Do not pass conduits through structural members, except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.
- .7 Conduits must not be used to support other conduits.

3.4 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.

3.5 CONDUITS IN CAST-IN-PLACE CONCRETE

- .1 Locate to suit reinforcing steel.
 - .1 Install in centre one third of slab.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed.
 - .1 Use cold mastic between sleeve and conduit.
- .5 Conduits in slabs: minimum slab thickness 4 times conduit diameter.
- .6 Encase conduits completely in concrete with minimum 25 mm concrete cover.
- .7 Organize conduits in slab to minimize cross-overs.

3.6 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

- .1 Run conduits 25 mm and larger below slab and encased in 75 mm concrete envelope. Provide 50 mm of sand over concrete envelope below floor slab.

3.7 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
- .2 For all non-PVC conduits run underground, provide waterproof joints with heavy coat of bituminous paint.

Part 1 General

1.1 SUMMARY

- .1 The work covered in this section is subject to the requirements in the General Conditions of the Specifications. Contractor shall coordinate the work in this section with the trades covered in other sections of the specification to provide a complete and operable system.
- .2 Extent of lighting control system work is indicated by drawings and by the requirements of this section. It is the intent of this section to provide an energy saving lighting control system consisting of Occupancy Sensors from a single supplier.

1.2 REFERENCE STANDARDS

- .1 N/A

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00- Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00- Submittal Procedures.
 - .2 Closeout Submittals:
 - .3 Submit maintenance data in accordance with Section 01 78 00- Closeout Submittals.
 - .4 Quality assurance submittals: submit following in accordance with Section 01 33 00- Submittal Procedures.

Part 2 Products

2.1 LOW VOLTAGE RELAYS

- .1 Operating voltage: 24 V, ac.
- .2 Coloured pre-stripped leads.
- .3 Relays shall provide the following ratings and features:
 - .1 20 amp tungsten at 120V
 - .2 Dual line and load terminals each support two #12 - #10 solid or stranded conductors.
 - .3 Tested to 300,000 mechanical on/off cycles (min).

2.2 OCCUPANCY SENSORS

- .1 Provide occupancy sensors to control relays in locations as shown on the plans. Sensors shall be dual technology. Sensors shall be either ceiling or wall mounded. Occupancy sensors shall have the following features:
 - .1 Ultrasonic sensitivity adjustment.
 - .2 PIR sensitivity adjustment
 - .3 Time delay, 1 - 30 minutes.
 - .4 Test mode with five-second time delay for simplified walk testing.

Part 3 Execution

3.1 INSTALLATION

- .1 Locate and install equipment in accordance with manufacturer's recommendations and as indicated on the drawings.
- .2 Configure timeout to 30 minutes.
- .3 Where applicable, adjust the sensor settings to ensure against interference from the adjacent HVAC diffusers.

3.2 TESTS

- .1 Actuate occupancy sensors in presence of Engineer's Representative to demonstrate lighting circuits are controlled as designated.

3.3 TRAINING

- .1 Provide a one hour of training of the Owner and the Owner's maintenance staff on the configuration of the occupancy sensors.
- .2 Provide a one-page look-up sheet complete with description of all the adjustments available on the sensor.

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 Common Work Results for Electrical
- .2 REFERENCE STANDARDS
- .3 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).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for wiring devices and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in province of Saskatchewan.

1.3 CLOSEOUT SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 SWITCHES

- .1 20A, 120 V, switches to: CSA C22.2 No.55.
- .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 Ivory toggle.
- .3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads heating loads.
- .4 Switches of one manufacturer throughout project.

2.2 RECEPTACLES

- .1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA C22.2 No.42 with following features:
 - .1 Ivory 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.
- .2 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:
 - .1 Ivory urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Four back wired entrances, 2 side wiring screws.
- .3 Other receptacles with ampacity and voltage as indicated.
- .4 Receptacles of one manufacturer throughout project.

2.3 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 for wiring devices mounted in flush-mounted outlet box.
- .4 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .5 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.

2.4 SOURCE QUALITY CONTROL

- .1 Cover plates from one manufacturer throughout project.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for 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 and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
 - .3 Mount toggle switches at height in accordance with Section 26 05 00-Common Work Results for Electrical.
- .2 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .2 Mount receptacles at height in accordance with Section 26 05 00-Common Work Results for Electrical.
 - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
 - .4 Install GFI type receptacles 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.

3.3 CLEANING

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

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 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

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 01.00 – COMMON WORK RESULTS FOR ELECTRICAL.

1.2 REFERENCE STANDARDS

- .1 CSA Group
 - .1 CAN/CSA-C22.2 No.4-latest edition, Enclosed and Dead-Front Switches (Tri-National Standard, with ANCE NMX-J-162-2004 and UL 98).

1.3 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 disconnect switches and include product characteristics, performance criteria, physical size, finish and limitations.

Part 2 Products

2.1 DISCONNECT SWITCHES

- .1 Fusible or non-fusible, horsepower rated disconnect switch in CSA Type 2 sprinkler proof enclosure, size as indicated.
- .2 Provision for padlocking in on-off switch position.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Quick-make, quick-break action.
- .5 ON-OFF switch position indication on switch enclosure cover.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification.
- .2 Indicate name of load controlled on nameplate.

2.3 MANUFACTURERS

- .1 The following are acceptable manufacturers:
 - .2 Schneider Electric.
 - .3 Eaton Cutler-Hammer.
 - .4 Siemens.

Part 3 Execution

3.1 INSTALLATION

- .1 Install disconnect switches complete with fuses if applicable.

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 Common Work Results for Electrical

1.2 REFERENCE STANDARDS

- .1 CSA International
 - .1 CSA C22.2 No.14-10, Industrial Control Equipment.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA ICS 1-2000(R2008), Industrial Control and Systems: General Requirements.

1.3 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 control devices and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Saskatchewan, Canada.
 - .2 Include schematic, wiring, interconnection diagrams.

1.4 QUALITY ASSURANCE

- .1 Conduct tests in accordance with Section 26 05 00- Common Work Results for Electrical.

1.5 CLOSEOUT SUBMITTALS

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

1.6 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 and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 AC CONTROL RELAYS

- .1 Control Relays: to CSA C22.2 No.14.
- .2 Convertible contact type: contacts field convertible from NO to NC, electrically held.
- .3 Sealed contact type: electrically held.

2.2 RELAY ACCESSORIES

- .1 Standard contact cartridges: normally-open - convertible to normally-closed in field.

2.3 PUSHBUTTONS

- .1 Green or Red LED light, complete with NO or NC labels, as indicated.
- .2 Operator type: as indicated.

2.4 THERMOSTAT (LINE VOLTAGE)

- .1 Wall mounted, for exhaust fan control.
- .2 Full load rating: 8A at 120V AC.
- .3 Digital temperature setting range: 16 to 28 degrees Celsius.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for control 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 and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install control devices in accordance with manufacturer's instructions at locations indicated on the drawings. Where locations are not specified, confirm the proposed device location prior to commencing rough-ins.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00- Common Work Results for Electrical.
- .2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at time and check out operation of section.
- .3 Upon completion of sectional test, undertake group testing.
- .4 Check out complete system for operational sequencing.

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00.00 – COMMON WORK RESULTS FOR ELECTRICAL.
- .2 Section 26 05 21.00 – WIRES AND CABLES 1000V.
- .3 Section 26 06 05.16 – LUMINAIRE SCHEDULE.

1.2 REFERENCE STANDARDS American National Standards Institute (ANSI)

- .1 ANSI C82.1, Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.
- .2 ANSI C82.4, Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps Multi Supply Type.
- .2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- .3 ASTM International Inc.
 - .1 ASTM F1137, Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- .4 Canadian Standards Association (CSA International)
- .5 ICES-005, Radio Frequency Lighting Devices.
- .6 Underwriters' Laboratories of Canada (ULC)

1.3 SUBSTITUTION

- .1 The lighting equipment for this project and specified herein has been carefully selected for its ability to meet the project's luminous environment requirements. Manual and computer calculations have been performed to ensure that the lighting equipment that has been specified complies with established criteria. The Engineer's Representative reserves the right not to accept any alternates or substitutions. If alternates or substitutions are entertained, then it is the responsibility of the Contractor/Supplier to provide all information required herein and detailed layouts and lighting calculations demonstrating that the performance of the alternate luminaire meets or exceeds the original lighting design while not consuming any additional energy. The Contractor/Supplier is responsible to ensure the light levels provided in the alternate submittal package will achieve the design light levels. Where the light levels are not achieved, the Contractor is responsible to replace the luminaire with a luminaire that will meet the required levels with no increase in energy use at no cost to the Owner. Rather than replacing the luminaires, the Engineer's Representative may accept the installation of additional luminaires by the Contractor at no cost to the Owner in order to achieve the required light levels.

- .2 Accompanying the request for a luminaire or lamp substitution, the contractor shall submit a complete lighting calculation report with photometric modeling of the space showing light levels including average, maximum, minimum and max to min values.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00- Submittal Procedures.
- .2 Submit a shop drawing for each luminaire specified, including lamp.
- .3 Luminaire submittals are to consist of a physical description, manufacturer's specification sheets, dimensioned drawings, and complete photometric data from an independent test laboratory in the form of IES computer files of the equipment being submitted and hard copy of the photometric report. Coordinate ceiling types to ensure proper supports and luminaire framing.
- .4 LED submittals are to consist of manufacturer's technical data for diodes and drivers with respective luminaire shop drawing. Submittal to include operating wattage, voltage, maximum distance from drivers, wiring diagrams and lumen output at time of delivery. LED Drivers must have a 50,000 hours warranty.

1.5 FIXED PER UNIT COST LUMINAIRES

- .1 Listed in the luminaire schedule are a fixed per unit cost for certain luminaire types. Electrical contractor is responsible for completing a take-off of the drawings to determine quantity of each luminaire type and use the listed fixed unit price to calculate the total cost per luminaire type. The total cost for all luminaires shall be carried in the bid for the electrical contract. Provide a breakdown of the total cost, per luminaire type, that is carried under the electrical contract. All luminaires are to be included in the electrical contract including all luminaires identified with fixed unit costs. The electrical contractor is to include fixed per unit cost luminaires in Light Fixtures – Materials in the standard progress draw breakdown defined in Section 26 05 00.00 – COMMON WORK RESULTS FOR ELECTRICAL.
- .2 The fixed per unit cost excludes applicable taxes and includes lamps and distributor markups. Electrical Contractor is responsible to include in the base bid for delivery, scheduling, receiving, storage, partial assembly, installation, wiring, aiming, cleaning and warranties for all fixed per unit cost luminaires. Show the applicable taxes as a separate line item.

1.6 WARRANTY

- .1 The manufacturer shall provide a five year warranty against defects in material and workmanship for five years after the substantial completion.
- .2 LED's, Drivers, Lamps and ballasts showing signs of premature failure within 12 months of the substantial completion shall be replaced at no cost to the owner.

1.7 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.

Part 2 Products

2.1 GENERAL

- .1 All products must be CSA approved or cUL listed.

2.2 LAMPS AND LEDS

- .1 All Lamps are to meet the standards of the Consortium of Energy Efficiency (CEE) guidelines.
- .2 Refer to luminaire schedule for project specific details, and lamps required.
- .3 Incandescent, tungsten halogen, high intensity discharge, compact fluorescent and linear fluorescent lamps are to be in accordance with the lamp specifications detailed in the Luminaire Schedule and as noted below. Luminaire schedule shall take precedence where differences occur.
- .4 All lamps are to be new and are to be from the same manufacturing batch to avoid colour differences. Replace all lamps that exhibit colour shift, or exhibit premature lumen intensity decline, at no cost to the owner.
- .5 Linear Fluorescent
 - .1 Linear T8 fluorescent lamps shall have a minimum average rated life of 20,000 hours. The peak lumen output will be at 35 deg. C. The CRI shall be 85 or better and the colour temperature will be 3500 deg. K. unless noted otherwise on the luminaire schedule. Lamp wattage as noted on Luminaire Schedule.
 - .2 All linear fluorescents must be low content mercury lamps. The Standard of acceptance are Philips "Alto", Sylvania "Ecologic XP" for T8 lamps, Sylvania "Pentron" for T5 lamps and GE "Ecolux" series.
- .6 Light Emitting Diodes (LED)
 - .1 LEDs shall meet the standards of IESNA LM-79 and LM-80.
 - .2 All LED drivers shall be tested and comply with the maximum in-rush current limits as stated in NEMA 410.
 - .3 Colour temperature shall be as indicated on the luminaire schedule. Lamps are to be binned with no visible colour variance (3100K to 3300K maximum range). Rated life for 1 watt white LED shall be 50,000 hours. Lumen output to be maximum based on latest technology at time of delivery.

- .4 All LED luminaires that present signs of failure on site, within the warranty period, must be replaced at no cost to the owner. If temporary luminaires are required to replace any failed LED luminaires, during the waiting time for parts (i.e. drivers, boards, heat sinks, etc.), the labour cost including installation, temporary luminaire supply, temporary luminaire removal and reinstallation of the LED luminaire must be provided at no cost of the owner. Additional electrical costs, associated with higher Wattage temporary luminaires, must be reimbursed with interest to the owner by the manufacturer.
- .5 In case of failure of an LED luminaire, complete or part thereof, an independent third party testing Laboratory (approved by Smith + Andersen) shall be commissioned by the manufacturer or vendor to perform tests on samples taken from the failed luminaires installed on corresponding site. All reporting including the test results must be submitted to Smith + Andersen for evaluation and final approval.
- .6 Any additional time involved by Smith + Andersen will be billed at our hourly rates to the manufacturer or vendor.

2.3 DRIVERS

- .1 All drivers are to be tested and comply with maximum in-rush current limits within NEMA 410 standards. This is to be clearly indicated on shop drawing submittal.
- .2 LED dimming shall be equal in range and quality to a commercial grade incandescent dimmer. Quality of dimming to be defined by dimming range, freedom from perceived flicker or visible stroboscopic flicker, smooth and continuous change in level (no visible steps in transitions), natural square law response to control input, and stable when input voltage conditions fluctuate over what is typically experience in a commercial environment. Demonstration of this compliance to dimming performance will be necessary for substitutions or prior approval.
- .3 Withstand up to a 1,000 volt surge without impairment of performance as defined by ANSI C62.41 Category A.
- .4 No visible change in light output with a variation of plus/minus 10 percent line voltage input.
- .5 Total Harmonic Distortion less than 20% percent and meet ANSI C82.11 maximum allowable THD requirements at full output. THD shall at no point in the dimming curve allow imbalance current to exceed full output THD.
- .6 Driver must support automatic adaptation, allowing for future luminaire upgrades and enhancements and deliver improved performance:
 - .1 Adjustment of forward LED voltage, supporting 3V through 55V.
 - .2 Adjustment of LED current from 200mA to 1.05A at the 100 percent control input point in increments of 1mA

- .3 Adjustment for operating hours to maintain constant lumens (within 5 percent) over the 50,000 hour design life of the system, and deliver up to 20 percent energy savings early in the life cycle.
- .7 Driver must be able to operate for a (+/- 10%) supply voltage of 120V through 277VAC at 60Hz.
- .8 Driver should be cUL listed under the component program and shall be modular for simple field replacement. Drivers that are not cUL listed or not suited for field replacement will not be considered.
- .9 Drivers to track evenly across multiple fixtures at all light levels, and shall have an input signal to output light level that allows smooth adjustment over the entire dimming range.
- .10 Driver and luminaire electronics shall deliver illumination that is free from objectionable flicker as measured by flicker index (ANSI/IES RP-16-10). At all points within the dimming range from 100-0.1 percent luminaire shall have:
 - .1 LED dimming driver shall provide continuous, linear, step-free, flicker free dimming similar to incandescent source.
 - .2 Flicker index shall be equal to incandescent, less than 1% at all frequencies below 1000 Hz.
- .11 Control Input
 - .1 4-Wire (0-10V DC Voltage Controlled) Dimming Drivers
 - .1 Must meet IEC 60929 Annex E for General White Lighting LED drivers
 - .2 Connect to devices compatible with 0 to 10V Analog Control Protocol, Class 2, capable of sinking 0.6 ma per driver at a low end of 0.3V. Limit the number of drivers on each 0-10V control output based on voltage drop and control capacity.

2.4 LUMINAIRES

- .1 All luminaires are to be complete with mounting brackets, transformers, supports, trims, louvers, lenses and other accessories as required to make luminaire operational and allow it to be installed in the respective location.
- .2 Luminaires shall be suitable for the environment where installed, include seals and gaskets, and corrosion resistant baked-on finish as required and as specified.
- .3 Where drawings show luminaires mounted end-to-end, luminaires shall be suitable for continuous, seamless and tandem mounting.
- .4 The supply and installation of fixed per unit cost and 'cash allowance' luminaires shall comply with all standards set forth in Electrical Specifications. Electrical Contractor is responsible to include in the base bid for delivery, scheduling,

receiving, storage, partial assembly, installation, wiring, aiming, cleaning and warranties for all fixed per unit cost and 'cash allowance' luminaires.

2.5 LUMINAIRES

- .1 As indicated in luminaire schedule.

Part 3 Execution

3.1 INSTALLATION

- .1 It is the responsibility of the contractor to obtain the information related to the luminaire and luminaire trim finishes/colours from the Interior Designer or Architects prior to the fabrication of luminaires. The Contractor shall provide adequate time for the design team to review and comment on luminaire and luminaire trim finishes
- .2 The contractor will provide, receive, unload, uncrate, store, protect and install lamps, luminaires, and other related lighting equipment as specified herein. Lamps for all equipment will be provided and installed by the contractor according to equipment manufacturer's instructions.
- .3 Locate luminaires in accordance with the Architect's Drawings. Coordinate exact locations on site. Refer to Architect's drawings for dimensions of coves and valences.
- .4 Install in accordance with Manufacturer's Instructions, Local Codes, Electrical Division Drawings and Specifications.
- .5 All suspended luminaires shall have cables and support stems vertically aligned.
- .6 Suspend luminaires in mechanical rooms after all the mechanical equipment and ductwork are installed. Luminaires are not to be suspended from mechanical pipes, ductwork or other building services.
- .7 All luminaires shall be installed underneath other services located within ceiling space. Contractor is responsible for interference drawings to ensure all services in ceiling are coordinated.
- .8 Any dimensions provided in the drawings or schedules are intended as general guidelines. For exact dimensioning refer to the Architectural drawings. The detailed information shall be cross referenced with the electrical specifications and the Luminaire Schedule applying the most stringent requirement.
- .9 It is the responsibility of the Electrical Contractor to coordinate luminaire trims and mounting system with ceiling finishes. Luminaires delivered on site with the wrong ceiling mounting system shall be replaced without additional costs for the owner. Restocking fees will not be accepted.
- .10 For suspended ceiling installations support luminaires from structural slab in accordance with local inspection requirements.
- .11 Where luminaires are mounted in tandem, align luminaires mounted in continuous rows to form straight uninterrupted line.

- .12 Align luminaires mounted individually parallel or perpendicular to building grid lines.
- .13 Ensure light leakage does not occur from openings and trim rings. Contractor is responsible to repair the ceiling at no cost to the Owner if cut-out is too large.
- .14 Connect luminaires to lighting circuits.
- .15 Provide all wiring in conduit with junction boxes on a grid pattern to limit the run of flexible armoured cable drops from the ceiling mounted junction box to each luminaire to a maximum of 3 m in length unless approved otherwise in writing from the Engineer's Representative.
- .16 Modular wiring systems shall be employed only where indicated or with approval of the Engineer's Representative.
- .17 Luminaires are not to be used as temporary construction lighting. After being tested to ensure acceptable operation, luminaires will not be used until substantial completion unless permission is received from the owner, architect or Engineer's Representative.
- .18 Lamps are to be installed after luminaire is cleaned. All fluorescent lamps shall be run through a minimum of 12 hours initial start to increase the lamp life and all lamps shall be run through a minimum of 100 hours initial start prior to any dimming.
- .19 Clean all luminaires, inside and out at time of substantial completion. Replace all scratched or damaged luminaires, lenses, louvers and diffusers at no cost to the owner.
- .20 Installation of exit signs
 - .1 Rough-in and installation of exit signs shall be carefully coordinated on site such that after installation of all equipment/services, including equipment/services from other trades (i.e. sprinkler lines, plumbing pipes, way-finding signs, etc.), shall not interfere with the line-of-sight visibility of the exit sign(s) from approach of the intended egress pathway(s).
 - .2 If exit sign(s) have been installed and do not meet the satisfaction of the Engineer's Representative/Architect/Authority Having Jurisdiction, the Contractor shall lower, raise or relocate the exit sign(s) such that proper and adequate visibility of the exit sign(s) is achieved at no additional cost to the Owner.

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 Common Work Results for Electrical.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 Provide telecommunications raceways system consists of outlet boxes, cover plates, conduits, pull boxes, sleeves and caps, fish wires, service fittings.
- .2 Provide adequate support for new and existing CAT6 wiring in the basement and the crawlspace. Note:

2.2 MATERIAL

- .1 Conduits: 26 05 34- Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Overhead distribution system: J-hooks.
- .3 Junction boxes, outlet boxes: in accordance with Section 26 05 31- Splitters, Junction, Pull Boxes and Cabinets.
- .4 Fish wire: polypropylene type.

Part 3 Execution

3.1 INSTALLATION

- .1 Install raceway system, including the overhead distribution system, fish wire, terminal cabinets, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves and caps, miscellaneous and positioning material to constitute complete system.
- .2 Vertical drops to recessed voice/data outlets in walls shall be using EMT conduit, terminated with a 103x103mm recessed junction box and a reducer ring, as required.
 - .1 Stub out conduit in the accessible ceiling space or accessible crawlspace.
 - .2 Bend conduit at a 45 degree angle.
 - .3 Each conduit end shall be complete with a protective nylon bushing.
 - .4 Each conduit shall be sized to ensure a maximum fill of 40%.
- .3 Distance between j-hooks shall not exceed 800mm. Distance between the vertical conduit drop and the adjacent j-hook shall not exceed 400mm.

3.2 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by pathways for communications systems installation.

Part 1 General

1.1 WORK INCLUDED

- .1 Supply and install a CAT6 structured cabling system as detailed in Contract Documents.
 - .1 The Cabling Contractor shall use pathways (by Electrical Contractor) to distribute the cables throughout the facility.
 - .2 The Cabling Contractor shall supply patch panels, network jacks, faceplates and any other accessories required for a complete and fully functional structured cabling system.
- .2 Ensure that all cable lengths are sufficient to allow for slack, vertical runs, wastage, terminations and future moves.
- .3 The Contractor shall ensure ANSI/EIA/TIA-568-D installation practices are followed. Install horizontal cables in accordance with manufacturer's specifications ensuring that proper installation techniques are adhered to.
- .4 The Contractor shall terminate all pairs of cable at each cable end.
- .5 Inform the Engineer's Representative immediately of any horizontal cable runs exceeding 90 m 295'(ft). Minimum horizontal cable run (if required) shall not be less than that specified in manufacturer's specifications.
- .6 The Engineer's Representative shall determine the quality of workmanship during installation. Cables that have not been properly installed will be reinstalled by the cabling contractor at no additional expense to the contract.

1.2 CABLE ROUTING

- .1 Make any necessary changes or additions to routing of cables, pathways to accommodate structural, mechanical, electrical and architectural conditions. Where pathways or cables are shown diagrammatically run them parallel to building columns. If it is necessary to run cables otherwise to accommodate acceptable cable lengths, written permission must be obtained from the Communications Engineer's Representative prior to installation.
- .2 Any deviation from the cable routing, outlet and equipment locations shown on drawings must be approved by the Communications Engineer's Representative and documented on as-built drawings.

Part 2 Products

2.1 4-PAIR HORIZONTAL COPPER CABLE

- .1 Four pair, twisted pair cable consisting of #23 AWG CU solid conductors, formed into four individually twisted pairs and enclosed in an appropriately rated thermoplastic jacket as required by local codes. All individual conductors to be insulated with fluorinated ethylene propylene (FEP).
- .2 All cabling must be CSA certified and stamped accordingly.

- .3 Cable to withstand a bend radius of 25.4 mm (1") at a temperature of -20°C ± 1°C without jacket or insulation cracking.
- .4 All cables shall have an outer jacket colour as identified below:

Cable Designation	Colour
Data	Blue

Part 3 Execution

3.1 GENERAL CONDITIONS

- .1 When terminating copper cables remove only enough cable jacket to perform termination, untwist pairs a maximum of 13 mm (1/2"). Any specific manufacturer's installation guidelines shall supersede the above.
- .2 The cabling contractor shall not splice any cables for any reason, unless prior consent is given by the Engineer's Representative.
- .3 Structured cabling system standard of acceptance shall be Belden or approved equal.
- .4 Provide a 10 year (minimum) system warranty on the structured cabling system.
 - .1 Include the system certificate and the warranty letter in the Operations and Maintenance manual.

3.2 HORIZONTAL CABLE DISTRIBUTION

- .1 Provide a minimum of 3.05 m (10'-0") of slack at both ends of each cable to permit future cable relocation. Neatly coil slack and suspend off j-hooks in the crawlspace. For completely enclosed zone conduit distribution systems, provide 3.05 m (10'-0") of slack at the telecommunications room end only.
- .2 Follow proper installation and termination practices for Category 6 cables. Do not kink or exceed the cable minimum bend radius or maintain a minimum of ten (10) times cable diameter as bend radii if the manufacturer specifies no bend radius.
- .3 All horizontal cables shall be bundled on the Telecommunications Racks using Panduit Velcro straps.
- .4 Bundles shall be tie-wrapped in telecommunications rooms, at a maximum of 203 mm 8"(in) separation and shall contain no more than fifty (50) cables to eliminate any excessive stress on the cable jackets.
- .5 When bundling cables, comply with manufacturer's recommended bundling practices for installation. Ensure that excess pressure is not placed on the cable at any point that may result in the compression or deformation of the cable jacket and internal pair/conductor geometry.
- .6 All exposed cabling at the workstation between wall/floor-input point locations and systems furniture is to be wrapped with black split loom tubing, size and length as required to suit.

- .7 Cabling Contractor will be required to route/install telecommunications cabling in systems furniture, lab casework furniture & mill work as denoted on floor plans.
- .8 Avoid scraping, denting or otherwise damaging cables before, during or after installation. The cabling contractor shall make every effort to protect all exposed cabling from other trades during construction phase until cables can be placed in final pathway. The Cabling Contractor without any additional compensation shall replace damaged cables.
- .9 Provide data cables to each outlet indicated on the drawings. The Cabling Contractor shall refer to the legends on the drawing to determine the number of cables to each outlet location.
- .10 Terminate test and label each cable in accordance to the parameters stated in this specification document and in accordance with manufacturer's recommendations.
 - .1 Testing shall be completed to TIA-586-D.
 - .2 A complete test report, detailing test results for every cable, shall be submitted for Engineer's review in .pdf format.
- .11 Ground all cables and components to manufacturer's specifications and standard practices.

END OF SECTION 27 15 00