Tender Documents

December 05, 2014

PROJECT

MECHANICAL UPGRADE

Regina, Saskatchewan

PROJECT No.	SET No.
17/2014	
DATE	
2014-12-05	

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Part 1 General

1.1 WORK COVERED BY CONTRACT DOCUMENTS

.1 Work of this Contract generally comprises of replacement of mechanical equipment, a new service platform as well as associated architectural and electrical work. The project site is located in Regina, Saskatchewan and further identified as “Mechanical Upgrade Works Building, Regina, Sask.

1.2 WORK SEQUENCE

.1 The General Contractor will be responsible for the coordination of all work.

1.3 CONTRACTOR USE OF PREMISES

.1 Coordinate use of premises under direction of Departmental Representative.

.2 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.

.3 Cooperate with other contractors employed by the Departmental Representative for other work within the building.

1.4 EXISTING SERVICES

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

.2 Where Work involves breaking into or connecting to existing services, give Departmental Representative 48 hours of notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to pedestrian, vehicular traffic and tenant operations.

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

.4 Submit schedule to and obtain approval from Departmental Representative for any 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 Departmental Representative to maintain critical building and tenant systems.

.6 Provide adequate bridging over trenches which cross sidewalks or roads to permit normal traffic.

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

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

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

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

END OF SECTION

Part 1 General

1.1 USE OF SITE AND FACILITIES

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

.2 Noise generating activities and access to the occupied spaces are to be conducted outside of normal hours of operation.

1.2 EXISTING SERVICES AND BUILDING SYSTEMS

.1 Notify, Departmental Representative of intended interruption of services or building mechanical or electrical systems, and obtain required permission.

.2 Where Work involves breaking into or connecting to existing services or disruption to electrical or mechanical systems, give Departmental Representative 48 hours of notice for necessary interruption of mechanical or electrical service throughout course of work. Keep duration of interruptions minimal.

.3 Carry out interruptions after normal working hours of occupants, preferably on weekends.

1.3 SPECIAL REQUIREMENTS

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

.2 Ensure that Contractor 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.

1.4 SECURITY CLEARANCES

.1 Contractor personnel must submit to local law enforcement verification by RCMP, prior to admittance to the facility site. The Client reserves the right to deny access to any facility / site or part thereof to any Contractor personnel, at any time.

.2 All access to the building is to be through a designated entrance. Personnel will be signed in daily at start of work shift and provided with pass, which must be worn at all times. Pass must be returned at end of work shift and personnel checked out.

1.5 SECURITY ESCORT

.1 Personnel employed on this project must be escorted when executing work in non-public areas during normal working hours. Personnel must be escorted in all areas after normal working hours.

1.6 BUILDING SMOKING ENVIRONMENT

.1 Comply with smoking restrictions. No smoking will be allowed in or around the building. Smoking is allowed only in areas indicated by Departmental Representative.

.2 Turn off vehicles when they are parked next to building.

1.7 OCCUPIED SPACES

.1 Coordinate the work to with the occupancy schedule, which will be provided by the Departmental Representative. The building will be occupied during construction. Schedule work outside of the occupancy schedule within the identified occupied spaces.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE

.1 Project meetings will be scheduled throughout the progress of the work and at the call of Departmental Representative.

.2 Provide physical space and make arrangements for meetings.

.3 The Consultant shall chair meetings.

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

1.2 PRECONSTRUCTION MEETING

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

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

1.3 PROGRESS MEETINGS

.1 During course of Work, progress meetings will be held on a regular basis. Schedule to be determined.

.2 Contractor, major Subcontractors involved in Work, Departmental Representative, Consultant and Owner's representatives are to be in attendance.

.3 Minutes of meetings will be recorded by the Consultant. Minutes will be distributed within 3 working days.

.4 Agenda for project meetings to include the following:

.1 Review, approval of minutes of previous meeting.
.2 Review of Work progress since previous meeting.
.3 Field observations, problems, conflicts.
.4 Problems which impede construction schedule.
.5 Review of off-site fabrication delivery schedules.
.6 Corrective measures and procedures to regain projected schedule.
.7 Revision to construction schedule.
.8 Progress schedule, during succeeding work period.
.9 Review submittal schedules: expedite as required.
.10 Maintenance of quality standards.
.11 Review proposed changes to determine how these will affect the 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 Departmental Representative to enable monitoring of project work in relation to established milestones.

1.2 REQUIREMENTS

.1 Ensure Project Schedule and Detail Schedules are practical and remain within specified Contract duration.

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

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

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

1.3 SUBMITTALS

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

.2 Submit to Departmental Representative within 7 working days of Award of Contract Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of project progress.

.3 Provide schedule in PDF format in sized so that description of work can be clearly read when printed out.

1.4 PROJECT MILESTONES

.1 Project milestones form interim targets for Project Schedule.

.1 Project milestone will be identified through discussion with the Contractor and Departmental Representative at the outset of the project.

1.5 PROJECT SCHEDULE REPORTING

.1 Update Project Schedule on a monthly 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.

1.6 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

1.1 ADMINISTRATIVE

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

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

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

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

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

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

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

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

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

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

1.2 SHOP DRAWINGS AND PRODUCT DATA

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

.2 Submit where required in the specifications, shop drawings bearing stamp and signature of qualified professional engineer registered or licensed in Province of Saskatchewan, Canada.

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

.4 Allow 7 days for Departmental Representative's review of each submission.

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

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

.7 Accompany submissions with transmittal letter, containing:

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

.8 Submissions include:

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

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

.10 Submit 6 copies of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.

.11 Submit 6 copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.

.12 Submit 6 copies of test reports for requirements requested in specification Sections and as requested by Departmental Representative.

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

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

.13 Submit 6 copies of certificates for requirements requested in specification Sections and as requested by Departmental Representative.

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

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

.14 Submit 6 copies of manufacturer’s instructions for requirements requested in specification Sections and as requested by Departmental Representative.

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

.15 Submit 6 copies of manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental 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 6 copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.

.17 Delete information not applicable to project.

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

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

.20 The review of shop drawings by Departmental Representative is for sole purpose of ascertaining conformance with general concept.

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

.2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains

solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

.21 Electronic submission of Shop Drawings

.1 Electronic Shop Drawings (PDF format) shall not exceed 11x17 actual size. Electronic transfer of shop drawings relies on Architect and Engineering Consultants to print a record copy for their files - this can be done providing shop drawings do not exceed 11x17. Larger shop drawings would require hard copies for review.

.2 General Contractor to review shop drawing and place their electronic stamp signifying review.

.3 General Contractor to email all shop drawings to Architect with copy to Engineering Consultant as applicable.

.4 Engineering Consultant to review and place their electronic stamp / marks up, then email to Architect only (Engineering Consultant will not copy anyone else).

.5 Architect to check for coordination and transmit reviewed shop drawings by email to General Contractor.

1.3 SAMPLES

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

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

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

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

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

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

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

1.4 MOCK-UPS

.1 Erect mock-ups in accordance with 01 45 00 - Quality Control and as specified in each applicable Section.

END OF SECTION

Part 1 General

1.1 REFERENCES

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

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

.1 Material Safety Data Sheets (MSDS).

.3 Province of Saskatchewan

.1 Occupational Health and Safety Act, 1993, S.S. 2005.

1.2 SUBMITTALS

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

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

.1 Results of site specific safety hazard assessment.

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

.3 Submit 1 copy of Contractor's authorized representative's work site health and safety inspection reports to Departmental Representative, weekly.

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

.5 Submit copies of incident and accident reports.

.6 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 33 00 - Submittal Requirements and Section 02 81 01 - Hazardous Materials.

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

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

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

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

1.3 FILING OF NOTICE

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

1.4 SAFETY ASSESSMENT

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

1.5 MEETINGS

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

1.6 REGULATORY REQUIREMENTS

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

1.7 GENERAL REQUIREMENTS

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

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

1.8 RESPONSIBILITY

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

.2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

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 UNFORSEEN HAZARDS

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

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 site-related working experience specific to activities associated with overhead work.

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

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

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

.5 Be on site during execution of Work.

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 Departmental Representative.

1.13 CORRECTION OF NON-COMPLIANCE

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

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

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

1.14 BLASTING

.1 Blasting or other use of explosives is not permitted.

1.15 POWDER ACTUATED DEVICES

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

1.16 WORK STOPPAGE

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

END OF SECTION

Part 1 General

1.1 REFERENCES AND CODES

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

.2 Meet or exceed requirements of:

.1 Contract documents.

.2 Specified standards, codes and referenced documents.

1.2 HAZARDOUS MATERIAL DISCOVERY

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

.2 Note requirements in Contract Documents for removal or known asbestos containing materials. Notify Departmental Representative is suspicious material is encountered elsewhere within this work.

1.3 BUILDING SMOKING ENVIRONMENT

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

.2 Smoking on site is restricted to within personal vehicles or designated smoking locations.

END OF SECTION

Part 1 General

1.1 INSPECTION

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

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

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

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

1.2 ACCESS TO WORK

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

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

1.3 PROCEDURES

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

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

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

1.4 REJECTED WORK

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

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

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

1.5 REPORTS

.1 Submit two (2) copies of inspection and test reports to Departmental Representative.

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

1.6 TESTS AND MIX DESIGNS

.1 Furnish test results and mix designs as requested.

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

1.7 MOCK-UPS

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

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

.3 Prepare mock-ups for Departmental Representative and Consultant'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 Mock-ups may remain as part of Work.

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 in order to execute work expeditiously.

.2 Remove from site all such work after use.

1.3 WATER SUPPLY

.1 Departmental Representative will make available a continuous supply of potable water for construction use.

1.4 TEMPORARY HEATING AND VENTILATION

.1 Maintain temperatures of minimum 10 degrees C in areas where construction is in progress.

.2 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 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.

.3 Permanent heating system of building, to be used when available. Be responsible for damage to heating system if use is permitted.

.4 On completion of Work for which permanent heating system is used, provide service maintenance to system at discretion of the Departmental Representative.

.5 Pay costs for maintaining temporary heat, when not using permanent heating system. Owner will pay utility charges when temporary heat source is existing building equipment.

.6 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.

.7 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

1.5 TEMPORARY POWER AND LIGHT

.1 Provide and maintain temporary lighting throughout project. Existing lighting and power systems may be utilized.

1.6 TEMPORARY COMMUNICATION FACILITIES

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

1.7 FIRE PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

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

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 Identify areas which have to be gravelled to prevent tracking of mud.

.3 Indicate use of supplemental or other staging area.

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

.5 Remove from site all such work after use.

1.4 SCAFFOLDING

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

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

1.5 HOISTING

.1 Provide, operate and maintain hoists and 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 but may be limited. Parking arrangements will be provided by the Departmental Representative at project start up.

.2 Provide and maintain adequate access to project site.

1.8 OFFICES

.1 Provide and maintain, during the entire progress of the Work, a suitable office on the site, for own use, with suitable tables or benches for the examination of drawings, specifications, etc., and where all notices and instructions from the Consultant may be received and acknowledged. Provide suitable meeting space for site meetings. Provide adequate heating, ventilating and lighting. Location of these offices to be coordinated with the Departmental Representative.

.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 SANITARY FACILITIES

.1 One female washroom and one male washroom will be designated on site, for Contractor's use during this project. Final location to be coordinated and confirmed with the Departmental Representative.

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

.3 Contractor shall be responsible for cleaning and maintenance or designated facilities.

1.11 CONSTRUCTION SIGNAGE

.1 No signs or advertisements, other than warning signs, are permitted on site.

1.12 PROTECTION AND MAINTENANCE OF TRAFFIC AND PEDESTRIANS

.1 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by Departmental 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 Do not disrupt training on site around building.

.5 Do not block roads without obtaining approval to do so from the Departmental Representative.

.6 Contractor's traffic on roads selected for hauling material shall not interfere with on-going training on site.

.7 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to roads caused by construction operations.

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

1.13 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 on an on-going basis.

.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, BARRICADES, AND SIGNAGE

.1 Provide secure, rigid guard rails and barricades around deep excavations, open shafts, open stair wells, open edges of floors and roofs.

.2 Provide Construction Zone warning and access control signage.

1.3 WEATHER ENCLOSURES

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

.2 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.

.3 Design enclosures to withstand wind pressure and snow loading.

1.4 DUST TIGHT SCREENS

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

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

.3 Maintain negative pressure in area of dust generating work. Exhaust directly to the exterior.

1.5 ACCESS TO SITE

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

1.6 PUBLIC TRAFFIC FLOW

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

1.7 FIRE ROUTES

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

1.8 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.

1.9 PROTECTION OF BUILDING FINISHES

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

.2 Provide necessary screens, covers, and hoardings.

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

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

1.10 WASTE MANAGEMENT AND DISPOSAL

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

END OF SECTION

Part 1 General

1.1 REFERENCES

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

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

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

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

1.2 QUALITY

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

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

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

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

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

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

1.3 STORAGE, HANDLING AND PROTECTION

.1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.

.2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.

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

.4 Store cementitious products clear of earth or concrete floors, and away from walls.

.5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.

.6 Store sheet materials, lumber, steel members, doors and frames on flat, solid supports and keep clear of ground. Slope to shed moisture.

.7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.

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

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

1.4 TRANSPORTATION

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

1.5 MANUFACTURER'S INSTRUCTIONS

.1 Unless otherwise indicated in specifications install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.

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

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

1.6 QUALITY OF WORK

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

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

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

1.7 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.

1.8 CONCEALMENT

.1 In finished areas conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.

.2 Before installation inform Departmental Representative if there is interference. Install as directed by Departmental Representative.

1.9 REMEDIAL WORK

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

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

1.10 LOCATION OF FIXTURES

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

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

1.11 FASTENINGS

.1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.

.2 Prevent electrolytic action between dissimilar metals and materials.

.3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.

.4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.

.5 Keep exposed fastenings to a minimum, space evenly and install neatly.

.6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.12 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.

1.13 PROTECTION OF WORK IN PROGRESS

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

1.14 EXISTING UTILITIES

.1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work, and/or building occupants.

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

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

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

.3 Include in request:

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

1.2 FORMS

.1 Special forms required during the course of this Work may include the following. Forms will be supplied by the Departmental Representative.

1.3 MATERIALS

.1 Required for original installation.

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

1.4 PREPARATION

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

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

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

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

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

1.5 EXECUTION

.1 Execute cutting, fitting, and patching including excavation and fill, to complete Work.

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

.3 Uncover Work to install ill-timed Work.

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

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

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

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

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

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

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

.11 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with firestopping or firestopping sealant material using UL or ULC rated assembly in accordance with manufacturer's instructions.

.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.

1.6 WASTE MANAGEMENT AND DISPOSAL

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

END OF SECTION

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. Do not burn waste materials on site.

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

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

.5 Dispose of waste materials and debris off site.

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

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

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

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

.10 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. Remove debris and surplus materials from accessible concealed spaces.

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

.4 Vacuum carpet in renovated areas and where construction traffic occurs. If heavily soiled carpeting shall be commercially steam cleaned. This will be at the discretion of the Departmental Representative.

.5 Clean and wax areas of resilient sheet and tile flooring in renovated areas, where required by specification section.

.6 Dust all horizontal surfaces, clean all glass and wipe down walls in renovated areas.

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

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

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

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

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

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

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

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

.8 Source Separation: acts of keeping different types of waste materials separate beginning from first time they became waste.

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

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

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

1.2 SUBMITTALS

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

1.3 WASTE REDUCTION WORKPLAN (WRW)

.1 Prepare WRW prior to project start-up.

.2 WRW should include but not limited to:

- .1 Destination of materials listed.
- .2 Deconstruction/disassembly techniques and sequencing.
- .3 Schedule for deconstruction/disassembly.
- .4 Location.
- .5 Security.
- .6 Protection.
- .7 Clear labelling of storage areas.
- .8 Details on materials handling and removal procedures.

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

.4 Describe management of waste.

.5 Identify opportunities for reduction, reuse, and recycling of materials.

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

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

.8 Monitor and report on waste reduction.

1.4 MATERIALS SOURCE SEPARATION PROGRAM (MSSP)

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

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

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

.4 Provide containers to deposit reusable and recyclable materials.

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

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

.7 Collect, handle, store on-site, and transport off-site, salvaged materials in separate condition.

- .1 Transport to 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.

1.5 STORAGE, HANDLING AND PROTECTION

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

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

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

.4 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.

1.6 DISPOSAL OF WASTES

.1 Do not bury rubbish or waste materials.

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

1.7 USE OF SITE AND FACILITIES

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

.2 Maintain security measures established by existing facility and where required provide temporary security measures approved by Departmental Representative.

1.8 SCHEDULING

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

Part 2 Execution

2.1 APPLICATION

.1 Do Work in compliance with WRW.

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

2.2 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.

END OF SECTION

Part 1 General

1.1 INSPECTION AND DECLARATION

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

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

.2 Request Departmental Representative Inspection.

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

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

.1 Work has been completed and inspected for compliance with Contract Documents.

.2 Defects have been corrected and deficiencies have been completed.

.3 Equipment and systems have been tested, adjusted and balanced and are fully operational.

.4 Certificates required by Fire Commissioner and Utility companies have been submitted.

.5 Operation of systems have been demonstrated to Owner's personnel.

.6 Work is complete and ready for final inspection.

.4 Final Inspection: when items noted above are completed, request final inspection of Work by Departmental Representative, Consultants and Contractor. If Work is deemed incomplete by Departmental Representative, complete outstanding items and request re-inspection.

.5 Where re-inspection is required due to uncompleted deficiencies, the time required by the Departmental Representative and Consultants will be recorded and reimbursement of this time may be charges back to the Contractor by deducting from amounts retained.

1.2 CLEANING

.1 In accordance with Section 01 74 11 - Cleaning.

.2 Remove waste and surplus materials, rubbish and construction facilities from the site in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

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

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

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

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

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

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

.7 Furnish evidence, if requested, for type, source and quality of products provided.

.8 Defective products will be rejected, regardless of previous inspections. Replace products at Contractor’s own expense.

.9 Pay costs of transportation.

1.2 FORMAT

.1 Organize data as instructional manual.

.2 Provide four (4) bound copies and two (2) PDF copies on DVD or CD.

.3 Binders: cloth, hard covered, expandable, loose leaf paper size 219 x 279 mm. Colour “black.” Provide four (4) copies.

.4 When multiple binders are used correlate data into related consistent groupings. Identify contents of each binder on spine.

.5 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents. Lettering to be “gold” colour.

.6 Provide printed title on DVD/CD version to coincide with title on bound version.

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

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

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

.10 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

1.3 CONTENTS - EACH VOLUME

.1 Table of Contents: provide title of project;

.1 Date of submission; names.

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

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

.2 For each product or system:

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

.3 Shop Drawings: illustrating details of a portion of work.

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

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

.6 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.

1.4 AS-BUILTS AND SAMPLES

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

.1 Contract Drawings.

.2 Specifications.

.3 Addenda.

.4 Change Orders and other modifications to Contract.

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

.6 Field test records.

.7 Inspection certificates.

.8 Manufacturer's certificates.

.2 Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.

.3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.

.4 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.

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

1.5 RECORDING ACTUAL SITE CONDITIONS

.1 Record information on set of opaque drawings, provided by Departmental Representative.

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

.3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.

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

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

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

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

.4 Field changes of dimension and detail.

.5 Changes made by change orders.

.6 Details not on original Contract Drawings.

.7 References to related shop drawings and modifications.

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

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

.2 Changes made by Addenda and change orders.

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

1.6 EQUIPMENT AND SYSTEMS

.1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

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

.3 Include installed colour coded wiring diagrams.

.4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

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

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

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

.8 Include sequence of operation by controls manufacturer.

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

.10 Provide installed control diagrams by controls manufacturer.

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

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

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

.14 Include test and balancing reports as specified in Section 01 45 00 - Quality Control.

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

1.7 MATERIALS AND FINISHES

.1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.

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

.3 Moisture-Protection and Weather-Exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.4 Additional Requirements: as specified in individual specifications sections.

1.8 SPARE PARTS

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

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

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

.4 Receive and catalogue items. Submit inventory listing to Departmental Representative. Include approved listings in Maintenance Manual.

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

1.9 MAINTENANCE MATERIALS

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

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

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

.4 Receive and catalogue items. Submit inventory listing to Departmental Representative. Include approved listings in Maintenance Manual.

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

1.10 SPECIAL TOOLS

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

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

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

.4 Receive and catalogue items. Submit inventory listing to Departmental Representative. Include approved listings in Maintenance Manual.

1.11 STORAGE, HANDLING AND PROTECTION

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

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

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

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

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

1.12 WARRANTIES AND BONDS

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

.2 Assemble approved information in binder and submit upon acceptance of work. 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.

.3 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.

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

.5 Written verification will follow oral instructions. Failure to respond will be cause for the Departmental Representative to proceed with action against Contractor.

1.13 PRE-WARRANTY CONFERENCE

.1 Meet with Departmental Representative, to develop understanding of requirements of this section. Schedule meeting prior to contract completion, and at time designated by Departmental Representative.

.2 Departmental Representative will establish communication procedures for:

.1 Notification of construction warranty defects.

.2 Determine priorities for type of defect.

.3 Determine reasonable time for response.

.3 Provide name, telephone number and address of licensed and bonded company that is authorized to initiate and pursue 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.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 General requirements relating to commissioning of project's components and systems, specifying general requirements to PV of components, equipment, sub-systems, systems, and integrated systems.

.2 Refer to all project Specification Sections for detailed description of commissioning requirements.

.3 Acronyms:

.1 Cx - Commissioning.

.2 Cx Authority – Commissioning Authority.

.3 EMCS - Energy Monitoring and Control Systems.

.4 O&M - Operation and Maintenance.

.5 PI - Product Information.

.6 PV - Performance Verification.

.7 TAB - Testing, Adjusting and Balancing.

1.2 GENERAL

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

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

.2 Ensure appropriate documentation is compiled into the O&M manual.

.3 Effectively train O&M staff.

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

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

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

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

1.3 COMMISSIONING OVERVIEW

.1 Commissioning (Cx) Plan. The Contractor will be responsible for developing the Commissioning (Cx) Plan.

.2 The parties responsible for Cx activities shall be identified in the Commissioning (Cx) Plan.

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

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

.5 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the installed systems are proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities include transfer of critical knowledge to facility operational personnel.

.6 Departmental Representative will issue Interim Acceptance Certificate when:

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

.2 Equipment, components and systems have been commissioned.

.3 O&M training has been completed.

1.4 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

.1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Cx, correct deficiencies, re-verify equipment and components within the unfunctional system, including related systems as deemed required by Consultant and Cx Authority, to ensure effective performance.

.2 Costs for corrective work, additional tests, inspections, to determine acceptability and proper performance of such items to be borne by Contractor. Above costs to be in form of progress payment reductions or hold-back assessments.

1.5 PRE-CX REVIEW

.1 Before Construction:

.1 Review contract documents, confirm by writing to Departmental Representative:

.1 Adequacy of provisions for Cx.

.2 Aspects of design and installation pertinent to success of Cx.

.2 During Construction:

.1 Co-ordinate provision, location and installation of provisions for Cx.

.3 Before start of Cx:

.1 Have Cx Plan up-to-date.

.2 Ensure installation of related components, equipment, sub-systems, systems is complete.

.3 Fully understand Cx requirements and procedures.

.4 Have Cx documentation shelf-ready.

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

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

.7 Have Cx schedules up-to-date.

.8 Ensure systems have been cleaned thoroughly.

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

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

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

1.6 CONFLICTS

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

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

1.7 SUBMITTALS

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

.1 Submit:

.1 Name of Contractor's Cx agent.

.2 Draft Cx documentation.

.3 Preliminary Cx schedule.

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

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

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

1.8 COMMISSIONING DOCUMENTATION

.1 Refer to individual equipment Specification Sections for (Cx) forms: Installation Check Lists, Product Information (PI) and Performance Verification (PV) forms for requirements.

.2 Consultant and Cx Authority to review and approve Cx documentation.

.3 Provide completed and approved Cx documentation to Departmental Representative.

1.9 COMMISSIONING SCHEDULE

.1 Provide detailed Cx schedule as part of construction schedule in accordance with Section 01 32 16.07 - Construction Progress Schedules.

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

.1 Approval of Cx reports.

.2 Verification of reported results.

.3 Repairs, retesting, re-commissioning, re-verification.

.4 Training.

1.10 COMMISSIONING MEETINGS

.1 Cx meetings will be held following project meetings and as specifically requested.

.2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.

.3 Cx meetings will be held on a regular basis until commissioning deliverables have been addressed.

.4 At approximately 50% completion stage a separate Cx scope meeting will be held to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:

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

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

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

.6 Meeting will be chaired by Contractor, who will record and distribute minutes.

.7 Ensure subcontractors and relevant manufacturer representatives are present at 50% and subsequent Cx meetings and as required.

1.11 STARTING AND TESTING

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

1.12 WITNESSING OF STARTING AND TESTING

.1 Provide 14 days notice prior to commencement.

.2 Departmental Representative may witness start-up.

.3 Consultant and Cx Authority will witness testing for PV.

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

1.13 MANUFACTURER'S INVOLVEMENT

.1 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with Departmental Representative.

.1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.

.2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.

.2 Integrity of warranties:

.1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.

.2 Verify with manufacturer that testing as specified will not void warranties.

.3 Qualifications of manufacturer's personnel:

.1 Experienced in design, installation, and operation of equipment and systems.

.2 Ability to interpret test results accurately.

.3 To report results in clear, concise, logical manner.

1.14 PROCEDURES

.1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.

.2 Conduct start-up and testing in following distinct phases:

.1 Included in delivery and installation:

.1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.

.2 Visual inspection of quality of installation.

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

.3 Operational testing: document equipment performance.

.4 System PV: include repetition of tests after correcting deficiencies.

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

.3 Correct deficiencies and obtain approval from Consultant and Cx Authority after distinct phases have been completed and before commencing next phase.

.4 Documents require tests on approved PV forms.

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

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

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

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

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

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

1.15 START-UP DOCUMENTATION

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

.2 Start-up documentation to include:

.1 Factory and on-site test certificates for specified equipment.

.2 Pre-start-up inspection reports.

.3 Signed installation/start-up check lists.

.4 Start-up reports,

.5 Step-by-step description of complete start-up procedures, to permit Departmental Representative to repeat start-up at any time.

1.16 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

.1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.

.2 With assistance of manufacturer develop written maintenance program and submit Departmental Representative for approval before implementation.

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

.4 After completion of commissioning, operate and maintain systems until issuance of certificate of interim acceptance.

1.17 TEST RESULTS

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

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

1.18 START OF COMMISSIONING

.1 Notify Departmental Representative at least 14 days prior to start of Cx.

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

1.19 INSTRUMENTS / EQUIPMENT

.1 Submit to Departmental Representative for review and approval:

.1 Complete list of instruments proposed to be used.

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

.2 Provide the following equipment as required:

.1 2-way radios.

.2 Ladders.

.3 Equipment as required to complete work.

1.20 COMMISSIONING PERFORMANCE VERIFICATION

.1 Carry out Cx:

.1 Under actual operating conditions, over entire operating range, in all modes.

.2 On independent systems and interacting systems.

.2 Cx procedures to be repeatable and reported results are to be verifiable.

.3 Follow equipment manufacturer's operating instructions.

.4 EMCS trending to be available as supporting documentation for performance verification.

1.21 WITNESSING COMMISSIONING

.1 Consultant and Cx Authority to witness activities and verify results.

1.22 AUTHORITIES HAVING JURISDICTION

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

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

.3 Provide copies to Departmental Representative within 10 days of test and with Cx report.

1.23 COMMISSIONING CONSTRAINTS

.1 Commissioning will be undertaken on new equipment and modified equipment provided under this contract. Where these are tied into existing building systems the Cx will need to be coordinated with the building operator.

1.24 EXTRAPOLATION OF RESULTS

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

1.25 EXTENT OF VERIFICATION

.1 Tenant areas:

.1 Provide manpower and instrumentation to verify up to 100% of reported results.

.2 Number and location to be at discretion of Departmental Representative.

.3 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.

.4 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.

.5 Perform additional commissioning until results are acceptable to Consultant and Cx Authority.

1.26 REPEAT VERIFICATIONS

.1 Assume costs incurred by Departmental Representative for third and subsequent verifications where:

.1 Verification of reported results fail to receive Consultant's or Cx Authority approval.

.2 Repetition of second verification again fails to receive approval.

.3 Departmental Representative deems Contractor's request for second verification was premature.

1.27 SUNDRY CHECKS AND ADJUSTMENTS

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

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

1.28 DEFICIENCIES, FAULTS, DEFECTS

.1 Correct deficiencies found during start-up and Cx to satisfaction of Departmental Representative.

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

1.29 COMPLETION OF COMMISSIONING

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

.2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx prior to issuance of Interim Certificate of Completion.

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

1.30 ACTIVITIES UPON COMPLETION OF COMMISSIONING

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

1.31 TRAINING

.1 Provide training in accordance with Section 01 91 41 - Commissioning (Cx) - Training and requirements of Contract Specification Sections.

1.32 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

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

1.33 OCCUPANCY

.1 Cooperate fully with Departmental Representative during stages of acceptance; facility will remain fully occupied.

1.34 INSTALLED INSTRUMENTATION

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

.1 Accuracy complies with these specifications.

.2 Calibration certificates have been deposited with Departmental Representative.

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

1.35 PERFORMANCE VERIFICATION TOLERANCES

.1 Application tolerances:

.1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. Unless noted otherwise in this contract Specifications, to be within +/- 10% of specified values.

.2 Instrument accuracy tolerances:

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

.3 Measurement tolerances during verification:

.1 Unless noted otherwise in this contract Specifications actual values to be within +/- 2 % of recorded values.

1.36 OWNER'S PERFORMANCE TESTING

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

Part 2 Schedules

2.1 CX SCHEDULE FOR MECHANICAL SYSTEMS

.1 Produce schedule of Cx activities in bar chart format to a scale that will ensure legibility. Bar chart to indicate:

.2 Sequences of testing equipment and systems, interrelationship between tests, duration of tests and training periods.

.3 Cx resources which will be committed to this project to ensure completion by prescribed dates Training.

.1 Plan.

.2 Cx Documentation Plan.

.4 Commission as soon as installation is complete, using procedures described in NFPA reference standards to provide protection for exterior envelope of new building during construction.

.5 HVAC systems:

.1 Ductwork, piping and conduit systems that will be concealed to be tested and certified to specified standards before being concealed. This work is specified in relevant technical sections of Division 23.

.2 HVAC systems to be initially started up, "bumped" in a stand-alone mode and pre-start-up inspections completed.

.3 Start after dust-producing construction procedures have been completed and areas are dust-free.

.4 Start HVAC to replace temporary heating systems after Consultant's written approval.

.5 Operate HVAC to permit TAB and ensure full compliance with contract documents when weatherstripping, caulking and sealing of exterior envelope has been completed, and interior partitions and doors are installed and ceiling return plenums are in place.

.6 Hydronic systems:

.1 To be filled, pumps "bumped" in stand-alone mode and pre-start-up inspections completed. Then undertake cleaning and flushing processes.

.2 Commission after exterior envelope has been completed and exterior has been caulked, but only after relevant water treatment systems have been commissioned.

.3 Commission at same time as HVAC systems are being TAB'd.

.7 HVAC and related hydronic systems:

.1 Test in conjunction with EMCS, and fire and smoke detection systems.

.8 Items which have a detrimental effect on operation and maintenance. To receive preliminary attention at this point. To be fully commissioned at same time as relevant equipment and systems.

.9 Vibration isolation and seismic control measures:

.1 Test these measures at same time as connected system.

.10 Equipment and systems subject to specified codes and standards or subject to approval of an authority having jurisdiction:

.1 Commission equipment and systems in accordance with those requirements.

.2 Where testing is required as part of a regulatory process, and where Cx procedures are fully developed, are appropriate to project, ensure tests as required by such codes are performed. Consultant to witness tests as part of Quality Assurance role.

.11 EMCS:

.1 Testing and Cx to be specified in Section 25 01 11 - EMCS: Start-Up, Verification and Commissioning, which defines conditions for acceptance.

.2 Point-by-point and end-to-end testing to be carried out by installation Contractor, monitored by Consultant and CxA and verified as part of system verification.

.3 Demonstration of operation of systems under operating conditions and over full operating range to take place prior to 30-day test period and to be witnessed by Consultant and CxA. Includes simulated opposite-season tests. EMCS programming and operation to be verified after HVAC systems have been TAB'd and to include specified 30-day test period.

.12 To reduce VOC concentrations to acceptable levels:

.1 Flow rates of outside air into HVAC systems to be adjusted as required during Cx, after occupancy and as necessary after occupancy.

.13 Commission mechanical systems and associated equipment as follows:

.1 HVAC and exhaust systems:

.1 HVAC systems (Heat Exchangers, Make-up air units, Air Handling Units, Gas Fired Unit Heaters, Radiant Tube Heaters,)

.2 Exhaust systems.

.2 EMCS (Energy Management Control System:

.1 Entire EMCS system for all new installed systems and equipment from graphic to device (point-to-point) performance verification.

.14 Product Information forms and Performance Verification will be carried out on the following mechanical systems:

.1 Pumps P-1, P-2 and P-3 (PI sample provided) – 100% to be reviewed with Cx Agent after commissioning is complete.

.2 Exhaust fans EF-1 through to EF-10 (PV and PI sample provided) – 100% to be reviewed with Cx Agent after commissioning is complete.

.3 Heat Exchangers HE-1, HE-2, and HE-3 – 100% to be reviewed with Cx Agent after commissioning is complete.

.4 Gas fired unit heaters UH-1A and UH-1B and Gas fired radiant tube heater RTH-1 – 100% to be reviewed with Cx Agent after commissioning is complete

.5 System Fill Tanks GFT-1 and GFT-2 – 100% to be reviewed with Cx Agent after commissioning is complete.

.6 Radiation: 30% to be reviewed with Cx Agent after commissioning is complete.

.7 Testing and Air Balancing Report: 30% to be reviewed with Cx Agent after commissioning is complete.

2.2 SCHEDULE OF ELECTRICAL SYSTEMS

.1 The following is a listing of the building electrical systems to be commissioned:

.1 Motor Starters To 600 V

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Commissioning forms to be completed for equipment, system and integrated system.

.2 Where referred to in other Sections comply also with requirements of Section SW0101R3E Procurement and Installation and Section SW0102R6E Quality Control. The commissioning process for Section SW0101R3E Procurement and Installation and Section SW0102R6E Quality Control will be carried out separate from the base building or other tenant fit-up components.

1.2 INSTALLATION/START-UP CHECK LISTS

.1 Include the following data:

.1 Product manufacturer's installation instructions and recommended checks.

.2 Special procedures as specified in relevant technical sections.

.3 Items considered good installation and engineering industry practices deemed appropriate for proper and efficient operation.

.2 Equipment manufacturer's installation/start-up check lists are acceptable for use. As deemed necessary by Departmental Representative supplemental additional data lists may be required for specific project conditions.

.3 Use check lists for equipment installation. Document check list verifying checks have been made, indicate deficiencies and corrective action taken.

.4 Installer to sign check lists upon completion, certifying stated checks and inspections have been performed. Return completed check lists to Departmental Representative. Check lists will be required during Commissioning and will be included in O&M Manual at completion of project.

.5 Use of check lists will not be considered part of commissioning process but will be stringently used for equipment pre-start and start-up procedures.

1.3 PRODUCT INFORMATION (PI) REPORT FORMS

.1 Product Information (PI) forms compiles gathered data on items of equipment produced by equipment manufacturer, includes nameplate information, parts list, operating instructions, maintenance guidelines and pertinent technical data and recommended checks that is necessary to prepare for start-up and functional testing and used during operation and maintenance of equipment. This documentation is included in the Cx Manual at completion of work.

.2 Prior to Performance Verification (PV) of systems complete items on PI forms related to systems and obtain Consultant and Cx Authority approvals.

1.4 PERFORMANCE VERIFICATION (PV) FORMS

.1 PV forms to be used for checks, running dynamic tests and adjustments carried out on equipment and systems to ensure correct operation, efficiently and function independently and interactively with other systems as intended with project requirements.

.2 PV report forms include those developed by Contractor, and records the measured data and readings taken during functional testing and Performance Verification procedures.

.3 Prior to PV of integrated system, complete the PV forms of related systems and obtain Consultant's and Cx Authority approval.

1.5 COMMISSIONING FORMS

.1 The Consultant will develop and provide the Contractor with final project-specific Commissioning forms in hard-copy format complete with specification data.

.2 Revise items on Commissioning forms to suit project requirements.

1.6 COMMISSIONING VERIFICATION PROCESS

.1 Use Commissioning forms to verify installation and record performance of equipment and systems.

.2 Strategy for Use:

.1 Consultant provides Contractor project-specific Commissioning forms with Specification data included.

.2 Contractor will provide required shop drawings information and verify correct installation and operation of items indicated on these forms.

.3 Confirm operation as per design criteria and intent.

.4 Identify variances between design and operation and reasons for variances.

.5 Verify operation in specified normal and emergency modes and under specified load conditions.

.6 Record analytical and substantiating data.

.7 Reported results will be verified by the Consultant and Cx Authority.

.8 Form to bear signatures of recording technician and reviewed and signed off by Consultant and Cx Authority.

.9 Submit immediately after tests are performed.

.10 Reported results in true measured SI unit values.

.11 Originals of completed forms are to be retained on site during start-up, testing and commissioning period. Maintain in Commissioning Manual binder.

.12 Forms to be hard copy with type written results in Commissioning Manual Binder.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 This Section specifies roles and responsibilities of Training.

1.2 TRAINEES

.1 Trainees: personnel selected for operating and maintaining this facility. Includes Facility Manager, building operators, maintenance staff, security staff, and technical specialists as required.

.2 Trainees will be available for training for purposes of familiarization with systems.

1.3 INSTRUCTORS

.1 Consultant will provide:

.1 Descriptions of systems.

.2 Instruction on design philosophy, design criteria, and design intent.

.2 Contractor and certified factory-trained manufacturers' personnel: to provide instruction on the following:

.1 Start-Up, operation, shut-down of equipment, components and systems.

.2 Control features, reasons for, results of, implications on associated systems of, adjustment of set points of control and safety devices.

.3 Instructions on servicing, maintenance and adjustment of systems, equipment and components.

.3 Contractor and equipment manufacturer to provide instruction on:

.1 Start-up, operation, maintenance and shut-down of equipment they have certified installation, started up and carried out PV tests.

1.4 TRAINING OBJECTIVES

.1 Training to be detailed and duration to ensure:

.1 Safe, reliable, cost-effective, energy-efficient operation of systems in normal and emergency modes under all conditions.

.2 Effective on-going inspection, measurements of system performance.

.3 Proper preventive maintenance, diagnosis and trouble-shooting.

.4 Ability to update documentation.

.5 Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

1.5 TRAINING MATERIALS

.1 Instructors to be responsible for content and quality.

.2 Training materials to include:

.1 "As-Built" Contract Documents.

.2 Operating & Maintenance Manual.

.3 TAB and PV Reports.

.3 Departmental Representative will review training manuals.

.4 Training materials to be in a format that permits future training procedures to same degree of detail.

.5 Supplement training materials:

.1 Transparencies for overhead projectors.

.2 Multimedia presentations.

.3 Manufacturer's training videos.

.4 Equipment models.

1.6 SCHEDULING

.1 Include in Commissioning Schedule time for training.

.2 Deliver training during regular working hours, training sessions to be for duration specified in relevant Specification Sections.

.3 Training to be completed prior to acceptance of facility.

1.7 RESPONSIBILITIES

.1 Be responsible for:

.1 Implementation of training activities,

.2 Coordination among instructors,

.3 Quality of training, training materials,

.2 Departmental Representative will evaluate training and materials.

.3 Upon completion of training, provide written report, signed by Instructors, with complete list of attendees, and witnessed by Consultant and Cx Authority.

.4 Coordination with Departmental Representative.

1.8 TRAINING CONTENT

.1 Training to include demonstrations by Instructors using the installed equipment and systems.

.2 Content includes:

.1 Review of facility and occupancy profile.

.2 Functional requirements.

.3 System philosophy, limitations of systems and emergency procedures.

.4 Review of system layout, equipment, components and controls.

.5 Equipment and system start-up, operation, monitoring, servicing, maintenance and shut-down procedures.

.6 System operating sequences, including step-by-step directions for starting up, shut-down, operation of valves, dampers, switches, adjustment of control settings and emergency procedures.

.7 Maintenance and servicing.

.8 Trouble-shooting diagnosis.

.9 Interaction among systems during integrated operation.

.10 Review of O&M documentation.

.3 Provide specialized training as specified in relevant Sections of the Specifications.

1.9 ADDITIONAL REQUIREMENTS FOR CSC SPECIFIC SYSTEMS

.1 The contractor shall provide, install and test the new security electronics equipment and verify that systems are fully functional. The new systems shall meet or exceed all of the performance and operational requirements contained in the SOW's, specifications and standards listed in the specifications.

.2 Operator Training

.1 The contractor shall prepare and present a one-day training course on each system, in English and French, to two groups with five Operator/Trainers in each group, responsible for the operation of the equipment in accordance with the specification ES/SOW-0101 Statement of Work. The course shall concentrate on the features and proper operation of the installed systems. The course shall be presented on the site within two weeks of the successful acceptance testing of the system.

.3 Maintenance Training

.1 The contractor shall prepare and present a two-day training course on each system, in English, to five persons responsible for the maintenance of the equipment. The course shall concentrate heavily on the material contained in the technical manual and site manual. The course shall be presented on the site within two weeks of the successful acceptance testing of the system.

.4 Manuals

.1 The contractor shall provide the operator and technical manuals, in PDF and hard copy format, in English and French, in accordance with the specification ES/SOW-0101 Statement of Work. The contractor shall provide ten copies of the operator manual in English, and one copy of the maintenance manual in French and to the site. The contractor shall provide 1 hard copy and 2 disk copies of the operator and maintenance manuals to the CSC Technical Authority. Maintenance manuals shall all include completed ATP forms. The contractor shall provide copies of the completed Maintenance Handover Report Form.

.5 As-Built Drawings

.1 The contractor shall provide as-built drawings of the site installation in AutoCAD 2010 format and in accordance with specification ES/SOW Statement of Work. The contractor shall provide four copies of the as-built drawings to the CSC Technical Authority.

.6 Software

.1 The contractor shall provide CD copies of any system software in accordance with specification ES/SOW-0101 Statement of Work. The contractor shall provide two copies of the software to the site, one to the CSC Technical Authority.

END OF SECTION

Part 1 General

1.1 GENERAL CONDITIONS

.1 The General Conditions of the Contract, Supplementary General Conditions and General Requirements are hereby made part of this section.

1.2 WORK INCLUDED

.1 Form for all cast-in-place concrete indicated on drawings and subsequently remove all such forms.

1.3 RELATED WORK

.1	Concrete Reinforcing	Section 03 20 00
.2	Cast-in-Place Concrete	Section 03 30 00
.3	Concrete Finishing	Section 03 35 00
.4	Structural Steel for Buildings	Section 05 12 23
.5	Metal Fabrications	Section 05 50 00

1.4 DESIGN AND CODE REQUIREMENTS

.1 Formwork and supporting falsework shall be designed and constructed in accordance with the requirements of CAN/CSA S269.3-M92 (R2008) and CAN/CSA -A23.1-09 as applicable to the work.

.2 Assume full responsibility for the design and for the adequacy and safety of all formwork and falsework.

.3 Retain a professional engineer to design falsework which consists of shoring more than one tier in height or which is a framed structure.

.4 The design and erection of formwork and related supporting works shall comply with construction safety legislation and regulations.

1.5 HANDLING AND STORAGE

.1 Deliver, handle and store formwork materials to prevent weathering, warping or damage detrimental to the strength of the materials or to the surface to be formed.

.2 Ensure that formwork surfaces which will be in contact with concrete are not contaminated by foreign matter. Handle and erect the fabricated formwork so as to prevent damage.

Part 2 Products

2.1 QUALITY AND STRENGTH

.1 The quality and strength of formwork material shall comply with the requirements set forth in this Specification and CAN/CSA A23.1-09.

2.2 FINISHES

.1 Form materials for concrete surfaces which will be exposed to view, or which require smooth and uniform surfaces for applied finishes or other purposes, shall consist of square edges, smooth panels of plywood, metal or plastic to approval of the Consultant. The panels shall be square and made in a true plane, clean, free of holes, surface markings and defects.

.2 Square edged, tongue and groove or shiplap lumber may be used to form concrete which will not be exposed to view or which does not require smooth uniform surface for other purposes.

2.3 MATERIALS

.1 Form plywood: exterior grade, Douglas Fir conforming to CSA Standard O121-08. Plywood shall be resin coated one side (in contact with concrete). Use sound undamaged plywood with clean true edges. Make up or patching strips between panels shall be kept to a minimum.

.2 Lumber for forms, falsework, shoring and bracing: conform to CAN/CSA O141-05 (R2009) for Softwood Lumber, and the applicable authorized grading authority. All lumber shall be a grade to which allowable unit stresses may be assigned in accordance with the National Building Code. All lumber shall be grade marked by the authorized grading authority.

.3 Form Ties: Fabricated units having a minimum working strength when assembled of 21 MPa and shall be adjustable in lengths to permit tightening and alignment of forms. Ties shall be made with breakback ends or other means of removing the tie end to a depth of at least 25 mm from the concrete surface, after the forms are removed. Flat tie for Architectural exposed concrete to include plastic cones leaving no metal within 20 mm of surface.

.4 Form release agent: Proprietary material which will not stain the concrete or impair the natural bonding or colour characteristics of coating intended for use on the concrete.

.5 Waterstops: Purpose made polyvinyl chloride; 12 MPa minimum tensile strength, -46^0 C. to $+70^0$ C working temperature range, conforming to CGSB 41 GP 35M, Type 2.

.6 Tubular column forms: round spirally wound laminated fibre forms, internally treated with release material.

.7 Dovetail anchor slots: minimum 0.6 mm galvanized steel with insulation filled slots.

.8 Pre-moulded joint fillers:
- .1 Bituminous impregnated fibreboard: ASTM D1751-73.
- .2 Vinyl Foam: to ASTM D1752-67 (1973) Type I, flexible grade.
- .3 Standard Cork: to ASTM D1752-67 (1973) Type II.

Part 3 Execution

3.1 CONDITION OF SURFACES

.1 Examine the excavations and foundations for adequate working room and support for the work of this section.

.2 Verify lines, levels and centre lines before proceeding with the work and ensure that dimensions agree with drawings.

.3 Report to the Consultant discrepancies in other work which affect the work of this section.

3.2 PREPARATION

.1 Coat the inside surfaces of forms with a form release agent, used in accordance with the manufacturer's instructions.

.2 Apply the agent prior to placing reinforcing steel, anchoring devices and embedded parts.

3.3 ASSEMBLY AND ERECTION

.1 Construct the formwork and shoring and bracing to meet the design and code requirements, accurately so that the resultant finished concrete shall conform to the shapes, lines and dimensions shown on the drawings, within the specified tolerances.

.2 Formwork shall be so arranged and assembled as to permit easy dismantling and stripping so that the concrete will not be damaged during its removal.

.3 Review locations of ties and form panels for exposed concrete work with the Consultant.

.4 Check and correct formwork as required, both horizontally and vertically, during the placing of the concrete.

.5 Construct formwork to maintain the following maximum tolerances:

.1 Deviation from horizontal and vertical lines:
6 mm in 3000 mm
20 mm in 12000 mm.

.2 Deviation of building dimensions indicated on Drawings and position of columns, walls and partitions:
6 mm.

.3 Deviation in cross sectional dimensions of columns or beams or in thickness of slabs and walls:
± 6 mm.

.4 Camber slabs and beams:
10 mm per 3000 mm of span unless indicated on drawings.

.6 Obtain Consultant's approval for use of earth forms.

3.4 JOINTS IN FORMS

.1 Make form joints tight in order to prevent leakage of mortar.

.2 Clean all edges and contact surfaces before erection.

.3 Where required, install pvc waterstop to manufacturer's instructions and without displacing reinforcement. Do not distort or pierce waterstop.

3.5 SHORING AND BRACING

.1 Provide bracing to ensure the stability of the formwork as a whole.

.2 Prop or strengthen all previously constructed parts liable to be overstressed by construction loads.

.3 Arrange forms to allow stripping without removal of the principal shores, where these are required to remain in place.

3.6 EMBEDDED PARTS AND OPENINGS

.1 Provide formed openings where required for pipes, conduit, sleeves and other work to be embedded in and passing through concrete members. Accurately locate and set in place items which are to be cast directly into the concrete. Co-ordinate the work of other sections and co-operate with the trade involved in the forming and setting of openings, slots, recesses, chases, sleeves, bolts, anchors and other inserts. No such forming or setting of openings, slots, recesses, chases, sleeves, or parts shall be done unless specifically shown on the drawings or approved prior to installation.

.2 Obtain Consultant's approval before framing openings in concrete beams or columns not specifically detailed on structural drawings.

.3 Provide temporary ports or openings where required to facilitate cleaning and inspection. Openings at the bottom of forms shall be located so that flushing water will drain from the forms.

.4 Close the temporary ports or openings with tight fitting panels, flush with the inside face of the forms, neatly fitted so that the joints will not be apparent in exposed concrete surfaces.

.5 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval in writing or all modifications from the Consultant before placing concrete.

.6 Install continuous vertical anchor slots where concrete walls or columns are masonry faced. Co-ordinate extent and locations of anchor slots with spacing of masonry ties as specified in Division 4.

3.7 FIELD QUALITY CONTROL

.1 Inspect and check the completed formwork, shoring and bracing to ensure that the work is in accordance with the formwork design, and that the supports, fastenings, wedges, ties and parts are secure. The Engineer responsible for the design of the formwork shall assist in this inspection.

.2 Inform the Consultant when the formwork is complete and has been cleaned. Obtain the approval of the engineer responsible for the design of the formwork and the general approval of the Consultant before placing concrete.

3.8 CLEANING

.1 Clean the forms as erection proceeds to remove foreign matter.

.2 Remove cuttings, shavings and debris from within the forms.

.3 Flush the completed forms with water or air jet to remove remaining foreign matter. Ensure that water and debris drain to the exterior through the clean-out ports.

3.9 WINTER CONSTRUCTION

.1 Remove ice and snow from within the forms.

.2 The use of de-icing salts will not be permitted.

.3 Unless formwork and concrete construction proceed within a heated enclosure, do not use water to clean out completed forms. Use compressed air or other means to remove foreign matter.

3.10 REMOVAL OF FORMWORK

.1 Notify the Consultant before removing formwork.

.2 Remove formwork progressively and in accordance with the reference code requirements, and so that no shock loads or imbalanced loads are imposed on the structure.

.3 Do not remove forms and shoring before concrete has attained sufficient strength to ensure safety of structure. If evidence to verify concrete strength is not available, the forms and shores shall not be removed before the following minimum intervals after concrete is placed.

.1 Footings, walls and grade beams - 4 days.

.2	Columns	- 7 days.
.3	Beams, soffits and slabs	- 21 days.

.4 Loosen forms carefully. Do not wedge pry bars, hammers or tools against concrete surfaces.

.5 Leave forms loosely in place, against vertical surfaces, for protection until complete removal is approved by Consultant.

.6 Store removed forms, for exposed architectural concrete, in a manner that surfaces to be in contact with fresh concrete will not be damaged. Marked or scored forms will be rejected.

.7 Re-shore structural members where required due to design requirements or construction conditions and as required to permit progressive construction.

.8 Remove forms not directly supporting weight of concrete as soon as stripping operations will not damage concrete.

.9 Re-use of formwork and falsework is subject to the requirements of CAN/CSA A23.1-09.

END OF SECTION

Part 1 General

1.1 GENERAL CONDITIONS

.1 The General Conditions of the Contract, Supplementary General Conditions and General Requirements are hereby made a part of this section.

1.2 WORK INCLUDED

.1 Furnish and install all bonded reinforcement and associated items required and/or indicated on the Drawings for all cast-in-place concrete and reinforced masonry work.

1.3 RELATED WORK

.1	Bored Piles	Section 31 63 00
.2	Concrete Forming and Accessories	Section 03 10 00
.3	Cast-in-Place Concrete	Section 03 30 00
.4	Concrete Finishing	Section 03 35 00
.5	Concrete Unit Masonry	Section 04 22 00

1.4 INSPECTION AND TESTING

.1 Upon request, provide certified copy of mill test report of steel supplied, showing physical and chemical analysis.

1.5 REFERENCE STANDARDS

.1 Do reinforcing work in accordance with CAN/CSA A23.1-09 and welding of reinforcement with CSA W186-M1990 (R2007).

1.6 SUBMITTALS

.1 Prepare, check and submit reinforcing steel and mesh placing drawings and bar bending and cutting schedules for all steel reinforcement shown or specified in accordance with General Conditions.

.2 All drawings and schedules shall be prepared and checked under the direct supervision of a qualified professional engineer who is experienced in this work.

.3 Clearly indicate bar sizes, spacing, location and quantities of reinforcement, mesh, chairs, spacers and hangers with identifying code marks to permit correct placement without reference to structural drawings; to ACI - 315 Manual of Standard Practice and Metric Supplement 1977 by Reinforcing Steel Institute of Ontario.

.4 Design and detail lap lengths and bar development lengths to CAN3 A23.3-04, unless specified on drawings.

.5 Review of shop drawings for size and arrangement of principal and auxiliary members only. Such review will not relieve the Contractor of responsibility for general and detail dimension and fit, or any errors or omissions.

1.7 SUBSTITUTES

.1 Substitution of different size bars permitted only upon written approval of the Consultant.

1.8 DELIVERY AND STORAGE

.1 Reinforcing steel, welded wire fabric and accessories shall be delivered, handled and stored in a manner which prevents contamination from bond reducing or foreign matter and damage to its fabricated form.

Part 2 Products

2.1 MATERIALS

.1 *All reinforcing steel:* unless noted otherwise on the drawings or herein shall be deformed bars of new billet steel conforming to the current CAN/CSA G.30.18-09 Grade 400, plain finish for all bars. Minimum splice for 10 M bars to be 450 mm. Minimum lap splice for all other bars to be 36 bar diameters or 675 mm, whichever is greater.

.2 *Tie wires:* shall be 1.29 mm or heavier annealed wire or a patented system approved by the Consultant.

.3 *Mechanical splices:* subject to the approval of the Consultant.

2.2 FABRICATION

.1 Fabricate bends, splices and ties and supply bar supports and accessories in accordance with the requirements of CAN-A23.3-04. Spacing and arrangements of supports in accordance with ACI 315.

.2 All intermediate grade reinforcing bars shall be bent cold without hickeying. All high strength steel shall be preheated.

.3 Reinforcing bars shall not be straightened or rebent.

.4 Location of reinforcement splices not shown on the drawings subject to approval by the Consultant and shall, for beams and slabs be away from points of maximum stress in the steel.

.5 *Welding of reinforcing bars:* use only weldable bars, preheat and weld to CSA W186-1990 (R2007).

Part 3 Execution

3.1 EXAMINATION

.1 Examine the work upon which this section depends and report any discrepancies to the Consultant.

.2 Commencement of the work shall imply acceptance of conditions.

3.2 PLACING

.1 Reinforcement of the size and shapes shown on the drawings shall be accurately placed in accordance with the approved shop drawings, the structural drawings and the requirements of the current National Building Code.

.2 Clear distances between parallel bars, except for columns, shall be not less than 1.4 times the diameter of the bar, or 30 mm or 1.4 times the maximum size of the coarse aggregate. Bars placed in two or more layers shall be placed directly above and below each other.

.3 Clear distance between bars in columns shall be not less than 1½ the nominal diameter of the bar or 40 mm or 1½ times the maximum size of the coarse aggregate.

.4 Reinforcing steel shall, where not otherwise shown on the structural drawings, be protected by the clear cover of concrete over the reinforcement as follows:

.1 Where concrete is formed against earth, not less than 75 mm.

.2 Where concrete placed against forms is to be exposed to the weather or be in contact with the ground, not less than 50 mm for bars larger than 15 M, and not less than 40 mm for bars 15 M and smaller.

.3 In slabs and walls not exposed to the ground or weather, not less than 20 mm.

.4 In beams, girders and columns not exposed to the ground or weather, not less than 40 mm to principal reinforcement, ties and stirrups.

The foregoing clear covers shall be maintained within 5 mm.

.5 Reinforcement shall be adequately supported by metal chairs, spacers or hangers and secured against displacement within the tolerance permitted and in accordance with the latest ACI Standard 315.

.6 For slabs on grade, footings or similar construction, concrete blocks may be used in place of metal chairs.

.7 Unless specifically detailed otherwise, supply and install additional 10 M bars by 2400 long at 300 mm centres above all steel floor beams supporting open web steel floor joists. Bars to be centred above beam and placed with 25 mm cover to top of slab. Provide 1 - 15 M carrier bar below for chairing.

.8 Unless detailed otherwise, all exterior slabs, walks and pads abutting building foundations to be dowelled with 15 M at 400 on centre, extending minimum 750 into slab.

.9 Review with the Consultant, placement of reinforcement prior to concreting.

.10 Notify the Consultant twenty-four (24) hours prior to placing concrete.

3.3 CLEANING

.1 All materials shall be clean and free of all form oil or deleterious materials.

.2 All deleterious material shall be removed from the surface of the reinforcing steel in a manner acceptable to the Consultant.

3.4 WELDING

.1 Do welding to meet requirements of CSA W186-M1990 (R2007). Have welding performed by workmen qualified under CSA W47.1-09. Welding only by written authority of the Consultant.

END OF SECTION

Part 1 General

1.1 GENERAL CONDITIONS

.1 The General Conditions of the Contract, Supplementary General Conditions and General Requirements are hereby made part of this section.

1.2 WORK INCLUDED

.1 Cast-in-Place Concrete required for this work is indicated on drawing and includes, but is not necessarily limited to:

.1 Concrete Beams and Pedestals
.2 Concrete Slabs
.3 Concrete Columns and Walls
.4 Concrete Toppings
.5 Miscellaneous Concrete
.6 Finishing of all Formed Concrete Surfaces.

1.3 RELATED WORK

.1	Bored Piles	Section 31 63 00
.2	Concrete Forming and Accessories	Section 03 10 00
.3	Concrete Reinforcing	Section 03 20 00
.4	Concrete Finishing	Section 03 35 00
.5	Structural Steel for Buildings	Section 05 12 23
.6	Metal Fabrications	Section 05 50 00

1.4 QUALITY ASSURANCE

.1 Provide at least one person who shall be present at all times during execution of this portion of the Work and who shall be thoroughly trained and experienced in placing the types of concrete specified and who shall direct all work performed under this Section.

.2 For finishing of exposed surfaces of the concrete, use only thoroughly trained and experienced journeyman concrete finishers.

.3 Perform cast-in-place concrete work to requirements of CAN/CSA-A23.1-09 - "Concrete Materials and Methods of Concrete Construction".

1.5 PRODUCT HANDLING

.1 Use all means necessary to protect cast-in-place concrete materials before, during and after installation and to protect the installed work and materials of all other trades.

.2 In the event of damage, immediately make all repairs and replacements necessary to approval of the Consultant and at no additional cost to the Owner.

1.6 INSPECTION AND TESTING

.1 Inspection and testing will be performed by a firm approved by the Consultant and paid for by the Contractor. Unless approved otherwise, the testing agency must perform all aspects of testing including cylinder preparation.

.2 Provide free access to all portions of work and co-operate with appointed firm.

.3 Submit proposed mix design for each class of concrete to Consultant for approval two (2) weeks prior to commencement of work.

.4 Tests of cement and aggregates may be performed to ensure conformance with requirements stated herein.

.5 One concrete test, consisting of three test cylinders, will be taken for every 50 cubic meters or less of each class of concrete placed. One cylinder to be tested at seven (7) days, the remaining two cylinders to be tested at twenty-eight (28) days.

.6 One (1) additional test cylinder will be taken during cold weather concreting, and be cured on job site under same conditions of concrete it represents.

.7 One (1) slump test and one (1) air content test will be taken for each set of test cylinders taken.

.8 Testing of concrete will be performed in accordance with CAN/CSA-A23.2-09 "Method of Test for Concrete".

.9 Test results will be issued to the Contractor, Consultant and Owner. Test reports are to be numbered consecutively beginning with number one.

.10 Required retesting will be paid for by the Contractor.

.11 The Consultant may order additional testing any time even though the required tests indicate the strength requirements have been met. In this instance, the Owner will pay for those tests that meet the specified requirements and the Contractor will pay for those that do not.

.12 Non-destructive methods for testing concrete shall be according to CAN/CSA A23.2-09.

1.7 SHOP DRAWINGS

.1 Submit shop drawings in accordance with General Conditions.

.2 Prepare and submit to the Consultant for review, shop drawings showing detailed layout of form dimensions, form joint fitting, form sealing and placement, location of openings and placement of form ties. Submit a detailed description of the exact construction method to be used, for all area designated as sand blasted finish, exposed aggregate finish and architectural exposed concrete.

Part 2 Products

2.1 CONCRETE MATERIALS

.1 *Cement:* Normal - N and Sulphate Resistant - HS Portland Type, to CSA A3000-08 - "Portland Cements".

.2 *Fine and Coarse Aggregates:* conforming to CAN/CSA-A23.1-09 - "Concrete Material and Methods of Concrete Construction".

.3 *Fine and Coarse Aggregates:* conforming to CAN/CSA-A23.1-09 - "Concrete Materials and Methods of Concrete Construction". The fine and coarse aggregate for concrete floor slabs and finish toppings shall contain a maximum of 0.4% low density particles as determined by CSA Test A23.2-09 "Low Density Material in Aggregate". Test results shall be submitted to Consultant for review.

.4 *Water:* clean and free from injurious amounts of oil, alkali, organic matter, or other deleterious material.

2.2 ADMIXTURES

.1 *Air Entrainment:* to ASTM C260-06 - "Air-Entraining Admixtures for Concrete".

.2 *Chemical:* to ASTM C494-08a - "Chemical Admixtures for Concrete"; water reducing, strength increasing type WN - normal setting.

.3 *Pozzolanic Mineral:* to CSA A3000-08 "Supplementary Cementing Materials and Their Use in Concrete Construction", fly ash permitted only as approved by Consultant.

2.3 ACCESSORIES

.1 *Vapour Barrier:* 6 mil polyethylene film, to CGSB 70-GP-1a, Type 1 - low permeance heavy duty.

.2 *Curing Compounds:* shall conform to the requirements of the latest issue of ASTM Standard C309.

.3 *Non-shrink Grout:* premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 20 MPa at 3 days and 50 MPa at 28 days. CPD Non Shrink Grout by CPD Construction Products or approved equivalents.

.4 *Void Form:* **to comply with either of the following:**

.1 Biodegradable Void Form: biodegradable, 150 mm deep, structurally sufficient to support weight of wet concrete and other superimposed loads without collapsing until concrete has gained sufficient strength to support these loads after which time the form must promptly degrade. Do not wrap void form. Do not place void form on poly ground sheet. The onus is entirely on the Contractor and Supplier to ensure that the void form is installed to perform as intended.

.2 Compressible Void Form: GeoVoid (below slabs) or Geospan (below grade beams) compressible void form by Plasti-Fab designed for 150 mm soil heave, installed to supplier's specifications.

.5 *Joint Filler:* pre moulded bituminous impregnated cane fibre board Flexcell as manufactured by Sternson or approved equal.

.6 *Concrete Expansion Anchors:* to be Hilti Kwik-Bolt or approved equivalent. Sized as per drawings. Minimum embedment length of all Hilti Kwik-Bolt to be 150 mm unless noted otherwise.

.7 *Concrete Inserts with Bolt Extension:* Concrete inserts to be Hilti HKD Anchors or approved equivalent, sized as detailed on drawings. Bolt extensions to be mild steel threaded extensions sized as detailed on drawings.

.8 *Concrete Patching Material:* pre-packaged, polymer modified, cementitious product containing graded natural aggregate, Planitop X - Rapid Setting Mortar as manufactured by MAPEI Inc.

2.4 CONCRETE MIXES

.1 Mechanical mix concrete in accordance with the requirements of CAN/CSA A23.1-09.

.2 All concrete shall have the following minimum properties.

Based on 2010 National Building Code

Location	Exposure Class	Comp. Strength (MPa) and Age	Aggregate	Air Entrainment	Slump
1. Piling	S-2	32 @ 56 d	40	3 – 6	80 ± 30
2. Pilecaps	S-2	32 @ 56 d	20	4 – 7	80 ± 30
3. Interior Grade Supported Slab	N	25 @ 28 d	20	0	80 ± 30

Minimum cement content for Type N or HS cement to be 280 kg/m3.
Maximum free water/cement ratio for Type N or HS cement to be 0.5.

Semi-lightweight concrete to have unit weight of 2075 ± 75kg/m3.
Lightweight concrete to have unit weight of 1850 ± 75 kg/m3.

.3 Each load of ready-mixed or transit-mixed concrete delivered to the project site shall be accompanied by duplicate delivery slips providing the following information:

.1 Name of ready-mix batch plant
.2 Serial number of ticket
.3 Date and truck number
.4 Name of contractor
.5 Specific designation of project
.6 Specific class of concrete
.7 Amount of concrete in cubic metres

.8 Time of loading or first mixing of aggregate, cement and water.

Part 3 Execution

3.1 INSPECTION

.1 Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

.2 Verify that all items to be embedded in concrete are in place.

.3 Verify that concrete may be placed to the lines and elevations indicated on the Drawings, with all required clearance from reinforcement.

3.2 DISCREPANCIES

.1 In the event of discrepancy, immediately notify the Consultant.

.2 Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.3 PREPARATION

.1 Remove all wood scraps and debris from the formed areas in which concrete will be placed.

.2 Thoroughly clean the forms to ensure proper placement and bonding of concrete.

.3 Thoroughly wet the forms, except in freezing weather, or oil them; remove all standing water.

.4 Thoroughly clean all transporting and handling equipment.

3.4 PLACING CONCRETE

.1 Place concrete in accordance with requirements of CAN/CSA A23.1-09 and as indicated on Drawings.

.2 Notify Consultant and Inspection and Testing Firm a minimum of twenty-four (24) hours prior to commencement of concreting operations.

.3 Ensure all anchors, seats, plates and other items to be cast into concrete are placed, held securely and will not cause undue hardship in placing concrete.

.4 Maintain accurate records of poured concrete items. Record date, location of pour, quantity, air temperature and test samples taken.

.5 Ensure reinforcement, inserts, embedded parts, formed joints and fitments are not disturbed during concrete placement.

.6 Prepare previously placed concrete by cleaning with steel brush.

.7 Pour concrete continuously between predetermined construction and control joints. All construction joints subject to approval of the Consultant.

.8 Approval to place concrete shall be contingent on the formwork and reinforcing steel placement and evidence that the Contractor can place the planned casting without stopping.

.9 Pour slabs on grade in checkerboard pattern or saw cut, as indicated on Drawings. Saw cut control joints within twenty-four (24) hours after finishing. Use 6 mm thick blades, cutting 20 mm into depth of slab thickness. Vacuum clean saw cut prior to installation of sealant.

.10 Excessive honeycomb or embedded debris in concrete is not acceptable. Remove and replace defective concrete. Excessive honeycomb is when eraser end of a pencil fits into cavity.

3.5 COLD WEATHER REQUIREMENTS

.1 When the air temperature is at or below 5^0 C. or when there is a probability of it falling to this limit during the placing or curing period, cold weather requirements shall be applicable.

.2 Provide heating equipment or heating plant on the job ready for use when concrete is being placed during cold weather. Such equipment shall be adequate for the purpose of maintaining the required temperature during the placing and curing of the concrete. The methods used for heating shall be approved by the Consultant. Equipment inducing carbon monoxide gas in the building shall not be accepted.

.3 Concrete shall not be placed on or against reinforcement, formwork, ground or any surface that is at a temperature less than 5^0 C.

.4 The temperature of the concrete at all surfaces shall be maintained at not less than 15^0 C for three (3) days, or at not less than 10^0 C for five days after placing. Means shall be provided to humidify the air within enclosures and to keep the concrete and formwork continuously moist if dry heat is used. The concrete shall be kept above freezing temperature for a period of seven (7) days, and shall be kept from alternate freezing and thawing for at least fourteen (14) days after placement.

.5 At the end of the specified protection period the temperature of the concrete shall be reduced gradually at a rate not exceeding that shown in CAN/CSA A23.1-09.

.6 Accelerator or so-called anti-freeze compounds shall ***not*** be permitted unless otherwise approved in writing by the Consultant.

.7 All protective coverings shall be kept clear of the concrete and form surfaces to permit free circulation of air and shall be maintained intact for at least twenty-four (24) hours after artificial heat is discontinued.

3.6 HOT WEATHER REQUIREMENTS

.1 When the air temperature exceeds 27^0, hot weather requirements shall be applicable.

.2 Time of initial mixing to complete discharge shall not exceed 1 hour and 15 minutes and concrete placed shall not exceed 27^0.

.3 Concrete forming surfaces and reinforcing steel shall be sprinkled with cool water just prior to placing concrete. Standing water or puddles shall be removed prior to concrete placement.

.4 Special wind protection will be required as directed by the Consultant.

.5 Columns, walls, beams and slabs shall be kept continuously damp for twenty-four (24) hours by normal curing procedures as outlined by this Specification. Slabs cured by the applications of sealing, shall have curing compound applied immediately after finishing of the slab but before evaporation of surface moisture.

.6 The use of water reducing agents shall be subject to the approval of the Consultant when hot weather conditions prevail.

3.7 DEFECTIVE CONCRETE

.1 Concrete not meeting the requirements of the Specifications and drawings shall be considered defective concrete.

.2 Concrete not conforming to the lines, details and grade specified herein or as shown on the drawings shall be modified or replaced at the Contractor's expense and to the satisfaction of the Consultant. Finished lines, dimensions and surfaces shall be correct and true within tolerances specified in the Formwork Section of these Specifications.

.3 Concrete not properly placed resulting in excessive honeycombing and all honeycombing and other defects in critical areas of stress, shall be repaired or replaced at the Contractor's expense and to the satisfaction of the Consultant.

.4 Concrete of insufficient strength or improper consistency shall be, as required by the Consultant, subject to one or more of the following:

.1 Changes in mix proportions for the remainder of the work.

.2 Cores drilled and tested from the areas in question as directed by the Consultant and in accordance with CAN/CSA A23.2-09. The test results shall be indicative of the in-place concrete.

.3 Load testing of the structural elements in accordance with CAN3 A23.3-04.

.4 The changes in the mix proportions and the testing shall be at the Contractor's expense.

.5 Concrete failing to meet the strength requirements of this Specification shall be strengthened or replaced at the Contractor's expense and to the satisfaction of the Consultant.

3.8 PATCHING CONCRETE

.1 After the removal of the forms concrete surfaces may be subject to inspection by the Consultant.

.2 All exposed metal form ties, nails, wires, shall be removed, fins broken off and all loose concrete removed.

.3 Form tie pockets shall be thoroughly wetted and patched with patching concrete followed by proper curing.

.4 Honeycombed and other defective surfaces shall be chipped away to a depth of not less than 25 mm with the edges perpendicular to the surface, thoroughly wetted and patched with patching concrete followed by proper curing.

.5 Patching concrete shall be thoroughly compacted into place and finished in such a manner as to match the adjoining concrete. The design mix of the patching concrete shall be approved by the Consultant.

3.9 FINISHING OF FORMED SURFACES

.1 On all exposed formed concrete surfaces, except at unfinished areas: remove blemishes, formwork joint marks by rubbing with carborundum block and water. Leave finished surfaces smooth, unmarred. Complete rubbing within twenty-four (24) hours for stripping formwork.

3.10 ANCHOR BOLTS AND WELDMENTS

.1 Set anchor bolts and weldments to the following tolerances:

.1 Alignment: ± 3mm of location, plumb and true.
.2 Projection: ± 6mm of elevations called for.

3.11 BASE PLATES GROUTING

.1 Mix and place as per Manufacturer's specifications. Pack grout tightly under plates and leave no voids. Neatly finish edges.

3.12 EQUIPMENT PADS

.1 Provide concrete pads for equipment where and as indicated on Drawings.

.2 Insert bolts and sleeves and pack solidly with non-shrink grout, in accordance with setting details and templates.

.3 Steel trowel top surfaces smooth. Tool edges.

3.13 CONCRETE TOPPING

.1 All concrete toppings indicated on drawings are to be bonded toppings.

.2 Concrete toppings are to be bonded by either of the following methods unless specifically directed:

.1 Application of cement/bonding agent/sand grout to prepared base course in accordance with CAN/CSA A23.1-09, Clause 7.6.4.2.2 (b).
.2 Application of approved bonding agent to prepared base course.

.3 The following toppings are to be bonded specifically by application of approved bonding agent:

.1 All toppings cast over existing slabs.
.2 All interior toppings.

.4 New concrete slabs which are to receive toppings are to be prepared in accordance with CAN/CSA A23.1-09, Clause 23 and Section 03 35 00.

.5 Existing concrete slabs which are to receive toppings are to be prepared in accordance with Specification Section 03 35 00 and as detailed on the Drawings.

END OF SECTION

Part 1 General

1.1 GENERAL CONDITIONS

.1 The General Conditions of the Contract, Supplementary General Conditions and General Requirements are hereby made part of this section.

1.2 WORK INCLUDED

.1 Finish separate floor toppings, slabs on fill and monolithic floor slabs.

.2 Apply concrete hardener, sealer.

.3 Cure finished surfaces.

1.3 RELATED WORK

.1 Cast-in-Place Concrete Section 03 30 00

Part 2 Products

2.1 COMPOUNDS/HARDENERS/SEALERS

.1 *Non-metallic Surface Sealer:* premixed natural mineral type; "Eurocure 700, by Elsro Ltd., "Flor Seal" by Sternson Ltd., "Master Seal" by Master Builders, "Sealtight CS-309" by W. R. Meadows or approved equal.

Part 3 Execution

3.1 FLOOR FINISHING

.1 All concrete slabs noted in Architect's Room Finish Schedule as receiving application of Penetrating Epoxy Sealer are to be final finished with a swirl trowel finish suitable for the application of penetrating type epoxy sealer. Slab is to be finished to a hard, smooth surface free from blemishes. Final finish to achieve a “flat” floor in accordance with CAN/CSA A23.1, Clause 7.5.6.1 to produce floor surface of pleasing appearance, easily cleaned and maintained with high wear-resistance qualities. Maintain surface flatness with maximum variation of 5 mm in 3 M and absolute maximum of ± 6 mm. Co-ordinate suitable curing method for slabs where penetrating type of sealer is used. Supplier's representative must be on site prior to application to advise on finishing procedures and application rate. Apply sealer at rate recommended for medium traffic in a minimum of two passes.

.2 Apply concrete Surface Sealer on floor surfaces noted in Architect's Room Finish Schedule as exposed concrete. Apply strictly in accordance with manufacturer's recommendations.

3.2 CURING AND PROTECTION

.1 All equipment needed for the curing and protection of the concrete shall be on hand and ready for use before actual placing is started.

.2 All exposed non-formed surfaces shall be kept continuously moist for a minimum of seven consecutive days after placement of the concrete. The water for curing shall be clean and free from any materials that will cause staining or discolouration of the concrete. A liquid, membrane forming, curing compound shall be used under circumstances where the application of moisture is impracticable and where such compounds will not jeopardize the appearance of the concrete nor the bonding of future floor finishes.

.3 Special curing techniques shall be employed when the concrete is subject to drying conditions such as high temperatures, low relative humidity and high winds. Concrete wall and column forms shall be kept continuously moist.

.4 Freshly placed concrete shall be protected from the effects of direct sunshine, drying winds, cold, excessive heat and running water by the use of adequate tarpaulins or other suitable material to cover completely or enclose all freshly finished surfaces until the end of the curing period specified.

END OF SECTION

Part 1 General

1.1 GENERAL CONDITIONS

.1 The General Conditions of the Contract, Supplementary General Conditions and General Requirements are hereby made part of this Section.

1.2 WORK INCLUDED

.1 Structural steel framing members, structural steel support members, struts, complete with required bracing, welds, washers, nuts, shims, anchor plates and bolts.

.2 Baseplates, connectors and bearing plates.

.3 Field and shop welded composite beam studs shall be supplied and installed under this section.

.4 Erection.

1.3 RELATED WORK

.1	Cast-in-Place Concrete	Section 03 30 00
.2	Painting and Finishing	Section 09 90 00

1.4 QUALITY ASSURANCE

.1 Structural steel fabricator to be certified as minimum Division 2 Company under CSA W47.1-09 - “Certification of Companies for Fusion Welding of Steel Structures” or CSA Standard W55.3-08 “Resistance Welding Qualification Code for Fabricators of Structural Members” or both, as applicable.

.2 Design to strictly adhere to all codes and standards as enumerated under Section 1.5 Reference Standards.

.3 In the event of conflict between pertinent codes, standards and/or regulations, most stringent shall govern.

1.5 REFERENCE STANDARDS

.1 CSA Standard CAN/CSA-S16-01 - “Limit States Design of Structural Steel Buildings”.

.2 CSA G40.21-04 (R2009) - “Structural Quality Steel”.

.3 ASTM Standard A325M - “High Strength Bolts for Structural Steel Joints including Suitable Nuts and Plane Hardened Washers”.

.4 CSA Standard W59-03 (R2008) - ‘Welded Steel Construction”.

.5 CSA Standard W47.1-09 - “Certification of Companies for Fusion Welding of Steel Structures”.

.6 ASTM Standard A53 - "Welded and Seamless Steel Pipe".

1.6 SHOP DRAWINGS

.1 Submit shop drawings in accordance with General Conditions.

.2 Clearly indicate sizes, spacing and locations of structural members, connections, attachments, anchorages, framed openings and size and type of fasteners and welds.

.3 Indicate all shop and erection details including cuts, copes, connections, holes, threaded fasteners and welds.

.4 Show all welds, both shop and field, by the currently recommended symbols of the Canadian Welding Bureau.

.5 Provide drawings stamped and signed by a Professional Engineer registered in the Province of Saskatchewan.

.6 Review of shop drawings for size and arrangement of principal and auxiliary members only. Such review will not relieve the Contractor of responsibility for general and detail dimension and fit, or any errors or omissions.

1.7 INSPECTION AND TESTING

.1 Materials and workmanship subject to inspection on behalf of Owner.

.2 Report failure of material to fit together properly to Consultant. No corrective measures permitted unless approved by Consultant in writing.

Part 2 Products

2.1 MATERIALS/COMPONENTS

.1 *Standard Rolled Sections:* new material conforming to CSA G40.21-04 (R2009), Grade 350W.

.2 *Hollow Structural Sections:* new material conforming to CSA G40.21-04 (R2009), Grade 350W, Class C.

.3 *Base and Cap Plates:* new material conforming to CSA G40.21-04 (R2009), Grade 300W.

.4 *Beam End Plates, Ledger Angles and Miscellaneous Steel:* new material conforming to CSA G40.21-04 (R2009), Grade 300W.

.5 *Anchor Bolts:* new material conforming to CSA G40.21-04 (R2009), Grade 260W.

.6 *Bolts, Nuts and Washers:* high strength type recommended for structural steel joints, conforming to requirements of ASTM A325M-83c.

.7 *Paint for Primer:* shall be grey (unless approved otherwise) and meet requirements of one of the following:

.1 CGSB 1-GP-40d, Primer, Structural Steel, oil alkyd type.
.2 CISC/CPMA Standard 1-73a, quick drying one-coat paint for use on structural steel.

2.2 FABRICATION

.1 Fabricate structural steel members in accordance with building design drawings and all requirements of CAN/CSA S16-01. Welding to conform to CSA W59-03 (R2008) "Welded Steel Construction". Verify all dimensions prior to fabrication.

.2 No cutting of openings in structural members except as shown on structural drawings. Reinforce openings to maintain required design strength.

.3 Accurately cut and mill column ends to assure full contact of bearing surfaces.

.4 Camber horizontal members as specified on drawings. Mill camber up where not specifically detailed.

.5 All bolted connections to be "bearing" type connections except where subject to stress reversal which are to be "slip resistant" type connections.

.6 All connections showing combined axial load (tension or compression) across the joint to be designed for loads shown. Such connection to be bolted through columns only.

.7 All beams to be connected for the greater of the following conditions.

.1 Loads shown on drawings.
.2 50% of the total uniformly distributed load resistance of the member.
.3 Half depth of the connected member using M20 bolts (minimum two bolts) in double shear.

.8 Shop installed shear studs to be installed in strict conformance with requirements of CSA Standard W59. Refer to Part 3 Execution for additional requirements.

.9 All exposed steel and all related bridging and bracing shall be fabricated with clean, neat fitting welded connections.

2.3 PAINTING

.1 All steel in contact with concrete and all faying surfaces of high strength bolted slip-resistant connections shall <u>not</u> be primed.

.2 Top flange of steel beams that have shop or field installed shear studs shall <u>not</u> be painted.

.3 Structural steel to be cleaned to SSPC-2, primed and ready for painting.

Part 3 Execution

3.1 ERECTION

.1 Erect structural steel in accordance with building design drawings and all requirements on CAN/CSA S16-01.

.2 Make adequate provision for all erection loads and for sufficient temporary bracing to maintain structure safe, plumb and in true alignment until completion of erection. Leave such bracing in place as long as required for safety and integrity of the structure.

.3 As erection progresses, securely bolt work to take care of full design loads and to provide structural integrity as required.

.4 Use high tensile bolts for field connections unless otherwise noted on building design drawings.

.5 Set all baseplates which are shop welded to columns to proper elevation on steel shims. Maximum tolerance from stated elevations to be ± 2mm.

.6 Tolerances

.1 Tolerance of all other structural steel shall be maintained strictly in accordance with CAN/CSA S16-01.

.7 After erection, prime all welds, abrasions, bolted connections and all other surfaces not shop primed, except surfaces to be in contact with concrete.

.8 Obtain written permission of Consultant prior to altering or field welding of structural members.

END OF SECTION

Part 1 General

1.1 GENERAL CONDITIONS

.1 All component selection and connection design shall be performed by a professional engineer, registered in the Province of Work, whose area of practice includes this type of Work.

.2 Metal studs and framing to conform to CAN/CSA-S136.

.3 Steel to conform to ASTM A653.

.4 Workmanship to conform to Association of Wall & Ceiling Contractors (AWCC) as a minimum.

.5 Store materials flat, blocked off the ground in a manner to prevent kinking or permanent set. Bent, kinked or twisted studs and track will be rejected.

.6 Submit shop drawings clearly indicating all construction details including connections and anchor requirements. All Submittals shall bear the seal of a professional engineer registered in the Province of Work. Submit engineer's design notes and calculations upon request of the Consultant.

.7 Exterior walls shall be designed in accordance with Building Code for the following minimum criteria:

.1 Maximum allowable deflection under q10 sustained wind loading shall be as follows:

.1 Behind brick veneer - L/600.

.2 Behind metal/acrylic plaster - L/360.

.2 Studs, clip anchor, screws and other attachments shall meet the requirements of the wind loading structural design criteria set out on the structural drawings, in the Building Code and system dead loads.

.3 Top of wall anchor shall allow for dead load deflections (⅜”) during construction and live load deflections (⅜”) after construction.

.4 Stud sizes, gauges and spacings, sill and top track, and fastening details specified herein are to be considered as minimums only. Revise upwards as required by engineering design as specified herein.

2 Products

2.1 MATERIALS

.1 *Exterior walls:* Studs to CAN/CSA-S136, hot dipped galvanized steel. Sections are to be roll formed with knurled flanges, services and bracing cutouts; spacing at 16” O.C. or as indicated. Metal core thickness 0.047 ”(18 gauge) or 0.035” (20 gauge) as indicated.

.2 *Exterior sill tracks:* To CAN/CSA-S136. Exterior top track shall be a double track system, hot dipped galvanized. Outer track shall have minimum metal core thickness of 0.075" (14 gauge) with 2" flanges to suit vertical deflection of 1" and width to suit stud width. Inner top track and bottom track shall have minimum metal core thickness equal to that of studs, with 3" and 1¼" flanges respectfully. All tracks shall be hot-dipped galvanized. Refer to Drawings for installation details.

.3 *Movement connection clips:* Purpose made clip designed to allow structural member vertical movement and to transfer wind suction or pressure to structural frame.

.4 *Channel stiffener:* 19 mm (¾") cold-rolled channel of 2.657 mm metal core thickness (0.104") (12 ga.) hot dipped galvanized steel.

.5 Fasteners:

.1 *Stud to stud:* To ASTM C1002, steel, self-drilling, self-threading, case hardened shallow Phillips type heads with integral washer, 25 mm (1") minimum length.

.2 *Track to concrete*: Secure track to concrete with either Hilti "Kwikbolts 3" expansion type anchors or metal hit type 6.25 mm (¼") at 400 mm (16") centres. Do ***not*** use Powder Actuated Fasteners.

.3 *Track to steel:* Secure track to structural steel over 8 mm thickness with Hilti E N27 S12 fasteners at 300 mm on centre.

Part 3 Execution

3.1 ERECTION

.1 For exterior walls ensure all flashings and waterproof membranes provided by others are properly installed to divert moisture to exterior.

.2 Ensure all door and window frames placed and securely braced in proper location.

.3 Align exterior wall partition tracks at floor and underside of deck and secure.

.4 At exterior wall, bottom of studs to be cut square and set with full contact in bottom track. Screw fasten both flanges to sill track.

.5 Place studs vertically at not over 400mm O.C. unless otherwise shown.

.6 Cross-brace steel studs as required to provide rigid installation to design engineer's instructions. Provide horizontal bridging in all walls at maximum 1200mm on centre. Secure bridging to each stud using metal clips and screws.

.7 Erect metal studding to tolerance of L/500.

.8 Attach studs to lower ceiling track using specified fasteners.

.9 Co-ordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.

.10 Co-ordinate erection of studs with installation of door/window frames and special supports or anchors for Work specified in other Sections.

.11 Provide minimum two studs extending from floor to ceiling at each side of openings wider than stud centres specified. Secure studs together, 16" apart using column clips or other approved means of fastening placed alongside frame anchor clips.

.12 Erect track at head of door openings and sills of sidelight/window openings to accommodate intermediate studs. Secure track to studs at each end, in accordance with engineer's instructions. Install intermediate studs above and below openings in same manner and spacing as wall studs.

.13 Install steel studs or furring channel between studs for attaching electrical and other boxes.

.14 Install all attachments within steel-stud partitions for fixtures being hung from or anchored to such partitions.

.15 Install access doors to electrical or mechanical fixtures supplied under respective Sections.

.16 Rigidly secure frames to furring or framing systems.

.17 Install pressed-steel frames supplied under other Sections in steel-stud partitions.

.18 The installation of the exterior steel stud walls shall be inspected periodically by the professional engineer responsible for the component selection and connection designs for conformance to the shop drawings and design intent.

.19 Copies of inspection reports shall be forwarded to Consultant, the trade responsible for the Work and the general contractor.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society for Testing and Materials International, (ASTM)

- .1 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Steamless.
- .2 ASTM A276-13a, Standard Specification for Stainless Steel Bars and Shapes.
- .3 ASTM A307-12, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.2 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB-1.40-97, Anti-corrosive Structural Steel Alkyd Primer.
- .2 CAN/CGSB-1.181-99, Ready-Mixed, Organic Zinc-Rich Coating.

.3 Canadian Standards Association (CSA International)

- .1 CSA-G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel.
- .2 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
- .3 CAN/CSA-S16.1-01, Limit States Design of Steel Structures.
- .4 CSA W48-06(R2011), Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).
- .5 CSA W59-13, Welded Steel Construction (Metal Arc Welding).

1.2 SUBMITTALS

.1 Product Data:

- .1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOC's:
  - .1 For finishes, coatings, primers and paints.

.2 Shop Drawings

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.

1.3 QUALITY ASSURANCE

.1 Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.

.2 Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.3 Pre-installation Meetings: Conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Packing, Shipping, Handling and Unloading:

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

.2 Storage and Protection:

.1 Cover exposed stainless steel surfaces with pressure sensitive heavy protection paper or apply strippable plastic coating, before shipping to job site.

.2 Leave protective covering in place until final cleaning of building. Provide instructions for removal of protective covering.

1.5 WASTE MANAGEMENT AND DISPOSAL

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

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.

Part 2 Products

2.1 MATERIALS

.1 Steel sections and plates: to CAN/CSA-G40.20/G40.21, Grade 300W or 350W.

.2 Steel pipe: to ASTM A53/A53M extra strong, galvanized finish.

.3 Welding materials: to CSA W59.

.4 Welding electrodes: to CSA W48 Series.

.5 Bolts and anchor bolts: to ASTM A307.

.6 Grout: non-shrink, non-metallic, flowable, 15 MPa at 24 hours.

2.2 FABRICATION

.1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.

.2 Use self-tapping shake-proof flat headed screws on items requiring assembly by screws or as indicated.

.3 Where possible, fit and shop assemble work, ready for erection.

.4 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

2.3 FINISHES

.1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m^2 to CAN/CSA-G164.

.2 Chromium plating: chrome on steel with plating sequence of 0.009 mm thickness of copper, 0.010 mm thickness of nickel and 0.0025 mm thickness of chromium.

.3 Shop coat primer: to CAN/CGSB-1.40.

.4 Zinc primer: zinc rich, ready mix to CAN/CGSB-1.181.

2.4 ISOLATION COATING

.1 Isolate aluminum from following components, by means of bituminous paint:

.1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.

.2 Concrete, mortar and masonry.

.3 Wood.

2.5 SHOP PAINTING

.1 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, grease. Do not paint when temperature is lower than 7 degrees C.

.3 Clean surfaces to be field welded; do not paint.

2.6 STEEL LADDER

.1 Steel ladder fabricated as detailed in the drawings.

2.7 PIPE RAILINGS

.1 Steel pipe: 38 mm nominal outside diameter, formed to shapes and sizes as indicated.

Part 3 Execution

3.1 ERECTION

.1 Do welding work in accordance with CSA W59 unless specified otherwise.

.2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.

.3 Provide suitable means of anchorage acceptable to Departmental Representative such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.

.4 Exposed fastening devices to match finish and be compatible with material through which they pass.

.5 Provide components for building by other sections in accordance with shop drawings and schedule.

.6 Make field connections with bolts to CAN/CSA-S16.1, or weld.

.7 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.

.8 Touch-up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection with primer.

.9 Touch-up galvanized surfaces with zinc rich primer and zinc finish coating where burned by field welding.

3.2 PIPE RAILINGS

.1 Install pipe railings to stairs, catwalk, and ramp.

3.3 CHANNEL FRAMES

.1 Install steel channel frames to openings as indicated.

3.4 CLEANING

.1 Perform cleaning after installation to remove construction and accumulated environmental dirt.

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

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society for Testing and Materials (ASTM International)

.1 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 Canadian Roofing Contractors Association (CRCA)

.1 Roofing Specifications Manual 2012.

.3 Canadian Standards Association (CSA International)

.1 CSA B111-1974(R2003), Wire, Nails, Spikes and Staples

1.2 SAMPLES

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Submit duplicate 100 x 100 mm samples of each type of sheet metal material, colour and finish.

1.3 WARRANTY

.1 Contractor shall warrant that sheet metal flashings will stay in place and remain leakproof for two years.

Part 2 Products

2.1 SHEET METAL MATERIALS

.1 Zinc coated steel sheet: 0.8 mm thickness, commercial quality to ASTM A653/A653M, with Z275 designation coating.

2.2 PREFINISHED STEEL SHEET

.1 Prefinished steel with factory applied silicone modified polyester finish.

.1 Stelco / Dafasco 8000 Series

.2 Colour: to match existing brown siding.

2.3 ACCESSORIES

.1 Isolation coating: alkali resistant bituminous paint.

.2 Plastic cement: to CAN/CGSB 37.5.

.3 Sealants: two component polyurethane, colour to match adjacent materials.

.4 Cleats: of same material, and temper as sheet metal, minimum 50 mm wide. Thickness: same as sheet metal being secured.

.5 Fasteners: of same material as sheet metal, to CSA B111, ring thread flat head roofing nails of length and thickness suitable for metal flashing application.

.6 Washers: of same material as sheet metal, 1 mm thick with rubber packings.

.7 Solder: to ASTM B32, alloy composition Sn .

.8 Touch-up paint: as recommended by prefinished material manufacturer.

2.4 FABRICATION

.1 Fabricate metal flashings and other sheet metal work in accordance with applicable CRCA 'FL' series details as indicated.

.2 Form pieces in 2400 mm maximum lengths. Make allowance for expansion at joints.

.3 Hem exposed edges on underside 12 mm. Mitre and seal corners with sealant.

.4 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

.5 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

2.5 METAL FLASHINGS

.1 Form flashings, copings and fascias to profiles indicated of 0.8mm thick prefinished steel

Part 3 Execution

3.1 METAL FLASHINGS

.1 Install sheet metal work in accordance with CRCA FL series details, FL Aluminum Sheet Metal Work in Building Construction as detailed.

.2 Use concealed fastenings except where approved before installation.

.3 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs. Flash joints using S-lock forming tight fit over hook strips, as detailed.

.4 “S-Lock” end joints and caulk with sealant.

.5 Install metal flashing under cap flashing to form weather tight junction.

END OF SECTION

Part 1 General

1.1 REFERENCES

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

.1 Material Safety Data Sheets (MSDS).

.2 Underwriter's Laboratories of Canada (ULC)

.1 ULC-S115-05, Fire Tests of Fire stop 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 non-combustible 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 SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

.3 Shop Drawings:

.1 Submit shop drawings to show location, proposed material, reinforcement, anchorage, fastenings and method of installation.

.2 Construction details should accurately reflect actual job conditions.

.4 Samples:

.1 Submit duplicate 300 x 300 mm samples showing actual fire stop material proposed for project.

.5 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.

.1 Test reports: in accordance with CAN-ULC-S101 for fire endurance and CAN-ULC-S102 for surface burning characteristics.

.1 Submit certified test reports from approved independent testing laboratories, indicating compliance of applied fire stopping with specifications for specified performance characteristics and physical properties.

.2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.

1.4 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: company specializing in fire stopping installations with 5 years' experience.

.2 Site Meetings: as part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.

.1 Upon completion of Work, after cleaning is carried out.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

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

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.3 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, and ULC markings.

.2 Storage and Protection:

.1 Store materials indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Replace defective or damaged materials with new.

.3 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Waste Management and Disposal.

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 Fire stop system rating: as indicated on drawings.

.2 Re-penetrable fire stop system for power and communication cables and cable trays.

.3 Service penetration assemblies: systems tested to CAN-ULC-S115.

.4 Service penetration fire stop components: certified by test laboratory to CAN-ULC-S115.

.5 Fire-resistance rating of installed fire stopping assembly in accordance with NBC.

.6 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.

.7 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal.

.8 Primers: to manufacturer's recommendation for specific material, substrate, and end use.

.9 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.

.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.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PREPARATION

.1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.

.1 Ensure that substrates and surfaces are clean, dry and frost free.

.2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.

.3 Maintain insulation around pipes and ducts penetrating fire separation [without interruption to vapour barrier.

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

3.3 INSTALLATION

.1 Install fire stopping and smoke seal material and components in accordance with manufacturer's certified tested system listing.

.2 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.

.3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.

.4 Tool or trowel exposed surfaces to neat finish.

.5 Remove excess compound promptly as work progresses and upon completion.

3.4 SPECIAL REQUIREMENTS

.1 Location of special requirements for fire stopping and smoke seal materials at openings and penetrations in fire resistant rated assemblies are as follows:

.1 Designed for re-entry, removable at: cable trays, electrical and communication rooms.

3.5 SEQUENCES OF OPERATION

.1 Proceed with installation only when submittals have been reviewed by Departmental Representative.

.2 Install floor fire stopping before interior partition erections.

.3 Metal deck bonding: fire stopping to precede spray applied fireproofing to ensure required bonding.

.4 Mechanical pipe insulation: certified fire stop system component.

.1 Ensure pipe insulation installation precedes fire stopping.

3.6 FIELD QUALITY CONTROL

.1 Inspections: notify Departmental Representative when ready for inspection and prior to concealing or enclosing fire stopping materials and service penetration assemblies.

3.7 CLEANING

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

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

.3 Remove temporary dams after initial set of fire stopping and smoke seal materials.

3.8 SCHEDULE

.1 Fire stop and smoke seal at:

.1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.

.2 Top of fire-resistance rated masonry and gypsum board partitions.

.3 Intersection of fire-resistance rated masonry and gypsum board partitions.

.4 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.

.5 Penetrations through fire-resistance rated floor slabs, ceilings and roofs.

.6 Openings and sleeves installed for future use through fire separations.

.7 Around mechanical and electrical assemblies penetrating fire separations.

.8 Rigid ducts: greater than 129 cm^2 : fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society for Testing and Materials International, (ASTM)

.1 ASTM C919-12, Standard Practice for Use of Sealants in Acoustical Applications.

.2 ASTM E814-13, Standard Test Method for Fire Tests of Penetration Firestop Systems.

.3 ASTM E1966-07(2011), Standard Test Method for Fire-Resistive Joint Systems.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-19.13-M87, Sealing Compound, One-component, Elastomeric, Chemical Curing.

.2 CAN/CGSB-19.17-M90, One-Component Acrylic Emulsion Base Sealing Compound.

.3 CAN/CGSB-19.24-M90, Multi-component, Chemical Curing Sealing Compound.

.3 Department of Justice Canada (Jus)

.1 Canadian Environmental Protection Act, 1999 (CEPA).

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

.1 Material Safety Data Sheets (MSDS).

.5 Transport Canada (TC)

.1 Transportation of Dangerous Goods Act, 1992 (TDGA).

1.2 SUBMITTALS

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

.2 Manufacturer's product to describe.

.1 Caulking compound.

.2 Primers.

.3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.

.3 Submit manufacturer's instructions in accordance with Section 01 33 00 - Submittal Procedures.

.1 Instructions to include installation instructions for each product used.

1.3 DELIVERY, STORAGE, AND HANDLING

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

.2 Deliver and store materials in original wrappings and containers with manufacturer's seals and labels, intact. Protect from freezing, moisture, water and contact with ground or floor.

1.4 WASTE MANAGEMENT AND DISPOSAL

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

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Place materials defined as hazardous or toxic in designated containers.

.4 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.

.5 Unused sealant material must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.

.6 Divert unused joint sealing material from landfill to official hazardous material collections site approved by Departmental Representative.

.7 Empty plastic joint sealer containers are not recyclable. Do not dispose of empty containers with plastic materials destined for recycling.

1.5 PROJECT CONDITIONS

.1 Environmental Limitations:

.1 Do not proceed with installation of joint sealants under following conditions:

.1 When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 4.4 degrees C.

.2 When joint substrates are wet.

.2 Joint-Width Conditions:

.1 Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

.3 Joint-Substrate Conditions:

.1 Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.6 ENVIRONMENTAL REQUIREMENTS

.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of Material Safety Data Sheets (MSDS) acceptable to Labour Canada.

.2 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.

.3 Ventilate area of by use of approved portable supply and exhaust fans approved by Departmental Representative.

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 which offgas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize offgas time.

.3 Where sealants are qualified with primers use only these primers.

2.2 SEALANT MATERIAL DESIGNATIONS

.1 Type 1 - Urethanes Two Part.

.1 Non-Sag to CAN/CGSB-19.24, Type 2, Class B, colour as selected by Departmental Representative from manufacturer's standard range.

.2 Type 2 - Urethanes One Part.

.1 Non-Sag to CAN/CGSB-19.13, Type 2, MCG-2-25 or MCG-2-40, colour as selected by Departmental Representative from manufacturer's standard range.

.3 Type 3 - Silicones One Part.

.1 To CAN/CGSB-19.13.

.2 Mildew resistant: for use in interior areas where water may contact sealant.

.4 Type 4 - Acrylic Latex One Part.

.1 To CAN/CGSB-19.17.

2.3 PREFORMED COMPRESSIBLE AND NON-COMPRESSIBLE BACK-UP MATERIALS.

.1 Polyethylene, Urethane, Neoprene or Vinyl Foam.

.1 Extruded closed cell foam backer rod.

.2 Size: oversize 30 to 50 %.

.2 Neoprene or Butyl Rubber.

.1 Round solid rod, Shore A hardness 70.

.3 High Density Foam.

.1 Extruded closed cell polyvinyl chloride (PVC), extruded polyethylene, closed cell, Shore A hardness 20, tensile strength 140 to 200 kPa, extruded polyolefin foam, 32 kg/m^3 density, or neoprene foam backer, size as recommended by manufacturer.

.4 Bond Breaker Tape.

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

2.4 SEALANT SELECTION

.1 Exterior sealant: Sealant type: 1 or 2.

.2 Perimeters of exterior openings where door and window frames meet exterior facade of building: Sealant type: 1 or 2.

.3 Seal exterior and interior perimeters of exterior openings: Sealant type: 3

.4 Perimeters of interior window and door frames, base of interior door frames between frame and floor finish: Sealant type: 4.

.5 In additional locations as noted on the drawings: confirm with Consultant.

2.5 JOINT CLEANER

.1 Non-corrosive and non-staining type, compatible with joint forming materials and sealant recommended by sealant manufacturer.

.2 Primer: as recommended by manufacturer.

Part 3 Execution

3.1 PROTECTION

.1 Protect installed Work of other trades from staining or contamination.

3.2 SURFACE PREPARATION

.1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.

.2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair Work.

.3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.

.4 Ensure joint surfaces are dry and frost free.

.5 Prepare surfaces in accordance with manufacturer's directions.

3.3 PRIMING

.1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.

.2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.

3.4 BACKUP MATERIAL

.1 Apply bond breaker tape where required to manufacturer's instructions.

.2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

3.5 MIXING

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

3.6 APPLICATION

.1 Sealant.

- .1 Apply sealant in accordance with manufacturer's written instructions.
- .2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.
- .3 Apply sealant in continuous beads.
- .4 Apply sealant using gun with proper size nozzle.
- .5 Use sufficient pressure to fill voids and joints solid.
- .6 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.
- .7 Tool exposed surfaces before skinning begins to give slightly concave shape.
- .8 Remove excess compound promptly as work progresses and upon completion.

.2 Curing.

- .1 Cure sealants in accordance with sealant manufacturer's instructions.
- .2 Do not cover up sealants until proper curing has taken place.

.3 Cleanup.

- .1 Clean adjacent surfaces immediately and leave Work neat and clean.
- .2 Remove excess and droppings, using recommended cleaners as work progresses.
- .3 Remove masking tape after initial set of sealant.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society for Testing and Materials International (ASTM)

.1 ASTM A653/A653M-11, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 ASTM C591-13, Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation

.3 ASTM C1289-13e1, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.2 CGSB 41-GP-19Ma-84, Rigid Vinyl Extrusions for Windows and Doors.

.3 CAN/CGSB 12.1 M90, Tempered or Laminated Safety Glass.

.4 CAN/CGSB 12.11 M90, Wired Safety Glass.

.3 Canadian Standards Association (CSA International)

.1 CSA-G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 CSA W59-13, Welded Steel Construction (Metal Arc Welding).

.4 Canadian Steel Door Manufacturers' Association (CSDMA)

.1 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames, 2006.

.2 CSDMA, Selection and Usage Guide for Commercial Steel Doors, 2009.

.5 National Fire Protection Association (NFPA)

.1 NFPA 80-2013, Standard for Fire Doors and Fire Windows.

.2 NFPA 252-2013, Standard Methods of Fire Tests of Door Assemblies.

.6 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC S104-10, Standard Method for Fire Tests of Door Assemblies.

1.2 SYSTEM DESCRIPTION

.1 Design Requirements:

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

.2 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN/ULC S104 for ratings specified or indicated.

.3 Provide fire labelled frames for openings requiring fire protection ratings. Test products in conformance with CAN/ULC S104, ASTM E152 or NFPA 252 and listed by nationally recognized agency having factory inspection services.

1.3 SUBMITTALS

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

.2 Provide product data: in accordance with Section 01 33 00 - Submittal Procedures.

.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 Province of Saskatchewan, Canada.

.2 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, glazed, louvred, arrangement of hardware and fire rating and finishes.

.3 Indicate each type frame material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings and reinforcing, fire rating, and finishes.

.4 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.

1.4 DELIVERY, STORAGE AND HANDLING

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

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling 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 A653M, ZF75, minimum base steel thickness in accordance with CSDMA Table 1 - Thickness for Component Parts.

.2 Reinforcement channel: to CSA G40.20/G40.21, Type 44W, coating designation to ASTM A653M, ZF75.

2.2 DOOR CORE MATERIALS

.1 Honeycomb construction:

.1 Structural small cell, 24.5 mm maximum kraft paper 'honeycomb', weight: 36.3 kg per ream minimum, density: 16.5 kg/m^3 minimum sanded to required thickness.

.2 Temperature rise rated (TRR): core composition to limit temperature rise on unexposed side of door. Core to be tested as part of a complete door assembly, in accordance with CAN/ULC S104, ASTM E152 or NFPA 252, covering Standard Method of Tests of Door

Assemblies and listed by nationally recognized testing agency having factory inspection service.

2.3 ADHESIVES

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

.1 Adhesive: maximum VOC content 50 g/L.

.2 Polystyrene and polyurethane cores: heat resistant, epoxy resin based, low viscosity, contact cement.

2.4 PRIMER

.1 Touch-up prime CAN/CGSB-1.181.

.1 Maximum VOC limit 50 g/L.

2.5 PAINT

.1 Field paint steel doors and frames in accordance with Section 09 91 23 - Interior Painting. Protect weatherstrips from paint. Provide final finish free of scratches or other blemishes.

2.6 ACCESSORIES

.1 Door silencers: single stud rubber/neoprene type.

.2 Exterior and interior top and bottom caps: steel.

.3 Fabricate glazing stops as formed channel, minimum 16 mm height, accurately fitted, butted at corners and fastened to frame sections with counter-sunk oval head sheet metal screws.

.4 Metallic paste filler: to manufacturer's standard.

.5 Fire labels: metal rivited.

.6 Sealant: in accordance with Section 07 92 00 – Joint Sealants.

.7 Maximum VOC limit 250 g/L.

.8 Wired glass: to CAN/CGSB 12.11, 6 mm thick (transparent).

.1 Type 1 Polished both sides

.2 Wire mesh styles 3 Square.

.9 Make provisions for glazing as indicated and provide necessary glazing stops.

.1 Provide removable stainless steel glazing beads for use with glazing tapes and compounds and secured with countersunk stainless steel screw.

.2 Design exterior glazing stops to be tamperproof.

.3 Setting blocks: Neoprene, 80 90 Shore durometer hardness to ASTM D2240, to suit glazing method, glass light, weight and area.

.4 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.

.5 Glazing tape: Preformed butyl compound, 10 15 Shore durometer hardness to ASTM D2240; coiled on release paper; black colour.

2.7 FRAMES FABRICATION GENERAL

.1 Fabricate frames in accordance with CSDMA specifications.

.2 Fabricate frames to profiles and maximum face sizes as indicated.

.3 Interior frames: 1.6 mm welded type construction.

.4 Blank, reinforce, drill and tap frames for mortised, templated hardware using templates provided by finish hardware supplier. Reinforce frames for surface mounted hardware.

.5 Protect mortised cutouts with steel guard boxes.

.6 Prepare frame for door silencers, 3 for single door, 2 at head for double door.

.7 Manufacturer's nameplates on frames and screens are not permitted.

.8 Conceal fastenings except where exposed fastenings are indicated.

.9 Mortise, reinforce, drill and tap frames and reinforcements to receive hardware using templates provided under Section 08 71 00 - Door Hardware – General.

.10 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.

2.8 FRAME ANCHORAGE

.1 Provide appropriate anchorage to floor and wall construction.

.2 Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.

.3 Provide 2 anchors for rebate opening heights up to 1520 mm and 1 additional anchor for each additional 760 mm of height or fraction thereof.

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

2.9 FRAMES: WELDED TYPE

.1 Welding in accordance with CSA W59.

.2 Accurately mitre or mechanically joint frame product and securely weld on inside of profile.

.3 Cope accurately and securely weld butt joints of mullions, transom bars, centre rails and sills.

.4 Grind welded joints and corners to a flat plane, fill with metallic paste and sand to uniform smooth finish.

.5 Securely attach floor anchors to inside of each jamb profile.

.6 Weld in 2 temporary jamb spreaders per frame to maintain proper alignment during shipment.

2.10 DOOR FABRICATION GENERAL

.1 Doors: swing type, flush, with provision for glass and/or louvre openings as indicated.

.2 Fabricate doors with longitudinal edges welded. Seams: grind welded joints to a flat plane, fill with metallic paste filler and sand to a uniform smooth finish.

.3 Blank, reinforce, drill doors and tap for mortised, templated hardware and electronic hardware.

.4 Factory prepare holes 12.7 mm diameter and larger except mounting and through-bolt holes, on site, at time of hardware installation.

.5 Reinforce doors where required, for surface mounted hardware. Provide flush steel top caps to exterior doors. Provide inverted, recessed, spot welded channels to top and bottom of interior doors.

.6 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.

.7 Provide fire labelled doors for those openings requiring fire protection ratings, as scheduled. Test such products in conformance with CAN/ULC S104, ASTM E152, 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.

.8 Manufacturer's nameplates on doors are not permitted.

2.11 DOORS: HONEYCOMB CORE CONSTRUCTION

.1 Form face sheets for exterior doors from 1.6 mm sheet steel with honeycomb core laminated under pressure to face sheets.

.2 Form face sheets for interior doors from 1.6 mm sheet steel with honeycomb core laminated under pressure to face sheets.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION GENERAL

.1 Install labelled steel fire rated doors and frames to NFPA 80 except where specified otherwise.

.2 Install doors and frames to CSDMA Installation Guide.

3.3 FRAME INSTALLATION

.1 Set frames plumb, square, level and at correct elevation.

.2 Secure anchorages and connections to adjacent construction.

.3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.

.4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.

.5 Caulk perimeter of frames between frame and adjacent material.

.6 Maintain continuity of air barrier and vapour retarder.

3.4 DOOR INSTALLATION

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

.2 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows.

.1 Hinge side: 1.0 mm.

.2 Latchside and head: 1.5 mm.

.3 Finished floor, top of carpet, and thresholds: 13 mm.

.3 Adjust operable parts for correct function.

.4 Install louvres.

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 INSTALLATION: INTERIOR DRY METHOD (TAPE AND TAPE)

.1 Perform work in accordance with FGMA Glazing Manual for glazing installation methods.

.2 Cut glazing tape to length and set against permanent stops, projecting 1.6 mm above sight line.

.3 Place setting blocks at 1/4 points, with edge block maximum 150 mm from corners.

.4 Rest glazing on setting blocks and push against tape for full contact at perimeter of light or unit.

.5 Place glazing tape on free perimeter of glazing in same manner described.

.6 Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.

.7 Knife trim protruding tape.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Steel Door and Frame Manufacturers' Association (CSDFMA).

.1 CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction): standard hardware location dimensions.

.2 Canadian General Standards Board (CGSB).

.1 CAN/CGSB-69.18-M90/ANSI/BHMA A156.1-1981, Butts and Hinges.

.2 CAN/CGSB-69.19-93/ANSI/BHMA A156.3-1989, Exit Devices.

.3 CAN/CGSB-69.20-M90/ANSI/BHMA A156.4-1986, Door Controls (Closers).

.4 CAN/CGSB-69.21-M90/ANSI/BHMA A156.5-1984, Auxiliary Locks and Associated Products.

.5 CAN/CGSB-69.22-M90/ANSI/BHMA A156.6-1986, Architectural Door Trim.

.6 CAN/CGSB-69.26-96/ANSI/BHMA A156.10-1991, Power-operated Pedestrian Doors.

.7 CAN/CGSB-69.28-M90/ANSI/BHMA A156.12-1986, Interconnected Locks and Latches.

.8 CAN/CGSB-69.29-93/ANSI/BHMA A156.13-1987, Mortise Locks and Latches.

.9 CAN/CGSB-69.32-M90/ANSI/BHMA A156.16-1981, Auxiliary Hardware.

.10 CAN/CGSB-69.35-M89/ANSI/BHMA A156.19-1984, Power Assist and Low Energy Power Operated Doors.

1.2 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 - Submittal Procedures.

.2 Hardware List:

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

.2 Indicate specified hardware, including make, model, material, function, size, finish and other pertinent information.

.3 Manufacturer's Instructions:

.1 Submit manufacturer's installation instructions.

.4 Closeout Submittals

.1 Provide operation and maintenance data for door closers, locksets, door holders electrified hardware and fire exit hardware for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.3 QUALITY ASSURANCE

.1 Regulatory Requirements:

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

.2 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

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

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Packing, Shipping, Handling and Unloading:

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

.2 Package each item of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.

.2 Storage and Protection:

.1 Store finishing hardware in locked, clean and dry area.

1.5 WASTE DISPOSAL AND MANAGEMENT

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

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Dispose of corrugated cardboard, polystyrene, plastic, and packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

1.6 MAINTENANCE

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Supply two sets of wrenches for door closers, locksets, and fire exit hardware.

Part 2 Products

2.1 HARDWARE ITEMS

.1 For new hardware use one manufacturer's products only for similar items.

2.2 DOOR HARDWARE

.1 Locks and latches:

.1 Mortise locks and latches: to CAN/CGSB-69.29, series 1000 mortise lock, grade 1, designed for function as stated in Hardware Schedule.

.2 Lever handles: match lunch room lever.

.3 Roses: match lunch room lever.

.4 Escutcheons : match lunch room hardware.

.5 Normal strikes: box type, lip projection not beyond jamb.

.6 Cylinders: match building pin and keyway; key into keying keying system as directed.

.7 Finish: 26D.

.8 Acceptable manufacturer: Sargent.

.9 List of locksets:

a) ANSI F01 (Passage)

b) ANSI F05 (Classroom)

c) ANSI F07 (Storeroom)

d) ANSI F10 (Office)

.2 Butts and hinges:

.1 Butts and hinges: to CAN/CGSB-69.18, listed in Hardware Schedule.

.2 List of hinges:

a) FBB 168 114 x 114.

b) FBB 168 114 x 144 NRP.

.3 Acceptable manufacturers: Stanley, Hager, Monthard, McKimmey or approved alternate.

.3 Door Closers and Accessories:

.1 Door controls (closers): to CAN/CGSB-69.20, size in accordance with CAN/CGSB-69.20, table A1, finished to 630.

.1 Grade 1, heavy duty, adjustable hyudraulic back check, separate regulation of closing speed and latching speed, rack and pinion action.

.2 List of closers:

.1 LCN 4040 with delayed action function.

.3 Acceptable manufacturers: LCN, Sargent, Norton, Rixson or approved alternate.

.2 Door controls (overhead door stop): to ANSI A156.8, as listed in Hardware Schedule, finished to 652.

.1 Heavy duty stop, grade 1, heavy duty shock spring, concealed mounted, 110° opening, arm, shoe and slider cam assembly.

.2 Acceptable manufacturers: Rixson 1-336 or approved alternate.

.4 Architectural door trim: to CAN/CGSB-69.22, as listed in Hardware Schedule, finish as noted

.1 Door protection plates: kick plate type, 1.27 mm thick stainless steel, bevelled edges, 300 mm high by 25 mm less than door width, 32D finish.

.5 Thresholds:

a) 165 mm wide x full width of door opening, extruded aluminum mill finish, serrated surface.

.6 Weatherstripping:

.1 Head and jamb seal:

.1 Extruded aluminum frame and solid closed cell neoprene insert, clear anodized finish.

.2 Door bottom seal:

.1 Heavy duty, extruded aluminum frame and closed cell neoprene weather seal, surface mounted, closed ends, adjustable, clear anodized finish.

2.3 FASTENINGS

.1 Use only fasteners provided by manufacturer. Failure to comply may void warranties and applicable licensed labels.

.2 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.

.3 Exposed fastening devices to match finish of hardware.

.4 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices, and install so pull can be secured through door from reverse side. Install push plate to cover fasteners.

.5 Use fasteners compatible with material through which they pass.

2.4 KEYING

.1 Owner will provide construction cores. Contractor to install construction cores and perform operation verification for all locks.

.2 Provide 000000 bitted for keying by Owner.

.3 Provide two blank keys, in duplicate, for every lock in this Contract.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

.2 Furnish metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.

.3 Furnish manufacturers' instructions for proper installation of each hardware component.

3.2 INSTALLATION

.1 Install hardware to standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufacturers' Association.

.2 Where door stop contacts door pulls, mount stop to strike bottom of pull.

.3 Use only manufacturer's supplied fasteners. Failure to comply may void manufacturer's warranties and applicable licensed labels. Use of "quick" type fasteners, unless specifically supplied by manufacturer, is unacceptable.

.4 Remove construction cores and locks when directed by Departmental Representative; install permanent cores and check operation of locks.

3.3 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 provide tight fit at contact points with frames.

3.4 TESTING

.1 All locks must be tested by the Contractor with the installed permanent cores for proper installation. All doors and locks not installed and operating correctly will be rejected.

3.5 CLEANING

.1 Perform cleaning after installation to remove construction and accumulated environmental dirt.

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

3.6 DEMONSTRATION

.1 Maintenance Staff Briefing:

.1 Brief maintenance staff regarding:

.1 Proper care, cleaning, and general maintenance of projects complete hardware.

.2 Description, use, handling, and storage of keys.

.3 Use, application and storage of wrenches for door closers, locksets, and fire exit hardware.

.2 Demonstrate operation, operating components, adjustment features, and lubrication requirements.

3.7 SCHEDULE

Group 1

1 lockset type (a)
1½ pair hinges
1 closer
1 overhead stop
1 weatherstrip
1 door bottom
1 threshold
2 kickplates

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society for Testing and Materials International, (ASTM)

- .1 ASTM C36/C36M-03e1, Specification for Gypsum Wallboard.
- .2 ASTM C475-12, Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- .3 ASTM C840-11, Specification for Application and Finishing of Gypsum Board.
- .4 ASTM C841-03(2008), Standard Specification for Installation of Interior Lathing and Furring.
- .5 ASTM C1002-07, Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
- .6 ASTM C1047-10a, Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
- .7 ASTM C1178/C1178M-11, Specification for Glass Mat Water-Resistant Gypsum Backing Board.
- .8 ASTM C1396/C1396M-11, Standard Specification for Gypsum Board.
- .9 ASTM C1629/C1629M-06(2011), Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels

.2 Association of the Wall and Ceilings Industries International (AWEI)

.3 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB-51.34-M86(R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

.4 Underwriters' Laboratories of Canada (ULC)

- .1 CAN/ULC-S102-2007, Surface Burning Characteristics of Building Materials and Assemblies.

1.2 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials in original packages, containers or bundles bearing manufacturers brand name and identification.

.2 Store materials inside, level, under cover. Keep dry. Protect from weather, other elements and damage from construction operations and other causes.

.3 Handle gypsum boards to prevent damage to edges, ends or surfaces. Protect metal accessories and trim from being bent or damaged.

1.3 SITE ENVIRONMENTAL REQUIREMENTS

.1 Maintain temperature minimum 10 degrees C, maximum 21 degrees C for 48 hours prior to and during application of gypsum boards and joint treatment, and for at least 48 hours after completion of joint treatment.

.2 Apply board and joint treatment to dry, frost free surfaces.

.3 Ventilation: Ventilate building spaces as required to remove excess moisture that would prevent drying of joint treatment material immediately after its application.

1.4 WASTE MANAGEMENT AND DISPOSAL

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

.2 Divert unused metal materials from landfill to metal recycling facility.

.3 Do not dispose of unused paint and caulking materials into sewer systems, into lakes, streams, onto ground or in other locations where it will pose health or environmental hazard.

Part 2 Products

2.1 MATERIALS

.1 Standard board: to ASTM C36/C36M, Type X, 16 mm thick, 1200 mm wide x maximum practical length, ends square cut, edges bevelled.

.2 Moisture resistant (mold resistant) gypsum board: to ASTM C1396/C1396M, regular, thickness as indicated in drawings thickness as indicated in drawings, 1200 mm wide x maximum practical length.

.3 Metal furring runners, hangers, tie wires, inserts, and anchors required for installation to ASTM C841.

.4 Drywall furring channels: 0.5 mm core thickness galvanized steel channels for screw attachment of gypsum board.

.5 Resilient drywall furring: 0.5 mm base steel thickness galvanized steel for resilient attachment of gypsum board.

.6 Metal channel stiffener: 19 x 1.4 mm thick cold rolled steel, coated with rust inhibitive coating.

.7 Steel drill screws: to ASTM C1002.

.8 Casing beads, corner beads, control joints and edge trim: to ASTM C1047, metal, zinc-coated by electrolytic process, 0.5 mm base thickness, perforated flanges, one piece length per location.

.9 Sealants: in accordance with Section 07 92 00 - Joint Sealants.

.10 Acoustic sealant: in accordance with Section 07 92 00 - Joint Sealants.

.11 Polyethylene: to CAN/CGSB-51.34, Type 2.

.12 Insulating strip: rubberized, moisture resistant, 3 mm thick closed cell neoprene strip, 12 mm wide, with self-sticking permanent adhesive on one face, lengths as required.

.13 Joint compound: to ASTM C475, asbestos-free.

Part 3 Execution

3.1 ERECTION

.1 Do application and finishing of gypsum board in accordance with ASTM C840 except where specified otherwise.

.2 Erect hangers and runner channels for suspended gypsum board ceilings in accordance with ASTM C840 except where specified otherwise.

.3 Support light fixtures by providing additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.

.4 Install work level to tolerance of 1:1200.

.5 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, and grilles.

.6 Furr for gypsum board faced vertical bulkheads within and at termination of ceilings.

.7 Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.

.8 Install wall furring for gypsum board wall finishes in accordance with ASTM C840, except where specified otherwise.

.9 Furr openings and around built-in equipment, cabinets, access panels, on four sides. Extend furring into reveals. Check clearances with equipment suppliers.

.10 Furr duct shafts, beams, columns, pipes and exposed services where indicated.

.11 Erect drywall resilient furring transversely across studs, spaced maximum 600 mm on centre and not more than 150 mm from ceiling/wall juncture. Secure to each support with 25 mm drywall screw.

3.2 APPLICATION

.1 Do not apply gypsum board until bucks, anchors, blocking, sound attenuation, electrical and mechanical work are approved.

.2 Apply single and double layer gypsum board (as indicated on drawings) to metal furring or framing using screw. Maximum spacing of screws, 300 mm on centre.

.1 Single-Layer Application:

.1 Apply gypsum board on ceilings prior to application of walls in accordance with ASTM C840.

.2 Apply gypsum board vertically or horizontally, providing sheet lengths that will minimize end joints.

.2 Double-Layer Application:

.1 Install gypsum board for base layer and exposed gypsum board for face layer.

.2 Apply base layer to ceilings prior to base layer application on walls; apply face layers in same sequence. Offset joints between layers at least 250 mm.

.3 Apply base layers at right angles to supports unless otherwise indicated.

.4 Apply base layer on walls and face layers vertically with joints of base layer over supports and face layer joints offset at least 250 mm with base layer joints.

.3 Apply water-resistant gypsum board where wall tiles to be applied. Apply water-resistant sealant to edges, ends, cut-outs which expose gypsum core and to fastener heads. Do not apply joint treatment on areas to receive tile finish.

.4 Install ceiling boards in direction that will minimize number of end-butt joints. Stagger end joints at least 250 mm.

.5 Install gypsum board on walls vertically to avoid end-butt joints. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs, except where local codes or fire-rated assemblies require vertical application.

.6 Install gypsum board with face side out.

.7 Do not install damaged or damp boards.

.8 Locate edge or end joints over supports. Stagger vertical joints over different studs on opposite sides of wall.

3.3 INSTALLATION

.1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure at 150 mm on centre.

.2 Install casing beads around perimeter of suspended ceilings.

.3 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated.

.4 Install closed cell foam neoprene gasket where partitions abut window mullions, to provide sound seal gasket.

.5 Construct control joints of preformed units set in gypsum board facing and supported independently on both sides of joint.

.6 Provide continuous polyethylene dust barrier behind and across control joints.

.7 Apply 12 mm diameter bead of acoustic sealant continuously around perimeter of first layer of multiple layers of gypsum board to seal gypsum board/structure junction where partitions abut fixed building components. Seal full perimeter of cut-outs around electrical boxes, ducts, and penetrations, in partitions where perimeter sealed with acoustic sealant.

.8 Install access doors to electrical and mechanical fixtures specified in respective sections.

.1 Rigidly secure frames to furring or framing systems.

.9 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.

.10 Gypsum Board Finish: finish gypsum board walls and ceilings to following levels in accordance with Association of the Wall and Ceiling Industries (AWCI) International Recommended Specification on Levels of Gypsum Board Finish:

.1 Levels of finish:

.1 Level 0: No tapping, finishing or accessories required.

.2 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.

.3 Level 2: Embed tape for joints and interior angles in joint compound and apply one separate coat of joint compound over joints, angles, fastener heads and accessories; surfaces free of excess joint compound; tool marks and ridges are acceptable.

.4 Level 3: Embed tape for joints and interior angles in joint compound and apply two separate coats of joint compound over joints, angles, fastener heads and accessories; surfaces smooth and free of tool marks and ridges.

.5 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.

.6 Level 5: Embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; apply a thin skim coat of joint compound to entire surface; surfaces smooth and free of tool marks and ridges.

.11 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.

.12 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.

.13 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.

.14 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.

.15 Mix joint compound slightly thinner than for joint taping.

.16 Apply thin coat to entire surface using trowel or drywall broadknife to fill surface texture differences, variations or tool marks.

.17 Allow skim coat to dry completely.

.18 Remove ridges by light sanding or wiping with damp cloth.

.19 Provide protection that ensures gypsum drywall work will remain without damage or deterioration at time of substantial completion.

3.4 CONTROL JOINTS

.1 Provide control joints at not greater than 9 m spacing on continuous gypsum board walls in a single plane and at not greater than 9 m spacing on ceilings and bulkheads except where indicated otherwise in the drawings.

.1 Confirm location of control joints with the Consultant prior to installation of gypsum board

.2 Provide control joints of preformed units set in gypsum board facing and supported independently on both sides of joint. Interrupt top and bottom tracks at location of control joint.

.3 Install control joints straight and true. Finish control joints as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.

3.5 SCHEDULES

.1 Levels of finish: Interior partitions;

.1 Level 1:

.1 Plenums above suspended ceilings, inside of duct shafts and other gypsum board wall areas not exposed to view.

.2 Level 4:

.1 Vertical surfaces (walls, other than corridors) exposed to view.

.2 Ceilings and underside of bulkheads exposed to view.

.3 Level 5:

.1 Vertical surfaces (walls in corridors) exposed to view.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society for Testing and Materials International, (ASTM).

.1 ASTM C645-11a, Specification for Nonstructural Steel Framing Members.

.2 ASTM C754-11, Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.

.2 Canadian Standards Association (CSA International)

.1 CSA W59-03(R2008),Welded Steel Construction (Metal Arc Welding).

1.2 QUALITY ASSURANCE

.1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

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

1.3 WASTE MANAGEMENT AND DISPOSAL

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

.2 Divert unused metal materials from landfill to metal recycling facility.

Part 2 Products

2.1 MATERIALS

.1 Non-load bearing channel stud framing: to ASTM C645, stud size as noted on drawings and Partition Schedule, roll formed from 0.478 mm steel (25ga) and from 1.146 steel (18ga) as noted on drawings and Partition Schedule; hot dipped galvanized steel sheet, for screw attachment of gypsum board. Knock-out service holes at 460 mm centres.

.2 Floor and ceiling tracks: to ASTM C645, in widths to suit stud sizes, 32 mm flange height. Thickness as noted for studs in Partition Schedule.

.3 Metal channel stiffener: cold rolled steel, coated with rust inhibitive coating.

.4 Acoustical sealant: in accordance with Section 07 92 00 – Joint Sealants.

.5 Insulating strip: rubberized, moisture resistant 3 mm thick closed cell neoprene strip, 12 mm wide, with self-sticking permanent adhesive on one face, lengths as required.

.6 Welding materials: to CSA W59.

Part 3 Execution

3.1 ERECTION

.1 Align partition tracks at floor and ceiling and secure at 400 mm on centre maximum.

.2 Install damp proof course under stud shoe tracks of partitions on slabs on grade.

.3 Place studs vertically at 400 mm and 600 mm on centre (refer to drawings) and not more than 50 mm from abutting walls, and at each side of openings and corners. Position studs in tracks at floor and ceiling. Cross brace steel studs as required to provide rigid installation to manufacturer's instructions.

.4 Erect metal studding to tolerance of 1:1000.

.5 Attach studs to bottom 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. Weld studs together, placed alongside frame anchor clips.

.9 Do welding work in accordance with CSA W59 unless specified otherwise

.10 Erect track at head of door/window openings and sills of sidelight/window openings to accommodate intermediate studs. Secure track to studs at each end, in accordance with manufacturer's instructions. Install intermediate studs above and below openings in same manner and spacing as wall studs.

.11 Frame openings and around built-in equipment, cabinets, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.

.12 Install steel studs or furring channel between studs for attaching electrical and other boxes.

.13 Extend partitions to ceiling height except where noted otherwise on drawings.

.14 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs. Use double track slip joint.

.15 Install continuous insulating strips to isolate studs from uninsulated surfaces.

.16 Install two continuous beads of acoustical sealant or insulating strip under studs and tracks around perimeter of sound control partitions.

3.2 CLEANING

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

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society for Testing and Materials International (ASTM)

.1 ASTM E1264-08e1, Standard Classification for Acoustical Ceiling Products.

.2 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 International)

.1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.

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

.1 Material Safety Data Sheets (MSDS).

.5 Underwriter's Laboratories of Canada (ULC)

.1 CAN/ULC-S102-10, Surface Burning Characteristics of Building Materials and Assemblies.

1.2 SUBMITTALS

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

.2 Product Data: submit WHMIS MSDS in accordance with Section 02 81 01 - Hazardous Materials.

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 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Protect on site stored or installed absorptive material from moisture damage.

.2 Store extra materials required for maintenance, where directed by Departmental Representative.

.3 Waste Management and Disposal:

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

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, and packaging material for recycling in accordance with Waste Management Plan (WMP).

1.5 ENVIRONMENTAL REQUIREMENTS

.1 Permit wet work to dry before beginning to install.

.2 Maintain uniform minimum temperature of 15 degrees C and humidity of 20-40% before and during installation.

.3 Store materials in work area 48 hours prior to installation.

1.6 EXTRA MATERIALS

.1 Provide extra materials of acoustic units in accordance with Section 01 78 00 - Closeout Submittals.

.2 Provide acoustical units amounting to 5% of gross 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 Departmental Representative, upon completion of the work of this section.

Part 2 Products

2.1 MATERIALS

.1 Acoustic units for suspended ceiling system: to CAN/CGSB-92.1 and ASTM E1264

.1 Class A

.2 Texture: medium textured, non-directional pattern.

.3 Flame spread rating in accordance with CAN/ULC-S102

.4 Smoke developed in accordance with CAN/ULC-S102

.5 Noise Reduction Coefficient (NRC) designation of .55.

.6 Ceiling Attenuation Class (CAC) rating of 35 in accordance with ASTM C 1414

.7 Light Reflectance (LR) range of 0..85.

.8 Edge type: Square.

.9 Colour: White.

.10 Size: 610 x 1220 x 16 mm thick.

.11 Size: 610 x 610 x 16 mm thick.

.12 Shape: flat.

.13 Approved materials:

.1 CGC, “Radar ClimaPlus” or equivalent.

.14 Acceptable manufacturers:

.1 Armstrong, CertainTeed, or approved alternate.

.2 Adhesive: low VOC type recommended by acoustic unit manufacturer.

.3 Staples, nails and screws: to CSA B111 non-corrosive finish as recommended by acoustic unit manufacturer.

Part 3 Execution

3.1 EXAMINATION

.1 Do not install acoustical panels and tiles until work above ceiling has been inspected by Departmental Representative.

3.2 INSTALLATION

.1 Install acoustical panels and tiles in ceiling suspension system.

3.3 APPLICATION

.1 Install acoustical units parallel to building lines with edge unit not less than 50% of unit width. Refer to reflected ceiling plan.

.2 Scribe acoustic units to fit adjacent work. Butt joints tight, terminate edges with moulding.

3.4 INTERFACE WITH OTHER WORK

.1 Attend Pre-Installation Meeting to coordinate work of ceilings, mechanical units and electrical cable trays.

.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 Co-ordinate ceiling components to accommodate components associated with operation and maintenance of Mechanical fan coils units installed above suspended ceiling.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society for Testing and Materials International (ASTM)

.1 ASTM C635-04, Standard Specifications for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.

1.2 DESIGN REQUIREMENTS

.1 Maximum deflection: 1/360th of span to ASTM C635 deflection test.

1.3 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 MATERIALS

.1 Heavy duty system to ASTM C635.

.2 Basic materials for suspension system: commercial quality cold rolled steel hot dipped galvanized steel.

.3 Exposed tee bar grid components: Components die cut. Main tee with double web, steel construction. Main beams and cross tees shall have rotary stitching.

.4 Suspension systems: non fire rated.

.5 Hanger wire: galvanized soft annealed steel wire: To ASTM A641, Class 1 zinc coating, soft temper, pre-stretched, with a yield stress load of at least three times design load, but not less than:

.1 3.6 mm diameter for access tile ceilings

.2 2.6 mm diameter for other ceilings

.6 Hanger inserts: purpose made.

.7 Carrying channels: thickness to suit, galvanized steel.

.8 Accessories: splices, clips, wire ties, retainers and wall moulding flush reveal, to complement suspension system components, as recommended by system manufacturer.

2.2 ACOUSTICAL SUPSPENSION:

.1 Coordinate suspension components with suspended tile and panel requirements.

.2 Components: All main beams and cross tees shall be commercial quality hot-dipped galvanized (galvanized steel, aluminum, or stainless steel) as per ASTM A 653. Main beams and cross tees are double-web steel construction with 15/16 inch type exposed flange design. Exposed surfaces chemically cleansed, capping pre-finished galvanized steel (aluminum or stainless steel) in baked polyester paint. Main beams and cross tees shall have rotary stitching (exception: extruded aluminum or stainless steel).

.1 Structural Classification: ASTM C 635 HD.

.2 Colour: White and match the actual color of the selected ceiling tile, unless noted otherwise.

.3 Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct hung unless otherwise indicated.

.4 Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft temper, pre-stretched, with a yield stress load of at least time three design load, but not less than 12 gauge.

.5 Edge Moldings and Trim: Metal or extruded aluminum of types and profiles indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations, including light fixtures, that fit type of edge detail and suspension system indicated. Provide moldings with exposed flange of the same width as exposed runner.

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

.1 Installation: in accordance with ASTM C636 except where specified otherwise.

.2 Do not erect ceiling suspension system until work above ceiling has been inspected by Consultant.

.3 Secure hangers to overhead structure using industry approved attachment methods.

.4 Install hangers spaced at maximum 1200 mm centres and within 150 mm from ends of main tees.

.5 Lay out centre line of ceiling both ways, to provide balanced borders at room perimeter unless otherwise indicated.

.6 Ensure suspension system is co-ordinated with location of related components.

.7 Install wall moulding to provide correct ceiling height.

.8 Completed suspension system to support super-imposed loads, such as lighting fixtures diffusers grilles and speakers.

.9 Support at light fixtures diffusers with additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.

.10 Interlock cross member to main runner to provide rigid assembly.

.11 Frame at openings for light fixtures, air diffusers, speakers and at changes in ceiling heights.

.12 Finished ceiling system to be square with adjoining walls and level within 1:1000.

3.3 CLEANING

.1 Proceed in accordance with Section 01 74 11 – Cleaning Procedures

.2 Touch up scratches, abrasions, voids and other defects in painted surfaces.

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, 2004.

.5 National Fire Code of Canada - 2010

.6 Society for Protective Coatings (SSPC)

.1 SSPC Painting Manual, Volume Two, 8th Edition, Systems and Specifications Manual.

1.2 QUALITY ASSURANCE

.1 Qualifications:

.1 Contractor: minimum of five years proven satisfactory experience. Provide list of last three comparable jobs including, job name and location, specifying authority, and project manager.

.2 Journeymen: qualified journeymen who have "Tradesman Qualification Certificate of Proficiency" engaged in painting work.

.3 Apprentices: working under direct supervision of qualified trades person in accordance with trade regulations.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.3 SCHEDULING

.1 Submit work schedule for various stages of painting to Departmental Representative for review. Submit schedule minimum of 48 hours in advance of proposed operations.

.2 Obtain written authorization from Departmental Representative for changes in work schedule.

.3 Schedule painting operations to prevent disruption of occupants.

1.4 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 two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures. 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, stain, clear coating, and special finish with specified paint or coating in colours, gloss/sheen and textures required to MPI Architectural Painting Specification Manual standards submitted on following substrate materials:

.3 Retain reviewed samples on-site to demonstrate acceptable standard of quality for appropriate on-site surface.

.4 Test reports: submit certified test reports for paint from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

.1 Lead, cadmium and chromium: presence of and amounts.

.2 Mercury: presence of and amounts.

.3 Organochlorines and PCBs: presence of and amounts.

.5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.6 Manufacturer's Instructions:

.1 Submit manufacturer's installation and application instructions.

.7 Closeout Submittals: submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals include following:

.1 Product name, type and use.

.2 Manufacturer's product number.

.3 Colour numbers.

.4 MPI Environmentally Friendly classification system rating.

1.5 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 - four litre can of each type and colour of primer, stain, and finish coating. Identify colour and paint type in relation to established colour schedule and finish system.

.3 Delivery, storage and protection: comply with Departmental 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 with temperature range 7 degrees C to 30 degrees 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 Type ABC fire extinguisher adjacent to storage area.

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

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

.9 Waste Management and Disposal:

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

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, and packaging material for recycling in accordance with Waste Management Plan (WMP).

.4 Place materials defined as hazardous or toxic in designated containers.

.5 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal, regulations.

.6 Ensure emptied containers are sealed and stored safely.

.7 Unused paint and coating materials must be disposed of at official hazardous material collections site as approved by Departmental Representative.

.8 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.

.9 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.

.10 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.

.11 To reduce the amount 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).

.12 Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility.

1.7 SITE CONDITIONS

.1 Heating, Ventilation and Lighting:

.1 Ventilate enclosed spaces in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

.2 Provide heating facilities to maintain ambient air and substrate temperatures above 10 degrees C for 24 hours before, during and after paint application until paint has cured sufficiently.

.3 Provide continuous ventilation for seven days after completion of application of paint.

.4 Coordinate use of existing ventilation system with Departmental Representative and ensure its operation during and after application of paint as required.

.5 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.

.6 Provide minimum lighting level of 323 Lux on surfaces to be painted.

.2 Temperature, Humidity and Substrate Moisture Content Levels:

.1 Unless pre-approved written approval by Specifying body and product manufacturer, perform no painting when:

.1 Ambient air and substrate temperatures are below 10 degrees C.

.2 Substrate temperature is above 32 degrees 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 The relative humidity is under 85% or when the dew point is more than 3 degrees C variance between the air/surface temperature. Paint should not be applied if the dew point is less than 3 degrees C below the ambient or surface temperature. Use sling psychrometer to establish the relative humidity before beginning paint work.

.5 Rain or snow is forecast to occur before paint has thoroughly cured or when it is foggy, misty, raining or snowing at site.

.6 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 Allow new concrete and masonry to cure minimum of 28 days.

.2 15% for wood.

.3 12% for plaster and gypsum board.

.3 Test for moisture using calibrated electronic Moisture Meter. Test concrete floors for moisture using "cover patch test".

.4 Test concrete, masonry and plaster surfaces for alkalinity as required.

.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 Departmental 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 Only qualified products with E3 "Environmentally Friendly" rating are acceptable for use on this project. Do not exceed VOC limits of Green Seal Standard GS-11 “Paints” 1993 and latest revision.

.4 Conform to latest MPI requirements for interior painting work including preparation and priming.

.5 Materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, etc.) in accordance with MPI Architectural Painting Specification Manual "Approved Product" listing.

.6 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.

.7 Provide paint products meeting MPI "Environmentally Friendly" E3 ratings based on VOC (EPA Method 24) content levels.

.8 Use MPI listed materials having minimum E3 rating where indoor air quality (odour) requirements exist.

.9 Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids:

- .1 Water-based.
- .2 Non-flammable.
- .3 Manufactured without compounds which contribute to ozone depletion in the upper atmosphere.
- .4 Manufactured without compounds which contribute to smog in the lower atmosphere.
- .5 Do not contain methylene chloride, chlorinated hydrocarbons, andtoxic metal pigments.

.10 Formulate and manufacture water-borne surface coatings with no aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium or their compounds.

.11 Flash point: 61.0 degrees C or greater for water-borne surface coatings and recycled water-borne surface coatings.

.12 Ensure manufacture and process of both water-borne surface coatings and recycled water-borne surface coatings does not release:

- .1 Matter in undiluted production plant effluent generating 'Biochemical Oxygen Demand' (BOD) in excess of 15 mg/L to natural watercourse or sewage treatment facility lacking secondary treatment.
- .2 Total Suspended Solids (TSS) in undiluted production plant effluent in excess of 15 mg/L to natural watercourse or a sewage treatment facility lacking secondary treatment.

.13 Water-borne paints and stains, recycled water-borne surface coatings and water borne varnishes to meet minimum "Environmentally Friendly" E3 rating.

.14 Recycled water-borne surface coatings to contain 50 % post-consumer material by volume.

.15 Recycled water-borne surface coatings must not contain:

.1 Lead in excess of 600.0 ppm weight/weight total solids.

.2 Mercury in excess of 50.0 ppm weight/weight total product.

.3 Cadmium in excess of 1.0 ppm weight/weight total product.

.4 Hexavelant chromium in excess of 3.0 ppm weight/weight total product.

.5 Organochlorines or polychlorinated biphenyls (PCBS) in excess of 1.0 ppm weight/weight total product.

2.2 COLOURS

.1 Departmental Representative will provide Colour Schedule after Contract award.

.2 Selection of colours from manufacturer’s full range of colours.

.3 Where specific products are available in restricted range of colours, selection based on limited range.

.4 Each coat in multi 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.

.2 Where thinner is required, use and add thinner in accordance with paint manufacturer's recommendations. Do not use kerosene or similar organic solvents to thin water-based paints.

.3 Thin paint for spraying in accordance with paint manufacturer's instructions.

.4 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

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 @ 60 degrees	Sheen @ 85 degrees
Gloss Level 7 - High Gloss Finish	More than 85	

.2 Gloss level ratings of painted surfaces as indicated herein and as noted on Finish Schedule.

2.5 INTERIOR PAINTING SYSTEMS

.1 Metal fabrications: steel pipe railings, stair handrails, stairs, structural steel and as noted on drawings:

.1 INT 5.1U – Polyurethane, Pigmented (over high build self-priming epoxy).

.1 Gloss Level: G6, Grade: Premium

.2 Galvanized metal: doors & frames.

.1 INT 5.3M – High Performance Architectural Latex

.1 Gloss Level: G5; Grade: premium.

.3 Dressed lumber: window frames, casings, mouldings:

.1 INT 6.3A - High performance architectural latex, G5 premium finish.

.2 INT 6.3W - Waterborne clear acrylic, G4 finish (over stain).

.4 Plaster and gypsum board: gypsum wallboard, drywall, "sheet rock type material", and textured finishes:

.1 INT 9.2M - Institutional low odour/low VOC, G4 (ceilings only), premium finish.

.2 INT 9.2M - Institutional low odour/low VOC, G4, premium finish. (typical)

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 GENERAL

.1 Perform preparation and operations for interior 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 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Departmental Representative damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.

.2 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test".

Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.

.3 Maximum moisture content as follows:

.1 Stucco, plaster and gypsum board: 12%.

.2 Concrete: 12%.

.3 Clay and Concrete Block/Brick: 12%.

.4 Wood: 15%.

3.4 PREPARATION

.1 Protection:

.1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore surfaces as directed by Departmental Representative.

.2 Protect items that are permanently attached such as Fire Labels on doors and frames.

.3 Protect factory finished products and equipment.

.4 Protect passing pedestrians, building occupants and 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 approval of Departmental Representative.

.3 Clean and prepare surfaces in accordance with MPI Architectural Painting Specification Manual requirements. Refer to MPI Manual in regard to specific requirements and as follows:

.1 Remove dust, dirt, and other surface debris by vacuuming, or wiping with dry, clean cloths.

.2 Wash surfaces with a biodegradable detergent and clean warm water using a 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 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.

.5 Where possible, prime non-exposed surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.

.1 Apply vinyl sealer to MPI #36 over knots, pitch, sap and resinous areas.

.2 Apply wood filler to nail holes and cracks.

.3 Tint filler to match stains for stained woodwork.

.6 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.

.7 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.

.8 Touch up of shop primers with primer as specified.

.9 Do not apply paint until prepared surfaces have been accepted by Departmental Representative.

3.5 APPLICATION

.1 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 period 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 Finish closets and alcoves as specified for adjoining rooms.

.9 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

3.6 FIELD QUALITY CONTROL

.1 Standard of Acceptance:

.1 Walls: no defects visible from a distance of 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 Departmental 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 personnel 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 Departmental Representative.

3.7 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 Departmental Representative. Avoid scuffing newly applied paint.

.5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by Departmental Representative.

END OF SECTION

Part 1 General

1.1 PRODUCT DATA

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

1.2 SAMPLES

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

.2 Submit for approval: complete assembly of each type of insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix typewritten label beneath sample indicating service.

1.3 QUALIFICATIONS

.1 Installer to be specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Protect from weather and construction traffic.

.3 Protect against damage from any source.

.4 Store at temperatures and conditions recommended by manufacturer.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.2 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site for recycling in accordance with Waste Management Plan.

.3 Divert unused metal materials from landfill to metal recycling facility approved by Consultant.

.4 Divert unused adhesive materials from landfill to official hazardous material collections site approved by Consultant.

.5 Do not dispose of unused adhesive materials into sewer systems, into lakes, streams, onto ground or in other locations where it will pose health or environmental hazard.

Part 2 Products

2.1 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 INSULATION

.1 Mineral fibre: includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code A-1: Rigid moulded mineral fibre without factory applied vapour retarder jacket.

.1 Mineral fibre: ASTM C547.

.2 Maximum "k" factor: ASTM C547.

.4 TIAC Code A-3: Rigid moulded mineral fibre with factory applied vapour retarder jacket.

.1 Mineral fibre: ASTM C547.

.2 Jacket: to CGSB 1-GP-52Ma.

.3 Maximum "k" factor: ASTM C547.

.5 TIAC Code C-1: Rigid mineral fibre board, unfaced.

.1 Mineral fibre: ASTM C612.

.2 Maximum "k" factor: ASTM C612.

.6 TIAC Code C-4: Rigid mineral fibre board faced with factory applied vapour retarder jacket.

.1 Mineral fibre: ASTM C612.

.2 Jacket: to CGSB51-GP-52Ma.

.3 Maximum "k" factor: ASTM C612.

.7 TIAC Code C-2: Mineral fibre blanket unfaced or faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).

.1 Mineral fibre: ASTM C553.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: ASTM C553.

2.3 CEMENT

.1 Thermal insulating and finish

.1 To: ASTM C449/C449M.

.2 Hydraulic setting or Air drying on mineral wool, to ASTM C449.

2.4 JACKETS

.1 Aluminium:

.1 To ASTM B209.

.2 Thickness: 0.50 mm sheet.

.3 Finish: Stucco finish.

.4 Joining: Longitudinal and circumferential slip joints with 50 mm laps.

.5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.

.6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

2.5 INSULATION SECUREMENTS

.1 Tape: Self-adhesive, aluminium, reinforced, 50 mm wide minimum.

.2 Contact adhesive: Quick setting.

.3 Tie wire: 1.5 mm diameter stainless steel.

.4 Bands: Stainless steel, 19 mm wide, 0.5 mm thick.

.5 Fasteners: 2 mm diameter pins with 35 mm diameter square clips. Length of pin to suit thickness of insulation.

2.6 VAPOUR RETARDER LAP ADHESIVE

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

2.7 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

Part 3 Execution

3.1 PRE- INSTALLATION REQUIREMENTS

.1 Pressure testing of equipment and adjacent piping systems complete, witnessed and certified.

.2 Surfaces clean, dry, free from foreign material.

3.2 INSTALLATION

.1 Install in accordance with TIAC National Standards

.1 Hot equipment: To TIAC code 1503-H.

.2 Cold equipment: to TIAC code 1503-C.

.2 Elastomeric Insulation: to remain dry. Overlaps to manufacturer's instructions. Joints tight and sealed properly.

.3 Provide vapour retarder as recommended by manufacturer.

.4 Apply materials in accordance with insulation and equipment manufacturer's instructions and this specification.

.5 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.

.6 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Hangers, supports outside vapour retarder jacket.

.7 Supports, Hangers:

.1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.3 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

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

.2 Installation to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

3.4 EQUIPMENT INSULATION SCHEDULES

.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.

.2 Hot Equipment:

.1 TIAC code A-1 or C-1 with mechanical fastenings or wire or bands and 13 mm cement reinforced with one layer of reinforcing mesh.

.2 TIAC code C-2 unfaced with wire or bands and 13 mm cement precede by one layer of reinforcing mesh.

.3 Thicknesses:

Domestic hot water storage tanks	25mm
Heat exchangers	50mm
Steam condensate receivers	50mm
Deaerator-feedwater heaters	50mm

.3 Cold equipment:

.1 TIAC A-3 or C-4 with mechanical fastenings or wire or bands and 13 mm cement reinforced with one layer of reinforcing mesh.

.2 TIAC C-2 faced with vapour retardant jacket and with wire or bands and 13 mm cement preceded by one layer of reinforcing mesh.

.3 TIAC A-6 or C-4 with mechanical fastenings or wire or bands.

.4 Thicknesses: Chillers (except factory insulated) 50 mm.

.4 Finishes:

.1 Equipment in mechanical rooms: TIAC code CEF/1 with canvass jacket.

.2 Equipment elsewhere: TIAC code CEF/2 with canvass jacket.

END OF SECTION

Part 1 General

1.1 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 defined herein.

.2 TIAC ss:

.1 CRF: Code Rectangular Finish.

.2 CPF: Code Piping Finish.

1.2 SHOP DRAWINGS

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

.2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for pipe, fittings, valves and jointing recommendations.

1.3 SAMPLES

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

.2 Submit for approval: complete assembly of each type of insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix typewritten label beneath sample indicating service.

1.4 QUALIFICATIONS

.1 Installer to be specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Protect from weather, construction traffic.

.3 Protect against damage from any source.

.4 Store at temperatures and conditions required by manufacturer.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.2 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site for recycling in accordance with Waste Management Plan.

.3 Place excess or unused insulation and insulation accessory materials in designated containers.

.4 Divert unused metal materials from landfill to metal recycling facility approved by Consultant.

.5 Dispose of unused adhesive material at official hazardous material collections site approved by Consultant.

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 ^{o}C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code A-1: Rigid moulded mineral fibre without factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/ULC-S702.

.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 without factory applied vapour retarder jacket (as scheduled in PART 3 of this section).

.1 Mineral fibre: to CAN/ULC-S702.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to CAN/ULC-S702.

2.3 INSULATION SECUREMENT

.1 Tape: Self-adhesive, aluminium, reinforced, 50 mm wide minimum.

.2 Contact adhesive: Quick setting.

.3 Canvas adhesive: Washable.

.4 Tie wire: 1.5 mm diameter stainless steel.

.5 Bands: Stainless steel, 19 mm wide, 0.5 mm thick.

2.4 CEMENT

.1 Thermal insulating and finishing cement:

.1 Hydraulic setting or Air drying on mineral wool, to ASTM C449/C449M.

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 JACKETS

.1 Aluminium:

.1 To ASTM B209.

.2 Thickness: 0.50 mm sheet.

.3 Finish: Stucco finish.

.4 Joining: Longitudinal and circumferential slip joints with 50 mm laps.

.5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.

.6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

Part 3 Execution

3.1 PRE- INSTALLATION REQUIREMENT

.1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.

.2 Surfaces to be clean, dry, free from foreign material.

3.2 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with 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 Hangers, supports to be outside vapour retarder jacket.

.5 Supports, Hangers:

.1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.3 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

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

.2 Design: To permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

.3 Insulation:

.1 Insulation, fastenings and finishes: same as system.

.2 Jacket: high temperature fabric.

3.4 INSTALLATION OF ELASTOMERIC INSULATION

.1 Insulation to remain dry at all times. Overlaps to manufacturers instructions. Ensure tight joints.

.2 Provide vapour retarder as recommended by manufacturer.

3.5 PIPING INSULATION SCHEDULES

.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.

.2 TIAC Code: A-1.

.1 Securements: SS Wire Bands Tape at 300 mm oc.

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code 1501-H.

.3 TIAC Code: A-3.

.1 Securements: SS Wire Bands Tape at 300 mm oc.

.2 Seals: VR lap seal adhesive, VR lagging adhesive.

.3 Installation: TIAC Code: 1501-C.

.4 TIAC Code: C-2.

.1 Insulation securements: SS Wire Bands Tape at 300 mm oc.

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code: 1501-C.

.5 Thickness of insulation to be as listed in following table.

.1 Run-outs to individual units and equipment not exceeding 4000 mm long.

.2 Do not insulate exposed run-outs to plumbing fixtures, chrome plated piping, valves, fittings.

Application	**Temp °C**	**TIAC code**	**Pipe sizes (NPS) and insulation thickness (mm)**					
			Run out	**to 1**	**1 1/4 to 2**	**2 1/2 to 4**	**5 to 6**	**8 & over**
Steam	up to 175	A-1	38	50	65	75	90	90
Condensate Return	60 - 94	A-1	25	38	38	38	38	38
Pumped Condensate return	up to 94	A-1	25	38	38	38	38	38
Hot Water Heating	60 - 94	A-1	25	38	38	38	38	38
Hot Water Heating	up to 59	A-1	25	25	25	25	38	38
Domestic HWS		A-1	25	25	25	38	38	38
Chilled Water	4 - 13	A-3	25	25	25	25	25	25
Chilled Water or Glycol	below 4	A-3	25	25	38	38	38	38

Application	Temp °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
Domestic CWS with vapour retarder		C-2	25	25	25	25	25	25

.6 Finishes:

.1 Exposed indoors: Canvas jacket.

.2 Exposed in mechanical rooms: Canvas jacket.

.3 Concealed, indoors: canvas on valves, fittings. No further finish.

.4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.

.5 Finish attachments: SS screws bands, at 150 mm oc. Seals: wing closed.

.6 Installation: To appropriate TIAC code CRF/1 through CPF/5.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for copper domestic water service used in the following:

.1 Hard drawn copper domestic hot and cold water services inside building.

1.2 SUBMITTALS

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

.2 Submit product data for following: valves.

.3 Submit WHMIS MSDS - Material Safety Data Sheets.

.4 Provide maintenance data for incorporation into manual.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.2 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site for recycling in accordance with Waste Management Plan.

.3 Place excess or unused insulation and insulation accessory materials in designated containers.

.4 Divert unused metal materials from landfill to metal recycling facility approved by Consultant.

.5 Dispose of unused adhesive material at official hazardous material collections site approved by Consultant.

Part 2 Products

2.1 PIPING

.1 Domestic hot, cold and recirculation systems, within building.

.1 Above ground: copper tube, hard drawn, type K L M: to ASTM B88M.

.2 Buried or embedded: copper tube, soft annealed, type K L: to ASTM B88M, in long lengths and with no buried joints.

2.2 FITTINGS

.1 Bronze pipe flanges and flanged fittings, Class 150 and 300: to ANSI/ASME B16.24.

.2 Cast bronze threaded fittings, Class 125 and 250: to ANSI/ASME B16.15.

.3 Cast copper, solder type: to ANSI/ASME B16.18.

.4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.

.5 NPS 2 and larger: roll grooved to CSA B242.

2.3 JOINTS

.1 Rubber gaskets, latex-free 1.6 mm thick: to AWWA C111.

.2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.

.3 Solder: 95/5 tin copper alloy .

.4 Teflon tape: for threaded joints.

.5 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM flush seal gasket.

.6 Dielectric connections between dissimilar metals: dielectric fitting to ASTM F492, complete with thermoplastic liner.

2.4 GATE VALVES

.1 NPS 2 and under, soldered:

.1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc as specified Section 23 05 22 - Valves - Bronze .

.2 NPS 2 and under, screwed:

.1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc as specified Section 23 05 22 - Valves - Bronze .

.2 .

.3 NPS 2-1/2 and over, flanged:

.1 Non-rising stem: to MSS-SP-70, Class 125, 860 kPa, flat flange faces, cast-iron body, bronze trim, bolted bonnet specified Section 23 05 23 - Valves - Cast Iron: Gate, Globe, Check.

2.5 GLOBE VALVES

.1 NPS2 and under, soldered:

.1 To MSS-SP-80, Class 125, 860 kPa, bronze body, renewable composition disc, screwed over bonnet as specified Section 23 05 22 - Valves - Bronze .

.2 NPS 2 and under, screwed:

.1 To MSS-SP-80, Class 150, 1 MPa, bronze body, screwed over bonnet, renewable composition disc as specified Section 23 05 22 - Valves - Bronze .

2.6 SWING CHECK VALVES

.1 NPS 2 and under, soldered:

.1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, re-grindable seat as specified Section 23 05 22 - Valves - Bronze .

.2 NPS 2 and under, screwed:

.1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, re-grindable seat as specified Section 23 05 22 - Valves - Bronze .

.3 NPS 2-1/2 and over, flanged:

.1 To MSS-SP-71, Class 125, 860 kPa, cast iron body, flat flange faces, regrind renewable seat, bronze disc, bolted cap specified Section 23 05 23 - Valves - Cast Iron: Gate, Globe, Check .

2.7 BALL VALVES

.1 NPS 2 and under, screwed:

.1 Class 150.

.2 Bronze body, chrome plated brass stainless steel ball, PTFE adjustable packing, brass gland and PTFE BunaN seat, steel lever handle as specified Section 23 05 22 - Valves - Bronze .

.2 NPS 2 and under, soldered:

.1 To ANSI/ASME B16.18, Class 150.

.2 Bronze body, chrome plated brass stainless steel ball, PTFE adjustable packing, brass gland and PTFE BunaN seat, steel lever handle, with NPT to copper adaptors as specified Section 23 05 22 - Valves - Bronze .

Part 3 Execution

3.1 INSTALLATION

.1 Assemble piping using fittings manufactured to ANSI standards.

3.2 PRESSURE TESTS

.1 Conform to requirements of Section 23 05 00 - Common Work Results - Mechanical .

.2 Test pressure: greater of 1 times maximum system operating pressure or 860 kPa.

3.3 FLUSHING AND CLEANING

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

3.4 PRE-START-UP INSPECTIONS

.1 Systems to be complete, prior to flushing, testing and start-up.

.2 Verify that system can be completely drained.

.3 Ensure that pressure booster systems are operating properly.

.4 Ensure that air chambers, expansion compensators are installed properly.

3.5 START-UP

.1 Timing: Start up after:

.1 Pressure tests have been completed.

.2 Provide continuous supervision during start-up.

.3 Start-up procedures:

.1 Establish circulation and ensure that air is eliminated.

.2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.

.3 Check control, limit, safety devices for normal and safe operation.

.4 Rectify start-up deficiencies.

3.6 PERFORMANCE VERIFICATION

.1 Procedures:

.1 Verify compliance with safety and health requirements.

END OF SECTION

Part 1 General

1.1 WASTE MANAGEMENT AND DISPOSAL

.1 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.2 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site for recycling in accordance with Waste Management Plan.

.3 Divert unused metal materials from landfill to metal recycling facility approved by Consultant].

.4 Dispose of unused adhesive material at official hazardous material collections site approved by Consultant.

Part 2 Products

2.1 PIPING

.1 Piping: to ASTM A53/A53M, schedule 80 seamless black steel.

.2 Fittings:

.1 NPS2 and smaller: to ASME B16.11, schedule 80 steel, socket welded.

.2 NPS2 1/2 and larger: to ASME B16.11, schedule 80 steel, butt or socket welded.

.3 Couplings: to ASME B16.11, socket welded or threaded half coupling type.

.4 Unions: 1000 kPa malleable iron with brass-to-iron ground seat.

.5 Dissimilar metal junctions: use dielectric unions.

.6 Flanges:

.1 NPS2 and smaller: to ASME B16.5, forged steel, raised face and socket welded.

.2 NPS2 1/2 and larger: to ASME B16.5, forged steel, raised face and slip-on or weld neck.

.7 Joints:

.1 NPS2 and smaller: socket welded.

.2 NPS2 1/2 and larger: butt welded.

2.2 BALL VALVES

.1 Three piece design or top entry for ease of in-line maintenance.

.1 To ASTM A181/A181M, Class 70, carbon steel body socket welded or screwed ends, carbon steel ball and associated trim suitable for compressed air application.

.2 To withstand 1034 kPa maximum pressure.

2.3 COUPLERS/CONNECTORS

.1 Industrial interchange series, full-bore.

.2 Maximum inlet pressure: 1700 kPa.

.3 Valve seat: moulded nylon.

.4 Body: zinc plated steel.

.5 Threads: NPT.

Part 3 Execution

3.1 COMPRESSED AIR PIPING CONNECTIONS AND INSTALLATION

.1 Install tees in lieu of elbows at changes in direction of piping. Install plug in open ends of tees.

.2 Grade piping at 1]% slope minimum.

.3 Install compressed air trap and pressure equalizing pipe at moisture collecting points. Drain pipe to nearest floor drain.

.4 Make branch connections from top of main.

.5 Install compressed air trap at bottom of risers and at low points in mains, piped to nearest drain. Distance between drain points to be 30 m maximum.

.6 Weld steel piping in accordance with;

.1 To ASME code and requirements of authority having jurisdiction.

.2 Weld concealed and inaccessible piping regardless of size.

.7 Cleaning:

.1 Blow out piping to clean interior thoroughly of oil and foreign matter.

.8 Testing:

.1 Pressure test in accordance with requirements of Section 23 05 00 - Common Work Results - Mechanical], for 4 h minimum, to 1100 kPa, with outlets closed and with compressor isolated from system. Pressure drop not to exceed 10 kPa.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

.2 For product data, indicate dimensions, construction details and materials for items specified herein.

1.2 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual.

.2 Data to include:

.1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.

.2 Details of operation, servicing and maintenance.

.3 Recommended spare parts list.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.2 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site for recycling in accordance with Waste Management Plan.

.3 Divert unused metal materials from landfill to metal recycling facility approved by Consultant.

.4 Dispose of unused adhesive material at official hazardous material collections site approved by Consultant.

Part 2 Products

2.1 PRESSURE REGULATORS

.1 Up to NPS1-1/2 bronze bodies, screwed: to ASTM B62.

.2 NPS2 and over, semi-steel bodies, Class 125, flanged: to ASTM A126, Class B.

.3 Semi-steel spring chambers with bronze trim.

2.2 WATER METERS

.1 Displacement type to AWWA C700.

2.3 STRAINERS

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

.2 NPS2 and under, bronze body, screwed ends, with brass cap.

.3 NPS22 and over, cast iron body, flanged ends, with bolted cap.

Part 3 Execution

3.1 INSTALLATION

.1 Install in accordance with Canadian Plumbing Code provincial codes, and local authority having jurisdiction or .

.2 Install in accordance with manufacturer's instructions and as specified.

3.2 STRAINERS

.1 Install with sufficient room to remove basket.

3.3 WATER METERS

.1 Install water meter provided by local water authority.

.2 Install water meter as indicated.

3.4 START-UP

.1 Timing: Start-up only after:

.1 Pressure tests have been completed.

.2 Certificate of static completion has been issued.

.2 Provide continuous supervision during start-up.

3.5 TESTING AND ADJUSTING

.1 Application tolerances:

.1 Pressure at fixtures: +/- 70 kPa.

.2 Flow rate at fixtures: +/- 20%.

.2 Pressure regulators, PRV assemblies:

.1 Adjust settings to suit locations, flow rates, pressure conditions.

.3 Strainers:

.1 Clean out repeatedly until clear.

.2 Verify accessibility of cleanout plug and basket.

.3 Verify that cleanout plug does not leak.

END OF SECTION

Part 1 General

1.1 TRIAL USAGE

.1 Consultant may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

1.2 PROTECTION OF OPENINGS

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

1.3 PAINTING

.1 Prime and touch up marred finished paintwork to match original.

.2 Restore to new condition, finishes which have been damaged too extensively to be merely primed and touched up.

1.4 SPARE PARTS

.1 Furnish spare parts as follows:

.1 One set of packing for each pump.

.2 One casing joint gasket for each size pump.

1.5 SPECIAL TOOLS

.1 Provide one set of special tools required to service equipment as recommended by manufacturers.

1.6 DEMONSTRATION AND OPERATING AND MAINTENANCE INSTRUCTIONS

.1 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.

.2 Use operation and maintenance manual, as-built drawings, audio visual aids, etc. as part of instruction materials.

.3 Where deemed necessary, Owner may record these demonstrations on video tape for future reference.

1.7 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for incorporation into manual.

.2 Operation and maintenance manual to be approved by, and final copies deposited with, Consultant before final inspection.

.3 Operation data to include:

.1 Control schematics for each system including environmental controls.

.2 Description of each system and its controls.

.3 Description of operation of each system at various loads together with reset schedules and seasonal variances.

.4 Operation instruction for each system and each component.

.5 Description of actions to be taken in event of equipment failure.

.6 Valves schedule and flow diagram.

.7 Colour coding chart.

.4 Maintenance data shall include:

.1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.

.2 Data to include schedules of tasks, frequency, tools required and task time.

.5 Performance data to include:

.1 Equipment manufacturer's performance data sheets with point of operation as left after commissioning is complete.

.2 Equipment performance verification test results.

.3 Special performance data as specified elsewhere.

.4 Testing, adjusting and balancing reports.

.6 Approvals:

.1 Submit 2 copies of draft Operation and Maintenance Manual to Consultant for approval. Submission of individual data will not be accepted unless so directed by Consultant.

.2 Make changes as required and re-submit as directed by Consultant.

.7 Additional data:

.1 Prepare and insert into operation and maintenance manual when need for same becomes apparent during demonstrations and instructions specified above.

1.8 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

.2 Shop drawings and product data shall show:

.1 Mounting arrangements.

.2 Operating and maintenance clearances. e.g. access door swing spaces.

.3 Shop drawings and product data shall be accompanied by:

.1 Detailed drawings of bases, supports, and anchor bolts.

.2 Points of operation on performance curves.

.3 Manufacturer to certify as to current model production.

.4 Certification of compliance to applicable codes.

1.9 CLEANING

.1 Clean interior and exterior of all systems including strainers.

1.10 AS-BUILT DRAWINGS

.1 Site records:

.1 Consultant will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of the work. Mark there on all changes as work progresses and as changes occur. This shall include changes to existing mechanical systems, control systems and low voltage control wiring.

.2 On a weekly basis, transfer information to reproducibles, revising reproducibles to show all work as actually installed.

.3 Use different colour waterproof ink for each service.

.4 Make available for reference purposes and inspection at all times.

.2 As-built drawings:

.1 Prior to start of Testing, Adjusting and Balancing (TAB), finalize production of as-built drawings.

.2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (date).

.3 Submit to Consultant for approval and make corrections as directed.

.4 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

1.11 WASTE MANAGEMENT AND DISPOSAL

.1 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.2 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site for recycling in accordance with Waste Management Plan.

.3 Divert unused metal materials from landfill to metal recycling facility approved by Consultant.

.4 Dispose of unused adhesive material at official hazardous material collections site approved by Consultant.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 WASTE MANAGEMENT AND DISPOSAL

.1 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.2 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site for recycling in accordance with Waste Management Plan.

.3 Divert unused metal materials from landfill to metal recycling facility approved by Consultant.

.4 Dispose of unused adhesive material at official hazardous material collections site approved by Consultant.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 CONNECTIONS TO EQUIPMENT

.1 In accordance with manufacturer's instructions unless otherwise indicated.

.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

.3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.2 CLEARANCES

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

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

3.3 DRAINS

.1 Install piping with grade in direction of flow except as indicated.

.2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.

.3 Pipe each drain valve discharge separately to above floor drain. Discharge to be visible.

.4 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.4 AIR VENTS

.1 Install manual air vents at high points in piping systems.

.2 Install isolating valve at each automatic air valve.

.3 Install drain piping to approved location and terminate where discharge is visible.

3.5 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.

3.6 PIPEWORK INSTALLATION

.1 Screwed fittings jointed with Teflon tape.

.2 Protect openings against entry of foreign material.

.3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.4 Assemble piping using fittings manufactured to ANSI standards.

.5 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of main.

.1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.

.6 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

.7 Install concealed pipework to minimize furring space, maximize headroom, conserve space.

.8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

.9 Install, except where indicated, to permit separate thermal insulation of each pipe.

.10 Group piping wherever possible and as indicated.

.11 Ream pipes, remove scale and other foreign material before assembly.

.12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

.13 Provide for thermal expansion as indicated.

.14 Valves:

.1 Install in accessible locations.

.2 Remove interior parts before soldering.

.3 Install with stems above horizontal position unless otherwise indicated.

.4 Valves accessible for maintenance without removing adjacent piping.

.5 Install globe valves in bypass around control valves.

.6 Use gate or ball valves at branch take-offs for isolating purposes except where otherwise specified.

.7 Install butterfly valves between weld neck flanges to ensure full compression of liner.

.8 Use chain operators on valves NPS 2-1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.

.15 Check Valves:

.1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and elsewhere as indicated.

.2 Install swing check valves in horizontal lines on discharge of pumps and elsewhere as indicated.

3.7 SLEEVES

.1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.

.2 Material: Schedule 40 black steel pipe.

.3 Construction: Foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.

.4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.

.5 Installation:

.1 Concrete, masonry walls, concrete floors on grade: Terminate flush with finished surface.

.2 Other floors: Terminate 25 mm above finished floor.

.3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.

.6 Sealing:

.1 Foundation walls and below grade floors: Fire retardant, waterproof non-hardening mastic.

.2 Elsewhere: Provide space for firestopping. Maintain fire rating integrity.

.3 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.

.4 Ensure no contact between copper pipe or tube and sleeve.

3.8 PREPARATION FOR FIRESTOPPING

.1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to Section 07 84 00 - Firestopping.

.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 firestopping material or installation.

.4 Insulated pipes and ducts: Ensure integrity of insulation and vapour barriers.

3.9 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

.1 Advise Consultant 48 hours minimum prior to performance of pressure tests.

.2 Pipework: Test as specified in relevant sections of Division 15.

.3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant sections of Division 15.

.4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

.5 Conduct tests in presence of Consultant.

.6 Pay costs for repairs or replacement, retesting, and making good. Engineer Consultant to determine whether repair or replacement is appropriate.

.7 Insulate or conceal work only after approval and certification of tests by Engineer Consultant.

3.10 EXISTING SYSTEMS

.1 Connect into existing piping systems at times approved by Engineer Consultant.

.2 Request written approval 10 days minimum, prior to commencement of work.

.3 Be responsible for damage to existing plant by this work.

.4 Ensure daily clean-up of existing areas.

END OF SECTION

Part 1 General

1.1 SECTIONS INCLUDES

.1 Electrical work to conform to Division 16 including the following:

.1 Starters, motor protection and manual control devices are specified and indicated in Division 16 except where otherwise indicated or specified. Wiring to packaged mechanical equipment is indicated on electrical drawings.

.2 Supplier and installer responsibility is on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.

.3 Control wiring and conduit is specified in Division 16 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 15. Refer to Division 16 for quality of materials and workmanship.

1.2 SHOP DRAWINGS

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

1.3 CLOSEOUT SUBMITTALS

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

Part 2 Products

2.1 GENERAL

.1 Motors to be high efficiency.

2.2 MOTORS

.1 Provide motors for mechanical equipment as specified.

.2 If delivery of specified motor will delay delivery or installation of equipment, install motor approved by Consultant for temporary use. Final acceptance of equipment will not occur until specified motor is installed.

.3 Motors under 1/2 HP : speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.

.4 Motors 1/2 HP and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40°C, 3 phase, 575 V, unless otherwise specified or indicated.

2.3 TEMPORARY MOTORS

.1 If delivery of specified motor will delay completion or commissioning work, install motor approved by Consultant for temporary use. Work will only be accepted when specified motor is installed.

2.4 DRIVE GUARDS

.1 Provide guards for unprotected drives.

.2 Provide means to permit lubrication and use of test instruments with guards in place.

.3 Guard for flexible coupling:

.1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.

.2 Securely fasten in place.

.3 Removable for servicing.

Part 3 Execution

3.1 INSTALLATION

.1 Fasten securely in place.

.2 Make removable for servicing, easily returned into, and positively in position.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)

- .1 ANSI/ASME B31.1, Power Piping.
- .2 ANSI/ASME B31.3, Process Piping Addenda A.
- .3 ANSI/ASME B31.3, Process Piping Addenda B.
- .4 ANSI/ASME Boiler and Pressure Vessel Code-1998:
  - .1 Section I: Power Boilers.
  - .2 Section V: Non-destructive Examination.
  - .3 Section IX: Welding and Brazing Qualifications.

.2 American National Standards Institute/American Water Works Association (ANSI/AWWA)

- .1 ANSI/AWWA C206, Field Welding of Steel Water Pipe.

.3 American Welding Society (AWS)

- .1 AWS C1.1, Recommended Practices for Resistance Welding.
- .2 AWS Z49.1, Safety Welding, Cutting and Allied Process.
- .3 AWS W1, Welding Inspection Handbook..

.4 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB-48.2, Spot Radiography of Welded Butt Joints in Ferrous Materials.

.5 Canadian Standards Association (CSA International)

- .1 CSA W47.2, Certification of Companies for Fusion Welding of Aluminium.
- .2 CSA W48 series, Filler Metals and Allied Materials for Metal Arc Welding.
- .3 CSA B51, Boiler, Pressure Vessel and Pressure Piping Code.
- .4 CSA-W117.2, Safety in Welding, Cutting and Allied Processes.
- .5 CSA W178.1, Certification of Welding Inspection Organizations.
- .6 CSA W178.2, Certification of Welding Inspectors.

1.2 QUALIFICATIONS

.1 Welders

- .1 Welding qualifications in accordance with CSA B51.
- .2 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.
- .3 Furnish welder's qualifications to Owner.
- .4 Each welder to possess identification symbol issued by authority having jurisdiction.

.5 Certification of companies for fusion welding of aluminium in accordance with CSA W47.2.

.2 Inspectors

.1 Inspectors qualified to CSA W178.2.

1.3 QUALITY ASSURANCE

.1 Registration of welding procedures in accordance with CSA B51.

.2 Copy of welding procedures available for inspection.

.3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

Part 2 Products

2.1 ELECTRODES

.1 Electrodes: in accordance with CSA W48 Series.

Part 3 Execution

3.1 WORKMANSHIP

.1 Welding: in accordance with ANSI/ASME B31.1 or B31.3, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS B3.0, AWS C1.1 and applicable requirements of provincial authority having jurisdiction.

3.2 INSTALLATION REQUIREMENTS

.1 Identify each weld with welder's identification symbol.

.2 Backing rings:

.1 Where used, fit to minimize gaps between ring and pipe bore.

.2 Do not install at orifice flanges.

.3 Fittings:

.1 NPS 2 and smaller: install welding type sockets.

.2 Branch connections: install welding tees or forged branch outlet fittings.

3.3 INSPECTION AND TESTS - GENERAL REQUIREMENTS

.1 Review weld quality requirements and defect limits of applicable codes and standards with Owner before work is started.

.2 Formulate "Inspection and Test Plan" in co-operation with Consultant and Owner.

.3 Do not conceal welds until they have been inspected, tested and approved by inspector.

.4 Provide for inspector to visually inspect welds during early stages of welding procedures in accordance with Welding Inspection Handbook. Repair or replace defects as required by codes and as specified.

3.4 SPECIALIST EXAMINATIONS AND TESTS

.1 General

.1 Perform examinations and tests by specialist qualified in accordance with CSA W178.1 and CSA W178.2 and approved by Consultant and Owner.

.2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.

.3 Inspect and test 10% of welds in accordance with "Inspection and Test Plan" by non-destructive visual examination.

.2 Hydrostatically test welds to requirements of ANSI/ASME B31.1.

.3 Visual examinations: include entire circumference of weld externally and wherever possible internally.

.4 Failure of visual examinations:

.1 Upon failure of welds by visual examination, perform additional testing as directed by Consultant of total of up to 10 % of welds, selected at random by Consultant by radiographic tests.

.5 Full radiographic tests for piping systems.

.1 Spot radiography to CAN/CGSB-48.2.

.1 Conduct spot radiographic tests of up to 10% of welds, selected at random by Consultant from welds which would be most difficult to repair in event of failure after system is operational.

.2 Radiographic film:

.1 Identify each radiographic film with date, location, name of welder, and submit to Consultant. Replace film if rejected because of poor quality.

.3 Interpretation of radiographic films:

.1 By qualified radiographer.

.4 Failure of radiographic tests:

.1 Extend tests to welds by welder responsible when those welds fails tests.

3.5 DEFECTS CAUSING REJECTION

.1 As described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code.

.2 In addition, chilled water systems:

.1 Undercutting greater than 0.8 mm adjacent to cover bead on outside of pipe.

.2 Undercutting greater than 0.8 mm adjacent to root bead on inside of pipe.

.3 Undercutting greater than 0.8 mm at combination of internal surface and external surface.

.4 Incomplete penetration and incomplete fusion greater than total length of 38 mm in 1500 mm length of weld depth of such defects being greater than 0.8 mm.

.5 Repair cracks and defects in excess of 0.8 mm in depth.

.6 Repair defects whose depth cannot be determined accurately on basis of visual examination or radiographic tests.

3.6 REPAIR OF WELDS WHICH FAILED TESTS

.1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for thermometers and pressure gauges in piping systems.

1.2 SUBMITTALS

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

.2 Submit shop drawings and product data.

.3 Submit manufacturer's product data for following items:

.1 Pressure gauges.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.2 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site for recycling in accordance with Waste Management Plan.

.3 Divert unused metal materials from landfill to metal recycling facility approved by Consultant.

.4 Dispose of unused adhesive material at official hazardous material collections site approved by Consultant.

Part 2 Products

2.1 GENERAL

.1 Design point to be at mid point of scale or range.

2.2 PRESSURE GAUGES

.1 112 mm, dial type: to ASME B40.100 Grade 2A, stainless steel bourdon tube having 0.5% accuracy full scale unless otherwise specified.

.2 Provide:

.1 Snubber for pulsating operation.

.2 Bronze stop cock.

Part 3 Execution

3.1 GENERAL

.1 Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units.

.2 Install between equipment and first fitting or valve.

3.2 PRESSURE GAUGES

.1 Install in following locations:

.1 Suction and discharge of pumps.

.2 Upstream and downstream of PRV's.

.3 Upstream and downstream of control valves.

.4 Elsewhere as shown on the drawings.

.2 Use extensions where pressure gauges are installed through insulation.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Bronze - valves.

1.2 SUBMITTALS

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

.2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets.

.3 Closeout Submittals:

.1 Submit maintenance data for incorporation into manual.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.2 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site for recycling in accordance with Waste Management Plan.

.3 Divert unused metal materials from landfill to metal recycling facility approved by Consultant.

.4 Dispose of unused adhesive material at official hazardous material collections site approved by Consultant.

Part 2 Products

2.1 MATERIALS

.1 Valves:

.1 Except for specialty valves, to be single manufacturer.

.2 All products to have CRN registration numbers.

.2 End Connections:

.1 Connection into adjacent piping/tubing:

.1 Steel pipe systems: Screwed ends to ANSI/ASME B1.20.1.

.2 Copper tube systems: Solder ends to ANSI/ASME B16.18.

.3 Gate Valves:

.1 Requirements common to gate valves, unless specified otherwise:

.1 Standard specification: MSS SP-80.

.2 Bonnet: union with hexagonal shoulders.

.3 Connections: screwed with hexagonal shoulders.

.4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.

.5 Packing: non-asbestos.

.6 Hand wheel: non-ferrous.

.7 Hand wheel Nut: bronze to ASTM B62.

.2 NPS 2 and under, non-rising stem, solid wedge disc, Class 125

.1 Body: with long disc guides, screwed bonnet with stem retaining nut.

.2 Operator: Hand wheel.

.3 NPS 2 and under, non-rising stem, solid wedge disc, Class 150:

.1 Body: with long disc guides, screwed bonnet with stem retaining nut.

.2 Operator: Hand wheel.

.4 NPS 2 and under, rising stem, split wedge disc, Class 125:

.1 Body: with long disc guides, screwed bonnet.

.2 Disc: split wedge, bronze to ASTM B283, loosely secured to stem.

.3 Operator: Hand wheel.

.5 NPS 2 and under, rising stem, solid wedge disc, Class 125:

.1 Body: with long disc guides, screwed bonnet.

.2 Operator: Hand wheel.

.6 NPS 2 and under, rising stem, solid wedge disc, Class 150:

.1 Body: with long disc guides, screwed union bonnet.

.2 Operator: Hand wheel.

.4 Globe Valves:

.1 Requirements common to globe valves, unless specified otherwise:

.1 Standard specification: MSS SP-80.

.2 Bonnet: union with hexagonal shoulders.

.3 Connections: screwed with hexagonal shoulders.

.4 Pressure testing: to MSS SP-80. Tests to be hydrostatic.

.5 Stuffing box: threaded to bonnet with gland follower, packing nut, high grade non-asbestos packing.

.6 Hand wheel: non-ferrous.

.7 Hand wheel Nut: bronze to ASTM B62.

.2 NPS 2 and under, composition disc, Class 125:

.1 Body and bonnet: screwed bonnet.

.2 Disc and seat: renewable rotating PTFEdisc composition to suit service conditions, regrindable bronze seat, loosely secured to bronze stem to ASTM B505.

.3 Operator: Hand wheel.

.3 NPS 2 and under, composition disc, Class 150:

.1 Body and bonnet: union bonnet.

.2 Disc and seat: renewable rotating PTFE disc in easily removable disc holder, regrindable bronze seat, loosely secured to bronze stem to ASTM B505.

.3 Operator: Hand wheel.

.5 Check Valves:

.1 Requirements common to check valves, unless specified otherwise:

.1 Standard specification: MSS SP-80.

.2 Connections: screwed with hexagonal shoulders.

.2 NPS 2 and under, swing type, bronze disc, Class 125:

.1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.

.2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.

.3 NPS 2 and under, swing type, bronze disc:

.1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.

.2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.

.4 NPS 2 and under, swing type, composition disc, Class 200:

.1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.

.2 Disc: renewable rotating disc of number 6 composition to suit service conditions, bronze two-piece hinge disc construction.

.5 NPS 2 and under, horizontal lift type, composition disc, Class 150:

.1 Body: with integral seat, union bonnet ring with hex shoulders, cap.

.2 Disc: renewable PTFE rotating disc in disc holder having guides top and bottom, of bronze to ASTM B62.

.6 NPS 2 and under, vertical lift type, bronze disc, Class 125:

.1 Disc: rotating disc having guides top and bottom, disc guides, retaining rings.

.6 Silent Check Valves:

.1 NPS 2 and under:

.1 Body: cast high tensile bronze to ASTM B62 with integral seat.

.2 Pressure rating: Class 125.

.3 Connections: screwed ends to ANSI B1.20.1 and with hex. shoulders.

.4 Disc and seat: renewable rotating disc.

.5 Stainless steel spring, heavy duty in down flow applications.

.6 Seat: regrindable.

.7 Ball Valves:

.1 NPS 2 and under:

.1 Body and cap: cast high tensile bronze to ASTM B62.

.2 Pressure rating: Class125, 860 kPa steam.

.3 Connections: Screwed ends to ANSI B1.20.1 and with hexagonal shoulders .

.4 Stem: tamperproof ball drive.

.5 Stem packing nut: external to body.

.6 Ball and seat: replaceable stainless steel hard chrome solid ball and Teflon seats.

.7 Stem seal: TFE with external packing nut.

.8 Operator: removable lever handle.

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.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Valves, gate, globe, and check.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME).

.1 ANSI/ASME B16.1, Cast Iron Pipe Flanges and Flanged Fittings.

.2 American Society for Testing and Materials International (ASTM).

.1 ASTM A49, Specification for Heat-Treated Carbon Steel Joint Bars.

.2 ASTM A126, Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

.3 ASTM B61, Specification for Steam or Valve Bronze Castings.

.4 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.

.5 ASTM B85, Specification for Aluminium-Alloy Die Castings.

.6 ASTM B209, Specification for Aluminium and Aluminium-Alloy Sheet and Plate.

.3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).

.1 MSS SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.

.2 MSS SP-71, Grey Iron Swing Check Valves, Flanged and Threaded Ends.

.3 MSS SP-82, Valve Pressure Testing Methods.

.4 MSS SP-85, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.3 SUBMITTALS

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

Part 2 Products

2.1 MATERIAL

.1 Valves:

.1 Except for specialty valves, to be of single manufacturer.

.2 Standard specifications:

.1 Gate valves: MSS SP-70.

.2 Globe valves: MSS SP-85.

.3 Check valves: MSS SP-71.

.3 Requirements common to valves, unless specified otherwise:

.1 Body, bonnet: cast iron to ASTM B209 Class B.

.2 Connections: flanged ends plain face with 2 mm raised face with serrated finish to ANSI B16.1.

.3 Inspection and pressure testing: to MSS SP-82.

.4 Bonnet gasket: non-asbestos.

.5 Stem: to have precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut.

.6 Stuffing box: non-galling two-piece ball-jointed packing gland, gland bolts and nuts.

.7 Gland packing: non-asbestos.

.8 Handwheel: Die-cast aluminium alloy to ASTM B85 or malleable iron to ASTM A49. Nut of bronze to ASTM B62.

.9 Identification tag: with catalogue number, size, other pertinent data.

.4 All products to have CRN registration numbers.

2.2 GATE VALVES

.1 NPS 2 1/2 - 8, non rising stem, inside screw, bronze trim, solid wedge disc:

.1 Body and multiple-bolted bonnet: with full length disc guides designed to ensure correct re-assembly. Class 125.

.2 Disc: solid offset taper wedge, bronze to ASTM B62.

.3 Seat rings: renewable bronze to ASTM B62, screwed into body.

.4 Stem: bronze to ASTM B62.

.5 Seat: Integral with body.

.6 Stem: wrought steel.

.7 Operator: Handwheel

2.3 GLOBE VALVES

.1 NPS 2 1/2 - 10, OSY:

.1 Body: with multiple-bolted bonnet.

.2 WP: 860 kPa steam, 1.4 MPa CWP.

.3 Bonnet-yoke gasket: non-asbestos.

.4 Disc: bronze to ASTM B62, fully guided from bottom, securely yet freely connected to stem for swivel action and accurate engagement with disc.

.5 Seat ring: renewable, regrindable, screwed into body.

.6 Stem: bronze to ASTM B62.

.7 Operator: Handwheel

2.4 VALVE OPERATORS

.1 Install valve operators as follows:

.1 Handwheel: on valves except as specified.

.2 Handwheel with chain operators: on valves installed more than 2400 mm above floor in boiler rooms and mechanical equipment rooms.

2.5 CHECK VALVES

.1 Swing check valves, Class 125:

.1 Body and bolted cover: with tapped and plugged opening on each side for hinge pin. Flanged ends: plain faced with smooth finish.

.1 Up to NPS 16: cast iron to ASTM A126 Class B.

.2 Ratings:

.1 NPS 2 1/2 - 12: 860 kPa steam; 1.4 MPa CWP.

.3 Seat rings: renewable bronze to ASTM B62 screwed into body.

.4 Hinge pin, bushings: renewable bronze to ASTM B62.

.5 Seat: cast iron, integral with body.

.6 Hinge pin: exelloy; bushings: malleable iron.

.7 Identification tag: fastened to cover.

.8 Hinge: galvanized malleable iron.

2.6 SILENT CHECK VALVES

.1 Construction:

.1 Body: malleable iron with integral seat.

.2 Pressure rating: class 125, WP = 860 kPa.

.3 Connections: grooved ends.

.4 Disc: stainless steel renewable rotating disc.

.5 Seat: renewable, EPDM.

.6 Spring required in vertical downflow applications: Stainless steel spring, heavy duty.

Part 3 Execution

3.1 INSTALLATION

.1 Install rising stem valves in upright position with stem above horizontal.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Butterfly Valves.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME).

.1 ANSI/ASME B1.20.1, Pipe Threads, General Purpose (Inch).
.2 ANSI/ASME B16.1, Cast Iron Pipe Flanges and Flanged Fittings.
.3 ANSI/ASME B16.5, Pipe Flanges and Flanged Fittings.
.4 ANSI/ASME B16.11, Forged Fittings, Socket-Welding and Threaded.
.5 ANSI/ASME B16.25, Buttwelding Ends.
.6 ANSI/ASME B16.34, Valves - Flanged, Threaded and Welding Ends.

.2 American National Standards Institute (ANSI)/American Petroleum Institute (API).

.1 ANSI/API 609, Lug- and Water-Type Butterfly Valves.

.3 American Society for Testing and Materials International, (ASTM).

.1 ASTM A126, Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
.2 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
.3 ASTM B209M, Specification for Aluminium and Aluminium-Alloy Sheet and Plate.

.4 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).

.1 MSS SP-67, Butterfly Valves.

1.3 SUBMITTALS

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

Part 2 Products

2.1 BUTTERFLY VALVES - RESILIENT SEAT - 200 PSIG

.1 Except to specialty valves, to be of single manufacturer.

.2 To be suitable for dead-end service.

.3 CRN registration number required for products.

.4 Sizes: Lug type: NPS 2 to 30.

.5 Pressure rating for tight shut-off at temperatures up to maximum for seat material.

.1 NPS 2 - 12: 200 psig.

.2 NPS 14 - 48: 200 psig.

.6 Minimum seat temperature ratings to135 degrees C.

.7 Application: on-off operation.

.8 Full lug body (threaded).

.9 Operators:

.1 NPS 2 - 6: Handles capable of locking in any of ten (10) positions - 0 degrees to 90 degrees. Handle and release trigger - ductile iron. Return spring and hinge pin: carbon steel. Latch plate and mounting hardware: cadmium plated carbon steel. Standard coating: black lacquer.

.2 NPS 8 - 30: Manual enclosed gear operator.

.10 Designed to comply with MSS SP-67 and API 609.

.11 Compatible with ANSI Class 125/Class 150 flanges.

.12 Construction:

.1 Body ductile iron.

.2 Disc: aluminium bronze.

.3 Seat: EPDM.

.4 Shaft: stainless steel.

.5 Taper pin: stainless steel.

.6 Key: carbon steel.

.7 O-Ring: Buna-N.

.8 Bushings: Luberized bronze.

2.2 MOUNTING FLANGES

.1 Class 125 cast iron to ANSI B16.1 or Class 150 steel to B16.5 pipe flanges.

Part 3 Execution

3.1 PREPARATION

.1 Valve and mating flange preparation.

.1 Inspect adjacent pipeline, remove rust, scale, welding slag, other foreign material.

.2 Ensure that valve seats and pipe flange faces are free of dirt or surface irregularities which may disrupt flange seating and cause external leakage.

.3 Install butterfly valves with disc in almost closed position.

.4 Inspect valve disc seating surfaces and waterway and eliminate dirt or foreign material.

3.2 INSTALLATION OF VALVES

.1 Install in accordance with manufacturer's instructions.

.2 Do not use gaskets between pipe flanges and valves unless instructed otherwise by valve manufacturer.

.3 Verify suitability of valve for application by inspection of identification tag.

.4 Mount actuator on to valve prior to installation.

.5 Handle valve with care so as to prevent damage to disc and seat faces.

.6 Valves in horizontal pipe lines should be installed with stem in horizontal position to minimize liner and seal wear.

.7 Ensure that valves are centered between bolts before bolts are tightened and then opened and closed to ensure unobstructed disc movement. If interference occurs due, for example to pipe wall thickness, taper bore adjacent piping to remove interference.

END OF SECTION

Part 1 General

1.1 DESIGN REQUIREMENTS

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

.2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.

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

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

.5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment to be in accordance with MSS SP58.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.2 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site for recycling in accordance with Waste Management Plan.

.3 Divert unused metal materials from landfill to metal recycling facility approved by Consultant.

.4 Dispose of unused adhesive material at official hazardous material collections site approved by Consultant.

Part 2 Products

2.1 GENERAL

.1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP58.

.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.2 PIPE HANGERS

.1 Finishes:

.1 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.

.2 Upper attachment to concrete.

.1 Ceiling: Carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.

.3 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 pipe work is anticipated.

.3 Do not use 22 mm or 28 mm rod.

.4 Pipe attachments: material to MSS SP58.

.1 Attachments for steel piping: carbon steel.

.2 Attachments for copper piping: copper plated black steel.

.3 Use insulation shields for hot pipe work.

.4 Oversize pipe hangers and supports.

.5 Adjustable clevis: material to MSS SP69 , clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.

.6 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.

.7 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.

.1 Finishes for steel pipe work: black.

.2 Finishes for copper, glass, brass or aluminium pipe work: black with formed portion plastic coated.

2.3 INSULATION PROTECTION SHIELDS

.1 Insulated cold piping:

.1 64 kg/m^3 density insulation plus insulation protection shield to: MSS SP69, 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 SP69.

2.4 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.

2.5 VARIABLE SUPPORT SPRING HANGERS

.1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.

.2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.

.3 Variable spring hanger to be complete with factory calibrated travel stops

.4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

Part 3 Execution

3.1 INSTALLATION

.1 Install in accordance with:

.1 manufacturer's instructions and recommendations.

.2 Vibration Control Devices:

.1 Install on piping systems at pumps and elsewhere as indicated.

.3 Clamps on riser piping:

.1 Support independent of connected horizontal pipe work using riser clamps and riser clamp lugs welded to riser.

.2 Bolt-tightening torques to be to industry standards.

.3 Steel pipes: Install below coupling or shear lugs welded to pipe.

.4 Cast iron pipes: Install below joint.

.4 Clevis plates:

.1 Attach to concrete with 4 minimum concrete inserts, one at each corner.

.5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

.6 Use approved constant support type hangers where:

.1 vertical movement of pipe work is 13 mm or more,

.2 transfer of load to adjacent hangers or connected equipment is not permitted.

.7 Use variable support spring hangers where:

.1 transfer of load to adjacent piping or to connected equipment is not critical.

.2 variation in supporting effect does not exceed 25 % of total load.

3.2 HANGER SPACING

.1 Copper piping: up to NPS 1/2: every 1.5 m.

.2 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.

.3 Within 300 mm of each elbow.

Maximum Pipe Size: NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.1 m	1.8 m

Maximum Pipe Size: NPS	Maximum Spacing Steel	Maximum Spacing Copper
1-1/2	2.7 m	2.4 m
2	3.0 m	2.7 m
2-1/2	3.6 m	3.0 m
3	3.6 m	3.0 m
3-1/2	3.9 m	3.3 m
4	4.2 m	3.6 m
5	4.8 m	
6	5.1 m	
8	5.7 m	
10	6.6 m	
12	6.9 m	

.4 Pipe work greater than NPS 12: to MSS SP69.

3.3 HANGER INSTALLATION

.1 Install hanger so that rod is vertical under operating conditions.

.2 Adjust hangers to equalize load.

.3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.4 HORIZONTAL MOVEMENT

.1 Angularity of rod hanger resulting from horizontal movement of pipe work 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.

3.5 FINAL ADJUSTMENT

.1 Adjust hangers and supports:

.1 Ensure that rod is vertical under operating conditions.

.2 Equalize loads.

.2 Adjustable clevis:

.1 Tighten hanger load nut securely to ensure proper hanger performance.

.2 Tighten upper nut after adjustment.

.3 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.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS

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

.2 Provide separate shop drawings for each isolated system complete with performance and product data.

Part 2 Products

2.1 GENERAL

.1 Size and shape of bases type and performance of vibration isolation to be as indicated.

2.2 ELASTOMERIC PADS

.1 Type EP1 - neoprene waffle or ribbed; 9mm minimum thick; 50 durometer; maximum loading 350 kPa.

.2 Type EP2 - rubber waffle or ribbed; 9 mm minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.

.3 Type EP3 - neoprene-steel-neoprene; 9 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.

.4 Type EP4 - rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.

2.3 ELASTOMERIC MOUNTS

.1 Type M1 - colour coded; neoprene in shear; maximum durometer of 60; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.

2.4 SPRINGS

.1 Design stable springs so that ratio of lateral to axial stiffness is equal to or greater than 1.2 times the ratio of static deflection to working height. Select for 50% travel beyond rated load. Units to be complete with levelling devices.

.2 Ratio of height when loaded to diameter of spring to be between 0.8 to 1.0.

.3 Cadmium plate for outdoor installations.

.4 Colour code springs.

2.5 SPRING MOUNT

.1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.

.2 Type M2 - stable open spring: support on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad.

.3 Type M3 - stable open spring: 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.

.4 Type M4 - restrained stable open spring: supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.

.5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg maximum.

2.6 HANGERS

.1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30^{o} arc without metal to metal contact.

.2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.

.3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.

.4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.

.5 Type H4 - stable spring, elastomeric element with precompression washer and nut with deflection indicator.

2.7 STRUCTURAL BASES

.1 Type B1 - Prefabricated steel base: integrally welded on sizes up to 2400 mm on smallest dimension, split for field welding on sizes over 2400 mm on smallest dimension and reinforced for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; pre-drilled holes to receive equipment anchor bolts; and complete with adjustable built-in motor slide rail where indicated.

.2 Type B2 - Steel rail base: structural steel, positioned for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; and pre-drilled holes to receive equipment anchor bolts.

.3 Bases to clear housekeeping pads by 25 mm minimum.

2.8 INERTIA BASE

.1 Type B3 - Full depth perimeter structural or formed channels, frames: welded in place reinforcing rods running in both directions; spring mounted, carried by gussetted height-saving brackets welded to frame; and clear housekeeping pads by 50 mm minimum.

.2 Pump bases: "T" shaped, where applicable, to provide support for elbows.

Part 3 Execution

3.1 INSTALLATION

.1 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.

.2 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.

.3 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:

.1 Up to NPS4: first 3 points of support. NPS5 to NPS8: first 4 points of support. NPS10 and Over: first 6 points of support.

.2 First point of support shall have a static deflection of twice deflection of isolated equipment, but not more than 50 mm.

.4 Where isolation is bolted to floor use vibration isolation rubber washers.

.5 Block and shim level bases so that ductwork and piping connections can be made to a rigid system at the operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.2 APPLICATION

.1 Install the following types of vibration isolation on equipment:

.1 Base Mounted Pumps Type B3

3.3 SITE VISIT

.1 Manufacturer to visit site and provide written certification that installation is in accordance with manufacturer's instructions and submit report to Consultant.

.2 Provide Consultant with notice 24 h in advance of visit.

.3 Make adjustments and corrections in accordance with written report.

END OF SECTION

Part 1 General

1.1 WASTE MANAGEMENT AND DISPOSAL

.1 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.2 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site for recycling in accordance with Waste Management Plan.

.3 Divert unused metal materials from landfill to metal recycling facility approved by Consultant.

.4 Dispose of unused adhesive material at official hazardous material collections site approved by Consultant.

Part 2 Products

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

.1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.

.2 Lettering and numbers to be raised or recessed.

.3 Information to include, as appropriate:

.1 Equipment: Manufacturer's name, model, size, serial number, capacity.

.2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

.1 Colours:

.1 Hazardous: red letters, white background.

.2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).

.2 Construction:

.1 3 mm thick laminated plastic or white anodized aluminium, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:

.1 Conform to following table:

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

.2 Use maximum of 25 letters/numbers per line.

.4 Locations:

.1 Terminal cabinets, control panels: Use size # 5.

.2 Equipment in Mechanical Rooms: Use size # 9.

2.3 EXISTING IDENTIFICATION SYSTEMS

.1 Apply existing identification system to new work.

.2 Where existing identification system does not cover for new work, use identification system specified this section.

.3 Before starting work, obtain written approval of identification system from Consultant.

2.4 PIPING SYSTEMS GOVERNED BY CODES

2.5 IDENTIFICATION OF PIPING SYSTEMS

.1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.

.2 Pictograms:

.1 Where required, to Workplace Hazardous Materials Information System (WHMIS) regulations.

.3 Legend:

.1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.

.4 Arrows showing direction of flow:

.1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.

.2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.

.3 Use double-headed arrows where flow is reversible.

.5 Extent of background colour marking:

.1 To full circumference of pipe or insulation.

.2 Length to accommodate pictogram, full length of legend and arrows.

.6 Materials for background colour marking, legend, arrows:

.1 Pipes and tubing 20 mm and smaller: Waterproof and heat-resistant pressure sensitive plastic marker tags.

.2 All other pipes: Pressure sensitive plastic-coated cloth vinyl with protective over coating, waterproof contact adhesive undercoating, suitable for ambient of 100%RH and continuous operating temperature of 150°C and intermittent temperature of 200°C.

.7 Colours and Legends:

.1 Where not listed, obtain direction from Engineer Consultant.

.2 Colours for legends, arrows: To following table:

Background colour:	Legend, arrows:
Yellow	BLACK
Green	WHITE
Red	WHITE

.3 Background colour marking and legends for piping systems:

Contents	Background colour marking	Legend
** Add design temperature		
++ Add design temperature and pressure		
Raw water	Green	RAW WATER
Compressed air (<700kPa)	Green	COMP. AIR ___ kPa
Compressed air (>700kPa)	Yellow	COMP. AIR ___ kPa
Condenser water supply	Green	COND. WTR. SUPPLY
Condenser water return	Green	COND. WTR. RETURN
Raw water	Green	RAW WATER
City water	Green	CITY WATER
Chilled water supply	Green	CH. WTR. SUPPLY
Chilled water return	Green	CH. WTR. RETURN

2.6 IDENTIFICATION DUCTWORK SYSTEMS

.1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.

.2 Colours: Black, or co-ordinated with base colour to ensure strong contrast.

2.7 VALVES, CONTROLLERS

.1 Brass tags with 12 mm stamped identification data filled with black paint.

.2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.8 CONTROLS COMPONENTS IDENTIFICATION

.1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.

.2 Inscriptions to include function and (where appropriate) fail-safe position.

2.9 LANGUAGE

.1 Identification to be in English.

Part 3 Execution

3.1 NAMEPLATES

.1 Locations:

.1 In conspicuous location to facilitate easy reading and identification from operating floor.

.2 Standoffs:

.1 Provide for nameplates on hot and/or insulated surfaces.

.3 Protection

.1 Do not paint, insulate or cover in any way.

3.2 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

.1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: At not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.

.2 Adjacent to each change in direction.

.3 At least once in each small room through which piping or ductwork passes.

.4 On both sides of visual obstruction or where run is difficult to follow.

.5 On both sides of separations such as walls, floors, partitions.

.6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.

.7 At beginning and end points of each run and at each piece of equipment in run.

.8 At point immediately upstream of major manually operated or automatically controlled valves, dampers, etc. Where this is not possible, place identification as close as possible, preferably on upstream side.

.9 Identification to be easily and accurately readable from usual operating areas and from access points.

.1 Position of identification to be approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.3 VALVES, CONTROLLERS

.1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S"hooks.

.2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Consultant. Provide one copy (reduced in size if required) in each operating and maintenance manual.

.3 Number valves in each system consecutively.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 QUALIFICATIONS OF TAB PERSONNEL

.1 Names of personnel it is proposed to perform TAB to be submitted to and approved by Consultant within 30 days of award of contract.

.2 Provide documentation confirming qualifications, successful experience.

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 so as to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

.3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.4 EXCEPTIONS

.1 TAB of systems and equipment regulated by codes, standards to be 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 so as to ensure completion before acceptance of project.

.2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.6 PRE-TAB REVIEW

.1 Review contract documents before project construction is started.

.2 Review specified standards and report to Consultant in writing all proposed procedures which vary from standard.

.3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.7 START-UP

.1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.

1.8 OPERATION OF SYSTEMS DURING TAB

.1 Operate systems for length of time required for TAB and as required by Consultant for verification of TAB reports.

1.9 START OF TAB

.1 Start TAB when work is essentially completed.

.2 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 Fire, smoke, volume control dampers installed and open.

.4 Access doors, installed, closed.

.5 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.

1.10 APPLICATION TOLERANCES

.1 Do TAB to following tolerances of design values:

.1 HVAC systems: plus 5 %, minus 5 %.

.2 Hydronic systems: plus or minus 10 %.

1.11 ACCURACY TOLERANCES

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

1.12 INSTRUMENTS

.1 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

.2 Calibrate within 3 months of TAB.

1.13 TAB REPORT

.1 TAB report to show results in SI units and to include:

.1 Project record drawings.

.2 System schematics.

.2 Submit 6 copies of TAB Report to Consultant for verification and approval.

1.14 VERIFICATION

.1 Reported results subject to verification by Consultant.

.2 Bear costs to repeat TAB as required to satisfaction of Consultant.

1.15 SETTINGS

.1 After TAB is completed to satisfaction of Consultant, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.

.2 Permanently mark settings to allow restoration at any time during life of facility. Markings not to be eradicated or covered in any way.

1.16 COMPLETION OF TAB

.1 TAB to be considered complete when final TAB Report received and approved by Consultant.

1.17 AIR SYSTEMS

.1 Do TAB of :

.1 Mechanical Room Fan Unit.

.2 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dew point), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.

1.18 HYDRONIC SYSTEMS

.1 Definitions: for purposes of this section, to include raw water pumping system.

.2 Do TAB of :

.1 New pumps.

.3 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: Flow rate, static pressure, pressure drop (or loss), temperature, specific gravity, density, RPM, electrical power, voltage, noise, vibration.

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 Ducts over 5 m in length, forming part of a supply, return or exhaust ductwork system directly or indirectly connected to air handling equipment to be pressure tested for leaks.

1.2 TIMING

.1 Ducts to be tested before installation of insulation or any other form of concealments.

.2 Test after seals have cured.

.3 Test when ambient temperature will not affect effectiveness of seals, gaskets, etc.

1.3 EXCLUSIONS

.1 Flexible connections to VAV boxes.

1.4 REFERENCES

.1 SMACNA HVAC Air Duct Leakage Test Manual, [1985].

1.5 TEST PROCEDURES

.1 Maximum lengths of ducts to be tested to be consistent with capacity of test equipment.

.2 Section of duct to be tested to include:

.1 Fittings, branch ducts, tap-ins.

.3 Repeat tests until specified pressures are attained. Bear costs for repairs and repetition to tests.

.4 Base partial system leakage calculations on Reference Standard.

.5 Seal leaks that can be heard or felt, regardless of their contribution to total leakage.

1.6 TESTING AGENCY

.1 Installing Contractor.

1.7 VERIFICATION

.1 Consultant to witness tests and to verify reported results.

.2 To be certified by the same TAB agency approved by Owner to undertake TAB on this project.

1.8 TEST INSTRUMENTS

.1 Testing agency to provide instruments for tests.

.2 Test apparatus to include:

.1 Fan capable of producing required static pressure.

.2 Duct section with calibrated orifice plate mounted and accurately located pressure taps.

.3 Flow measuring instrument compatible with the orifice plate.

.4 Calibration curves for orifice plates used.

.5 Flexible duct for connecting to ductwork under test.

.6 Smoke bombs for visual inspections.

.3 Test apparatus to be accurate to within +/- 3 % of flow rate and pressure.

.4 Submit details of test instruments to be used to Consultant at least three months before anticipated start date.

.5 Test instruments to be calibrated and certificate of calibration deposited with Consultant no more than 28 days before start of tests.

.6 Instruments to be re-calibrated every six months thereafter.

1.9 SYSTEM LEAKAGE TOLERANCES

.1 System leakage tolerances specified herein are stated as a percentage of total flow rate handled by the system. Therefore, when testing sections of ductwork this acceptable leakage shall be pro-rated to entire system. Leakage for sections of duct systems shall not exceed the total allowable leakage.

.2 Leakage tests on following systems not to exceed specified leakage rates.

.1 Small duct systems up to 250 Pa: Leakage [2] %.

.2 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.

1.10 EQUIPMENT LEAKAGE TOLERANCES

.1 Equipment and system components such as VAV boxes, duct heating Leakage: 2 %.

1.11 REPORT FORMS

.1 Submit proposed report form and test report format to [Engineer] [Consultant] for approval at least [three] months before proposed date of first series of tests. Do not start tests until approval received in writing from [Engineer] [Consultant].

1.12 PRESSURE TEST REPORTS

.1 Prepare report of results and submit to Consultant within 24 hours of completion of tests. Include:

- .1 Schematic of entire system.
- .2 Schematic of section under test showing test site.
- .3 Required and achieved static pressures.
- .4 Orifice differential pressure at test sites.
- .5 Permissible and actual leakage flow rate (L/s) for test sites.
- .6 Witnessed certification of results.

.2 Include test reports in final TAB report.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Approved: 2003-12-31

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

.3 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

1.2 REFERENCES

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

.1 ANSI/ASHRAE/IESNA 90.1-01, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 American Society for Testing and Materials International, (ASTM)

.1 ASTM B209M-02, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).

.2 ASTM C335-95, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.3 ASTM C411-97, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C547-00, Specification for Mineral Fiber Pipe Insulation.

.6 ASTM C553-00, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

.7 ASTM C612-00a, Specification for Mineral Fiber Block and Board Thermal Insulation.

.8 ASTM C795-92, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.

.9 ASTM C921-92(1998)e1, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.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 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (R1999).

.5 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102-M88(R2000), Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701-01, Thermal Insulation Polyotrene, Boards and Pipe Covering.

1.3 DEFINITIONS

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - will mean "not concealed" as defined herein.

.3 Insulation systems - insulation material, fasteners, jackets, and other accessories.

.2 TIAC Codes:

.1 CRD: Code Round Ductwork,

.2 CRF: Code Rectangular Finish.

1.4 SHOP DRAWINGS

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

.2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.

1.5 SAMPLES

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

.2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix typewritten label beneath sample indicating service.

1.6 MANUFACTURERS' INSTRUCTIONS

.1 Submit manufacturer's installation instructions in accordance with Section 01 33 00 - Submittal Procedures.

.2 Installation instructions to include procedures used, and installation standards achieved.

1.7 QUALIFICATIONS

.1 Installer: specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, member of TIAC.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Protect from weather and construction traffic.

.3 Protect against damage from any source.

.4 Store at temperatures and conditions recommended by manufacturer.

1.9 WASTE MANAGEMENT AND DISPOSAL

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

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate off site recycling in accordance with Waste Management Plan.

.4 Divert unused metal materials from landfill to metal recycling facility approved by Consultant.

.5 Divert unused adhesive material from landfill to official hazardous material collections site approved by Consultant.

.6 Do not dispose of unused adhesive materials into sewer systems, into lakes, streams, onto ground or in other locations where it will pose health or environmental hazard.

Part 2 Products

2.1 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 INSULATION

.1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24^{o}C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).

.4 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).

.1 Mineral fibre: to ASTM C553.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to ASTM C553.

2.3 JACKETS

.1 Canvas:

.1 220 gm/m^2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.2 Lagging adhesive: Compatible with insulation.

.3 Aluminum:

.1 To ASTM B209 with and without moisture barrier as scheduled in PART 3 of this section.

.2 Thickness: 0.50 mm sheet.

.3 Finish: Stucco embossed.

.4 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel.

.1 Stainless steel:

.5 Type: 316.

.6 Thickness: 0.25 0.50 mm sheet.

.7 Finish: Stucco embossed.

.8 Jacket banding and mechanical seals: 12 19 mm wide, 0.5 mm thick stainless steel.

2.4 ACCESSORIES

.1 Vapour retarder lap adhesive:

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

.2 Indoor Vapour Retarder Finish:

.1 Vinyl emulsion type acrylic, compatible with insulation.

.3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.

.4 ULC Listed Canvas Jacket:

.1 220 gm/m^2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.5 Outdoor Vapour Retarder Mastic:

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: Fibrous glass, untreated 305 g/m^2.

.6 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.

.7 Contact adhesive: quick-setting

.8 Canvas adhesive: washable.

.9 Tie wire: 1.5 mm stainless steel.

.10 Banding: 12 mm wide, 0.5 mm thick stainless steel.

.11 Facing: 25 mm galvanized steel hexagonal wire mesh stitched on one face of insulation.

.12 Fasteners: 2 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

Part 3 Execution

3.1 PRE-INSTALLATION REQUIREMENTS

.1 Pressure testing of ductwork systems complete, witnessed and certified.

.2 Surfaces clean, dry, free from foreign material.

3.2 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturers instructions and as indicated.

.3 Use two layers with staggered joints when required nominal thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Hangers, supports to be outside vapour retarder jacket.

.5 Supports, Hangers in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment].

.1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

.6 Fasteners: At 300 mm oc in horizontal and vertical directions, minimum two rows each side.

3.3 DUCTWORK INSULATION SCHEDULE

.1 Insulation types and thicknesses: Conform to following table:

	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular cold and dual temperature supply air ducts	[C-1]	[yes]	[50]
Round cold and dual temperatire supply air ducts	[C-2]	[yes]	[50]
Rectangular warm air ducts	[C-1]	[no]	[25]
Round warm air ducts	[C-1]	[no]	[25]
Supply, return and exhaust ducts exposed in space being served			[none]
Outside air ducts to mixing plenum	[C-1]	[yes]	[25]
Mixing plenums	[C-1]	[yes]	[25]
Exhaust duct between dampers and louvres	[C-1]	[no]	[25]
Rectangular ducts outside	[C-1]	[special]	[50]
Round ducts outside	[C-1]	[special]	[50]
Acoustically lined ducts	[none]		

.2 HERE Exposed round ducts 600 mm and larger, smaller sizes where subject to abuse:

.1 Use TIAC code C-1 insulation, scored to suit diameter of duct.

.1 Finishes: Conform to following table:

	TIAC Code Rectangular	Round
Indoor, concealed	none	none
Indoor, exposed within mechanical room	CRF/1	CRD/2
Indoor, exposed elsewhere	CRF/2	CRD/3
Outdoor, exposed to precipitation	CRF/3	CRD/4
Outdoor, elsewhere	CRF/4	CRD/5

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 ASTM E202, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

1.2 CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS

.1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

1.3 HYDRONIC SYSTEMS - PERFORMANCE VERIFICATION (PV)

.1 Timing:

.1 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 in relevant technical sections, 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.

1.4 HYDRONIC SYSTEM CAPACITY TEST

.1 Timing: 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 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 that OAT. RAT to be at least 23^0C.

.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, condenser water, etc., flow rates and supply and return temperatures simultaneously.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society for Testing and Materials

.1 ASTM E202, Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

Part 2 Products

2.1 CLEANING SOLUTIONS

.1 Tri-sodium phosphate: 0.40 kg per 100 L water in system.

.2 Sodium carbonate: 0.40 kg per 100 L water in system.

.3 Low-foaming detergent: 0.01 kg per 100 L water in system.

Part 3 Execution

3.1 CLEANING HYDRONIC SYSTEMS

.1 Timing

.1 Systems to be operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.

.2 Cleaning Agency:

.1 Retain qualified water treatment specialist to perform system cleaning.

.3 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist.

.4 Cleaning procedures:

.1 Provide detailed report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:

.1 Cleaning procedures, flow rates, elapsed time.

.2 Chemicals and concentrations to be used.

.3 Inhibitors and concentrations.

.4 Specific requirements for completion of work.

.5 Special precautions for protecting piping system materials and components.

.6 Complete analysis of water to be used to ensure water will not damage systems or equipment.

.5 Conditions at time of cleaning of systems

.1 Systems to be free from construction debris, dirt and other foreign material.

.2 Control valves to be operational, fully open to ensure that terminal units can be cleaned properly.

.3 Strainers to be clean prior to initial fill.

.4 Install temporary filters on pumps not equipped with permanent filters.

.5 Install pressure gauges on strainers to detect plugging.

.6 Report on Completion of Cleaning

.1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.

.7 Closed Loop Hydronic Systems:

.1 Fill system with water, ensure air is vented from system.

.2 Fill expansion tanks 1/3 to 1/2 full, charge system with compressed air to at least 35 kPa (does not apply to diaphragm type expansion tanks).

.3 Use water metre to record volume of water in system to +/- 0.5%.

.4 Add chemicals under direct supervision of chemical treatment supplier.

.5 Closed loop systems: circulate system cleaner at 60^{o}C for at least 36 h. Drain as quickly as possible. Refill with water and inhibitors. Test concentrations and adjust to recommended levels.

.6 Flush velocity in system mains and branches so as to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.

.7 Add chemical solution to system.

.8 Establish circulation, raise temperature slowly to maximum design 82^{0}C minimum. Circulate for 12 h, ensuring flow in all circuits. Remove heat, continue to circulate until temperature is below 38^{o}C. Drain as quickly as possible. Refill with clean water. Circulate for 6 h at design temperature. Drain and repeat procedures specified above. Flush through low point drains in system. Refill with clean water adding to sodium sulphite (test for residual sulphite).

3.2 START-UP OF HYDRONIC SYSTEMS

.1 After cleaning is completed and system is filled:

.1 Establish circulation and expansion tank level, set pressure controls.

.2 Ensure air is removed.

.3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.

.4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.

.5 Clean out strainers repeatedly until system is clean.

.6 Commission water treatment systems as specified in Section 23 25 00 - HVAC Water Treatment Systems.

.7 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.

.8 Repeat with water at design temperature.

.9 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.

.10 Bring system up to design temperature and pressure slowly over a 48 hour period.

.11 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.12 Adjust pipe supports, hangers, springs as necessary.

.13 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.

.14 If bellows type expansion joints flex incorrectly, shut down system, re-align, repeat start-up procedures.

.15 Re-tighten bolts, etc. using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.

.16 Check operation of drain valves.

.17 Adjust valve stem packings as systems settle down.

.18 Fully open all balancing valves (except those that are factory-set).

.19 Check operation of over-temperature protection devices on circulating pumps.

.20 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 The supply and installation of Hydronic Specialties Equipment.

1.2 REFERENCES

.1 American Society for Testing and Materials, (ASTM).

.1 ASTM A47/A47M, Specification for Ferritic Malleable Iron Castings.

.2 ASTM A278M, Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (345 degrees C).

.3 ASTM A516/A516M, Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.

.4 ASTM A536, Specification for Ductile Iron Castings.

.5 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.

.2 Canadian Standards Association (CSA International).

.1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.

1.3 SUBMITTALS

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

.1 Indicate on product data expansion tanks, air vents, separators, valves, strainers.

Part 2 Products

2.1 CLOSED EXPANSION TANK

.1 Expansion tank with threaded pipe connections.

.2 Construction:

.1 ASME code rated welded tank to 860 kPa test pressure of ASTM A516/A516M, pressure vessel carbon steel plate with dished heads galvanized after manufacture.

.2 Conform to: ANSI/ASME BPVC, Section VIII and CSA B51, and provincial regulations.

.3 Submit certificate of registration as required by provincial authorities.

.3 Supports: provide supports with hold down bolts and installation templates.

2.2 DIAPHRAGM TYPE EXPANSION TANK

.1 Pressurized diaphragm type expansion tank.

.2 Diaphragm sealed in EPDM suitable for 115 degrees C operating temperature.

.3 Working pressure: 860 kPa with ASME stamp and certification.

.4 Air precharged to 85 kPa (initial fill pressure of system).

.5 Saddles for horizontal installation. Base mount for vertical installation.

.6 Supports: provide supports with hold down bolts and installation templates.

.7 Renewable diaphragm.

2.3 AUTOMATIC AIR VENT

.1 Standard float vent: brass body and NPS 1/8 connection.

.2 Industrial float vent: cast iron body and NPS 1/2 connection.

.3 Float: solid material suitable for 115 degrees C working temperature.

2.4 COMBINATION SEPARATORS/STRAINERS

.1 Steel, tested and stamped in accordance with ANSI/ASME BPVC, for 860 kPa operating pressure, with galvanized steel integral strainer with 5 mm perforations, tangential inlet and outlet connections, and internal stainless steel air collector tube.

2.5 PIPE LINE STRAINER

.1 NPS 1/2 to 2: bronze body to ASTM B62, solder end or screwed connections, Y pattern.

.2 NPS 2 1/2 to 12: cast iron body to ASTM, Class 30 flanged connections.

.3 NPS 2 to 12: T type with ductile iron body to ASTM A536 malleable iron body to ASTM A47M, grooved ends.

.4 Screen: stainless steel with 1.19 mm perforations.

.5 Working pressure: 860 kPa.

.6 Blowdown connections.

2.6 SUCTION DIFFUSER

.1 Body: cast iron with grooved connections.

.2 Strainer: with built-in, disposable 1.19mm mesh, low pressure drop screen and blowdown connection.

.3 Full length straightening vanes.

.4 Pressure gauge tappings.

.5 Adjustable support leg.

Part 3 Execution

3.1 GENERAL

.1 Install as indicated and to manufacturer's recommendations.

.2 Run drain lines to terminate above nearest drain.

.3 Maintain proper clearance to permit service and maintenance.

.4 Should deviations beyond allowable clearances arise, request and follow Consultant’s directive.

.5 Check shop drawings for conformance of all tappings for ancillaries and for equipment operating weights.

3.2 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 larger than NPS 1 and radiation except at radiation and as indicated.

3.3 AIR VENTS

.1 Install at high points of systems.

.2 Install gate valve on automatic air vent inlet. Run discharge to nearest drain or service sink.

3.4 EXPANSION TANKS

.1 Adjust expansion tank pressure to suit design criteria.

3.5 PRESSURE SAFETY RELIEF VALVES

.1 Run discharge pipe to terminate above nearest drain.

3.6 SUCTION DIFFUSERS

.1 Install on inlet to pumps as specified.

3.7 PERFORMANCE VERIFICATION

.1 In accordance with Section 23 08 01 - Performance Verification of Mechanical Piping Systems, supplemented as specified herein.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Materials and installation for steel piping, valves and fittings for hydronic systems.

.2 American Society of Mechanical Engineers (ASME).

.1 ASME B16.1, Cast Iron Pipe Flanges and Flanged Fittings.

.2 ASME B16.3, Malleable Iron Threaded Fittings.

.3 ASME B16.5, Pipe Flanges and Flanged Fittings.

.4 ASME B16.9, Factory-Made Wrought Buttwelding Fittings.

.5 ASME B18.2.1, Square and Hex Bolts and Screws (Inch Series).

.6 ASME B18.2.2, Square and Hex Nuts (Inch Series).

.3 American Society for Testing and Materials International, (ASTM).

.1 ASTM A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.

.2 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.

.3 ASTM A536, Standard Specification for Ductile Iron Castings.

.4 ASTM B61, Standard Specification for Steam or Valve Bronze Castings.

.5 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.

.6 ASTM E202, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.

.4 American Water Works Association (AWWA).

.1 AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.5 Canadian Standards Association (CSA International).

.1 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings.

.2 CAN/CSA W48, Filler Metals and Allied Materials for Metal Arc Welding (Developed in cooperation with the Canadian Welding Bureau).

.6 Manufacturer's Standardization of the Valve and Fittings Industry (MSS).

.1 MSS-SP-67, Butterfly Valves.

.2 MSS-SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.

.3 MSS-SP-71, Cast Iron Swing Check Valves Flanged and Threaded Ends.

.4 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.

.5 MSS-SP-85, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.2 SUBMITTALS

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

.2 Closeout Submittals.

.1 Provide maintenance data for incorporation into manual.

Part 2 Products

2.1 PIPE

.1 Steel pipe: to ASTM A53/A53M, Grade B.

2.2 PIPE JOINTS

.1 NPS2 and under: screwed fittings with PTFE tape or lead-free pipe dope.

.2 NPS2-1/2 and over:

.1 welding fittings and flanges to CAN/CSA W48 ; or,

.2 Roll grooved: standard coupling to CSA B242.

.3 Flanges: plain face.

.4 Orifice flanges: slip-on raised face, 2100 kPa.

.5 Flange gaskets: to AWWA C111.

.6 Pipe thread: taper.

.7 Bolts and nuts: to ASME B18.2.1 and ASME B18.2.2.

.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 ASTM A47/A47M and ASME B16.3.

.5 Fittings for roll grooved piping: malleable iron to ASTM A47/A47M.

2.4 VALVES

.1 Connections:

.1 NPS2 and smaller: screwed ends.

.2 NPS2.1/2 and larger: Flanged or grooved ends.

.2 Gate valves: to MSS-SP-70 Application: Isolating equipment, control valves, pipelines:

.1 NPS2 and under:

.1 Mechanical Rooms : Class 125 , rising stem, split wedge disc, as specified Section 23 05 22 - Valves - Bronze.

.2 NPS21/2 and over:

.1 Mechanical Rooms: rising stem, split wedge disc, bronze trim, as specified Section 23 05 23 - Valves - Cast Iron: Gate, Globe, Check.

.3 Butterfly valves: to MSS-SP-67 Application: Isolating cells or section of multiple component equipment (i.e. multi-section coils, multi-cell cooling towers):

.1 NPS21/2 and over: Grooved ends: as specified Section 23 05 17 - Pipe Welding.

.4 Globe valves: to MSS-SP-80 Application: Throttling, flow control, emergency bypass:

.1 NPS2 and under:

.1 Mechanical Rooms: with PTFE disc, as specified Section 23 05 22 - Valves - Bronze.

.2 NPS21/2 and over:

.1 With composition disc, bronze trim, as specified Section 23 05 23 - Valves - Cast Iron: Gate, Globe, Check.

.5 Drain valves: Gate, Class 125 , non-rising stem, solid wedge disc, as specified Section 23 05 22 - Valves - Bronze.

.6 Swing check valves: to MSS-SP-71.

.1 NPS2 and under:

.1 Class 125 , swing, with composition disc, as specified Section 23 05 22 - Valves - Bronze.

.2 NPS21/2 and over:

.1 Flanged or Grooved ends: as specified Section 23 05 23 - Valves - Cast Iron: Gate, Globe, Check.

.7 Silent check valves:

.1 NPS2 and under:

.1 As specified Section 23 05 22 - Valves - Bronze.

.2 NPS21/2 and over:

.1 Flanged or Grooved ends: as specified Section 23 05 23 - Valves - Cast Iron: Gate, Globe, Check.

.8 Ball valves:

.1 NPS2 and under: as specified Section 23 05 22 - Valves - Bronze.

Part 3 Execution

3.1 PIPING INSTALLATION

.1 Install pipework in accordance with Section 23 05 01 - Installation of Pipe Work.

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.

3.3 TESTING

.1 Test system in accordance with Section 23 05 00 - Common Work Results - Mechanical.

3.4 BALANCING

.1 Balance water systems to within plus or minus 5% of design output.

.2 Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

3.5 PERFORMANCE VERIFICATION

.1 In accordance with Section 23 08 01 - Performance Verification of Mechanical Piping.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials, equipment selection, installation and start up for hydronic system pumps.

1.2 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures .

.2 Submit product data of pump curves for review showing point of operation.

.3 Indicate piping, valves and fittings shipped loose by packaged equipment supplier, showing their final location in field assembly.

.4 Provide maintenance data for incorporation into manual.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.2 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site for recycling in accordance with Waste Management Plan.

.3 Divert unused metal materials from landfill to metal recycling facility approved by Consultant.

.4 Dispose of unused adhesive material at official hazardous material collections site approved by Consultant.

1.4 EXTRA MATERIALS

.1 Furnish following spare parts: one spare set of seals for each pump.

Part 2 Products

2.1 SINGLE SUCTION CENTRIFUGAL PUMP

.1 General: bronze fitted pump complete with motor.

.2 Base: cast iron or fabricated steel with drip rim and tapping for drain connection.

.3 Volute: cast iron radially split, end suction, flanged suction and discharge, with drain plug and vent cock, suction and discharge pressure gauge tappings.

.4 Impeller: bronze or cast iron, keyed drive with locking nut or screw.

.5 Shaft: alloy steel or stainless steel with two point support.

.6 Seal assembly: mechanical

.7 Coupling: flexible self-aligning.

Part 3 Execution

3.1 INSTALLATION

.1 Base mounted type: supply templates for anchor bolt placement. Furnish anchor bolts with sleeves. Place level, shim unit and grout. Align coupling in accordance with manufacturer's recommended tolerance. Check oil level and lubricate where appropriate.

.2 Ensure that pump body does not support piping or equipment. Provide stanchions or hangers for this purpose. Refer to manufacturer's installation instructions for details.

.3 Install volute venting pet cock in accessible location.

.4 Check rotation prior to start-up.

.5 Install pressure gauge test cocks.

3.2 START-UP

.1 General

.1 In accordance with manufacturer's recommendations.

.2 Procedures:

.1 After starting pump, check for proper, safe operation.

.2 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.

.3 Check base for free-floating, no obstructions under base.

.4 Run-in pumps for 12 continuous hours.

.5 Verify operation of over-temperature and other protective devices under low- and no-flow condition.

.6 Eliminate air from scroll casing.

.7 Adjust alignment of piping and conduit to ensure true flexibility at all times.

.8 Eliminate cavitation, flashing and air entrainment.

.9 Adjust pump shaft seals, stuffing boxes, glands.

.10 Measure pressure drop across strainer when clean and with flow rates as finally set.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

1.2 SHOP DRAWINGS

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

1.3 CLOSEOUT SUBMITTALS

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

.2 Include following:

.1 Log sheets as recommended by manufacturer.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Dispose of unused water treatment chemicals at official hazardous material collections site approved by Owner.

.2 Do not dispose of unused water treatment chemicals into sewer system, into streams, lakes, onto ground or in other locations where it will pose health or environmental hazard.

Part 2 Products

2.1 MANUFACTURER

.1 Equipment, chemicals, service by one supplier.

2.2 POT FEEDER

.1 Welded steel, pressure rating 1200 kPa. Temperature rating: 90^{o}C.

2.3 SHIPPING/ FEEDING CHEMICAL CONTAINERS

.1 High density moulded polyethylene, with liquid level graduations, cover.

2.4 WATER TREATMENT FOR HYDRONIC SYSTEMS

.1 Chilled water system: Pot feeder, 25 L, operating pressure 1200 kPa.

.2 Micron filter for each pot feeder:

.1 Capacity 2% of pump recirculating rate at operating pressure.

.2 Six (6) sets of filter cartridges for each type, size of micron filter.

2.5 CHEMICALS

.1 Provide 1 years supply.

2.6 TEST EQUIPMENT

.1 Provide one set of test equipment for each system to verify performance.

.2 Complete with carrying case, reagents for chemicals, all specialized or supplementary equipment.

Part 3 Execution

3.1 INSTALLATION

.1 Install HVAC water treatment systems in accordance with ASME Boiler Code Section VII, and requirements and standards of authorities having jurisdiction, except where specified otherwise.

.2 Ensure adequate clearances to permit performance of servicing and maintenance of equipment.

3.2 CHEMICAL FEED PIPING

.1 Install crosses at all changes in direction. Install plugs in unused connections.

3.3 CLEANING OF MECHANICAL SYSTEM

.1 Provide copy of recommended cleaning procedures and chemicals for approval by Consultant.

.2 Thoroughly flush mechanical systems and equipment with approved cleaning chemicals designed to remove deposition from construction such as pipe dope, oils, loose mill scale and other extraneous materials. Chemicals to inhibit corrosion of various system materials and be safe to handle and use.

.3 During circulation of cleaning solution, periodically examine and clean filters and screens and monitor changes in pressure drop across equipment.

.4 Drain and flush systems until alkalinity of rinse water is equal to make-up water. Refill with clean water treated to prevent scale and corrosion during system operation.

.5 Disposal of cleaning solutions to be approved by authority having jurisdiction.

3.4 WATER TREATMENT SERVICES

.1 Provide water treatment monitoring and consulting services for period of one year after system start-up. Service to include:

.1 Initial water analysis and treatment recommendations.

.2 System start-up assistance.

.3 Operating staff training.

.4 Visit plant every 5 days during period of operation and as required until system stabilizes, and advise on treatment system performance.

.5 Provide necessary recording charts and log sheets for one year operation.

.6 Provide necessary laboratory and technical assistance.

.7 Instructions and advice to operating staff to be clear, concise and in writing.

3.5 START-UP

.1 Start up water treatment systems in accordance with manufacturer's instructions.

3.6 COMMISSIONING

.1 Commissioning Agency: To be installing water treatment sub-contractor.

.2 Timing:

.1 After start-up deficiencies rectified.

.2 After start-up and before TAB of connected systems.

.3 Pre-commissioning Inspections:

.1 Verify:

.1 Presence of test equipment, reagents, chemicals, details of specific tests to be performed, operating instructions.

.2 Suitability of log book.

.3 Currency and accuracy of raw water analysis.

.4 Required quality of treated water.

.4 Commissioning procedures - applicable to Water Treatment Systems:

.1 Establish, adjust as necessary and record all automatic controls and chemical feed rates.

.2 Monitor performance continuously during commissioning of connected systems and until acceptance of project.

.3 Establish test intervals, regeneration intervals.

.4 Record on approved report forms commissioning procedures, test procedures, dates, times, quantities of chemicals added, raw water analysis, treated water analysis, test results, instrument readings, adjustments made, results obtained.

.5 Establish, monitor and adjust automatic controls and chemical feed rates as necessary.

.6 Visit project at specified intervals after commissioning is satisfactorily completed to verify that performance remains as set during commissioning (more often as required until system stabilizes at required level of performance).

.7 Advise Engineer in writing on matters regarding installed water treatment systems.

.5 Commissioning procedures - Closed Circuit Hydronic Systems:

.1 Analyse water in system.

.2 Based upon an assumed rate of loss approved by Engineer, establish rate of chemical feed.

.3 Record types, quantities of chemicals applied.

.6 Training:

.1 Commission systems, perform tests in presence of, and using assistance of, assigned O&M personnel.

.2 Train O&M personnel in softener regeneration procedures.

.7 Certificates:

.1 Upon completion, furnish certificates confirming satisfactory installation and performance.

.8 Commissioning Reports:

.1 To include system schematics, test results, test certificates, raw and treated water analyses, design criteria, other data required by Consultant.

.9 Commissioning activities during Warranty Period:

.1 Check out water treatment systems on regular basis and submit written report to Owner.

END OF SECTION

Approved: 2001-12-04

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

.3 Section 23 05 94 - Pressure Testing of Ducted Air Systems.

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM)

.1 ASTM A480/A480M-[01], Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.

.2 ASTM A635/A635M-[00], Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.

.3 ASTM A653/A653M-[00], Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

.2 National Fire Protection Agency (NFPA)

.1 NFPA 90A-[99], Installation of Air Conditioning and Ventilating Systems.

.2 NFPA 90B-[99], Installation of Warm Air Heating and Air Conditioning Systems.

.3 NFPA 91-[1995], Standard for Exhaust System for Air Conveying of Vapours, Gases, Mists, and Noncombustible Particle Solids.

.4 NFPA 96-[98], Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible, 2nd Edition [1995] and Addendum No. 1, [1997].

.2 SMACNA HVAC Duct Leakage Test Manual, [1985], Technical Research Update-92.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

.2 Indicate following:

.1 Sealants.

.2 Tape.

.3 Proprietary Joints.

1.4 CERTIFICATION OF RATINGS

.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.5 WASTE MANAGEMENT AND DISPOSAL

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

.2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan

.3 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 SEAL CLASSIFICATION

.1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
500	[C]
250	[C]
125	[C]
125	[Unsealed]

.2 Seal classification:

.1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.

.2 Class B: longitudinal seams, transverse joints and connections made airtight with [sealant] [tape] [or combination thereof].

.3 Class C: transverse joints and connections made air tight with gaskets, sealant, tape, or combination thereof. Longitudinal seams unsealed.

.4 Unsealed seams and joints.

2.2 SEALANT

.1 Sealant: oil resistant, polymer type flame resistant duct sealant. Temperature range of minus 30^0C to plus 93^0C.

2.3 TAPE

.1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

2.4 DUCT LEAKAGE

.1 In accordance with SMACNA HVAC Duct Leakage Test Manual.

2.5 FITTINGS

.1 Fabrication: to SMACNA.

.2 Radiused elbows:

.1 Rectangular: standard radius.

.2 Round: five piece. Centreline radius: 1.5 times diameter.

.3 Mitred elbows, rectangular:

.1 To 400 mm: with double thickness turning vanes.

.2 Over 400 mm: with double thickness turning vanes.

.4 Branches:

.1 Rectangular main and branch: with radius on branch 1.5 times width of duct.

.2 Round main and branch: enter main duct at 45^0 with conical connection.

.3 Provide volume control damper in branch duct near connection to main duct.

.4 Main duct branches: with splitter damper.

.5 Transitions:

.1 Diverging: 20^0 maximum included angle.

.2 Converging: 30^0 maximum included angle.

.6 Offsets:

.1 as indicated.

.7 Obstruction deflectors: maintain full cross-sectional area. Maximum included angles: as for transitions.

2.6 FIRESTOPPING

.1 Retaining angles around duct, on both sides of fire separation.

.2 Firestopping material and installation must not distort duct.

2.7 GALVANIZED STEEL

.1 Lock forming quality: to ASTM A653, Z90 zinc coating.

.2 Thickness, fabrication and reinforcement: to SMACNA.

.3 Joints: to SMACNA proprietary manufactured duct joint. Proprietary manufactured flanged duct joint to be considered to be a class A seal.

2.8 HANGERS AND SUPPORTS

.1 Strap hangers: of same material as duct [but next sheet metal thickness heavier than duct]. Maximum size duct supported by strap hanger: [500] mm.

.2 Hanger configuration: to SMACNA.

.3 Hangers: galvanized steel angle with galvanized steel rods to SMACNA

.4 Upper hanger attachments:

.1 For concrete: manufactured concrete inserts.

.2 For steel joist: manufactured joist clamp.

.3 For steel beams: manufactured beam clamps:

Part 3 Execution

3.1 GENERAL

.1 Do work in accordance with SMACNA.

.2 Do not break continuity of insulation vapour barrier with hangers or rods. Insulate strap hangers 100 mm beyond insulated duct.

.3 Support risers in accordance with SMACNA.

.4 Install breakaway joints in ductwork on sides of fire separation.

.5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

.6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

3.2 HANGERS

.1 Strap hangers: install in accordance with SMACNA.

.2 Angle hangers: complete with locking nuts and washers.

.3 Hanger spacing: in accordance with SMACNA.

3.3 WATERTIGHT DUCT

.1 Provide watertight duct for:

.1 Dishwasher exhaust.

.2 Fresh air intake.

.3 As indicated.

.2 Form bottom of horizontal duct without longitudinal seams. Solder or weld joints of bottom and side sheets. Seal other joints with duct sealer.

.3 Slope horizontal branch ductwork down towards fume hoods served. Slope header ducts down toward risers.

.4 Fit base of riser with 150 mm deep drain sump and 32 mm drain connected, with deep seal trap and valve and discharging to open funnel drain.

3.4 SEALING AND TAPING

.1 Apply sealant to outside of joint to manufacturer's recommendations.

.2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturers recommendations.

3.5 LEAKAGE TESTS

.1 Refer to Section 23 05 94 - Pressure Testing of Ducted Air Systems.

.2 In accordance with SMACNA HVAC Duct Leakage Test Manual.

.3 Do leakage tests in sections.

.4 Make trial leakage tests as instructed to demonstrate workmanship.

.5 Install no additional ductwork until trial test has been passed.

.6 Test section minimum of 30 m long with not less than [three] branch takeoffs and two 90^0 elbows.

.7 Complete test before insulation or concealment.

END OF SECTION

Approved: 2001-12-04

Part 1 General

1.1 RELATED SECTIONS

.1 Section [01 33 00 - Submittal Procedures].

.2 Section [01 74 19 - Construction/Demolition Waste Management And Disposal].

1.2 REFERENCES

.1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, [95].

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section [01 33 00 - Submittal Procedures].

.2 Indicate the following:

.1 Flexible connections.
.2 Duct access doors.
.3 Turning vanes.
.4 Instrument test ports.

1.4 CERTIFICATION OF RATINGS

.1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section [01 74 19 - Construction/Demolition Waste Management And Disposal].

.2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan

.3 Fold up metal banding, flatten and place in designated area for recycling.

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 with fabric clenched by means of double locked seams.

.2 Material:

.1 Fire resistant, self-extinguishing, neoprene coated glass fabric, temperature rated at minus 40^0C to plus 90^0C, density of 1.3 kg/m^2.

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 300 mm: two sash locks complete with safety chain.

.2 301 to 450 mm: four sash locks complete with safety chain.

.3 451 to 1000 mm: piano hinge and minimum two sash locks.

.4 Doors over 1000 mm: piano hinge and two handles operable from both sides.

.5 Hold open devices.

.6 300 x 300 mm glass viewing panels.

2.4 TURNING VANES

.1 Factory or shop fabricated double thickness with trailing edge, and to recommendations of SMACNA and as indicated.

2.5 INSTRUMENT TEST

.1 [1.6] mm 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:

.1 600 x 600 mm for servicing entry.

.2 300 x 300 mm for viewing.

.3 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.

.2 For temperature readings:

.1 At outside air intakes.

.2 In mixed air applications in locations as approved by Consultant.

.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.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Sheet Metal and Air Conditioning National Association (SMACNA)

.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible- [1985] .

1.2 PRODUCT DATA

.1 Submit product data in accordance with Section [01 33 00 - Submittal Procedures].

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section [01 74 19 - Construction/Demolition Waste Management And Disposal] , and with the Waste Reduction Workplan.

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

Part 2 Products

2.1 GENERAL

.1 Manufacture to SMACNA standards.

2.2 SPLITTER DAMPERS

.1 Of same material as duct but one sheet metal thickness heavier, with appropriate stiffening.

.2 [Single] [Double] thickness construction.

.3 Control rod with locking device and position indicator.

.4 Rod configuration to prevent end from entering duct.

.5 Pivot: piano hinge.

.6 Folded leading edge.

2.3 SINGLE BLADE DAMPERS

.1 Of same material as duct, but one sheet metal thickness heavier. V-groove stiffened.

.2 Size and configuration to recommendations of SMACNA,

.3 Locking quadrant with shaft extension to accommodate insulation thickness.

.4 Inside and outside nylon end bearings.

.5 Channel frame of same material as adjacent duct, complete with angle stop.

2.4 MULTI-BLADED DAMPERS

.1 Factory manufactured of material compatible with duct.

.2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.

.3 Maximum blade height: 100 mm.

.4 Bearings: 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 For supply, return and exhaust systems, locate balancing dampers in each branch duct.

.4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.

.5 All dampers to be vibration free.

.6 Ensure damper operators are observable and accessible.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section [23 33 00 - Air Duct Accessories].

.2 Section [23 09 43 - Pneumatic Control System for HVAC].

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM)

.1 ASTM A 653M- [95] , Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section [01 33 00 - Submittal Procedures].

.2 Indicate the following:

.1 Performance data.

1.4 CLOSEOUT SUBMITTALS

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

1.5 CERTIFICATION OF RATINGS

.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section [01 74 19 - Construction/Demolition Waste Management And Disposal], and with the Waste Reduction Workplan.

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

Part 2 Products

2.1 MULTI-LEAF DAMPERS

.1 Opposed and/or Parallel blade type as indicated.

.2 Extruded aluminum , interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, extruded aluminum frame.

.3 Pressure fit self-lubricated bronze bearings.

.4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.

.5 Operator: to Section [23 09 43 - Pneumatic Control System for HVAC] .

.6 Performance:

.1 Leakage: in closed position to be less than 2% of rated air flow at 32 Pa differential across damper.

.2 Pressure drop: at full open position to be less than 16 Pa differential across damper at 0.047 m/s.

.7 Insulated aluminum dampers:

.1 Frames: insulated with extruded polystyrene foam with R factor of 5.0.

.2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, R factor of 5.0.

2.2 DISC TYPE DAMPERS

.1 Frame: insulated brake formed, welded, 1.6 mm thick, galvanized steel to ASTM A 653M.

.2 Disc: insulated spin formed, 1.6 mm thick, galvanized steel to ASTM A 653M.

.3 Gasket: extruded neoprene, field replaceable, with 10 year warranty.

.4 Bearings: roller self lubricated and sealed.

.5 Operator: compatible with damper, linear stroke operator, [spring loaded] actuator, zinc-aluminum foundry alloy casting cam follower.

.6 Performance:

.1 Leakage: in closed position to be less than 0.001% of rated air flow at 32 kPa pressure differential across damper.

.2 Pressure drop: at full open position to be less than 16 kPa differential across damper at .047 m/s.

2.3 BACK DRAFT DAMPERS

.1 Automatic gravity operated , multi leaf, aluminum construction with nylon bearings, spring assisted.

2.4 RELIEF DAMPERS

.1 Automatic multi-leaf aluminum dampers with ball bearing centre pivoted and counter-weights set to open at 32 Pa static pressure,

Part 3 Execution

3.1 INSTALLATION

.1 Install where indicated.

.2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.

.3 Seal multiple damper modules with silicon sealant.

.4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories .

.5 Ensure dampers are observable and accessible.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)

.1 ANSI/NFPA 90A- [1989] , Installation of Air Conditioning and Ventilating Systems.

.2 Underwriters Laboratories of Canada (ULC)

.1 CAN4-S112- [M82(R1987)] , Fire Test of Fire Damper Assemblies.

.2 CAN4-S112.2- [M84] , Fire Test of Ceiling Firestop Flap Assemblies.

.3 ULC-S505- [1974] , Fusible Links for Fire Protection Service.

1.2 PRODUCT DATA

.1 Submit product data in accordance with Section [01 33 00 - Submittal Procedures].

.2 Indicate the following:

.1 Fire dampers.

.2 Smoke dampers.

.3 Fire stop flaps.

.4 Operators.

.5 Fusible links.

.6 Design details of break-away joints.

1.3 CLOSEOUT SUBMITTALS

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

1.4 EXTRA MATERIALS

.1 Provide maintenance materials in accordance with Section [01 78 00 - Closeout Submittals].

.2 Provide following:

.1 6 fusible links of each type.

1.5 CERTIFICATION OF RATINGS

.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section [01 74 19 - Construction/Demolition Waste Management And Disposal] , and with the Waste Reduction Workplan.

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

Part 2 Products

2.1 FIRE DAMPERS

.1 Fire dampers: arrangement Type B, listed and bear label of ULC, meet requirements of Fire Commissioner of Canada (FCC) and the Authorities having jurisdiction. Fire damper assemblies to be fire tested in accordance with CAN4-S112.

.2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.

.3 Top hinged: offset single damper, round or square; multi-blade hinged or interlocking type; guillotine type; sized to maintain full duct cross section as indicated.

.4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.

.5 [40 x 40 x 3] mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.

2.2 SMOKE DAMPERS

.1 To be ULC or UL listed and labelled.

.2 Normally closed reverse action smoke vent (S/D-RASV): folding blade type, opening by gravity upon detection of smoke, and/or from remote alarm signalling device actuated by an electro thermal link. Two flexible stainless steel blade edge seals to provide required constant sealing pressure.

.3 Normally open smoke/seal (S/D-SSSD): folding blade type, closing when actuated by means of electro thermal link and/or from remote alarm signalling device. Blade edge seals of flexible stainless steel shall provide required constant sealing pressure. Stainless steel negator springs with locking devices shall ensure positive closure for units mounted horizontally in vertical ducts.

.4 Motorized (S/D-M): folding blade type, normally open with power on. When power is interrupted damper shall close automatically. Both damper and damper operator shall be ULC listed and labelled.

.5 Electro thermal link (S/D-ETL): dual responsive fusible link which melts when subjected to local heat of [74] EC and from external electrical impulse of low power and short duration; ULC or UL listed and labelled.

2.3 COMBINATION FIRE AND SMOKE DAMPERS

.1 Damper: similar in all respects to smoke dampers specified above.

.2 Combined actuator: electrical control system actuated from smoke sensor or smoke detection system and from fusible link.

2.4 FIRE STOP FLAPS

.1 To be ULC listed and labelled and fire tested in accordance with CAN4-S112.2.

.2 Construct of minimum 1.5 mm thick sheet steel with 1.6 mm thick non-asbestos ULC listed insulation and corrosion-resistant pins and hinges.

.3 Flaps to be held open with fusible link conforming to ULC-S505 and close at 74 EC.

Part 3 Execution

3.1 INSTALLATION

.1 Install in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing.

.2 Maintain integrity of fire separation.

.3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.

.4 Install access door adjacent to each damper. See Section [23 33 00 - Air Duct Accessories] .

.5 Coordinate with installer of firestopping.

.6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.

.7 Install break-away joints of approved design on each side of fire separation.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section [01 33 00 - Submittal Procedures].

.2 Section [01 74 19 - Construction/Demolition Waste Management And Disposal].

1.2 REFERENCES

.1 National Fire Protection Association (NFPA)

.1 NFPA 90A-[99], Installation of Air Conditioning and Ventilating Systems.

.2 NFPA 90B-[99], Installation of Warm Air Heating and Air Conditioning Systems.

.2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, [95] and Addendum No.1 [1997].

.3 Underwriter's Laboratories of Canada (ULC)

.1 CAN/ULC-S110-[M86(R2001)], Fire Tests for Air Ducts.

.2 UL 181-[96], Factory Made Air Ducts and Connectors.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section [01 33 00 - Submittal Procedures].

.2 Indicate the following:

.1 Thermal properties.

.2 Friction loss.

.3 Acoustical loss.

.4 Leakage.

.5 Fire rating.

1.4 CERTIFICATION OF RATINGS

.1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.5 SAMPLES

.1 Submit samples with product data of different types of flexible duct being used in accordance with Section [01 33 00 - Submittal Procedures].

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section [01 74 19 - Construction/Demolition Waste Management And Disposal].

.2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

.3 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 GENERAL

.1 Factory fabricated to CAN/ULC S110.

.2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.

.3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

2.2 METALLIC - UNINSULATED

.1 Type 1: spiral wound flexible aluminum.

.2 Performance:

.1 Factory tested to 2.5 kPa without leakage.

.2 Maximum relative pressure drop coefficient: 3.

2.3 METALLIC - INSULATED

.1 Type 2: spiral wound flexible aluminum with factory applied, 37 mm thick flexible glass fibre thermal insulation with vapour barrier and aluminum jacket.

.2 Performance:

.1 Factory tested to [2.5] kPa without leakage.

.2 Maximum relative pressure drop coefficient: [3].

2.4 NON-METALLIC - UNINSULATED

.1 Type 3: non-collapsible, coated aluminum foil mylar type, mechanically bonded to, and helically supported by, external [steel] wire.

.2 Performance:

.1 Factory tested to [2.5] kPa without leakage.

.2 Maximum relative pressure drop coefficient: [3].

2.5 NON-METALLIC - INSULATED

.1 Type 4: non-collapsible, coated aluminum foil mylar type mechanically bonded to, and helically supported by, external wire with factory applied, 37 mm thick flexible glass fibre thermal insulation with vapour barrier and reinforced mylar/neoprene laminate jacket.

.2 Performance:

.1 Factory tested to [2.5] kPa without leakage.

.2 Maximum relative pressure drop coefficient: [3].

Part 3 Execution

3.1 DUCT INSTALLATION

.1 Install in accordance with: SMACNA.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section [01 33 00 - Submittal Procedures].

.2 Section [01 74 19 - Construction/Demolition Waste Management And Disposal].

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM)

.1 ASTM C177-[97], Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

.2 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-10M-[76], Thermal Insulation, Mineral Fibre, Block or Board, for Ducting, Machinery and Boilers.

.2 CGSB 51-GP-11M-[76], Thermal Insulation, Mineral Fibre, Blanket, for Piping, Ducting, Machinery and Boilers.

.3 National Fire Protection Association (NFPA)

.1 NFPA 90A-[99], Installation of Air Conditioning and Ventilating Systems.

.2 NFPA 90B-[99], Installation of Warm Air Heating and Air Conditioning Systems.

.4 Sheet Metal and Air Conditioning Contractor=s National Association (SMACNA)

.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-[95 (Addendum No.1, Nov. 97)].

.5 Underwriter=s Laboratories of Canada (ULC)

.1 CAN/ULC-S102-[88(R2000)], Surface Burning Characteristics of Building Materials and Assemblies.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section [01 33 00 - Submittal Procedures].

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section [01 74 19 - Construction/Demolition Waste Management And Disposal].

.2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan

Part 2 Products

2.1 DUCT LINER

.1 General:

.1 Fibrous glass duct liner: air stream side faced with 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.

.2 Rigid:

.1 Use on flat surfaces.

.2 25 mm thick, to CGSB 51-GP-10M, fibrous glass rigid board duct liner.

.3 Density: 36 kg/m^3minimum.

.4 Thermal resistance to be minimum 0.76 m^2.EC/W for 25 mm thickness when tested in accordance with ASTM C177, at 24EC mean temperature.

.3 Flexible:

.1 Use on round or oval surfaces.

.2 [25] mm thick, to CGSB-51-GP-11M, fibrous glass blanket duct liner.

.3 Density: [24] kg/m^3 minimum.

.4 Thermal resistance to be minimum 0.37 m^2.EC/W for 12 mm thickness, when tested in accordance with ASTM C177, at 24EC mean temperature.

2.2 ADHESIVE

.1 Meet requirements of NFPA 90A and NFPA 90B.

.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 29EC to plus 93EC.

2.3 FASTENERS

.1 Weld pins 2.0 mm diameter, length to suit thickness of insulation. Metal retaining clips, [32] mm square.

2.4 JOINT TAPE

.1 Poly-Vinyl treated open weave fiberglass membrane 50 mm wide.

2.5 SEALER

.1 Meet requirements of NFPA 90A and NFPA90B.

.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 68EC to plus 93EC.

Part 3 Execution

3.1 GENERAL

.1 Do work in accordance with recommendations of SMACNA duct liner standards as indicated in SMACNA HVAC Duct Construction Standards, Metal and Flexible, except as specified otherwise.

.2 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 100% coverage of adhesive.

.2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 425 mm on centres.

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 [two] coats of sealer over tape.

.2 Replace damaged areas of liner at discretion of Consultant.

.3 Protect leading and trailing edges of duct sections with sheet metal nosing having 15 mm overlap and fastened to duct.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section [23 05 13 - Common Motor Requirements for HVAC Equipment].

.2 Section [23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment].

.3 Section [23 33 00 - Air Duct Accessories].

1.2 REFERENCES

.1 AMCA 99-[1986], Standards Handbook.

.2 ANSI/AMCA 210-[1985], Laboratory Methods of Testing Fans for Rating.

.3 AMCA 300-[1985 Revised 1987], Reverberant Room Method for Sound Testing of Fans.

.4 AMCA 301-[1990], Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.5 ANSI/ASHRAE 51- [1985], Laboratory Methods of Testing Fans for Rating.

.6 CGSB 1-GP-181M-[77], Coating, Zinc Rich, Organic, Ready Mixed.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section [01 33 00 - Submittal Procedures].

.2 Provide :

.1 Fan performance curves showing point of operation, BHP and efficiency.

.2 Sound rating data at point of operation.

.3 Indicate:

.1 Motors, sheaves, bearings, shaft details.

.2 Minimum performance achievable with variable speed controllers.

1.4 CLOSEOUT SUBMITTALS

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

1.5 EXTRA MATERIALS

.1 Provide maintenance materials in accordance with Section [01 78 00 - Closeout Submittals].

.1 Spare parts to include:

.1 Matched sets of belts.

.2 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

1.6 MANUFACTURED ITEMS

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards in force.

Part 2 Products

2.1 FANS GENERAL

.1 Capacity: flow rate, total static pressure, bhp, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.

.2 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.

.3 Sound ratings: comply with AMCA 301, tested to AMCA 300. Unit shall bear AMCA certified sound rating seal.

.4 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210, and ANSI/ASHRAE 51. Unit shall bear AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

.5 Motors:

.1 In accordance with Section [23 05 13 - Common Motors Requirements for HVAC Equipment] supplemented as specified herein.

.2 For use with variable speed controllers.

.3 Sizes as specified.

.6 Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards, coupling guards fan inlet and/or outlet safety screens as indicated and as specified in Section 23 05 13 - Common Motor Requirements for HVAC Equipment. outlet dampers and vanes and as indicated.

.7 Factory primed before assembly in colour standard to manufacturer.

.8 Scroll casing drains: as indicated.

.9 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

.10 Vibration isolation: to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

.11 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

2.2 CENTRIFUGAL FANS

.1 Fan wheels:

.1 Welded aluminum construction.

.2 Maximum operating speed of centrifugal fans not more than 40 % of first critical speed.

.3 Air foil, forward curved, or backward inclined blades, as indicated.

.2 Bearings: heavy duty flange mounted grease lubricated ball or roller self aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 200,000 h.

.3 Housings:

.1 Volute with inlet cones: fabricated steel for wheels 300 mm or greater, [cast iron], [steel], [aluminum], for smaller wheels, braced, and with welded supports.

.2 For horizontally and vertically split housings provide flanges on each section for bolting together, with gaskets of non-oxidizing non-flammable material.

.3 Provide [bolted] [latched] airtight access doors with handles.

.4 Variable volume control devices:

.1 Mounted by fan manufacturer.

.2 Adjustable inlet vanes: operated from a centre mechanism linked to each damper vane. Support each vane at ends in bronze bearings. On DWDI fans interconnect vanes to operate in unison. Provide locking devices for manual operation.

.3 Variable Speed Drives: Refer to Section 25 30 03 - Variable Frequency Drives.

2.3 CABINET FANS - GENERAL PURPOSE

.1 Fan characteristics and construction: as centrifugal fans.

.2 Cabinet hung single or multiple wheel with DWDI centrifugal fans in factory fabricated casing complete with vibration isolators and seismic control measures, motor, variable speed drive or V-belt drive and guard inside or outside casing.

.3 Fabricate casing of zinc coated or phosphate treated steel of thickness as indicated reinforced and braced for rigidity. Provide removable panels for access to interior. Uncoated, steel parts shall be painted over with corrosion resistant paint to CGSB 1-GP-181M. Finish inside and out, over prime coat, with rust resistant enamel.

2.4 IN-LINE CENTRIFUGAL FANS

.1 Characteristics and construction: as for centrifugal fan wheels, with axial flow construction and direct or belt drive as noted.

.2 Provide AMCA arrangements 1 or 9 as indicated with stiffened flanges, smooth rounded inlets, and stationary guide vanes.

2.5 PROPELLER FANS

.1 Fabricate multibladed propellers of aluminum within bell mouth entrance on integral mounts, with grease lubricated ball bearings, with extended lubrication fittings, suited for operating in any position, direct or belt driven, complete with motor as indicated.

.2 Provide blade guards, bird screen and automatic back draft dampers on discharge, with gasketted edges.

Part 3 Execution

3.1 FAN INSTALLATION

.1 Install fans as indicated, complete with resilient mountings specified in Section [23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment], flexible electrical leads and flexible connections in accordance with Section [23 33 00 - Air Duct Accessories].

.2 Provide sheaves and belts required for final air balance.

.3 Bearings and extension tubes to be easily accessible.

.4 Access doors and access panels to be easily accessible.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 AMCA 201- [1990] , AMCA Fan Application Manual - Fans and Systems.

.2 ANSI/AMCA 210- [85] , Laboratory Methods of Testing Fans for Rating.

.3 AMCA 301- [1990] , Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.4 AMCA 300- [85 Rev. 87] , Reverberant Room Method for Sound Testing of Fans.

.5 AMCA 302- [73] , Application of Sone Ratings for Non-Ducted Air Moving Devices.

.6 AMCA 303- [79] , Application of Sound Power Level Ratings for Fans.

.7 ANSI/ASHRAE 51- [1985] , Laboratory Methods of Testing Fans for Rating.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section [01 33 00 - Submittal Procedures].

1.3 CLOSEOUT SUBMITTALS

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

1.4 EXTRA MATERIALS

.1 Provide maintenance materials in accordance with Section [01 78 00 - Closeout Submittals].

.2 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

1.5 CERTIFICATION OF RATINGS

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

Part 2 Products

2.1 FANS GENERAL

.1 Standard of rating:

.1 AMCA 201 for fan application.

.2 AMCA 302 for application of sone loudness ratings for non-ducted air moving devices.

.3 AMCA 303 for application of sound power ratings for ducted air moving devices.

.4 Performance: to ANSI/AMCA 210 and ANSI/ASHRAE 51. Unit to bear AMCA certified seal .

.2 Pwl sound ratings to comply with AMCA 301, tested to AMCA 300 Unit to bear AMCA certified sound rating seal.

2.2 EXTERIOR MOUNTED DISCHARGE FANS

.1 Wall or Roof mounted, direct driven centrifugal fan, ball bearing thermally protected motor.

.2 Sizes and capacity: as indicated.

.3 Control: as indicated.

.4 Rust resistant aluminum with aluminum backdraft damper, complete with foam cushioned frame.

Part 3 Execution

3.1 INSTALLATION

.1 Install in accordance with manufacturer's recommendations.

3.2 ANCHOR BOLTS AND TEMPLATES

.1 Supply for installation by other Divisions.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section [01 33 00 - Submittal Procedures].

.2 Section [01 74 19 - Construction/Demolition Waste Management And Disposal].

.3 Section [01 78 00 - Closeout Submittals].

.4 Section [01 45 00 - Quality Control].

1.2 REFERENCES

.1 American National Standards Institute (ANSI)

.1 ANSI/ASHRAE 51/AMCA 210-[1999], Laboratory Methods of Testing Fans for Rating.

.2 ANSI/NFPA 90A-[1999], Installation of Air Conditioning and Ventilating Systems.

.2 International Organization of Standardization (ISO)

.1 ISO 3741-[1999], Acoustics-Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Methods for Reverberation Rooms.

.3 Underwriter's Laboratories (UL)

.4 UL 181-[1996], Factory-Made Air Ducts and Air Connectors.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section [01 33 00 - Submittal Procedures].

.2 Indicate the following:

.1 Capacity.

.2 Pressure drop.

.3 Noise rating.

.4 Leakage.

1.4 SAMPLES AND MOCK-UPS

.1 Submit duplicate samples and mock-ups in accordance with Section [01 33 00 - Submittal Procedures].

.2 Submit mock-ups in accordance with Section [01 45 00 - Quality Control].

1.5 TEST REPORTS

.1 To [ANSI/ASHRAE 51/AMCA 210]. Submit published test data on DIN (Direct Internal Noise), in accordance with ISO 3741 made by independent testing agency for 0, 2.5 and 6 m/s branch velocity or inlet velocity. Sound power level with minimum inlet pressure of 0.25 kPa in accordance with ISO 3741 for 2nd through 7th octave band, also made by independent testing agency. Pressure loss through silencer shall not exceed 60% of inlet velocity pressure maximum.

1.6 CLOSEOUT SUBMITTALS

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

1.7 CERTIFICATION

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from certified ADC (Air Diffusion Council) testing agency signifying adherence to codes and standards.

1.8 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section [01 74 19 - Construction/Demolition Waste Management And Disposal].

.2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Consultant.

.3 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.4 Dispose of corrugated, cardboard, polystyrene, and plastic packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

1.9 EXTRA MATERIALS

.1 Provide maintenance materials in accordance with Section [01 78 00 - Closeout Submittals].

.2 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

Part 2 Products

2.1 MANUFACTURED UNITS

.1 Terminal units of the same type to be product of one manufacturer.

2.2 VARIABLE VOLUME BOXES

.1 Pressure independent factory reset to air flow between minimum and maximum air volume.

.2 Sizes, capacities, differential pressures: as indicated.

.3 Differential pressure not to exceed 25 Pa at inlet air velocity of 10 m/s.

.4 Sound ratings of assembly not to exceed 32 NC.

.5 Complete with:

.1 Operator and controller: as specified

.6 Minimum 35 kPa reset span.

.7 Adjustable reset start point.

.8 Operator to be factory mounted and calibrated:

.1 Gauge taps for balancing with standard pressure gauge.

.2 Controller to have adjustable flow settings.

Part 3 Execution

3.1 INSTALLATION

.1 Install in accordance with manufacturers recommendations.

.2 Support independently of ductwork.

.3 Install with at least 1000 mm of flexible inlet ducting and minimum of four duct diameters of straight inlet duct, same size as inlet.

.4 Locate so that controls, dampers and access panels are easily accessible.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section [01 33 00 - Submittal Procedures].

.2 Section [01 74 19 - Construction/Demolition Waste Management And Disposal].

.3 Section [01 78 00 - Closeout Submittals].

.4 Door grilles: Section [08 90 00 - Louvres and Vents].

1.2 PRODUCT DATA

.1 Submit product data in accordance with Section [01 33 00 - Submittal Procedures].

.2 Indicate the following:

.1 Capacity.
.2 Throw and terminal velocity.
.3 Noise criteria.
.4 Pressure drop.

1.3 SAMPLES

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

1.4 CERTIFICATIONS

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section [01 74 19 - Construction/Demolition Waste Management And Disposal].

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Dispose of [corrugated cardboard] [polystyrene] [plastic] packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

1.6 EXTRA MATERIALS

.1 Provide maintenance materials in accordance with Section [01 78 00 - Closeout Submittals].

.2 Include:

.1 Keys for volume control adjustment.

.2 Keys for air flow pattern adjustment.

Part 2 Products

2.1 GENERAL

.1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity [as indicated].

.2 Frames:

.1 Full perimeter gaskets.

.2 Plaster frames where set into plaster or gypsum board at all locations and as specified.

.3 Concealed fasteners.

.3 Concealed manual volume control damper operators.

.4 Colour: as directed by Consultant.

2.2 MANUFACTURED UNITS

.1 Grilles, registers and diffusers of same generic type to be product of one manufacturer.

2.3 SUPPLY GRILLES AND REGISTERS

.1 General: with opposed blade dampers.

2.4 RETURN AND EXHAUST GRILLES AND REGISTERS

.1 General: with opposed blade dampers.

2.5 DIFFUSERS

.1 General: volume control dampers with flow straightening devices and blank-off quadrants and gaskets.

Part 3 Execution

3.1 INSTALLATION

.1 Install in accordance with manufacturer’s instructions.

.2 Install with painted flat head screws in countersunk holes where fastenings are visible.

.3 Provide concealed safety chain on each grille, register and diffuser in gymnasium and similar game rooms and elsewhere as indicated.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section [01 33 00 - Submittal Procedures].

.2 Section [01 74 19 - Construction/Demolition Waste Management And Disposal].

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/ National Fire Protection Association (NFPA)

.1 ANSI/NFPA 96-[01], Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

.2 American Society for Testing and Materials (ASTM)

.1 ASTM E90-[99], Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.4 Society of Automotive Engineers (SAE)

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section [01 33 00 - Submittal Procedures].

.2 Indicate the following:

.1 Pressure drop.

.2 Face area.

.3 Free area.

1.4 TEST REPORTS

.1 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E90.

1.5 CERTIFICATION OF RATINGS

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section [01 74 19 - Construction/Demolition Waste Management And Disposal].

.2 Unused metal materials are to be diverted from landfill to a metal recycling facility as approved by the Consultant.

.3 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.4 Dispose of corrugated cardboard, polystyrene, plastic, packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

Part 2 Products

2.1 GRAVITY ROOF OUTSIDE AIR INTAKES AND RELIEF VENTS

.1 Factory manufactured aluminum.

.1 Complete with integral birdscreen of [2.7] mm diam aluminum wire.

.2 Backdraft dampers on [four] [two] faces.

.3 Maximum throat velocity: 3.3 m/s intake.

.4 Maximum loss through unit: 15 Pa static pressure.

.5 Maximum velocity through damper area: 1.5 m/s.

.6 Shape: as indicated.

.2 Birdscreens:

.1 Complete with integral birdscreen of [2.7] mm diameter aluminum wire. Use 12 mm mesh on exhaust and 19 mm mesh on intake.

2.2 GOOSENECK HOODS

.1 Thickness: to and SMACNA.

.2 Fabrication: to SMACNA.

.3 Joints: to SMACNA and/or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint shall be considered to be a class A seal.

.4 Supports: as indicated.

.5 Complete with integral birdscreen of 2.7 mm diameter aluminum wire. Use 12 mm mesh on exhaust, 19 mm mesh on intake.

2.3 FIXED LOUVRES - ALUMINUM

.1 Construction: welded with exposed joints ground flush and smooth.

.2 Material: extruded aluminum alloy 6063-T5.

.3 Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1500 mm.

.4 Frame, head, sill and jamb: 100 mm deep one piece extruded aluminum, minimum 3 mm thick with approved caulking slot, integral to unit.

.5 Mullions: at 1500 mm maximum centres.

.6 Fastenings: stainless steel (Society of Automotive Engineers) SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.

.7 Screen: 12 mm exhaust, 19 mm intake mesh, 2 mm diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.

.8 Finish: factory applied enamel. Colour: to Consultant's approval.

Part 3 Execution

3.1 INSTALLATION

.1 In accordance with manufacturer's and SMACNA recommendations.

.2 Reinforce and brace as indicated.

.3 Anchor securely into opening. Seal with caulking around to ensure weather tightness.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section [01 33 00 - Submittal Procedures].

.2 Section [01 74 19 - Construction/Demolition Waste Management And Disposal].

.3 Section [01 78 00 - Closeout Submittals].

.4 Section [03 30 00 - Cast-in-Place Concrete].

1.2 REFERENCES

.1 Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

.2 Underwriters' Laboratories of Canada (ULC)

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section [01 33 00 - Submittal Procedures].

1.4 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section [01 33 00 - Submittal Procedures].

.2 Clearly indicate following:

.1 Methods of sealing sections.
.2 Methods of expansion.
.3 Details of thimbles.
.4 Bases/Foundations.
.5 Supports.
.6 Guy details.
.7 Rain caps.
.8 [___].

1.5 CLOSEOUT SUBMITTALS

.1 Submit operation and maintenance data for incorporation into manual specified in Section [01 78 00 - Closeout Submittals].

1.6 CERTIFICATIONS

.1 Catalogued or published ratings shall be those obtained from tests carried out by independent testing agency or manufacturer signifying adherence to codes and standards.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section [01 74 19 - Construction/Demolition Waste Management And Disposal].

.2 Divert unused metal materials from landfill to metal recycling facility approved by [Engineer] [Consultant].

.3 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.4 Dispose of [corrugated cardboard] [polystyrene] [plastic] packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

Part 2 Products

2.1 BREECHINGS

.1 Shop fabricated [3.5] mm thick [mild steel], [stainless steel] [galvanized steel] [welded,] with sweep bends from boiler outlet to thimble or chimney as indicated.

2.2 ALL FUELS PRESSURE CHIMNEY AND BREECHING

.1 ULC labelled, [760]^{o}C rated, all fuels.

.2 Sectional, prefabricated, double wall with [air space] [mineral wool insulation] with mated fittings and couplings.

.1 Liner: [___] mm thick, type[304] [316] stainless steel.

.2 Shell: [___] mm thick, [type [304] [316] stainless steel] [aluminized steel].

.3 Outer seals between sections: [to suit application].

.4 Inner seals between sections: [to suit application].

2.3 TYPE B GAS VENT

.1 ULC labelled, [288]^{o}C rating maximum, atmospheric gas vent only.

.2 Sectional, prefabricated, double wall with 13 mm air space. Aluminum inner wall. Galvanized steel outer wall. Mated fittings and couplings.

2.4 STEEL CHIMNEY REFRACTORY LINED

.1 Material:

.1 Prefabricated sections with [90] mm thick high temperature impervious insulating refractory lining, centrifugally spun into [3.5] mm thick circular casing.

.2 Construction:

.1 Prefabricated sections, welded [on site] [or] [at factory]. Use high temperature insulating cement at joints in refractory lining.

.3 Welding:

.1 To full thickness. All welds ground smooth.

.4 Supports:

.1 Welded gussets, cleats and bolts for installation on concrete base.

.2 Chimney to be [self supporting] [or] [[Laterally] [and] [Vertically] [braced, as indicated]].

.3 Concrete base by Section [03 30 00- Cast-in-Place Concrete].

.5 Breeching entry:

.1 Tee section with [150] mm minimum refractory lined projection.

.6 Access door: in bottom section.

.7 Drain connection: at base of stack.

.8 Dimensions: as indicated.

2.5 ACCESSORIES

.1 Cleanouts: bolted, gasketted type, full size of breeching, as indicated.

.2 Barometric dampers: [single] [double] acting, 70% of full size of breeching area.

.3 Hangers and supports: [in accordance with recommendations of Sheet Metal and Air Conditioning Contractors National Association Inc. (SMACNA)] [as indicated].

.4 Rain cap.

.5 Expansion sleeves with heat resistant caulking, held in place as indicated.

Part 3 Execution

3.1 INSTALLATION - GENERAL

.1 Follow manufacturer's and SMACNA installation recommendations for shop fabricated components.

.2 Suspend breeching at [1.5] m centres and at each joint.

.3 Support chimneys at bottom, roof and intermediate levels as indicated.

.4 Install thimbles where penetrating roof, floor, ceiling and where breeching enters masonry chimney. Pack annular space with heat resistant caulking.

.5 Install flashings on chimneys penetrating roofs, as indicated.

.6 Install rain caps and cleanouts, as indicated.

3.2 INSTALLATION - REFRACTORY LINED STEEL CHIMNEY

.1 Grind all welds smooth to form appearance of single tube.

.2 Seal insulating refractory at top of stack.

.3 Pack annular space around breeching at entry tee with heat resistant caulking.

.4 Run drain line from drain connection to [___].

.5 On completion, paint one coat of rust inhibitive primer and two coats of heat resisting paint of colour, make and quality as approved by [Engineer] [Consultant].

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME Boiler and Pressure Vessel Code, Section VIII for Unfired Pressure Vessels.

.2 Canadian Standards Association (CSA)

.1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.

1.2 SHOP DRAWINGS

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

.2 Indicate: manufacturer's recommended clearances for tube withdrawal and manipulation of tube cleaning tools.

Part 2 Products

2.1 PLATE HEAT EXCHANGER

.1 General:

.1 Water to water.

.2 Designed, constructed and tested in with accordance ASME Boiler and Pressure Vessel Code, Section VIII, CSA B51 and provincial pressure vessel regulations.

.2 Frames: carbon steel with baked epoxy enamel paint, side bolts and shroud.

.3 Plates: stainless steel.

.4 Gaskets: as recommended by manufacturer to suit fluid temperature.

.5 Supports: as indicated.

.6 Piping connections: as indicated.

.7 Capacity: as indicated.

Part 3 Execution

3.1 INSTALLATION

.1 General: install level and firmly anchored to supports in accordance with manufacturer's recommendations.

.2 Plate exchangers: install in accordance with manufacturer's recommendations.

3.2 APPURTENANCES

.1 Install with hose bib drain valve.

.2 Install thermometer wells with thermometers on inlet and outlet of primary and secondary side.

.3 Install pressure gauge on steam inlet.

3.3 START-UP

.1 Check heat exchanger for cleanliness on primary and secondary sides.

.2 Check water treatment system is complete, operational and correct treatment is being applied.

.3 Check installation, settings, operation of relief valves and safety valves.

.4 Check installation, location, settings and operation of operating, limit and safety controls.

.5 Check supports.

3.4 PERFORMANCE VERIFICATION

.1 Timing:

.1 Only after TAB of hydronic systems have been successfully completed.

.2 Primary side:

.1 Measure flow rate, pressure drop, and water temperature at inlet and outlet.

.2 Verify installation and operation of air elimination devices.

.3 Secondary side:

.1 Measure flow rate, pressure drop, and water temperature at inlet and outlet.

.2 Verify installation and operation of air elimination devices.

.4 Calculate heat transfer from primary and secondary sides.

.5 Simulate heating water temperature schedule and repeat above procedures.

.6 Verify settings, operation, safe discharge from safety valves and relief valves.

.7 Verify settings, operation of operating, limit and safety controls and alarms.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section [01 33 00 - Submittal Procedures].

.2 Section [01 74 19 - Construction/Demolition Waste Management And Disposal].

.3 Section [01 78 00 - Closeout Submittals].

.4 Section [23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment].

.5 Section [23 84 13 - Humidifiers].

.6 Section [23 33 00 - Air Duct Accessories].

.7 Section [23 33 15 - Dampers - Operating].

.8 Section [23 41 00 - Particulate Air Filtration].

1.2 REFERENCES

.1 American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)

.1 ANSI/ARI 430-[99], Central Station Air Handling Units.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB 1.181-[99], Ready-Mixed Organic Zinc-Rich Coating.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section [01 33 00 - Submittal Procedures].

.2 Indicate following: [fan] [fan curves showing point of operation] [motor drive] [bearings] [filters] [mixing box] [dampers] [VAV] [coil]; include performance data.

1.4 CLOSEOUT SUBMITTALS

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

.2 Include following: fan, bearings, motor, damper, VAV control, air volume, total cooling, sensible cooling, EDB, EWB, OAT.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section [01 74 19 - Construction/Demolition Waste Management And Disposal], and with the Waste Reduction Workplan.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Consultant.

.5 Divert unused paint material from landfill to official hazardous material collections site approved by Consultant.

.6 Do not dispose of unused paint materials into sewer systems, into lakes, streams, onto ground or in other locations where it will pose health or environmental hazard.

1.6 EXTRA MATERIALS

.1 Provide maintenance materials in accordance with Section [01 78 00 - Closeout Submittals].

.2 Provide one spare set of filters.

.3 Provide list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

.4 Spare filters: in addition to filters installed immediately prior to acceptance by Consultant, supply [1] complete set of filters for each filter unit or filter bank.

Part 2 Products

2.1 GENERAL

.1 Factory assembled components to form unit[s] supplying air at designed conditions, as indicated.

.2 Certify ratings: to ARI 430 with ARI seal.

.3 Vertical type, as indicated, having air tight modular components, consisting of casing, fan section with motor and drive, filter section, dampers, bypass section, heating coil, cooling coil, filter mixing box.

2.2 CASINGS

.1 Galvanized steel reinforced and braced for rigidity.

.1 Removable panels, Inspection doors: provide access for maintenance of internal parts.

.2 Paint steel parts, where not galvanized, with corrosion resistant paint to CGSB 1-GP-181M.

.3 Finish entire unit[s], inside and out, with rust resistant enamel.

.2 Line entire casing with perforated galvanized steel liner.

2.3 ACOUSTIC LINER

.1 Insulate internal surface of panels with 50 mm neoprene coated rigid duct liner of 72 kg/m ^{3} density.

.1 Apply with 100% coverage of adhesive with clip pins.

.2 Cover with 0.8 mm thick perforated galvanized sheet metal.

.3 Cover leading and trailing edges with sheet metal nosing and at edges around access doors and panels complete with 15 mm overlap.

2.4 DRAIN PANS

.1 Construction: stainless steel. Rounded corners.

.2 Insulation: external foam type, minimum [13] mm thick.

.3 Drain connection: in bottom at low point.

.4 Installation: slope without sag minimum 1% to ensure no standing water at any time or at any point.

.5 Dimensions: minimum [75] mm from upstream face of coil to [150] mm beyond downstream face of coil or eliminator and to include return bends and headers.

2.5 FANS

.1 Cabinet hung AMCA-rated for sound and performance centrifugal fans with backward inclined wheels, selected to operate in stable part of performance curve at times and 200,000 hours service self aligning bearings.

.1 Provide internally and/or externally mounted motor as indicated complete with adjustable V-belt drive and guard.

.2 Motor: as specified

.2 Maximum sound power levels, as indicated.

.3 Internally or externally mounted motor and fan.

2.6 VIBRATION ISOLATION

.1 Flexible connections at inlet and outlet of fan [section]: to Section [23 33 00 - Air Duct Accessories].

.2 Vibration isolators on fan section: to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment[and Seismic Control.

2.7 FILTER BOX

.1 Material to match casing. For flat bag type filter arrangement:

.1 Provide access to filter through hinged door with suitable hardware.

.2 Provide blank-off plates and gaskets to prevent air bypass.

.3 Filters: to Section [23 41 00 - Particulate Air Filtration].

2.8 MIXING BOX

.1 Material to match casing and produce uniformly mixed air temperature within plus or minus [5] ^{o}C of design across face of outlet.

.2 Dampers:

.1 Dampers for mixing boxes: to Section [23 33 15 - Dampers - Operating].

2.9 COILS

.1 Capacity: as indicated.

.2 Ratings: ARI certified.

.3 Construction:

.1 Casings: 1.5 mm thick galvanized sheet steel.

.1 Supports of galvanized steel channel.

.2 Blank-off plates. Insulated sandwich construction.

.2 Hot and Chilled water coils: cleanable fins.

.1 Tubes: copper or brass.

.2 Fins: copper plate.

.3 Headers: cast iron or galvanized steel or cast brass.

.4 Pressure tests: 1.7 MPa.

.3 Direct expansion refrigerant coils:

.1 Serpentine type, arranged to prevent trapping of oil.

.1 Liquid distributors to ensure even distribution of liquid refrigerant to all circuits.

.2 Silver solder or braze joints in refrigerant tubing.

.3 Evacuate and charge coil with nitrogen and seal before sending to site.

.2 Tubes: copper.

.3 Fins: copper.

.4 Headers: copper.

.5 Pressure tests: to Canadian Refrigeration Code. Dehydrated. Sealed with nitrogen charge.

Part 3 Execution

3.1 INSTALLATION

.1 Provide appropriate protection apparatus.

.2 Install units in accordance with manufacturer's instructions and as indicated.

.3 Ensure adequate clearance for servicing and maintenance.

3.2 FANS

.1 Install fan sheaves required for final air balance.

.2 Install flexible connections at fan inlet and fan outlets.

.3 Install vibration isolators.

3.3 DRIP PANS

.1 Install deep seal P-traps and trap seal prime on drip lines.

.1 Depth of water seal to be 1.5 times static pressure at this point.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Methods and procedures for start-up, verification and commissioning, for building Energy Monitoring and Control System (EMCS) and includes:

.1 Start-up testing and verification of systems.

.2 Check out demonstration or proper operation of components.

.3 On-site operational tests.

1.2 DEFINITIONS

.1 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

.2 AEL: ratio between total test period less any system downtime accumulated within that period and test period.

.3 Downtime: results whenever EMCS is unable to fulfill required functions due to malfunction of equipment defined under responsibility of EMCS contractor. Downtime is measured by duration, in time, between time that Contractor is notified of failure and time system is restored to proper operating condition. Downtime not to include following:

.1 Outage of main power supply in excess of back-up power sources, provided that:

.1 Automatic initiation of back-up was accomplished.

.2 Automatic shut-down and re-start of components was as specified.

.2 Failure of communications link, provided that:

.1 Controller automatically and correctly operated in stand-alone mode.

.2 Failure was not due to failure of any specified EMCS equipment.

.3 Functional failure resulting from individual sensor inputs or output devices, provided that:

.1 System recorded said fault.

.2 Equipment defaulted to fail-safe mode.

.3 AEL of total of all input sensors and output devices is at least 99 % during test period.

1.3 DESIGN REQUIREMENTS

.1 Confirm with Consultant that Design Criteria and Design Intents are still applicable.

.2 Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intents.

1.4 SUBMITTALS

.1 Final Report: submit report to Consultant.

.1 Include measurements, final settings and certified test results.

.2 Bear signature of commissioning technician and supervisor

.3 Report format to be approved by Consultant before commissioning is started.

.4 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit to Consultant in accordance with Section 01 78 00 - Closeout Submittals .

.5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

1.5 CLOSEOUT SUBMITTALS

.1 Provide documentation, O&M Manuals, and training of O&M personnel for review of Consultant before interim acceptance.

1.6 COMMISSIONING

.1 Carry out commissioning under direction of Consultant and in presence of Consultant.

.2 Inform, and obtain approval from, Consultant in writing at least 14 days prior to commissioning or each test. Indicate:

.1 Location and part of system to be tested or commissioned.

.2 Testing/commissioning procedures, anticipated results.

.3 Names of testing/commissioning personnel.

.3 Correct deficiencies, re-test in presence of Consultant until satisfactory performance is obtained.

.4 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.

.5 Load system with project software.

.6 Perform tests as required.

1.7 COMPLETION OF COMMISSIONING

.1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by Consultant.

1.8 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION

.1 Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation.

Part 2 Products

2.1 EQUIPMENT

.1 Provide sufficient instrumentation to verify and commission the installed system. Provide two-way radios.

.2 Instrumentation accuracy tolerances : higher order of magnitude than equipment or system being tested.

.3 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 2 months prior to tests.

.4 Locations to be approved, readily accessible and readable.

.5 Application: to conform to normal industry standards.

Part 3 Execution

3.1 PROCEDURES

.1 Test each system independently and then in unison with other related systems.

.2 Commission each system.

.3 Debug system software.

.4 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.

.5 Test full scale emergency evacuation and life safety procedures including operation and integrity of smoke management systems under normal and emergency power conditions as applicable.

3.2 FIELD QUALITY CONTROL

.1 Pre-Installation Testing.

.1 General: consists of field tests of equipment just prior to installation.

.2 Testing may be on site or at Contractor's premises as approved by Consultant.

.3 Configure major components to be tested in same architecture as designed system. Include BECC equipment and 2 sets of Building Controller's including MCU's, LCU's, and TCU's.

.4 Equip each Building Controller with sensor and controlled device of each type (AI, AO, DI, DO).

.5 Additional instruments to include:

.1 DP transmitters.

.2 VAV supply duct SP transmitters.

.3 DP switches used for dirty filter indication and fan status.

.6 In addition to test equipment, provide inclined manometer, digital micro-manometer, milli-amp meter, source of air pressure infinitely adjustable between 0 and 500 Pa, to hold steady at any setting and with direct output to milli-amp meter at source.

.7 After setting, test zero and span in 10 % increments through entire range while both increasing and decreasing pressure.

.8 Consultant to mark instruments tracking within 0.5% in both directions as "approved for installation".

.9 Transmitters above 0.5% error will be rejected.

.10 DP switches to open and close within 2% of set point.

.2 Completion Testing.

.1 General: test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.

.2 Include following activities:

.1 Test and calibrate field hardware including stand-alone capability of each controller.

.2 Verify each A-to-D convertor.

.3 Test and calibrate each AI using calibrated digital instruments.

.4 Test each DI to ensure proper settings and switching contacts.

.5 Test each DO to ensure proper operation and lag time.

.6 Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.

.7 Test operating software.

.8 Test application software and provide samples of logs and commands.

.9 Verify each CDL including energy optimization programs.

.10 Debug software.

.11 Blow out flow measuring and static pressure stations with high pressure air at 700kPa.

.12 Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. Include space on commissioning technician and Consultant. This document will be used in final start-up testing.

.3 Final Start-up Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of Consultant and provide:

.1 2 technical personnel capable of re-calibrating field hardware and modifying software.

.2 Detailed daily schedule showing items to be tested and personnel available.

.3 Consultant's acceptance signature to be on executive and applications programs.

.4 Commissioning to commence during final start-up testing.

.5 O&M personnel to assist in commissioning procedures as part of training.

.6 Commissioning to be supervised by qualified supervisory personnel and Consultant.

.7 Commission systems considered as life safety systems before affected parts of the facility are occupied.

.8 Operate systems as long as necessary to commission entire project.

.9 Monitor progress and keep detailed records of activities and results.

.4 Final Operational Testing: to demonstrate that EMCS functions in accordance with contract requirements.

.1 Prior to beginning of 30 day test demonstrate that operating parameters (set points, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure proper operation and operator notification in event of off-normal operation.

.1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.

.2 Test to last at least 30consecutive 24 hour days.

.3 Tests to include:

.1 Demonstration of correct operation of monitored and controlled points.

.2 Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.

.4 System will be accepted when:

.1 EMCS equipment operates to meet overall performance requirements. Downtime as defined in this Section must not exceed allowable time calculated for this site.

.2 Requirements of Contract have been met.

.5 In event of failure to attain specified AEL during test period, extend test period on day-to-day basis until specified AEL is attained for test period.

.6 Correct defects when they occur and before resuming tests.

3.3 ADJUSTING

.1 Final adjusting: upon completion of commissioning as reviewed by Consultant, set and lock devices in final position and permanently mark settings.

3.4 DEMONSTRATION

.1 Demonstrate to Consultant operation of systems including sequence of operations in regular and emergency modes, under normal and emergency conditions, start-up, shut-down interlocks and lock-outs.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Requirements and procedures for training program, instructors and training materials, for building Energy Monitoring and Control System (EMCS) Work.

1.2 DEFINITIONS

.1 CDL - Control Description Logic.

.2 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.3 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures, supplemented and modified by requirements of this Section.

.2 Submit training proposal complete with hour-by-hour schedule including brief overview of content of each segment to Consultant 30 days prior to anticipated date of beginning of training.

.1 List name of trainer, and type of visual and audio aids to be used.

.2 Show co-ordinated interface with other EMCS mechanical and electrical training programs.

.3 Submit reports within one week after completion of Phase 1 and Phase 2 training program that training has been satisfactorily completed.

1.4 QUALITY ASSURANCE

.1 Provide competent instructors thoroughly familiar with aspects of EMCS installed in facility.

.2 Consultant reserves right to approve instructors.

1.5 INSTRUCTIONS

.1 Provide instruction to designated personnel in adjustment, operation, maintenance and pertinent safety requirements of EMCS installed.

.2 Training to be project-specific.

1.6 TIME FOR INSTRUCTION

.1 Number of days of instruction to be as specified in this section (1 day = 8 hours including two 15 minute breaks and excluding lunch time).

1.7 TRAINING MATERIALS

.1 Provide equipment, visual and audio aids, and materials for classroom training.

.2 Supply manual for each trainee, describing in detail data included in each training program.

.1 Review contents of manual in detail to explain aspects of operation and maintenance (O&M).

1.8 TRAINING PROGRAM

.1 To be in 2 phases over 6 month period.

.2 Phase 1: 3 hour program to begin before 30 day test period at time mutually agreeable to Contractor and Owner.

.1 Train O&M personnel in functional operations and procedures to be employed for system operation.

.2 Supplement with on-the-job training during 30 day test period.

.3 Include overview of system architecture, communications, operation of computer and peripherals, report generation.

.4 Include detailed training on operator interface functions for control of mechanical systems, CDL's for each system, and elementary preventive maintenance.

.3 Phase 2: 2 hour day program to begin 8 weeks after acceptance for operators, equipment maintenance personnel and programmers.

.1 Provide multiple instructors on pre-arranged schedule. Include at least following:

.1 Operator training: provide operating personnel, maintenance personnel and programmers with condensed version of Phase 1 training.

.2 Equipment maintenance training: provide personnel with training in maintenance of EMCS equipment, including general equipment layout, trouble shooting and preventive maintenance of EMCS components, maintenance and calibration of sensors and controls.

.3 Programmers: provide personnel with training.

1.9 MONITORING OF TRAINING

.1 Consultant may monitor training program and may modify schedule and content.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 ACRONYMS, ABBREVIATIONS AND DEFINITIONS

.1 Acronyms used in EMCS.

.1 AI - Analog Input
.2 AO - Analog Output
.3 BACnet - Building Automation and Control Network
.4 CAB - Canadian Automated Building (CAB) Protocol
.5 CAD - Computer Aided Design
.6 CDL - Control Description Logic
.7 COSV - Change of State or Value
.8 CPU - Central Processing Unit
.9 DI - Digital Input
.10 DO - Digital Output
.11 ECU - Equipment Control Unit
.12 EMCS - Energy Monitoring and Control System
.13 HVAC - Heating, Ventilation, Air Conditioning
.14 IDE - Interface Device Equipment
.15 I/O - Input/Output
.16 ISA - Industry Standard Architecture
.17 LAN - Local Area Network
.18 LCU - Local Control Unit
.19 LonTalk - Echelon Corporation (proprietary protocol)
.20 MCU - Master Control Unit
.21 OS - Operating System
.22 O&M - Operation and Maintenance
.23 OWS - Operator Work Station
.24 PC - Personal Computer
.25 PCI - Peripheral Control Interface
.26 PCMCIA - Personal Computer Micro-Card Interface Adapter
.27 RAM - Random Access Memory
.28 ROM - Read Only Memory
.29 TCU - Terminal Control Unit
.30 USB - Universal Serial Bus
.31 UPS - Uninterruptible Power Supply

.2 Definitions:

.1 Point: a point may be logical or physical. Logical points are values calculated by system such as totals, counts, derived corrections i.e. as result of and/or statements in CDL's. Physical points are inputs or outputs which have hardware wired to controllers which are measuring or providing status conditions of

contacts or relays providing interaction with related equipment (stop, start) or valve or damper actuators.

.3 Symbols and engineering unit abbreviations utilized in displays: to ANSI/ISAS 5.5.

.1 Printouts: to ANSI/IEEE 260.

.2 Refer also to Section 25 05 54- EMCS: Identification.

1.2 PERMITS AND FEES

.1 In accordance with General Conditions of Contract.

.2 Submit certificate of acceptance from authority having jurisdiction to Owner.

1.3 GENERAL DESCRIPTION

.1 Work covered by sections referred to above consists of fully operational EMCS, including, but not limited to, following:

.1 Building Controllers MCU, LCU TCU.

.2 Control devices as listed in I/O Summaries.

.3 OWS as noted.

.4 Data communications equipment necessary to effect an EMCS data transmission system.

.5 Field control devices.

.6 Software complete with full documentation for software and equipment.

.7 Complete operating and maintenance manuals and field training of operators, programmers and maintenance personnel.

.8 Acceptance tests, technical support during commissioning, full documentation.

.9 Wiring interface co-ordination of equipment supplied by others.

.10 Miscellaneous work as specified in these sections and as indicated.

1.4 METRIC REFERENCES

.1 Conform to CAN/CSA-Z234.1.

.2 Provide required adapters between Metric and Imperial components.

1.5 STANDARDS COMPLIANCE

.1 All equipment and material to be from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.

.2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.

.3 Submit proof of compliance to specified standards with shop drawings and product data. Label or listing of specified organization is acceptable evidence.

.4 For materials whose compliance with organizational standards/codes/specifications is not regulated by an organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.

1.6 EXISTING CONTROL COMPONENTS

.1 Utilize any existing control wiring and/or piping as practicable.

.2 Field control devices that are usable in their original configuration may be re-used provided that they conform to applicable codes, standards, specifications. Do not modify original design of any existing devices without written permission from Consultant. Provide for new, properly designed device where components are not certain as to reusability. Provide list of equipment so included in bid. Include unit price of all for this equipment.

.3 Within 30 days of award of contract, and prior to installation of any new devices, inspect and test all existing devices intended for re-use. Furnish test report listing each component to be re-used and indicating whether it is in good order or requires repair.

.4 Non-functioning items:

.1 Provide with report specification sheets or written functional requirements to support findings.

.5 Submit written request for permission to disconnect any controls and to obtain equipment downtime before proceeding with work.

.6 Assume responsibility for existing controls to be incorporated into EMCS, to commence upon approval for disconnection of controls or equipment downtime.

.1 Be responsible for repair costs due to negligence or abuse of Owner's equipment.

.2 Responsibility for existing devices to terminate upon acceptance of EMCS or applicable portions thereof.

.7 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed.

1.7 EMCS CONTRACTOR QUALIFICATIONS

.1 EMCS contractor to:

.1 Be Andover with installer approved by the Owner.

.2 Have local office within 300 km of project for at least 5 years, staffed by trained personnel capable of providing instruction, routine maintenance, emergency service on systems,

.3 Provide record of successful installations performed by Contractor submitting tender of experience with similar computer-based systems.

.4 Have access to local supplies of essential parts and provide 7 year guarantee of availability of spare parts after obsolescence.

1.8 SYSTEM DESIGN RESPONSIBILITY

.1 Design and provide all conduit and wiring linking all elements of system, including future capability.

.2 Supply sufficient programmable controllers of all types to meet project requirements. Quantity and points contents to be approved by Consultant prior to installation.

.3 Location of controllers to be approved by Consultant prior to installation.

.4 Provide utility and emergency power to controllers.

1.9 LANGUAGE OPERATING REQUIREMENTS

.1 Operator to interface to system in English through operator selectable access codes.

.2 Use non-linguistic symbols for displays on graphic terminals wherever possible. All other information to be in English.

.3 Operating system executive: primary hardware-to-software interface (specified as part of hardware purchase) with associated documentation to be in English.

.4 System manager software: to include system definition point database, additions, deletions or modifications, control loop statements, use of high level programming languages, report generator utility and other OS utilities used for maintaining optimal operating efficiency. These functions to be in English.

.5 EMCS operator: include, in English:

.1 All input and output commands and messages from operator-initiated functions and/or field related changes and/or alarms as defined in CDL's or assigned limits (i.e. all commands relating to day-to-day operating functions and not related to system modifications, additions, or logic re-definements).

.2 Graphic "display" functions, point commands to turn systems on or off, manually override automatic control of specified hardware points. To be in English at all specified OWS and to be able to operate one terminal in English and second in French. Point name expansions in both languages.

.3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.

1.10 MATERIALS DELIVERY SCHEDULE

.1 Provide Consultant with "Materials Delivery Schedule" within 2 weeks after award of Contract.

Part 2 Products

2.1 ACCEPTABLE SYSTEMS SYSTEMS MANUFACTURERS

.1 Andover.

2.2 LOCKABLE PANELS

.1 Panel to be NEMA rated to suit environmental requirements.

.2 To have hinged doors equipped with standard keyed-alike cabinet locks, keyed to same key.

Part 3 Execution

3.1 MANUFACTURER'S RECOMMENDATIONS

.1 Installation to be to manufacturer's recommendations. Provide printed copies of recommendations with shop drawings or product data.

3.2 PAINTING

.1 Clean and touch up marred or scratched surfaces of factory finished equipment to match original finish.

.2 Restore to new condition, finished surfaces which have been damaged too extensively to be primed and touched up to make good.

.3 Clean and prime exposed hangers, racks, fastenings, and other support components.

.4 Paint all unfinished equipment installed indoors to CEMA 2Y.1.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Methods and procedures for shop drawings submittals, preliminary and detailed review process including review meetings, for building Energy Monitoring and Control System (EMCS).

1.2 DEFINITIONS

.1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.3 DESIGN REQUIREMENTS

.1 Preliminary Design Review: to contain following contractor and systems information.

.1 Location of local office.

.2 Description and location of installing and servicing technical staff.

.3 Location and qualifications of programming design and programming support staff.

.4 Names of sub-contractors and site-specific key personnel.

.5 Sketch of site-specific system architecture.

.6 Specification sheets for each item including memory provided, programming language, speed, type of data transmission.

.7 Descriptive brochures.

.8 Sample CDL and graphics (systems schematics).

.9 Response time for each type of command and report.

.10 Item-by-item statement of compliance.

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures and coordinate with requirements in this Section.

.2 Shop Drawings to consist of 3 hard copies and 1 soft copy of design documents, shop drawings, product data and software.

.3 Hard copy to be completely indexed and coordinated package to assure compliance with contract requirements and arranged in same sequence as specification and cross-referenced to specification section and paragraph number.

.4 Soft copy to be in AutoCAD - latest version and Microsoft Word latest version format, structured using menu format for easy loading and retrieval on OWS.

1.5 SHOP DRAWING REVIEW

.1 Submit preliminary shop drawings within 30 working days of award of contract and include following:

.1 Specification sheets for each item. To include manufacturer's descriptive literature, manufacturer's installation recommendations, specifications, drawings, diagrams, performance and characteristic curves, catalogue cuts, manufacturer's

name, trade name, catalogue or model number, nameplate data, size, layout, dimensions, capacity, other data to establish compliance.

.2 Detailed system architecture showing all points associated with each controller including , signal levels, pressures where new EMCS ties into existing control equipment.

.3 Spare point capacity of each controller by number and type.

.4 Controller locations.

.5 Auxiliary control cabinet locations.

.6 Single line diagrams showing cable routings, conduit sizes, spare conduit capacity between control centre, field controllers and systems being controlled.

.7 Valves: complete schedule listing including following information: designation, service, manufacturer, model, point ID, design flow rate, design pressure drop, required Cv, Valve size, actual Cv, spring range, pilot range, required torque, actual torque and close off pressure (required and actual).

.8 Wiring diagrams.

.9 Piping diagrams and hook-ups.

.10 Interface wiring diagrams showing termination connections and signal levels for equipment to be supplied by others .

.11 Shop drawings for each input/output point, sensors, transmitters, showing information associated with each particular point including:

.1 Sensing element type and location.

.2 Transmitter type and range.

.3 Associated field wiring schematics, schedules and terminations.

.4 Complete Point Name Lists.

.5 Set points, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.

.6 Software and programming details associated with each point.

.7 Manufacturer's recommended installation instructions and procedures.

.8 Input and output signal levels or pressures where new system ties into existing control equipment.

.12 Control schematics, narrative description, CDL's fully showing and describing automatic and manual procedure required to achieve proper operation of project, including under complete failure of EMCS.

.13 Graphic system schematic displays of all systems with point identifiers and textual description of system, and typical floor plans as specified.

.14 Complete system CDL's including companion English language explanations on same sheet but with different font and italics. CDL's to contain specified energy optimization programs.

.15 Listing and example of specified reports.

.16 Listing of time of day schedules.

.17 Mark up to-scale construction drawing to detail control room showing location of equipment and operator work space.

.18 Type and size of memory with statement of spare memory capacity.

.19 Full description of software programs provided.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Requirements and procedures for final control diagrams and operation and maintenance (O&M) manual, for building Energy Monitoring and Control System (EMCS) Work.

1.2 DEFINITIONS

.1 BECC - Building Environmental Control Centre.

.2 OWS - Operator Work Station.

.3 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.3 SUBMITTALS

.1 Submits to be provided to Consultant in English.

.2 Provide soft copies and hard copies in hard-back, 50 mm 3 ring, D-ring binders.

.1 Binders to be 2/3 maximum full.

.2 Provide index to full volume in each binder.

.3 Identify contents of each manual on cover and spine.

.4 Provide Table of Contents in each manual.

.5 Assemble each manual to conform to Table of Contents with tab sheets placed before instructions covering subject.

1.4 AS-BUILTS

.1 Provide 1 copy of detailed shop drawings generated in Section 25 05 02 - EMCS: Submittals and Review Process and include:

.1 Changes to contract documents as well as addenda and contract extras.

.2 Changes to interface wiring.

.3 Routing of conduit, wiring and control air lines associated with EMCS installation.

.4 Locations of obscure devices to be indicated on drawings.

.5 Listing of alarm messages.

.6 Panel/circuit breaker number for sources of normal/emergency power.

.7 Names, addresses, telephone numbers of each sub-contractor having installed equipment, local representative for each item of equipment, each system.

.8 Test procedures and reports: provide records of start-up procedures, test procedures, checkout tests and final commissioning reports as specified in Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

.9 Basic system design and full documentation on system configuration.

.2 Submit for final review by Consultant.

.3 Provide before acceptance 4 Hard and 1 soft copy incorporating changes made during final review.

1.5 O&M MANUALS

.1 Custom design O&M Manuals (both hard and soft copy) to contain material pertinent to this project only, and to provide full and complete coverage of subjects referred to in this Section.

.2 Include complete coverage in concise language, readily understood by operating personnel using common terminology of functional and operational requirements of system. Do not presume knowledge of computers, electronics or in-depth control theory.

.3 Functional description to include:

.1 Functional description of theory of operation.

.2 Design philosophy.

.3 Specific functions of design philosophy and system.

.4 Full details of data communications, including data types and formats, data processing and disposition data link components, interfaces and operator tests or self-test of data link integrity.

.5 Explicit description of hardware and software functions, interfaces and requirements for components in functions and operating modes.

.6 Description of person-machine interactions required to supplement system description, known or established constraints on system operation, operating procedures currently implemented for implementation in automatic mode.

.4 System operation to include:

.1 Complete step-by-step procedures for operation of system including required actions at each OWS.

.2 Operation of computer peripherals, input and output formats.

.3 Emergency, alarm and failure recovery.

.4 Step-by-step instructions for start-up, back-up equipment operation, execution of systems functions and operating modes, including key strokes for each command so that operator need only refer to these pages for keystroke entries required to call up display or to input command.

.5 Software to include:

.1 Documentation of theory, design, interface requirements, functions, including test and verification procedures.

.2 Detailed descriptions of program requirements and capabilities.

.3 Data necessary to permit modification, relocation, reprogramming and to permit new and existing software modules to respond to changing system functional requirements without disrupting normal operation.

.4 Software modules, fully annotated source code listings, error free object code files ready for loading via peripheral device

.5 Complete program cross reference plus linking requirements, data exchange requirements, necessary subroutine lists, data file requirements, other information necessary for proper loading, integration, interfacing, program execution.

.6 Software for each Controller and single section referencing Controller common parameters and functions.

.6 Maintenance: document maintenance procedures including inspection, periodic preventive maintenance, fault diagnosis, repair or replacement of defective components, including calibration, maintenance, repair of sensors, transmitters, transducers, controller and interface firmware's, plus diagnostics and repair/replacement of system hardware.

.7 System configuration document:

.1 Provisions and procedures for planning, implementing and recording hardware and software modifications required during operating lifetime of system.

.2 Information to ensure co-ordination of hardware and software changes, data link or message format/content changes, sensor or control changes in event that system modifications are required.

.8 Programmer control panel documentation: provide where panels are independently interfaced with BECC, including interfacing schematics, signal identification, timing diagrams, fully commented source listing of applicable driver/handler.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Requirements and procedures for identification of devices, sensors, wiring tubing, conduit and equipment, for building Energy Monitoring and Control System (EMCS) Work and nameplates materials, colours and lettering sizes.

1.2 SYSTEM DESCRIPTION

.1 Language Operating Requirements: provide identification for control items in English.

1.3 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures supplemented and modified by requirements of this Section.

Part 2 Products

2.1 NAMEPLATES FOR PANELS

.1 Identify by Plastic laminate, 3 mm thick Melamine, matt white finish, black core, square corners, lettering accurately aligned and engraved into core .

.2 Sizes: 25 x 67 mm minimum.

.3 Lettering: minimum 7 mm high, black .

.4 Inscriptions: machine engraved to identify function.

2.2 NAMEPLATES FOR FIELD DEVICES

.1 Identify by plastic encased cards attached by plastic tie.

.2 Sizes: 50 x 100 mm minimum.

.3 Lettering: minimum 5 mm high produced from laser printer in black .

.4 Data to include: point name and point address.

.5 Companion cabinet: identify interior components using plastic enclosed cards with point name and point address.

2.3 WARNING SIGNS

.1 Equipment including motors, starters under remote automatic control: supply and install orange coloured signs warning of automatic starting under control of EMCS.

.2 Sign to read: "Caution: This equipment is under automatic remote control of EMCS".

2.4 WIRING

.1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.

.2 Colour coding: to CSA C22.1 . Use colour coded wiring in communications cables, matched throughout system.

.3 Power wiring: identify circuit breaker panel/circuit breaker number inside each EMCS panel.

2.5 PNEUMATIC TUBING

.1 Numbered tape markings on tubing to provide uninterrupted tracing capability.

2.6 CONDUIT

.1 Colour code EMCS conduit.

.2 Pre-paint box covers and conduit fittings.

.3 Coding: use fluorescent orange.

Part 3 Execution

3.1 NAMEPLATES AND LABELS

.1 Ensure that manufacturer's nameplates, CSA labels and identification nameplates are visible and legible at all times.

3.2 EXISTING PANELS

.1 Correct existing nameplates and legends to reflect changes made during Work.

END OF SECTION

Part 1 General

1.1 SYSTEM DESCRIPTION

.1 Electrical:

.1 Provide power wiring from existing emergency power panels to EMCS field panels. Circuits to be for exclusive use of EMCS equipment. Panel breakers to be identified on panel legends tagged and locks applied to breaker switches.

.2 Hard wiring between field control devices and EMCS field panels.

.3 Communication wiring between EMCS field panels and OWSs including main control centre BECC.

.4 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.

.2 Pneumatic:

.1 Pneumatic tubing, valves and fittings for field control devices.

.3 Mechanical:

.1 Pipe Taps Required For EMCS equipment will be supplied and installed by piping subtrade.

.2 Wells and Control Valves Shall Be Supplied by EMCS Contractor and Installed by piping subtrade.

.4 Structural:

.1 Special steelwork as required for installation of work.

1.2 PERSONNEL QUALIFICATIONS

.1 Qualified supervisory personnel to:

.1 Continuously direct and monitor all work.

.2 Attend site meetings.

1.3 EXISTING CONDITIONS

.1 Repair all surfaces damaged during execution of work.

.2 Turn over to Owner existing materials removed from work not identified for re-use.

Part 2 Products

2.1 SPECIAL SUPPORTS

.1 Structural grade steel, primed and painted after construction and before installation.

2.2 PIPING FOR PNEUMATIC CONTROL SYSTEMS

.1 Copper:

.1 Tubing:

.1 Fittings: wrought copper solder type to ANSI/ASME B16.22, and 95.5 antimonial tin solder. At instruments use compression fittings.

.2 At panels and junction boxes where there is a transition from plastic to copper use bulkhead fittings.

.2 Plastic:

.1 Install in conduit where exposed (i.e. mechanical rooms, rooms without ceilings, etc.).

.2 Flame retardant, black PVC with minimum burst strength 1.3 MPa at 23EC installed in conduit.

.3 Fittings: compression or barbed type as required.

2.3 WIRING

.1 See requirements in Electrical sections of the drawings and specifications.

.2 For 70V and above copper conductor with chemically cross-linked thermosetting polyethylene insulation rated RW90 and 600V. Colour code to CSA 22.1.

.3 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. All other cases use FT4 wiring.

.4 Sizes:

.1 120V Power supply: to match or exceed breaker, size #12 minimum.

.2 Wiring for safeties/interlocks for starters, motor control centres, to be stranded, #14 minimum.

.3 Field wiring to digital device: #18AWG or 20AWG stranded twisted pair.

.4 Analog input and output: shielded #18 minimum solid copper or #20 minimum stranded twisted pair. Wiring must be continuous without joints.

.5 More than 4 conductors: #22 minimum solid copper.

.5 Terminations:

.1 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

2.4 CONDUIT

.1 As per requirements of Electrical sections of the drawings and specifications.

.2 Electrical metallic tubing to CSA C22.2 83. Flexible and liquid tight flexible metal conduit to CSA C22.2 56. Rigid steel threaded conduit to CSA C22.2 45.

.3 Junction and pull boxes: welded steel.

.1 Surface mounting cast FS: screw-on flat covers.

.2 Flush mounting: covers with 25 mm minimum extension all round.

.4 Cabinets: sheet steel, for surface mounting, with hinged door, latch lock, 2 keys, complete with perforated metal mounting backboard. Panels to be keyed alike for similar functions and or entire contract as approved.

.5 Outlet boxes: 100 mm minimum, square.

.6 Conduit boxes, fittings:

.1 Bushings and connectors: with nylon insulated throats.

.2 With push pennies to prevent entry of foreign materials.

.7 Fittings for rigid conduit:

.1 Couplings and fittings: threaded type steel.

.2 Double locknuts and insulated bushings: use on sheet metal boxes.

.3 Use factory "ells" where 90 degree bends required for 25 mm and larger conduits.

.8 Fittings for thin wall conduit:

.1 Connectors and couplings: steel, set screw type.

2.5 WIRING DEVICES, COVER PLATES

.1 Conform to CSA.

.2 Receptacles:

.1 Duplex: CSA type 5-15R.

.2 Single: CSA type 5-15R.

.3 Cover plates and blank plates: finish to match other plates in area.

2.6 STARTERS, CONTROL DEVICES

.1 Across-the-line magnetic starters:

.1 Enclosures: CSA Type 1, except where otherwise specified.

.2 Size, type and rating: to suit motors.

.2 Starter diagrams:

.1 Provide copy of wiring and schematic diagrams - mount one copy in each starter with additional copies for operation and maintenance manual.

.3 Auxiliary Control Devices:

.1 Control transformers: 60 Hz, primary voltage to suit supply, 120 V single phase secondary, VA rating to suit load plus 20% margin.

.2 Auxiliary contacts: one "Normally Open" and one "Normally Closed" spare auxiliary contact in addition to maintained auxiliary contacts as indicated.

.3 Hand-Off-Automatic switch: heavy duty type, knob lever operator.

.4 Double voltage relays: with barrier to separate relay contacts from operating magnet. Operating coil voltage and contact rating as indicated.

2.7 SUPPORTS FOR CONDUIT, FASTENINGS, EQUIPMENT

.1 Solid masonry, tile and plastic surfaces: lead anchors or nylon shields.

.1 Hollow masonry walls, suspended drywall ceilings: toggle bolts.

.2 Exposed conduits or cables:

.1 50 mm diameter and smaller: one-hole steel straps.

.2 Larger than 50 mm diameter: two-hole steel straps.

.3 Suspended support systems:

.1 Individual cable or conduit runs: support with 6 mm diameter threaded rods and support clips.

.2 Two or more suspended cables or conduits: support channels supported by 6 mm diameter threaded rod hangers.

Part 3 Execution

3.1 INSTALLATION

.1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.

3.2 TUBING

.1 Install piping straight, parallel and close to building structure with required grades for drainage and venting.

.2 Copper tubing not to come into contact with dissimilar metal.

3.3 PNEUMATIC CONTROL SYSTEMS

.1 General:

.1 Install tubing in accessible concealed locations, straight, parallel and close to building structure with required grades for drainage and venting.

.2 Install drip legs and drains at low points.

.3 Tubing to be free from surface damage.

.4 Tubing NOT to pass through or touch unheated ducts or enclosures.

.5 Do not cover pneumatic tubing with insulation.

.6 Test tubing, check joints after connection to system.

.2 Copper tubing:

.1 Not to come into contact with dissimilar metal. Use non-metallic stand-offs on air handling systems.

.2 Install dielectric couplings where dissimilar metals are connected.

.3 Plastic tubing:

.1 Inaccessible locations: install plastic tubing in conduit.

.2 Inside panels: install in tube trays or racks, or clip individually to back of panel.

.3 Multiple tube bundles: install in tube trays, conduit or armoured flexible cable.

3.4 ELECTRICAL GENERAL

.1 Do complete installation in accordance with requirements of:

.1 Electrical sections of the drawings and specifications.

.2 CSA 22.1 Canadian Electrical Code.

.3 ANSI/NFPA 70.

.4 ANSI C2.

.2 Fully enclose or properly guard electrical wiring, terminal blocks, high voltage above 70 V contacts and mark to prevent accidental injury.

.3 Do underground installation to CAN/CSA C22.3No.7, except where otherwise specified.

.4 Conform to manufacturer's recommendations for storage, handling and installation.

.5 Check factory connections and joints. Tighten where necessary to ensure continuity.

.6 Install electrical equipment between 1000 and 2000 mm above finished floor wherever possible and adjacent to related equipment.

.7 Protect exposed live equipment such as panel, mains, outlet wiring during construction for personnel safety.

.8 Shield and mark live parts "LIVE 120 VOLTS" or other appropriate voltage.

.9 Install conduits, and sleeves prior to pouring of concrete.

.10 Holes through exterior wall and roofs: flash and make weatherproof.

.11 Make necessary arrangements for cutting of chases, drilling holes and other structural work required to install electrical conduit, cable, pull boxes, outlet boxes.

.12 Install cables, conduits and fittings which are to be embedded or plastered over, neatly and closely to building structure to minimize furring.

3.5 CONDUIT SYSTEM

.1 Communication wiring shall be installed in conduit. Provide complete conduit system to link Building Controllers to BECC. Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems. Maximum conduit fill not to exceed 40%. Design drawings do not show conduit layout.

.2 Install conduits parallel or perpendicular to building lines, to conserve headroom and to minimize interference.

.3 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Obtain approval from Engineer Consultant before starting such work. Provide complete conduit system to link field panels and devices with main control centre. Conduit size to match conductors plus future expansion capabilities as specified.

.4 Locate conduits at least 150 mm from parallel steam or hot water pipes and at least 50 mm at crossovers.

.5 Bend conduit so that diameter is reduced by less than 1/10th original diameter.

.6 Field thread on rigid conduit to be of sufficient length to draw conduits up tight.

.7 Limit conduit length between pull boxes to less than 30 m.

.8 Use conduit outlet boxes for conduit up to 32 mm diameter and pull boxes for larger sizes.

.9 Fastenings and supports for conduits, cables, and equipment:

.1 Provide metal brackets, frames, hangers, clamps and related types of support structures as indicated and as required to support cable and conduit runs.

.2 Provide adequate support for raceways and cables, sloped vertically to equipment.

.3 Use supports or equipment installed by other trades for conduit, cable and raceway supports only after written approval from Engineer Consultant.

.10 Install polypropylene fish cord in empty conduits for future use.

.11 Where conduits become blocked, remove and replace blocked sections.

.12 Pass conduits through structural members only after receipt of Consultant's written approval.

.13 Conduits may be run in flanged portion of structural steel.

.14 Group conduits wherever possible on suspended or surface channels.

.15 Pull boxes:

.1 Install in inconspicuous but accessible locations.

.2 Support boxes independently of connecting conduits.

.3 Fill boxes with paper or foam to prevent entry of construction material.

.4 Provide correct size of openings. Reducing washers not permitted.

.5 Mark location of pull boxes on record drawings.

.6 Identify AC power junction boxes, by panel and circuit breaker.

.16 Install bonding conductor for 120 volt and above in conduit.

3.6 WIRING

.1 Install multiple wiring in ducts simultaneously.

.2 Do not pull spliced wiring inside conduits or ducts.

.3 Use CSA certified lubricants of type compatible with insulation to reduce pulling tension.

.4 Tests: use only qualified personnel. Demonstrate that:

.1 Circuits are continuous, free from shorts, unspecified grounds.

.2 Resistance to ground of all circuits is greater than 50 Megohms.

.5 Provide Consultant with test results showing locations, circuits, results of tests.

.6 Remove insulation carefully from ends of conductors and install to manufacturer's recommendations. Accommodate all strands in lugs. Where insulation is stripped in excess, neatly tape so that only lug remains exposed.

.7 Wiring in main junction boxes and pull boxes to terminate on terminal blocks only, clearly and permanently identified. Junctions or splices not permitted for sensing or control signal covering wiring.

.8 Do not allow wiring to come into direct physical contact with compression screw.

.9 Install ALL strands of conductor in lugs of components. Strip insulation only to extent necessary for installation.

3.7 WIRING DEVICES, COVER PLATES

.1 Receptacles:

.1 Install vertically in gang type outlet box when more than one receptacle is required in one location.

.2 Cover plates:

.1 Install suitable common cover plate where wiring devices are grouped.

.2 Use flush type cover plates only on flush type outlet boxes.

3.8 STARTERS, CONTROL DEVICES

.1 Install and make power and control connections as indicated.

.2 Install correct over-current devices.

.3 Identify each wire, terminal for external connections with permanent number marking identical to diagram.

.4 Performance Verification:

.1 Operate switches and controls to verify functioning.

.2 Perform start and stop sequences of contactors and relays.

.3 Check that interlock sequences, with other separate related starters, equipment and auxiliary control devices, operate as specified.

3.9 GROUNDING

.1 Install complete, permanent, continuous grounding system for equipment, including conductors, connectors and accessories.

.2 Install separate grounding conductors in conduit within building.

.3 Install ground wire in all PVC ducts and in tunnel conduit systems.

.4 Tests: perform ground continuity and resistance tests, using approved method appropriate to site conditions.

3.10 TESTS

.1 General:

.1 Perform following tests in addition to tests specified Section 25 08 20 - EMCS: Warranty and Maintenance.

.2 Give 14 days written notice of intention to test.

.3 Conduct in presence of Engineer Consultant and authority having jurisdiction.

.4 Conceal work only after tests satisfactorily completed.

.5 Report results of tests to Engineer Consultant in writing.

.6 Preliminary tests:

.1 Conduct as directed to verify compliance with specified requirements.

.2 Make needed changes, adjustments, replacements.

.3 Insulation resistance tests:

.1 Megger all circuits, feeders, equipment for 120 - 600V with 1000V instrument. Resistance to ground to be more than required by Code before energizing.

.2 Test insulation between conductors and ground, efficiency of grounding system to satisfaction of Consultant and authority having jurisdiction.

3.11 IDENTIFICATION

.1 Refer to Section 25 05 54- EMCS: Identification.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Requirements and procedures for warranty and activities during warranty period and service contracts, for building Energy Monitoring and Control System (EMCS).

1.2 DEFINITIONS

.1 BC(s) - Building Controller(s).

.2 OWS - Operator Work Station.

.3 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.3 SUBMITTALS

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

.2 Submit detailed preventative maintenance schedule for system components to Owner.

.3 Submit dated, maintenance task lists to Consultant and include the following sensor and output point detail, as proof of system verification:

.1 Point name and location.
.2 Device type and range.
.3 Measured value.
.4 System displayed value.
.5 Calibration detail
.6 Indication if adjustment required,
.7 Other action taken or recommended.

.4 Submit network analysis report showing results with detailed recommendations to correct problems found.

.5 Records and logs:

.1 Maintain records and logs of each maintenance task on site.
.2 Organize cumulative records for each major component and for entire EMCS chronologically.
.3 Submit records to Consultant, after inspection indicating that planned and systematic maintenance have been accomplished.

.6 Revise and submit to Consultant "As-built drawings" documentation and commissioning reports to reflect changes, adjustments and modifications to EMCS made during warranty period.

1.4 MAINTENANCE SERVICE DURING WARRANTY PERIOD

.1 Provide services, materials, and equipment to maintain EMCS for specified warranty period. Provide detailed preventative maintenance schedule for system components as described in Submittal article.

.2 Emergency Service Calls:

.1 Initiate service calls when EMCS is not functioning correctly.

.2 Qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost.

.3 Furnish Consultant with telephone number where service personnel may be reached at any time.

.4 Service personnel to be on site ready to service EMCS within 2 hours after receiving request for service.

.5 Perform Work continuously until EMCS restored to reliable operating condition.

.3 Operation: foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of EMCS based on original design conditions and as recommended by manufacturer.

.4 Work requests: record each service call request, when received separately on approved form and include:

.1 Serial number identifying component involved.

.2 Location, date and time call received.

.3 Nature of trouble.

.4 Names of personnel assigned.

.5 Instructions of work to be done.

.6 Amount and nature of materials used.

.7 Time and date work started.

.8 Time and date of completion.

.5 Provide system modifications in writing.

.1 No system modification, including operating parameters and control settings, to be made without prior written approval of Consultant.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

.1 Perform one inspection at the end of the warrantee period.

.2 Following inspections are minimum requirements and should not be interpreted to mean satisfactory performance:

.1 Perform calibrations using test equipment having traceable, certifiable accuracy at minimum 50% greater than accuracy of system displaying or logging value.

.2 Check and Calibrate each field input/output device in accordance with Canada Labour Code - Part I and CSA Z204.

.3 Provide dated, maintenance task lists, as described in Submittal article, as proof of execution of complete system verification.

.3 Inspections to include, but not limited to:

.1 Perform visual, operational checks to BC's, peripheral equipment, interface equipment and other panels.

.2 Check equipment cooling fans as required.

.3 Visually check for mechanical faults, air leaks and proper pressure settings on pneumatic components.

.4 Review system performance with Operations Supervisor to discuss suggested or required changes.

.5 Clean OWS(s) peripheral equipment, BC(s), interface and other panels, micro-processor interior and exterior surfaces.

.6 Check signal, voltage and system isolation of BC(s), peripherals, interface and other panels.

.7 Verify calibration/accuracy of each input and output device and recalibrate or replace as required.

.8 Provide mechanical adjustments, and necessary maintenance on printers.

.9 Run system software diagnostics as required.

.10 Install software and firmware enhancements to ensure components are operating at most current revision for maximum capability and reliability.

.1 Perform network analysis and provide report as described in Submittal article.

.4 Rectify deficiencies revealed by maintenance inspections and environmental checks.

.5 Continue system debugging and optimization.

END OF SECTION

Part 1 General

1.1 ACRONYMS

.1 Acronyms used in this section include see Section 25 05 01 - EMCS: General Requirements.

1.2 SYSTEM DESCRIPTION

.1 LAN to network any new OWS's and MCU's to existing network.

1.3 OWS/MCU PANEL SUPPORT

.1 OWS and MCU to reside directly on LAN so that communications may be executed directly between work-stations and controllers on peer-to-peer basis.

1.4 DYNAMIC DATA ACCESS

.1 LAN to provide capabilities for OWS devices to be able to access point status and application report data or execute control functions for other devices via LAN.

.2 Access to data to be based upon logical identification or building equipment.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 TERMS AND DEFINITIONS

.1 Terms used in this section.

.1 Point Object Type - refers to all points as Object types - AI, AO, DI, DO, TCU, ECU.

.2 Point Name - when used includes - Point Identifier and Point Expansion.

1.2 ACRONYMS

.1 Acronyms used in this section include: see Section 25 05 01 - EMCS: General Requirements.

1.3 OWS SYSTEM DESCRIPTION

.1 No new OWS is required for this work. All new programming, graphics, etc. to be carried out on existing OWS.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 ACRONYMS

.1 Acronyms used in this section include: see Section 25 05 01 - EMCS: General Requirements.

1.2 SUBMITTALS

.1 In accordance with Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process submit product data sheets for each product item proposed for this project.

Part 2 Products

2.1 SYSTEM DESCRIPTION

.1 General: A network of Controllers comprising of MCU(‘s), LCU(‘s), ECU(‘s) or TCU(‘s) to be provided as required to support building systems and associated sequence(s) of operations as detailed in these specifications.

.1 Provide sufficient Controllers to meet intents and requirements of this section.

.2 Controllers quantity, and point contents to be approved by Consultant at time of preliminary design review.

.2 Controllers to be stand-alone intelligent Control Unit. Controllers to:

.1 Incorporate programmable microprocessor, non-volatile program memory, RAM, power supplies, as required to perform specified functions.

.2 Incorporate communication interface port for communication to Local Controller’s LAN to exchange information with other Controllers.

.3 Be capable of interfacing with operator interface device.

.4 Interface with field sensors via input output termination board to be part of Controllers or located remotely.

.5 Execute its logic and control (direct digital or closed loop process) having primary inputs (input or outputs which have direct interaction with logic processing) connected directly to its onboard input/output field terminations or slave devices, and without need to interact with other processor. Secondary input used for reset such as outdoor air temperature to be located in other Controller(s).

.3 Interface to include provisions for use of dial-up modem for interconnection with remote LAN modem. Dial-up communications to use Hayes compatible 14.4/28.8/56 Kbit modems and voice grade telephone lines. Each stand-alone panel may have its own modem or a group of stand-alone panels may share modem.

2.2 BASIC FUNCTIONAL REQUIREMENTS

.1 To include:

.1 Scanning of AIs and DIs connected inputs for detection of change of value and processing the detection of alarm conditions.

.2 Perform On-Off digital control of connected points, including the resulting required states generated through programmable logic output.

.3 Perform Analog control using programmable logic, (including PID) with adjustable dead bands and deviation alarms.

.4 Control of systems as described in sequence of operations.

.5 Execution of optimization routines as listed in this section.

.2 Field Termination and Interface Devices.

.1 To conform to CSA C22.2No.205.

.2 To electronically interface sensors and control devices to processor unit.

.3 To include, but not be limited to, following:

.1 Programmed firmware or logic circuits to meet functional and technical requirements.

.2 Power supplies for operation of logics devices and associated field equipment.

.3 Lockable wall cabinet with tamper alarm (unless housed in processor unit cabinet).

.4 Required communications equipment and wiring (if remote units).

.5 Leave controlled system in "fail-safe" mode in event of loss of communication with, or failure of, processor unit.

.6 Input Output interface to accept as minimum AI, AO, DI, DO functions as specified.

.7 Wiring terminations shall use conveniently located screw type or spade lug terminals.

.4 AI interface equipment to:

.1 Convert analog signals to digital format with 12 bit analog-to-digital resolution.

.2 Provide for following input signal types and ranges:

.1 4 - 20 mA;

.2 4 - 20 mA.

.3 Meet IEEE 472 surge with stand capability.

.4 Have common mode signal rejection greater than 60 dB to 60 Hz.

.3 Where required, dropping resistors to be certified precision devices which complement accuracy of sensor and transmitter range specified.

.5 AO interface equipment to:

.1 Convert digital data from controller processor to acceptable analog output signals using 12 bit digital-to-analog resolution.

.2 Provide for following output signal types and ranges:

.1 4 - 20 mA.

.2 0 - 10 V DC.

.3 Meet IEEE 472 surge withstand capability.

.6 DI interface equipment to:

.1 Be able to reliably detect contact change of sensed field contact and feed condition to controller logic processor.

.2 Meet IEEE 472 surge withstand capability.

.3 Accept pulsed inputs up to 2 kHz.

.7 DO interface equipment to:

.1 Respond to controller processor output, switch respective outputs. Each DO hardware to be capable of switching up to 0.5 amps at 24 V AC.

.2 Switch up to 5 amps at 220 V AC using optional interface relay.

.3 Controller's and associated hardware and software to operate in conditions of 0EC to 44EC and 20 % to 90 % non-condensing RH.

.4 Controllers (MCU, LCU) to be mounted in wall mounted cabinet with hinged, keyed-alike locked door. Provide for conduit entrance from top, bottom or sides of panel. ECUs to be mounted in equipment enclosures and TCU's in ceiling space. Mounting details to be as approved by the Engineer for ceiling mounting.

.5 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.

.6 Provide surge and low voltage protection for interconnecting wiring connections.

2.3 MASTER CONTROL UNIT (MCU)

.1 Primary function of MCU is to provide co-ordination and supervision of subordinate devices. Supervisory role shall include coordination of subordinate devices in the execution of optimization routines such as demand limiting or enthalpy control.

.2 Include high speed communication LAN Port for Peer to Peer communications with OWS(s) and other MCU level devices.

.3 MCU shall have local I/O capacity as follows;

.1 To have at least 16 I/O points of which minimum to be 2AO, 6AI, 4DI, 4DO.

.2 LCU's to be added to support system functions as indicated in I/O Summary List.

.3 MCU to have 25 % spare input and 25 % output point capacity without addition of cards, terminals, etc.

.4 Central Processor Unit (CPU)

.1 Processor to consist of at minimum a 16 bit microprocessor capable of supporting software to meet specified requirements.

.2 CPU idle time to be more than 30 % when system configured to maximum input and output with worst case program use.

.3 Minimum addressable memory to be at manufacturer's discretion but to support at least all performance and technical specifications. Memory to include:

.1 Non-volatile EEPROM to contain operating system, executive, application, sub-routine, other configurations definition software. Tape media not acceptable.

.2 Battery backed (72 hr minimum capacity) RAM (to reduce the need to reload operating data in event of power failure) RAM to contain CDLs, application parameters, operating data or software that is required to be modifiable from operational standpoint such as schedules, set points, alarm limits, PID constants and CDL and hence modifiable on-line through operator panel or remote operator's interface. RAM to be down line loadable from OWS, CAB-Gateway, or locally installed floppy disk.

.4 Include uninterruptible clock accurate to plus or minus 5 secs/month, capable of deriving month/day/hour/minute/second, with rechargeable batteries for minimum 72 hr operation in event of power failure.

2.4 LOCAL CONTROL UNIT (LCU)

.1 Design to provide control functions for typical HVAC or Hydronic systems.

.2 Minimum of 16 I/O points of which minimum be 4 AOs, 4 AIs, 4 DIs, 4 DOs.

.3 Points of one Building System to be connected to one controller as listed in I/O Summary designations.

.4 To comprise of microprocessor capable of supporting necessary software and hardware to meet specified requirements. As per MCU requirements above with the following additions:

.1 Include as minimum 2 interface ports for connection local computer terminal.

.2 Design so that shorts, opens or grounds on any input or output will not interfere with other input or output signals.

.3 Physically separate line voltage (70V and over) circuits from DC logic circuits to permit maintenance on either circuit with minimum hazards to technician and equipment.

.4 Include power supplies for operation of LCU and associated field equipment.

.5 In event of loss of communications with, or failure of, MCU, LCU to continue to perform control. Controllers that use defaults or fail to open or close positions not acceptable.

.6 Provide conveniently located screw type or spade lug terminals for field wiring.

.7 LCU to have 25 % spare input and 25 % output point capacity without addition of cards, terminals, etc.

2.5 EQUIPMENT CONTROL UNIT (ECU)

.1 To consist of microprocessor capable of supporting necessary software and hardware to meet ECU functional specifications. ECU definitions to be consistent with those defined in ASHRAE HVAC Applications Handbook section 45.

2.6 SOFTWARE

.1 General:

.1 Include as minimum: operating system executive, communications, application programs, operator interface, and systems sequence of operation - CDL's.

.2 To include "firmware" or instructions which are programmed into ROM or EPROM, EEPROM other non-volatile memory.

.3 Include initial programming of all Controllers, for entire system.

.2 Program and data storage:

.1 Store executive programs and site configuration data in ROM, EEPROM or other non-volatile memory.

.2 Maintain CDL and operating data such as set points, operating constants, alarm limits in battery-backed RAM or EEPROM for display and modification by operator.

.3 Programming languages:

.1 CDL Control Description Logic software to be programmed using English like or graphical, high level, general control language.

.2 Structure software in modular fashion to permit simple restructuring of program modules if future software additions or modifications are required. GOTO constructs not allowed.

.4 Operator interface:

.1 MCU to perform operating and control functions specified Section 25 10 02 - EMCS: Operator Work Stations (OWS), including:

.1 Multi-level password access protection to allow user/manager to limit workstation control.

.2 Alarm management: processing and messages.

.3 Operator commands.

.4 Reports.

.5 Displays.

.6 Point identification.

.5 Pseudo or calculated points:

.1 Software to have access to any value or status in controller or other networked controller so as to define and calculate pseudo point from other values/status of controller. When current pseudo point value is derived, normal alarm checks must be performed or value used to totalize.

.2 Inputs and outputs for any process to be able to include data from controllers to permit development of network-wide control strategies. Processes also to permit operator to use results of one process as input to any number of other processes (e.g. cascading).

.6 Control Description Logic (CDL):

.1 Capable of generating on-line project-specific control loop algorithms (CDLs). CDLs to be software based, programmed into RAM or EEPROM and backed up to OWS. Owner must have access to these algorithms for modification or to be able to create new ones and to integrate these into sequence of operation descriptions on MCU, LCU from any OWS.

.2 Write CDL in high level language that allows algorithms and interlocking programs to be written simply and clearly. Use parameters entered into system (e.g. set points) to determine operation of algorithm. Operator to be able to alter operating parameters on-line from OWS or MCU and to tune control loops.

.3 Perform changes to CDL on-line.

.4 Control logic to have access to values or status of all points available to controller including global or common values, allowing cascading or inter-locking control.

.5 Energy optimization routines such as enthalpy control, supply temperature reset, etc. to be LCU or MCU resident functions and form part of CDL.

.6 MCU to be able to perform following pre-tested control algorithms:

.1 Two position control.

.2 Proportional plus integral plus Derivative (PID) control.

.3 Automatic control loop tuning.

.7 Control software to provide the ability to define the time between successive starts for each piece of equipment to reduce cycling of motors.

.8 Provide protection against excessive electrical-demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.

.9 Power Fail Restart: Upon detection of power failure system to verify availability of Emergency Power as determined by emergency power transfer switches and analyze controlled equipment to determine its appropriate status under Emergency power conditions and start or stop equipment as defined by I/O Summary. Upon resumption of normal power as determined by emergency power transfer switches, MCU to analyze status of controlled equipment, compare with normal occupancy scheduling, turn equipment on or off as necessary to resume normal operation.

.7 Event and Alarm management: The system to use a management by exception concept for Alarm Reporting. This is a system wide requirement. This approach will insure that only principal alarms are reported to OWS. Events which occur as a direct result of the primary event to be suppressed by the system and only events which fail to occur to be reported. Such event sequence to be identified in I/O Summary and sequence of operation. Examples of above are, operational temperature alarms limits which are exceeded when main air handler is stopped, or General Fire condition shuts air handlers down, only Fire alarm status shall be reported. The exception is, when an air handler which is supposed to stop or start fails to do so under the event condition.

.8 Energy management programs: The following programs shall include specific summarizing reports, to include the date stamp indicating sensor details which activated and or terminated the feature.

.1 MCU in coordination with subordinate LCU, TCU, ECU to provide for the following energy management routines:

.1 Time of day scheduling.

.2 Calendar based scheduling.

.3 Holiday scheduling.

.4 Temporary schedule overrides.

.5 Optimal start stop.

.6 Night setback control.

.7 Enthalpy (economizer) switchover.

.8 Peak demand limiting.

.9 Temperature compensated load rolling.

.10 Fan speed/flow rate control.

.11 Cold deck reset.

.12 Hot deck reset.

.13 Hot water reset.

.14 Chilled water reset.

.15 Condenser water reset.

.16 Chiller sequencing.

.17 Night purge.

.2 Programs to be executed automatically without need for operator intervention and be flexible enough to allow customization.

.3 Apply programs to equipment and systems as specified or requested by the Engineer.

.9 Function Totalization: Totalizing features to provide predefined reports which show daily, weekly, and monthly accumulating totals and which include high rate (time stamped) and low rate (time stamped) and accumulation to date for month.

.1 MCUs to accumulate and store automatically run-time for binary input and output points.

.2 Totalization routine to have sampling resolution of 1 min or less.

.3 User to be able to define warning limit and generate user-specified messages when limit reached.

.10 Analog/pulse Totalization: Totalizing features to provide reports which show daily, weekly monthly accumulating totals and which include high rate (time stamped) and low rate (time stamped) and accumulation to date for month.

.1 MCU to automatically sample, calculate and store consumption totals on daily, weekly or monthly basis for user-selected analog or binary pulse input-type points.

.2 Totalization to provide calculations and storage of accumulations up to 99,999.9 units (e.g. kWh, litres, tonnes, etc.).

.3 Totalization routine to have sampling resolution of 1 min or less.

.4 User to be able to define warning limit and generate user-specified messages when limit is reached.

.11 Event Totalization: Totalizing features to provide reports which show daily, weekly monthly accumulating totals and which include high rate (time stamped) and low rate (time stamped) and accumulation to date for month.

.1 MCU to automatically count events (number of times pump is cycled off and on) daily, weekly or monthly basis.

.2 Store totalization records with minimum of 9,999,999 events before reset.

.3 User to be able to define warning limit and generate user-specified messages when limit is reached.

2.7 LEVELS OF ADDRESS

.1 Upon operator's request, EMCS to present status of any single ‘point’, ‘system’ or point group, an entire ‘area’, or entire network on printer or OWS as selected by operator. Display analog values digitally to 1 place of decimals with negative sign as required. Update displayed analog values and status when new values received. Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm. Updates to be change-of-value (COV)-driven or if polled not exceeding 2 second intervals.

.2 Refer also to Section 25 05 01 - EMCS: General Requirements.

2.8 POINT NAME SUPPORT

.1 Controllers (MCU, LCU) to support PWGSC point naming convention as defined in section 25 90 01. Each point name to include; an identifier field for "area@, "system@, "point@ which has at minimum a 25 character string entry, and, point identifier expansion fields which at minimum support 32 character strings for each "system@ and "point@ identifier. Bilingual systems to include additional point identifier expansion fields of equal capacity for each point name for the second language. System to support use of numbers and readable characters including blanks, periods or underscores to enhance user readability for each of the above strings.

.2 Upon operator's request, system to present condition of any single point, system, area, or connected points on system to OWS or remote printer as selected by operator. Display analog values digitally to (1) place of decimals with negative sign as required. Update displayed analog values and status when new values received. Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm. Updates to be change-of-value (COV)-driven or if polled not to exceed 4 second intervals for points displayed.

.3 Refer also to Section 25 05 01 - EMCS: General Requirements.

Part 3 Execution

3.1 LOCATION

.1 Location of Controllers to be approved by Consultant.

3.2 INSTALLATION

.1 New controllers are required only where new functionality cannot be built into existing controllers.

.2 Provide necessary power from local 120 V branch circuit panel for equipment.

.3 Install tamper locks on breakers of circuit breaker panel.

.4 Use uninterruptible Power Supply (UPS) and emergency power when equipment must operate in an emergency and co-ordinating mode.

3.3 COMMISSIONING

.1 Refer to Section 25 08 20 - EMCS: Warranty and Maintenance.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute (ANSI)

.1 ANSI/IEEE C57.13, Requirements for Instrument Transformers.

.2 National Electrical Manufacturer's Association (NEMA)

.1 NEMA 1

.2 NEMA 12

1.2 SUBMITTALS

.1 Submit shop drawings and manufacturer’s installation instructions in accordance with Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

.2 Include:

.1 Information as specified for each device.

.2 Manufacturer's detailed installation instructions.

.3 Manufacturer’s Instructions

.1 Submit manufacturer’s installation instructions for specified equipment and devices.

1.3 CLOSEOUT SUBMITTALS

.1 Submit operating and maintenance data for inclusion in operation and maintenance manual in accordance with Section 25 05 03 - EMCS: Project Records Documents.

Part 2 Products

2.1 GENERAL

.1 Control devices of each category to be of same type and manufacturer.

.2 External trim materials to be corrosion resistant.

.3 Operating conditions: 0 - 32 °C with 10 - 90 % RH (non-condensing) unless otherwise specified.

.4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.

.5 Transmitters to be unaffected by external transmitters (i.e. walkie talkies).

.6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

.7 Outdoor installations: use weatherproof construction in EEMAC 12 enclosures.

.8 Devices to be installed in user occupied space must not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.

2.2 TEMPERATURE SENSORS

.1 General: to be resistance or thermocouple type to following requirements:

.1 Thermocouples: to be limited to temperature range of 200 °C and over.

.2 RTD's: 100 ohm at 0 °C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored lead wires. Coefficient of resistivity: 0.00385 ohms/ohmEC.

.3 Sensing element: hermetically sealed.

.4 Stem and tip construction: copper or type 304 stainless steel.

.5 Time constant response: less than 3 seconds to temperature change of 10 °C.

.6 Immersion wells: NPS 3/4, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length 100 mm as indicated.

.2 Sensors:

.1 Outside air type: complete with probe length 100 - 150 mm long, non-corroding shield to minimize solar and wind effects, threaded fitting for mating to 13 mm conduit, weatherproof construction in EEMAC 12 enclosure.

2.3 TEMPERATURE TRANSMITTERS

.1 Requirements:

.1 Input circuit: to accept 3-lead, 100 ohm at 0 deg C, platinum resistance detectors type sensors.

.2 Power supply: 575 ohms at 24 V DC into load of 575 ohms. Power supply effect less than 0.01 deg C per volt change.

.3 Output signal: 4 - 20 mA into 500 ohm maximum load.

.4 Input and output short circuit and open circuit protection.

.5 Output variation: less than 0.2 % of full scale for supply voltage variation of plus or minus 10 %.

.6 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 0.5 % of full scale output.

.7 Maximum current to 100 ohm RTD sensor: not to exceed 25 mA.

.8 Integral zero and span adjustments.

.9 Temperature effects: not to exceed plus or minus 1.0 % of full scale/ 50 EC.

.10 Long term output drift: not to exceed 0.25 % of full scale/ 6 months.

.11 Transmitter ranges: Select narrowest range to suit application from following:

.1 Minus 50 EC to plus 50 EC, plus or minus 0.5 EC.

.2 0 to 100 EC, plus or minus 0.5 EC.

.3 0 to 50 EC, plus or minus 0.25 EC.

.4 0 to 25 EC, plus or minus 0.1 EC.

.5 10 to 35 EC, plus or minus 0.25EC.

2.4 PRESSURE/CURRENT (P/I) TRANSMITTERS

.1 Requirements:

.1 Range: as indicated in I/O summaries.

.1 Pressure sensing elements: bourdon tube, bellows or diaphragm type.

.2 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.

.2 Output signal: 4 - 20 mA into 500 ohm maximum load.

.3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.

.4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.

.5 Integral zero and span adjustment.

.6 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 °C.

.7 Over-pressure input protection to at least twice rated input pressure.

.8 Output short circuit and open circuit protection.

.9 Pressure ranges: see I/O Summaries.

.10 Accuracy: plus or minus 1% of Full Scale.

2.5 DIFFERENTIAL PRESSURE (KPA) TRANSMITTERS

.1 Requirements:

.1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.

.2 Output signal: 4 - 20 mA into 500 ohm maximum load.

.3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.

.4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.

.5 Integral zero and span adjustment.

.6 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 °C.

.7 Over-pressure input protection to at least twice rated input pressure.

.8 Output short circuit and open circuit protection.

.9 The unit to have a 12.5 mm N.P.T. conduit connection. The enclosure shall be an integral part of the unit.

2.6 TURBINE FLOW METERS

.1 Requirements:

.1 Flow range: as specified in I/O summaries.

.2 Pressure rating: 1035 kPa (gauge) at 38 °C.

.3 Temperature rating: 73 to 260 °C.

.4 Repeatability: plus or minus 0.1 %.

.5 Accuracy and linearity: plus or minus 0.5 %.

.6 Flow rangability: at least 10:1.

.7 Output voltage: 30 to 300 mV peak-to-peak into 10 Kohm load.

.8 Ends:

.1 NPS 2 and under: screwed.

.2 NPS 2.1/2 and over: flanged.

2.7 FREQUENCY-TO-DC TRANSMITTERS FOR TURBINE METERS

.1 Requirements:

.1 Input: greater than 5000 ohm.

.1 Range: greater than 100 mV less than 20 V peak-to-peak, 200 through 400 Hz.

.2 Span adjustment: fully adjustable.

.3 Zero adjustment: 0 to 10% of output.

.4 Output: 4 to 20 mA into 500 ohm load.

.5 Load effect: plus or minus 0.1 % of span zero to maximum load resistance.

.6 Linearity and repeatability: plus or minus 0.05 % of span.

.7 Power input: 24 V DC plus or minus 10 %.

.8 Input, output and power input transformer isolated.

.9 Enclosure: general purpose NEMA 1.

2.8 PRESSURE AND DIFFERENTIAL PRESSURE SENSORS AND SWITCHES

.1 Requirements:

.1 Range: as indicated in I/O summaries.

.1 Pressure sensing elements: bourdon tube, bellows or diaphragm type.

.2 Adjustable set-point and differential.

.3 Switch: snap action type, rated at 120V, 15 amps AC or 24 V DC.

.4 Sensor assembly: to operate automatically and reset automatically when conditions return to normal. Over-pressure input protection to at least twice rated input pressure.

.5 Accuracy: within 2% repetitive switching.

.6 Provide sensor pressure and accuracy ratings:

.1 Chilled and condenser water: 860 kPa.

.7 Provide sensors with isolation valve and snubber between sensor and pressure source.

.8 Sensors on steam and high temperature hot water service: provide pigtail siphon.

2.9 CURRENT/PNEUMATIC (I/P) TRANSDUCERS

.1 Requirements:

.1 Input range: 4 to 20 mA.

.2 Output range: proportional 20-104 kPa or 20-186 kPa as applicable.

.3 Housing: dustproof or panel mounted.

.4 Internal materials: suitable for continuous contact with industrial standard instrument air.

.5 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 2 % of full scale over entire range.

.6 Integral zero and span adjustment.

.7 Temperature effect: plus or minus 2.0 % full scale/ 50 °C or less.

.8 Regulated supply pressure: 206 kPa maximum.

.9 Air consumption: 16.5 ml/s maximum.

.10 Integral gauge manifold c/w gauge (0-206 kPa).

2.10 SOLENOID CONTROL AIR VALVES

.1 Coil: 120V AC or 24V DC, as indicated.

.2 Complete with manual over-ride.

.3 Shall have the capacity to pass .07 l/s air at 104 kPa differential.

2.11 AIR PRESSURE GAUGES

.1 Diameter: 38 mm minimum.

.2 Range: zero to two times operating pressure of measured pressure media to nearest standard range.

2.12 ELECTRICAL RELAYS

.1 Requirements:

.1 Double voltage, DPDT, plug-in type with termination base.

.2 Coils: rated for 120V AC or 24V DC. Other voltage: provide transformer.

.3 Contacts: rated at 5 amps at 120 V AC.

.4 Relay to have visual status indication

2.13 CURRENT TRANSDUCERS

.1 Requirements:

.1 Range: as indicated on I/O Summaries.

.2 Purpose: measure line current and produce proportional signal in one of following ranges:

.1 4-20 mA DC.

.2 0-1 volt DC.

.3 0-10 volts DC.

.4 0-20 volts DC.

.3 Frequency insensitive from 10 - 80 Hz.

.4 Accuracy to 0.5% full scale.

.5 Zero and span adjustments. Field adjustable range to suit motor applications.

.6 Adjustable mounting bracket to allow for secure/safe mounting inside the MCC.

2.14 CURRENT SENSING RELAYS

.1 Requirements:

.1 Complete with metering transformer ranged to match load, plug-in base and shorting shunt to protect current transformer when relay is removed from socket.

.2 Suitable for single or 3 phase metering into single relay.

.3 To have adjustable latch level, adjustable delay on latch and minimum differential of 10 % of latch setting between latch level and release level.

.4 3-Phase application: provide for discrimination between phases.

.5 To have adjustable latch level to allow detection of worst case selection. To be powered from control circuit of motor starter being metered. Relay and base to be mounted in adjacent auxiliary cabinet only if control circuit power to be brought into auxiliary cabinet. Adjustments to be acceptable from auxiliary cabinet.

.6 Relay contacts: capable of handling 10 amps at 240 V AC.

2.15 CONTROL VALVES

.1 Requirements:

.1 NPS 2 and under: bronze with screwed ends.

.2 NPS 2 1/2 and over: cast iron with flanged ends.

.3 Trim: type 316 stainless steel.

.4 Leakage: 0.5 % of rated flow maximum.

.5 Two or three port as indicated. Normally Open or Normally Closed, as indicated.

.6 Flow characteristics: linear or equal percentage as indicated.

.7 Rangeability: 50:1 minimum.

.8 Performance: Capacity refer to I/O Summaries and Valve Schedule Division 15.

2.16 ELECTRONIC/ELECTRIC VALVE ACTUATORS

.1 Requirements:

.1 Construction: steel, cast iron, aluminium.

.2 Control voltage: 0-20V DC or 24V AC .

.3 Positioning time: to suit application. 90 sec maximum.

.4 Spring return to normal position as indicated.

2.17 PANELS

.1 Either free-standing or wall mounted enamelled steel cabinets with hinged and key-locked front door.

.2 To be modular multiple panels as required indicated to handle requirements with additional space to accommodate future capacity as required by Engineer Consultant without adding additional cabinets.

.3 Panels to be lockable with same key.

Part 3 Execution

3.1 INSTALLATION

.1 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.

.2 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in all cases when dissimilar metals make contact.

.3 Support field-mounted transmitters, sensors on pipe stands or channel brackets.

.4 Install wall mounted devices on plywood panel properly attached to wall.

3.2 TEMPERATURE SENSORS

.1 Stabilize to ensure minimum field adjustments or calibrations.

.2 To be readily accessible and adaptable to each type of application so as to allow for quick easy replacement and servicing without special tools or skills.

.3 Outdoor installation:

.1 Protect from solar radiation and wind effects by stainless steel shields.

.2 Install in NEMA 12 enclosures.

.4 Thermowells: install for piping installations. Where pipe diameter is less than well insertion length, locate well in elbow. Thermowell to restrict flow by less than 30%.

3.3 PANELS

.1 Arrange for conduit and tubing entry from top, bottom or either side.

.2 Use modular multiple panels if necessary to handle all requirements, with space for additional 20% PCU or FID if applicable without adding additional panels. Space to accommodate maximum capacity of associated controller (ECU, LCU, MCU, PCU, TCU).

.3 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.

.4 Identify wiring and conduit clearly.

3.4 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES

.1 Install isolation valve and snubber on sensors between sensor and pressure source. In addition, protect sensing elements on steam and high temperature hot water service with pigtail siphon between valve and sensor.

3.5 I/P TRANSDUCERS

.1 Install air pressure gauge on outlet.

3.6 PRESSURE GAUGES

.1 Install on pneumatic systems only.

.2 Install pressure gauges on pneumatic devices, I/P, pilot positioners, motor operators, switches, relays, valves, damper operators, valve actuators.

.3 Install pressure gauge on output of controller and auxiliary cabinet pneumatic devices.

3.7 AIR PRESSURE GAUGES

.1 Install on pneumatic systems only.

.2 Install on pneumatic devices including I/P's, pilot positioners, motor operators.

3.8 FIELD MOUNTED TRANSMITTERS AND SENSORS

.1 Support properly on pipe stands or channel brackets.

.2 Install wall mounted devices on plywood panel attached properly to wall.

3.9 IDENTIFICATION

.1 Identify field devices properly.

.2 Refer to Section 25 05 54 - EMCS: Identification.

3.10 TESTING

.1 Calibrate and test field devices for accuracy and performance. Submit report detailing tests performed, results obtained to Consultant for approval. Consultant will verify results at random. Provide testing equipment and manpower necessary for this verification.

3.11 COMMISSIONING

.1 Refer to Section 25 08 20 - EMCS: Warranty and Maintenance.

END OF SECTION

Part 1 GENERAL

1.1 SCOPE

.1 Supply and install fully operational variable frequency drives (VFDs) as specified herein.

1.2 CODES AND STANDARDS

.1 Install all components in accordance with the latest regulations of the Canadian Electrical Code, applicable Municipal and Provincial Codes and Regulations, and latest CSA Electrical Bulletins.

1.3 QUALITY ASSURANCE

.1 The equipment manufacturer shall have trained service representatives resident in Saskatchewan.

.2 To ensure quality and minimize infantile failures at the jobsite, the complete VFD shall be tested by the manufacturer. The VFD shall operate a dynamometer at full load and speed and shall be cycled during the test.

.3 All optional features shall be functionally tested at the factory for proper operation.

1.4 WARRANTY

.1 The VFD shall be warranted by the manufacturer for a period of 36 months from date of shipment. The warranty shall include parts, labour, travel costs, and living expenses incurred by the manufacturer to provide factory authorized on-site service. The warranty shall be provided by the VFD manufacturer.

1.5 SUBMITTALS

.1 Submit shop drawings and manufacturer’s installation instructions in accordance with Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

.2 Submit manufacturer’s performance data including dimensional drawings, power circuit diagrams, warranty description, VFD's FLA rating, certification agency file numbers, and catalogue information.

.3 Harmonic filtering.

.1 The Contractor shall, with the aid of the electrical power single line diagram, perform an analysis to initially demonstrate the supplied equipment will met the IEEE standards after installation.

.2 If, as a result of the analysis, it is determined that additional filter equipment is required to meet the IEEE recommendations, then the cost of such equipment shall be included in the bid.

.3 A harmonic analysis shall be submitted with the approval drawings to verify compliance with the latest version of IEEE-519 voltage and current distortion limits as shown in table 10.2 and 10.3 at the point of common coupling (PCC).

.4 The PCC shall be defined as the consumer-utility interface or primary side of the main distribution transformer.

.4 Include in the Operations and Maintenance Manuals:

.1 Approved shop drawings.

.2 Provide a user's manual with the following:

.1 Preliminary checks

.2 Design and Operation

.3 Technical characteristics

.4 Installation

.5 Connections

.6 Recommendations for use of the motor/speed drive combination

.7 Initial setting up and maintenance

.3 Provide a trouble shooting guide with the following:

.1 Observation, fault code

.2 Possible causes

.3 Checks to be made

.4 Result

.5 Remedial action

.6 Comments

1.6 CLOSEOUT SUBMITTALS

.1 Submit operating and maintenance data for inclusion in operation and maintenance manual in accordance with Section 25 05 03 - EMCS: Project Records Documents.

1.7 OWNER ORIENTATION

.1 Contractor to provide three weeks written notice to the Engineer and building Owner prior to commencing formal training sessions.

.2 Provide for a seminar/workshop for operator training covering all aspects of system use as follows:

.1 operation of hardware components

.2 system software configuration

.3 user/system interaction

.4 calibration of sensors and system

.5 trouble shooting of system and components

.6 preventive maintenance

Part 2 PRODUCTS

2.1 STANDARDS OF ACCEPTANCE

.1 The price submitted shall be based on the use of materials and equipment as specified. If the Contractor wishes to quote on equivalent materials and equipment which has not been specified, prior to quoting on such products, obtain written approval from the Engineer.

.2 The Contractor shall be fully responsible for any additional work or materials required by the mechanical trade or to other trades to accommodate approved equivalent materials or equipment. Extras will not be approved to cover such work.

.3 Contractor shall assume full responsibility for the expense of redesign, replacement, and adjustment to other parts of the project when tendering on approved equal or alternate equipment.

.4 The following products are considered acceptable alternatives to those specified:

.1 Toshiba

.2 ETN

.3 ABB

2.2 GENERAL

.1 Drives shall be fully compatible with supplied motors.

.2 Furnish complete VFDs as specified herein for the fans and pumps designated in the equipment schedules to be variable speed. Designation of either “VFD” or “VSD” indicates a variable frequency drive is required.

.1 Fan VFDs are to be supplied by the controls subtrade.

.3 All standard and optional features shall be included within the VFD enclosure, unless otherwise specified.

.1 VFD shall be housed in a metal NEMA 1 enclosure, or other NEMA type according to the installation and operating conditions at the job site.

.2 The VFD’s UL listing shall allow mounting in plenum or other air handling compartments.

.3 If a NEMA 12 enclosure is required for the plenum rating, the manufacturer must supply a NEMA 12 rated VFD.

.4 The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC motors. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump and fan control and to eliminate the need for motor derating.

.5 With the motor’s rated voltage applied to the VFD input, the VFD shall allow the motor to produce full rated power at rated amps, RMS fundamental volts, and speed without using the motor's service factor. VFDs utilizing sine weighted/coded modulation (with or without 3rd harmonic injection) must provide data verifying that the motors will not draw more than full load current during full load and full speed operation.

.6 The VFD shall include an input full-wave bridge rectifier and maintain a fundamental power factor near unity regardless of speed or load.

.7 The VFD and options shall be tested to ANSI/UL Standard 508 and be CSA or C-UL listed. The complete VFD, including all specified options, shall be assembled by the manufacturer, which shall be UL-508 certified for the building and assembly of option panels. Assembly of the option panels by a third-party panel shop is not acceptable. The appropriate UL stickers shall be applied to both the VFD and option panel, in the case where these are not contained in one panel. Both VFD and option panel shall be manufactured in ISO 9001 certified facilities.

.8 The VFD shall be CE marked, and conform to product standard EN 61800-3.

.9 The VFD shall have a dual 5% DC link reactor on the positive and negative rails of the DC bus to minimize power line harmonics and protect the drive from power line transients. The reactor shall be non-saturating (linear) to provide full harmonic filtering throughout the entire load range. VFDs with saturating (non-linear) DC link reactors shall require an additional 3% AC line reactor to provide acceptable harmonic performance at full load, where harmonic performance is most critical.

.10 The VFD's full load amp rating shall meet or exceed NEC Table 430-150. The VFD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 160% of rated current for up to 0.5 second while starting.

.11 The VFD shall be able to provide full torque at any selected frequency from 29 Hz to base speed to allow driving direct drive fans without derating.

.12 An automatic energy optimization selection feature shall be provided standard in the VFD. This feature shall automatically and continually monitor the motor's speed and load and adjust the applied voltage to maximize energy savings and provide up to an additional 3% to 10% energy savings.

.13 Input and output power circuit switching shall be able to be accomplished without interlocks or damage to the VFD. Switching rate may be up to 1 time per minute on the input and unlimited on the output.

.14 An automatic motor adaptation test algorithm shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to run the motor or de-couple the motor from the load to run the test.

.15 Galvanic and/or optical isolation shall be provided between the VFD's power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by voltage spikes, current surges, and ground loop currents. VFDs not including either galvanic or optical isolation on both analog I/O and discrete I/O shall include additional isolation modules.

.16 VFD shall minimize the audible motor noise through the used of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VFD efficiencies while reducing motor noise.

.17 All VFDs shall contain integral EMI filters to attenuate radio frequency interference conducted to the AC power line.

2.3 PROTECTIVE FEATURES

.1 A minimum of Class 20 I^2t electronic motor overload protection for single motor applications and thermal-mechanical overloads for multiple motor applications shall be provided.

.2 Provide protection against input transients, loss of AC line phase, output short circuit, output ground fault, overvoltage, undervoltage, VFD overtemperature and motor overtemperature. The VFD shall display all faults in plain English. Codes are not acceptable.

.3 Protect VFD from sustained power or phase loss. The VFD shall provide full rated output with an input voltage as low as 90% of the nominal. The VFD will continue to operate with reduced output with an input voltage as low as 164 V AC for 208/230 volt units, 313 V AC for 460 volt units, and 394 volts for 600 volts units.

.4 The VFD shall incorporate a motor preheat circuit to keep the motor warm and prevent condensation build up in the stator.

.5 VFD package shall include semi-conductor rated input fuses to protect power components.

.6 To prevent breakdown of the motor winding insulation, the VFD shall be designed to comply with IEC Part 34-17. Otherwise the VFD manufacturer must ensure that inverter rated motors are supplied and installed.

.7 VFD shall include a “signal loss detection” circuit to sense the loss of an analog input signal such as 4 to 20 mA or 2 to 10 V DC, and shall be programmable to react as desired in such an instance.

.8 VFD shall function normally when the keypad is removed while the VFD is running and continue to follow remote commands. No warnings or alarms shall be issued as a result of removing the keypad.

.9 VFD shall catch a rotating motor operating forward or reverse up to full speed.

.10 VFD shall be rated for 100,000 amp interrupting capacity (AIC).

.11 VFD shall include current sensors on all three output phases to detect and report phase loss to the motor. The VFD will identify which of the output phases is low or lost.

.12 VFD shall continue to operate without faulting until input voltage reaches 300 V AC on 208/230 volt units, 539 V AC on 460 volt units, and 690 volts on 600 volt units.

2.4 INTERFACE FEATURES

.1 Hand/Start, Off/Stop and Auto/Start selector switches shall be provided to start and stop the VFD and determine the speed reference.

.2 The VFD shall be able to be programmed to provide a 24 V DC output signal to indicate that the VFD is in Auto/Remote mode.

.3 The VFD shall provide digital manual speed control. Potentiometers are not acceptable.

.4 Lockable, alphanumeric backlit display keypad can be remotely mounted up to 10 feet away using standard 9-pin cable.

.5 The keypads for all sizes of VFDs shall be identical and interchangeable.

.6 To set up multiple VFDs, it shall be possible to upload all setup parameters to the VFD's keypad, place that keypad on all other VFDs in turn and download the setup parameters to each VFD. To facilitate setting up VFDs of various sizes, it shall be possible to download from the keypad only size independent parameters.

.7 A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.

.8 A quick setup menu with factory preset typical HVAC parameters shall be provided on the VFD eliminating the need for macros.

.9 The VFD shall include a communications port and capabilities to be connected to the Owner's Building Management System (EMCS). The use of gateways is not acceptable. The connection shall be software selectable by the user.

.10 As a minimum, the following points shall be controlled and/or accessible:

- .1 VFD Start/Stop
- .2 Speed reference
- .3 Fault diagnostics
- .4 Meter points:
  - .1 Motor power in HP
  - .2 Motor power in kW
  - .3 Motor kW-hr
  - .4 Motor current
  - .5 Motor voltage
  - .6 Hours run
  - .7 Feedback signal #1
  - .8 Feedback signal #2
  - .9 DC link voltage
  - .10 Thermal load on motor
  - .11 Thermal load on VFD
  - .12 Heatsink temperature

.11 Four additional Form C 230 volt programmable relays shall be available for factory or field installation within the VFD.

.12 Provide a communications protocol board fully compatible with the Owner's existing EMCS.

.13 Two set-point control interface (PID control) shall be standard in the unit. VFD shall be able to look at two feedback signals, compare with two set-points and make various process control decisions.

.14 Floating point control interface shall be provided to increase/decrease speed in response to contact closures.

.15 Four simultaneous displays shall be available. They shall include frequency or speed, run time, output amps and output power. VFDs unable to show these four displays simultaneously shall provide panel meters.

.16 Sleep mode shall be provided to automatically stop the VFD when its speed drops below set "sleep" level for a specified time. The VFD shall automatically restart when the speed command exceeds the set "wake" level.

.17 The sleep mode shall be functional in both follower mode and PID mode.

.18 Run permissive circuit shall be provided to accept a "system ready" signal to ensure that the VFD does not start until dampers or other auxiliary equipment are in the proper state for VFD operation. The run permissive circuit shall also be capable of sending an output signal as a start command to actuate external equipment before allowing the VFD to start.

.19 The following displays shall be accessible from the control panel in actual units:

- .1 Reference Signal Value in actual units
- .2 Output Frequency in Hz or percent
- .3 Output Amps
- .4 Motor HP
- .5 Motor kW
- .6 kWhr
- .7 Output Voltage
- .8 DC Bus Voltage
- .9 VFD Temperature in degrees
- .10 Motor Speed in engineering units per application (in GPM, LPS, CFM, etc.)
  - .1 VFD will read out the selected engineering unit either in a linear, square or cubed relationship to output frequency as appropriate to the unit chosen.

.20 The display shall be programmed to read in Pascals (Pa) for an air handler application, Kilo-Pascals (kPa) for a pump application, and temperature (°C) for a cooling tower application.

.21 VFD shall be able to be programmed to sense the loss of load and signal a no load/broken belt warning or fault.

.22 If the temperature of the VFD's heat sink rises to 80°C, the VFD shall automatically reduce its carrier frequency to reduce the heat sink temperature. If the temperature of the

heat sink continues to rise the VFD shall automatically reduce its output frequency to the motor. As the VFD's heat sink temperature returns to normal, the VFD shall automatically increase the output frequency to the motor and return the carrier frequency to its normal switching speed.

.23 The VFD shall have temperature controlled cooling fans for quiet operation and minimized losses. At low loads or low ambients the fans may be off even when the drive is running.

.24 The VFD shall store in memory the last 10 faults and related operational data.

.25 Eight programmable digital inputs shall be provided for interfacing with the systems control and safety interlock circuitry.

.26 Two programmable relay outputs, one Form C 240 V AC, one Form A 30 V AC, shall be provided for remote indication of VFD status.

.27 Three programmable analog inputs shall be provided and shall accept a direct-or-reverse acting signal. Analog reference inputs accepted shall include two voltage (0 to 10 V DC, 2 to 10 V DC) and one current (0 to 20 mA, 4 to 20 mA) input.

.28 Two programmable 0 to 20 mA analog outputs shall be provided for indication of VFD status. These outputs shall be programmable for output speed, frequency, current and power. They shall also be programmable to provide a selected 24 V DC status indication.

.29 Standard programmable firefighter's override mode allows a digital input to control the drive and override all other local or remote commands and ignoring most normal drive safety circuits.

.1 If equipped with bypass, the VFD may be programmed to switch to bypass immediately or only if the drive fails. The VFD's keypad shall display FIREMODE whenever in firefighter's override mode, even when running in bypass.

.30 A real-time clock shall be available, mounted in the drive, displaying through the keypad. The clock shall not require a battery, eliminating the need for battery replacement. Twenty programmable time periods, with individually selectable ON and OFF functions shall be available. All drive faults shall be time stamped to aid troubleshooting.

2.5 ADJUSTMENTS

.1 The VFD shall have an adjustable carrier frequency in steps of not less than 0.1 kHz to allow tuning the VFD to the motor.

.2 Sixteen preset speeds shall be provided.

.3 Four acceleration and four deceleration ramps shall be provided. Acceleration and deceleration time shall be adjustable over the range from 0 to 3,600 seconds to base speed. The shape of these curves shall be automatically contoured to ensure no-trip acceleration and deceleration.

.4 Four current limit settings shall be provided.

.5 If the VFD trips on one of the following conditions, the VFD shall be programmable for automatic or manual reset:

.1 Undervoltage

.2 Overvoltage

.3 current limit

.4 inverter overload

.6 The number of restart attempts shall be selectable from 0 through 20 or infinitely and the time between attempts shall be adjustable from 0 through 600 seconds.

.7 An automatic “on delay” may be selected from 0 to 120 seconds.

2.6 BYPASS

.1 Provide an optional, manual 3-contactor bypass consisting of a door interlocked main fused disconnect padlockable in the off position, a built-in motor starter and a four position DRIVE/OFF/BYPASS/TEST switch controlling three contactors.

.1 In the DRIVE position, the motor is operated at an adjustable speed from the VFD.

.2 In the OFF position, the motor and VFD are disconnected.

.3 In the BYPASS position, the motor is operated at full speed from the AC power line and power is disconnected from the VFD so that service can be performed.

.4 In the TEST position, the motor is operated at full speed from the AC line power while power is applied to the input of the VFD. This allows the VFD to be given an operational test while continuing to run the motor at full speed in bypass.

.5 In case of an external safety fault, a normally closed dry contact shall be able to stop the motor whether in DRIVE or BYPASS mode.

.2 Service personnel shall be able to defeat the main power disconnect and open the bypass enclosure without disconnecting power. This shall be accomplished through the use of a specially designed tool and mechanism while meeting all local and national code requirements for safety.

2.7 OTHER

.1 Elevation to 3,300 feet without derating.

.2 AC line voltage variation, -10 to +10% of nominal with full output.

.3 No side clearance shall be required for cooling of any units. All power and control wiring shall be done from the bottom.

2.8 SPECIAL FEATURES

.1 The following special features shall be included in the VFD enclosure, and shall not effect the CSA rating of the drive:

.1 A manual bypass shall provide all the circuitry necessary to transfer the motor from the VFD to the power line, or from the line to the controller. The bypass

circuitry shall be mounted in a separate section of the VFD enclosure. Motor overload protection shall be provided in both drive and bypass modes.

.2 A door interlocked, pad lockable drive disconnect switch shall be provided to disconnect power from the VFD only.

.3 A second fused disconnect switch or circuit breaker shall be provided as a means of disconnecting all power to both the VFD and bypass circuits, as well as providing short circuit and locked rotor protection to the motor while in the bypass mode.

.4 The disconnect and bypass functions may be accomplished via disconnects, capacitors, and overloads, or with a four position DRIVE/OFF/LINE/TEST switch with motor starter and bypass fuses.

.2 Line Reactors:

.1 All VFDs to include input line reactors.

.2 All VFDs to include output load reactors.

Part 3 EXECUTION

3.1 INSTALLATION

.1 Coordinate with all trades for proper installation and operation of the Variable Frequency Drive.

.2 Coordinate with all other sub-trades for proper controls and interlocks with the Variable Frequency Drive.

.3 The VFD is to be covered and protected from installation dust and contamination until the environment is cleaned and ready for operation.

.1 The VFD shall not be operated while the unit is covered.

.4 The Contractor to verify that job site conditions for installation meet factory recommended and code required conditions for VFD installation prior to start-up. These shall include, but are not limited to:

.1 Clearance spacing.

.2 Temperature, contamination, dust, and moisture of the environment.

.3 Separate conduit installation of the motor wiring, power wiring, and control wiring.

.4 Installation per the manufacturer’s recommendations.

.5 The ground bus shall be connected to the building ground system by Division 16.

3.2 START-UP SERVICE

.1 The manufacturer shall provide start-up commissioning of the VFD and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. Sales personnel and other agents who are not factory certified shall not be

acceptable as commissioning agents. Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system.

.2 Start-up services shall include checking for verification of proper operation and installation of the VFD, its options, and its interface wiring to the building automation system. This service shall include, but is not limited to:

.1 Verification of wire terminations to the VFD and associated devices.

.2 Installation verification for proper operation and reliability of the VFD, the motor being driven, and the building automation system.

.3 Up to one hour of customer operator training on operation and service diagnostics.

.4 Measurement for verification of proper operation on each of the following items:

.1 Motor voltage and frequency. Verification of proper motor operation.

.2 Control input for proper building automation system interface and control calibration.

.3 Calibration check, and adjustments as necessary, for the following set points:

.1 Minimum speed.

.2 Maximum speed.

.3 Acceleration and deceleration rates.

3.3 COMMISSIONING

.1 Refer to Section 25 08 20 - EMCS: Warranty and Maintenance.

END OF SECTION

Part 1 GENERAL

1.1 General

.1 The control sequences contain a general description of the intent of the operation of the systems to be controlled. The Contractor shall review individual systems to ensure equipment and life safety interlocks are not overridden.

.2 The relationships between the points, systems and building are described in the control sequences.

.3 Consult with the Consultant during the shop drawing stage to finalize the control sequences for each system.

.4 All set-points noted herein are to be operator adjustable.

.5 The Division 25 Contractor is responsible to ensure all equipment tie-in points are provided by the equipment manufacturers.

Part 2 PRODUCTS

2.1 Not used

.1 Not used

Part 3 EXECUTION

3.1 General

.1 Provide data base for all hardware points listed for system operation to meet specification operating sequences.

.2 Where future provision for future points is noted, provide for connection of hardware to panels such that no additional hardware interface devices will be required within the panels. Software, including set-up and programming sequences, need not be provided at this time.

Part 4 CONTROL SEQUENCES AND POINTS LISTS

4.1 Pumps P-1A, P-1B, P-2A, P-2B, P-3A, and P-3b

.1 Sequence

.1 Pumps P-1A, P-1B, P-2A, P-2B, P-3A and P-3B are each controlled by their own control unit.

.2 P-1A, P-1B, P-2A, P-2B, P-3A and P-3B are each rated at 100% of the required design capacity each and are normally activated via the building automation system and a lead/lag algorithm.

.1 When the system is energized either manually or by a time-clock function within the EMCS, the system shall be energized.

.3 In conjunction with the facility Operator, program a timed start/stop sequence to energize the system. Allow manual override (on and off) onto the EMCS screen graphics.

.4 Each group of pumps shall operate as primary standby with an operator adjustable timed schedule for operation.

.2 Points List

.1 The following points, as a minimum, shall be provided associated with the heating system. Each point shall also be shown on the heating system BMS system graphic.

.1	System Start/Stop	Pseudo point
.2	Lead Pump	Pseudo Point
.3	System Pressure Set Point	Pseudo Point
.4	System Pressure Sensor	AI
.5	P-1A Start-Stop	DO
.6	P-1A Speed Control	AO
.7	P-1A Speed Feedback	AI
.8	P-1A Status Alarm	DI
.9	P-1B Start-Stop	DO
.10	P-1B Speed Control	AO
.11	P-1B Speed Feedback	AI
.12	P-1B Status Alarm	DI
.13	P-2A Start-Stop	DO
.14	P-2A Speed Control	AO
.15	P-2A Speed Feedback	AI
.16	P-2A Status Alarm	DI
.17	P-2B Start-Stop	DO
.18	P-2B Speed Control	AO
.19	P-2B Speed Feedback	AI
.20	P-2B Status Alarm	DI
.21	P-3A Start-Stop	DO
.22	P-3A Speed Control	AO
.23	P-3A Speed Feedback	AI
.24	P-3A Status Alarm	DI
.25	P-3B Start-Stop	DO
.26	P-3B Speed Control	AO
.27	P-3B Speed Feedback	AI
.28	P-3B Status Alarm	DI
.29	P-1A suction side temperature	AI
.30	P-1A suction side water flow	AI
.31	P-1B suction side temperature	AI
.32	P-1B suction side water flow	AI
.33	HE-1 water inlet temperature	AI

.34	HE-1 water outlet temperature	AI
.35	HE-1 Heating water inlet temperature	AI
.36	HE-1 Heating water outlet temperature	AI
.37	MUA-1 water return temperature	AI
.38	MUA-1 3 way valve operator command	Pseudo Point
.39	HE-1 3 way valve	DO
.40	P-2A suction side temperature	AI
.41	P-2A suction side water flow	AI
.42	P-2B suction side temperature	AI
.43	P-2B suction side water flow	AI
.44	Chilled water return water temperature	AI
.45	Chilled water return water flow	AI
.46	Chilled water supply temperature	AI
.47	Chilled water supply water flow	AI
.48	HE-2 chilled water inlet temperature	AI
.49	HE-2 chilled water outlet temperature	AI
.50	HE-2 chilled water inlet temperature	AI
.51	HE-2 chilled water outlet temperature	AI
.52	MUA-2 water return temperature	AI
.53	MUA-2 3 way valve operator command	Pseudo Point
.54	HE-2 3 way valve	DO
.55	P-3A suction side temperature	AI
.56	P-3A suction side water flow	AI
.57	P-3B suction side temperature	AI
.58	P-3B suction side water flow	AI
.59	HE-3 water inlet temperature	AI
.60	HE-3 water outlet temperature	AI
.61	HE-3 Heating water inlet temperature	AI
.62	HE-3 Heating water outlet temperature	AI
.63	MUA-3 water return temperature	AI
.64	MUA-3 3 way valve operator command	Pseudo Point
.65	HE-3 3 way valve	DO

4.2 UNIT HEATERS AND FORCE FLOWS

.1 The wall mounted electric thermostat complete with tamper-proof cover shall cycle the fan motor on a drop in space temperature.

.2 No connections to the BMS are required from any unit heater or force flow.

4.3 GAS FIRED RADIANT HEATERS

.3 The surface mounted electric thermostat complete with tamper-proof cover shall cycle the burners on a drop in space temperature.

.4 No connections to the BMS are required from any unit heater or force flow.

4.4 BASEBOARD RADIATION AND RADIANT PANELS

.1 Thermostat shall modulate two-way normally open heating control valve. Valves shall be of the fail-last-position type.

.2 Where baseboard radiation and radiant panels are associated with VAV boxes, the reheat valves shall be sequenced with the variable volume terminal units.

.3 Points List: The following points, as a minimum, shall be provided associated with each section of baseboard radiation or radiant panel. Each point shall also be shown on an individual system graphic.

.1	Room temperature sensor reading	AI.TR
.2	Room temperature set-point	PP
.3	Valve set-point	AO.VM

4.5 REHEAT COILS

.1 Thermostat shall modulate two-way normally open heating control valve. Valves shall be of the fail-last-position type.

.2 Where reheat coils are associated with VAV boxes, the reheat valves shall be sequenced with the variable volume terminal units.

.3 Reheat Coil Points List : The following points, as a minimum, shall be provided associated with each non-VAV box associated reheat coil. Each point shall also be shown on an individual reheat coil system graphic.

.1	Room temperature sensor reading	AI
.2	Room temperature set-point	Pseudo Point
.3	Reheat valve set-point	AO

4.6 BASEBOARD RADIATION AND RADIANT PANELS

.4 Thermostat shall modulate two-way normally open heating control valve. Valves shall be of the fail-last-position type.

.5 Where baseboard radiation and radiant panels are associated with VAV boxes, the reheat valves shall be sequenced with the variable volume terminal units.

.6 Points List : The following points, as a minimum, shall be provided associated with each section of baseboard radiation or radiant panel. Each point shall also be shown on an individual system graphic.

.1	Room temperature sensor reading	AI

.2	Room temperature set-point	Pseudo Point
.3	Valve set-point	AO

4.7 REHEAT COILS

.7 Thermostat shall modulate two-way normally open heating control valve. Valves shall be of the fail-last-position type.

.8 Where reheat coils are associated with VAV boxes, the reheat valves shall be sequenced with the variable volume terminal units.

.9 Reheat Coil Points List : The following points, as a minimum, shall be provided associated with each non-VAV box associated reheat coil. Each point shall also be shown on an individual reheat coil system graphic.

.1	Room temperature sensor reading	AI
.2	Room temperature set-point	Pseudo Point
.3	Reheat valve set-point	AO

4.8 AIR HANDLING UNITS AHU-1

.1 Day/Night Modes

.1 The system will provide day/night temperature set-point capability for each zone, with manual override at zone level.

.2 System Start/Stop

.1 The air handling units will normally be energized via the BMS.

.2 The supply air isolation dampers shall be opened first.

.3 Once the end switches have proven open, the return fan shall be energized.

.4 After a 30 second time delay, the mix air dampers shall be energized and opened to their minimum position.

.5 This will be followed by supply fan energization.

.6 On system shut-down, after both supply fan and return fan are de-energized, and after a suitable time delay, the supply air isolation dampers shall be de-energized.

.3 Minimum Outdoor Damper Position

.1 The minimum outdoor damper position will be set by using calculation method to ensure minimum outdoor air is brought in. Outdoor air quantity will be computed by using the return air temperature, outdoor air temperature and mix air temperature. Computations will be carried out at the same sampling interval as the mix and return air temperature sampling interval. Outdoor air damper position will be reset to ensure minimum outdoor air is brought in.

.2 Minimum outdoor air amount is to be initially set to 20% of supply air quantity.

.4 Freeze Stats

.1 Provide averaging type freeze stat. Upon sensing a low temperature, the supply fan shall stop, and all outdoor and exhaust air dampers shall close. The return fan shall remain energized. The freeze stat must be reset manually.

.5 Mix Air Control

.1 Mix air dampers position shall be optimized by computing the enthalpy of outdoor air and return air.

.6 Purge and Warm-Up modes

.1 Purge and warm-up mode shall be energized 60 minutes before normal occupancy on occupied week-days.

.2 Cooling Purge Mode

.1 If the temperature detected at more than five VAV box thermostats exceeds 24°C (operator adjustable), the air handling unit will be placed on a building purge mode.

.1 Set mix air set point at 5°C

.2 Set supply air temperature set-point at 18°C

.3 De-energize cooling coil

.4 Allow all variable air volume boxes to full open position

.5 Energize all washroom and general exhaust fans

.3 Morning Warm-Up Mode

.1 If the temperature detected at more than five VAV box thermostats is less than 21°C (operator adjustable), the air handling unit will be placed on a building warm-up mode.

.2 In this mode, system will operate at 100% recirculation; air handling unit coils will modulate to maintain a supply temperature of 21°C. All variable air volume boxes will be allowed to open fully. Radiation valves and reheat coil valves will modulate open to maintain space temperature set point.

.7 Variable Air Flow Volume Control

.1 High static pressure sensors shall be provided in medium pressure duct supply mains, and when activated shall control the maximum air volume of the supply fans through the supply fan variable frequency drive controller.

.1 Duct static pressure sensors shall be located as follows:

.1 Main floor above room 101B.

.2 The supply fan speed shall be controlled to maintain a minimum constant static pressure set point at any one of the remote supply duct location.

.2 The return fan shall be modulated to maintain a constant air flow differential between the supply fan and the return fan. This differential shall be set up in a software table of a minimum of 20 steps. Air balancer shall be used to calibrate constant air flow differential.

.3 The fans shall stay on minimum speed and shall gradually modulate to their final control position. Ramping shall be provided to minimize cycling during start-up.

.4 On operation of the freeze stat and provided the supply fan stops with the return fan left running, the return fan speed shall be returned to a minimum position to provide some return air through the system. When the supply fan starts, the return fan inlet speed shall return to automatic control.

.8 AHU-1 Points List : The following points, as a minimum, shall be provided associated with the air handling unit. Each point shall also be shown on the AHU BMS system graphic.

.1	Supply fan Start/Stop	DO.VFD
.2	Supply fan status	DI.IR
.3	Supply fan speed set-point	AO.VFD
.4	Supply fan speed	AI.VFD
.5	Supply Fan VFD Alarm	DI.VFD
.6	Supply air temperature	AI.TDA
.7	Supply air temperature set-point PP or	AO.ZX
.8	Return air temperature	AI.TDA
.9	Mixed air temperature	AI.TDA
.10	Supply air humidity	AI.HD
.11	Return air humidity	AI.HD
.12	Humidity set-point	PP or AO.ZX
.13	Outdoor Air Damper	AO.DM
.14	Relief Damper	AO.DM
.15	Return Damper	AO.DM
.16	Minimum Outdoor Air Percentage	Pseudo Point

.17	Supply air pressure	AI.PA

4.9 AIR HANDLING UNITS MUA-1 and MUA-2

.1 Air Handling Unit MUA-1 is to come with its own control panel. Wire control panel and interface with the BMS as noted below.

.2 Day/Night Modes

.1 The system will provide day/night temperature set-point capability.

.3 System Start/Stop

.1 The air handling units will normally be operating 100% of the time.

.4 Freeze Stats

.1 Provide averaging type freeze stat in each air handling unit at location indicated. Upon sensing a low temperature, the supply fan shall stop, and all outdoor and exhaust air dampers shall close. On units with return fans, the return fan shall remain energized. The freeze stat must be reset manually.

.5 MUA-1 Points List : The following points, as a minimum, shall be provided associated with the air handling unit. Each point shall also be shown on the AHU BMS system graphic.

.1	Supply fan Start/Stop	DO.VFD
.2	Supply fan status	DI.IR
.3	Supply fan speed set-point	AO.VFD
.4	Supply fan speed	AI.VFD
.5	Supply Fan VFD Alarm	DI.VFD
.6	Supply air temperature	AI.TDA
.7	Supply air temperature set-point	PP or AO.ZX
.8	Outdoor Air Damper	AO.DM
.9	Supply_air pressure	AI.PA

4.10 DIGITAL VAV BOX CONTROL

.1 A digital controller shall be provided for the control of each VAV box to maintain a set flow and provide auxiliary control of the reheat and/or associated radiation vales, to maintain overall control of the space temperature. The unit shall have stand-alone capability and also communicate with the BMS.

.2 One full cooling, damper shall be fully open. As cooling load drops, damper shall modulate to its minimum closed position.

.3 As heating load increases, reheat coil valve modulates from full closed to full open.

.4 On further increase in heating load, air volume shall increase to maximum heating position (initially to be set to 50% of the maximum cooling load volume).

.9 At the room sensor location a plug-in facility shall be provided to allow for connection of a hand-held module to allow for monitoring and loading new parameters. All the parameters shall also be able to be loaded/monitored at the digital VAV box controller and at the central operator station of the BMS.

.10 VAV Box Points List : The following points, as a minimum, shall be provided associated with each VAV Box. Each point shall also be shown on the a BMS system graphic, one graphic per VAV box.

.1	Room Temperature	AI.TR
.2	Air Volume	AI.VAV
.3	Minimum Volume Setting	Pseudo Point
.4	Maximum Volume Setting	Pseudo Point
.5	Maximum Heating Volume Setting	Pseudo Point
.6	Room Temperature Set Point	Pseudo Point
.7	Day/Night Mode	Pseudo Point
.8	Heating Valve Position	AO.VM
.9	Damper Operator Position	AO.DM

.11 A room sensor input, with local reset, and a velocity pressure transmitter shall provide the basic inputs, with an electronic motor to operate the air valve as an output.

.12 The digital controller shall be supplied by the controls contractor and mounted on site.

.13 Normal day settings are 21°C for heating and 24°C for cooling.

.14 Day/night mode selection is through BMS. In the night mode set-point is setback to 13°C and set-up to 29°C. A manual override switch is provided at the sensor.

4.11 DIGITAL FAN POWERED VAV BOX CONTROL

.15 A digital controller shall be provided for the control of each fan powered VAV box to maintain a set flow and provide auxiliary control of the reheat and/or associated radiation vales, to maintain overall control of the space temperature. The unit shall have stand-alone capability and also communicate with the BMS.

.1 One full cooling, damper shall be fully open. As cooling load drops, damper shall modulate to its minimum closed position.

.2 On a call for heating, the fan shall energize.

.3 As heating load increases, reheat coil valve modulates from full closed to full open.

.16 At the room sensor location a plug-in facility shall be provided to allow for connection of a hand-held module to allow for monitoring and loading new parameters. All the parameters shall also be able to be loaded/monitored at the digital VAV box controller and at the central operator station of the BMS.

.17 Fan Powered VAV Box Points List : The following points, as a minimum, shall be provided associated with each Fan Powered VAV Box. Each point shall also be shown on a BMS system graphic, one graphic per Fan Powered VAV box.

.1	Room Temperature	AI.TR
.2	Primary Air Volume	AI.VAV
.3	Minimum Primary Air Volume Setting	Pseudo Point
.4	Maximum Primary Air Volume Setting	Pseudo Point
.5	Room Temperature Set Point	Pseudo Point
.6	Day/Night Mode	Pseudo Point
.7	Heating Valve Position	AO.VM
.8	Damper Operator Position	AO.DM
.9	Fan Status	DI.VAV

.18 A room sensor input, with local reset, and a velocity pressure transmitter shall provide the basic inputs, with an electronic motor to operate the air valve as an output.

.19 The digital controller shall be supplied by the controls contractor and mounted on site.

.20 Normal day settings are 21°C for heating and 24°C for cooling.

.21 Day/night mode selection is through BMS. In the night mode set-point is setback to 13°C and setup to 29°C. A manual override switch is provided at the sensor.

4.12 EXHAUST FAN EF-01 – VEHICLE STORAGE CO EXHAUST FAN

.1 Exhaust fan shall run on when the Vehicle Storage Garage #128 carbon monoxide detector unit is in alarm.

.2 Unit shall operate continuously to maintain specified room exhaust capacity as noted on the mechanical drawings.

.3 EF-01 Points List: The following points, as a minimum, shall be provided associated with the exhaust fan. Each point shall also be shown on the Storage Garage CO Exhaust System BMS system graphic.

.1	Exhaust fan Start/Stop	DO
.2	Exhaust fan status	DI
.4	Exhaust fan speed set-point	AO
.5	Exhaust fan speed	AI

4.13 EXHAUST FAN EF-02 – WELDING BAY CO EXHAUST FAN

.1 Exhaust fan shall run when the Welding Bay #140 carbon monoxide detector unit is in alarm.

.2 Interlock the exhaust fan EF-2 operation with VAV damper 01-001 and MUA-2 operation.

.3 EF-02 Points List: The following points, as a minimum, shall be provided associated with the exhaust fan. Each point shall also be shown on the MUA-2 BMS system graphic.

.1	Exhaust fan Start/Stop	DO
.2	Exhaust fan status	DI
.4	Exhaust fan speed set-point	AO
.5	Exhaust fan speed	AI

4.14 EXHAUST FAN EF-03 – REPAIR GARAGE CO EXHAUST FAN

.1 Exhaust fan shall run on an operator adjustable schedule and when either MUA-2 is energized or when the Repair Garage #141 carbon monoxide detector unit is in alarm.

.2 Unit shall modulate via its VFD drive to maintain specified room exhaust capacity as noted on the mechanical drawings.

.3 Interlock the exhaust fan EF-3 operation with VAV damper 01-002 and MUA-2 operation.

.4 EF-03 Points List: The following points, as a minimum, shall be provided associated with the exhaust fan. Each point shall also be shown on the MUA-2 BMS system graphic.

.1	Exhaust fan Start/Stop	DO.VFD
.2	Exhaust fan status	DI.IR
.5	Exhaust fan speed set-point	AO.VFD
.6	Exhaust fan speed	AI.VFD
.7	Exhaust Fan VFD Alarm	DI.VFD
.8	Minimum Volume Setting	Pseudo Point
.9	Maximum Volume Setting	Pseudo Point

4.15 EXHAUST FAN EF-04 – CARPENTERS SHOP EXHAUST FAN

.1 Exhaust fan shall run on an operator adjustable schedule or when AHU-1 is energized.

.2 Unit shall modulate via its VFD drive to maintain specified room exhaust capacity as noted on the mechanical drawings.

.3 Interlock the exhaust fan EF-4 operation with VAV damper 02-001 and MUA-1 operation.

.4 EF-04 Points List: The following points, as a minimum, shall be provided associated with the exhaust fan. Each point shall also be shown on the MUA-2 BMS system graphic.

.1	Exhaust fan Start/Stop	DO.VFD
.2	Exhaust fan status	DI.IR
.5	Exhaust fan speed set-point	AO.VFD
.6	Exhaust fan speed	AI.VFD
.7	Exhaust Fan VFD Alarm	DI.VFD
.8	Minimum Volume Setting	Pseudo Point
.9	Maximum Volume Setting	Pseudo Point

4.16 EXHAUST FAN EF-05 – BATTERY ROOM EXHAUST FAN

.1 Provide a wall mounted switch to energize fan EF-05.

.2 There are no requirements to tie this fans to the BMS system.

4.17 EXHAUST FAN EF-06 – ELECTRICAL ROOM EXHAUST FAN

.1 Provide a wall mounted switch to energize fan EF-06.

.2 There are no requirements to tie this fans to the BMS system.

4.18 EXHAUST FAN EF-07 – ELECTRICAL SHOP EXHAUST FAN

.1 Exhaust fan shall run from an operator adjustable occupied/unoccupied schedule or upon activation of the units associated wall mounted switch.

.2 When the Electrical Shop #104 is occupied the exhaust fan shall run on the designed low speed set point. When the room exhaust fan switch is activated the fan shall energize to full design capacity.

.3 Interlock the exhaust fan EF-7 operation with VAV Fan Powered Terminal, FPT-1 and MUA-1 operation.

.4 EF-07 Points List: The following points, as a minimum, shall be provided associated with the exhaust fan. Each point shall also be shown on the MUA-1 BMS system graphic.

.1	Exhaust fan Start/Stop	DO
.2	Exhaust fan status	DI
.5	Exhaust fan speed set-point	AO
.6	Exhaust fan speed	AI

4.19 EXHAUST FAN EF-08 – PLUMBING SHOP EXHAUST FAN

.7 Exhaust fan shall run from an operator adjustable occupied/unoccupied schedule or upon activation of the units associated wall mounted switch.

.8 When the Plumbing Shop #105 is occupied the exhaust fan shall run on the designed low speed set point. When the room exhaust fan switch is activated the fan shall energize to full design capacity.

.9 Interlock the exhaust fan EF-8 operation with VAV Fan Powered Terminal, FPT-2 and MUA-1 operation.

.10 EF-08 Points List: The following points, as a minimum, shall be provided associated with the exhaust fan. Each point shall also be shown on the MUA-1 BMS system graphic.

.1	Exhaust fan Start/Stop	DO
.2	Exhaust fan status	DI
.11	Exhaust fan speed set-point	AO
.12	Exhaust fan speed	AI

4.20 EXHAUST FAN EF-09 – PAINT SHOP TABLE HOOD EXHAUST FAN

.13 Exhaust fan shall run from a wall mounted switch.

.14 When the Paint Shop #112 is occupied the exhaust fan shall run on the designed low speed set point. When the room exhaust fan switch is activated the fan shall energize to full design capacity.

.15 Interlock the exhaust fan EF-9 operation with VAV damper 02-004 and MUA-1 operation.

4.21

.16 EF-09 Points List: The following points, as a minimum, shall be provided associated with the exhaust fan. Each point shall also be shown on the MUA-1 BMS system graphic.

.1	Exhaust fan Start/Stop	DO
.2	Exhaust fan status	DI
.3	Exhaust fan speed set-point	AO
.4	Exhaust fan speed	AI

4.22 EXHAUST FAN EF-10 – PAINT SHOP HOOD EXHAUST FAN

.1 Exhaust fan shall run from a wall mounted switch.

.2 When the Paint Shop #112 is occupied the exhaust fan shall run on the designed low speed set point. When the room exhaust fan switch is activated the fan shall energize to full design capacity.

.3 Interlock the exhaust fan EF-9 operation with VAV damper 02-004 and MUA-1 operation.

.4 EF-010 Points List: The following points, as a minimum, shall be provided associated with the exhaust fan. Each point shall also be shown on the MUA-1 BMS system graphic.

.1	Exhaust fan Start/Stop	DO
.2	Exhaust fan status	DI
.3	Exhaust fan speed set-point	AO
.4	Exhaust fan speed	AI

4.23 CARBON MONOXIDE DETECTOR

.1 Carbon monoxide detector units to be BACNET with replaceable calibration cartridges.

.2 Upon detector detecting a high level of carbon monoxide the detector shall notify the building management system which shall energize the Make-up air units and associated exhaust fan system fan as specified.

.3 Upon a detection of normal carbon monoxide level the detector shall notify the building management system to de-energize the system to normal operational parameters.

.4 Provide a temperature sensor and a system timed override switch that can override the system to operate the monoxide extraction system for a pre-set

period of time in the event of a high room temperature or other conditions as required by occupants.

.5 Points list : the following points, as a minimum, shall be provided. each point shall also be shown on the heating system DDC system graphic.

.1	unit on/off	DO
.2	unit status	DI
.3	Alarm Status	DI

4.24 MISCELLANSUOUS SENSORS

.1 Provide the following miscellaneous monitoring points, as a minimum. Each point shall be shown on an individual system graphic.

.1	Outdoor Air Temperature	AI
.2	Outdoor Air Humidity	AI
.3	Room temperature sensor near SNAGS bay emergency shower	AI
.4	Room temperature sensor near POL storage emergency shower	AI

END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

.1 This Section covers items common to Sections of Division 26, 27, 28 (Electrical Divisions). This section supplements requirements of Division 1.

1.2 CODES AND STANDARDS

.1 Do complete installation in accordance with CSA C22.1 2002 except where specified otherwise.

.2 Do overhead and underground systems in accordance with CSA C22.3 No.1 M1987 except where specified otherwise.

1.3 CARE, OPERATION AND START UP

.1 Instruct operating personnel in the operation, care and maintenance of systems, system equipment and components.

.2 Arrange and pay for services of manufacturer's factory service engineer to supervise startup of installation, check, adjust, balance and calibrate components and instruct operating personnel.

.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

1.4 VOLTAGE RATINGS

.1 Operating voltages: to CAN3 C235 83.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.5 PERMITS, FEES AND INSPECTION

.1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.

.2 Pay associated fees.

.3 Notify Engineer of changes required by Electrical Inspection Department prior to making changes.

.4 Furnish Certificates of Acceptance from Electrical Inspection Department and authorities having jurisdiction on completion of work to Engineer.

1.6 MATERIALS AND EQUIPMENT

.1 Provide materials and equipment in accordance with Section 01 61 00 - Common Product Requirements.

.2 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department.

.3 Factory assemble control panels and component assemblies.

1.7 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

.1 Supplier and installer responsibility is indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.

.2 Control wiring and conduit is specified in Electrical Division except for conduit, wiring and connections below 50 V which are related to control systems specified in Mechanical Division and shown on mechanical drawings.

1.8 FINISHES

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

.2 Paint indoor switchboards and distribution enclosures light grey ASA 61.

.3 Clean and touch up surfaces of shop painted equipment scratched or marred during shipment or installation, to match original paint.

.4 Clean and prime exposed non galvanized hangers, racks and fastenings to prevent rusting.

1.9 EQUIPMENT IDENTIFICATION

.1 Identify electrical equipment with nameplates and labels as follows:

.2 Nameplates:

.1 Lamecoid 3 mm thick plastic engraving sheet, black, blue, or red face, white core, mechanically attached with self tapping screws.

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

.3 Labels:

.1 Embossed plastic labels with 6 mm high letters unless specified otherwise.

.4 Allow for average of twenty five (25) letters per nameplate and label.

.5 Identification to be English.

.6 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

.7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.8 Terminal cabinets and pull boxes: indicate system and voltage.

.9 Transformers: indicate capacity, primary and secondary voltages.

1.10 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour code: to CSA C22.1.

.4 Use colour coded wires in communication cables, matched throughout system.

1.11 CONDUIT AND CABLE IDENTIFICATION

.1 Colour code conduits, boxes and metallic sheathed cables.

.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

.3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	Prime	Auxiliary
up to 250 V	Yellow	

up to 600 V	Yellow	Green
600 V and up	Yellow	Red
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Other Security Systems	Red	Yellow

1.12 WIRING TERMINATIONS

.1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

1.13 MANUFACTURERS AND CSA LABELS

.1 Visible and legible, after equipment is installed.

1.14 WARNING SIGNS

.1 As specified and to meet requirements of Electrical Inspection Department and Consultant.

.2 Decal signs, minimum size 175 x 250 mm.

1.15 SINGLE LINE ELECTRICAL DIAGRAMS

.1 Provide fire alarm riser diagram, plan and zoning of building at main fire alarm control panel.

.2 Drawings: minimum size as per tender sets.

1.16 LOCATION OF OUTLETS

.1 Locate outlets in accordance with drawings and specifications.

.2 Do not install outlets back to back in wall; allow minimum 150 mm horizontal clearance between boxes.

.3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.

.4 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

1.17 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: 1200 mm.
.2 Wall receptacles:

1. General: 300 mm.
2. Above top of counters or counter splash backs: 175 mm.
3. In mechanical rooms: 1400 mm.

.3 Fire alarm stations: 1200 mm.
.4 Fire alarm horn/strobe: 2100 mm.

1.18 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 Submit, at completion of work, report listing phase and neutral currents on panelboards, dry core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

1.19 CONDUIT AND CABLE INSTALLATION

.1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: plastic, sized for free passage of conduit, and protruding 50 mm.

.2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

.3 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

1.20 FIELD QUALITY CONTROL

.1 All electrical work to be carried out by qualified, licensed electricians or apprentices as per the conditions of the Provincial Act respecting manpower vocational training and qualification. Employees registered in a provincial apprentices program shall be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks the activities permitted shall be determined based on the level of training attained and the demonstration of ability to perform specific duties.

.2 The work of this division to be carried out by a contractor who holds a valid Master Electrical contractor license as issued by the Province of Saskatchewan.

.3 Conduct and pay for following tests:

.1 Power distribution system including phasing, voltage, grounding and load balancing.
.2 Lighting and its control.
.3 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
.4 Systems: fire alarm system.

.4 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.

.1 Insulation resistance testing.
.2 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
.3 Megger 350 600 V circuits, feeders and equipment with a 1000 V instrument.
.4 Check resistance to ground before energizing.
.5 Carry out tests in presence of Consultant.

.5 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.6 Submit test results for Consultant’s review.

1.21 COORDINATION OF PROTECTIVE DEVICES

.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

.2 In order to ensure that all overcurrent devices throughout the entire electrical system are coordinated, a complete coordination study of all new devices shall be prepared. This study shall include all 208 volt devices for the building.

.3 The coordination study shall be prepared in conjunction with the successful manufacturers of the equipment specified in the following sections:

26 23 00 Low Voltage Switchboards

26 24 17 Panelboards Breaker Type

26 24 02 Service Entrance Board

26 28 21 Moulded Case Circuit Breakers

26 28 23 Disconnect Switches – Fused and Non-Fused

26 28 14 Fuses – Low Voltage

26 12 17 Dry Type Transformer up to 600V Primary

26 24 19 Motor Control Centres

The successful manufacturers of the above equipment shall provide all necessary technical information to facilitate the overcurrent coordination study.

.4 The coordination study shall be prepared by the switchgear manufacturer, Schneider Electric, Cutler Hammer, or General Electric. Third party service or engineering companies will not be accepted.

1.22 COORDINATION REQUIREMENTS

.1 The coordination study shall be submitted to the Consultant for approval prior to the fabrication of any of the above equipment and within two months of contract award. Progressing will not be permitted on any of the above noted equipment until the coordination study has been submitted, reviewed and approved.

.2 The coordination study shall include but not be limited to the following:

.1 Short Circuit Study showing symmetrical and asymmetrical fault currents at all major points in the system.
.2 Protective device detail information including a fact sheet or catalogue sheet on each device.
.3 Coordination Time - Current Graphs with no more than four (4) curves per sheet. Submission must clearly demonstrate coordination of devices. Blueprint drawings are not acceptable.

Single line diagram of entire system clearly showing all devices and cross-referenced to Coordination Time - Current Graphs. Where possible, the information shall be provided in latest AutoCAD format. Electronic files shall be included with submission.

.3 When the above noted equipment has been installed on site, test, clean and correctly calibrate all protective relays, meters and circuit breaker trip devices supplied under this Division. All devices shall be set according to the coordination study. This may include the resetting of some of the existing devices.

.4 Any faulty material and equipment shall be repaired or replaced by the contractor.

.5 Certification of the above tests shall be submitted to the Consultant for final approval prior to substantial completion.

.6 The coordination study and test report shall be similar in presentation to the operating instruction and service manuals.

1.23 AS-BUILT DRAWINGS

.1 The electrical contractor shall provide as-built drawings in both electronic and hard copy formats. Maintain, on a daily basis, a complete set of marked-up white prints as record drawings that show in complete detail the final arrangement and location of all electrical components and the interconnecting wiring. These are to be maintained in a neat and substantial manner so as to properly and fully illustrate the way in which the installation has been completed.

.2 The record drawings will be reviewed by the Consultant. Final submission of As-built Drawings shall be provided by the contractor in the form of AutoCAD drawings complete with all architectural changes incorporated into the base plans. The submission of record drawings shall include DVD disc containing the AutoCAD drawing files as well as a hard set of paper plots.

.3 The AutoCAD record drawings shall follow stringent AutoCAD guidelines and the layering format for this project. All as-built drawings shall include all electrical installation revisions from tender drawings and all addendum items. As-built drawings shall also include full size drawings containing all updated panel schematics.

.4 In addition to the requirement for an over current coordination study, a full Arc Fault study shall be completed as well. All devices and busses shall be provided with lamecoid labels denoting the relevant information relating to the arc fault hazard present. Refer to specifications on specific requirements for lamecoid labels.

.5 Coordination Time - Current Graphs with no more than four (4) curves per sheet. Submission must clearly demonstrate coordination of devices.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for wire and box connectors.

1.2 RELATED SECTIONS

.1 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International) (Latest Editions)

.1 CAN/CSA C22.2No.18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
.2 CSA C22.2No.65, Wire Connectors.

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

.1 EEMAC 1Y 2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

.3 National Electrical Manufacturers Association (NEMA)

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Meet requirements of Section 01 74 19 - Waste Management and Disposal.

.2 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

Part 2 Products

2.1 MATERIALS

.1 Pressure type wire connectors: with current carrying parts of copper sized to fit copper conductors as required.

.2 Fixture type splicing connectors: with current carrying parts of copper sized to fit copper conductors #10 AWG or less.

.3 Bushing stud connectors: to EEMAC 1Y 2 to consist of:

.1 Connector body and stud clamp for round copper conductors.
.2 Clamp for round copper conductors.
.3 Stud clamp bolts.
.4 Sized for conductors as indicated.

.4 Clamps or connectors for armoured cable, aluminum sheathed cable, mineral insulated cable, flexible conduit, non-metallic sheathed cable as required.

Part 3 Execution

3.1 INSTALLATION

.1 Remove insulation carefully from ends of conductors and:

.1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
.2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2No.65.
.3 Install fixture type connectors and tighten. Replace insulating cap.
.4 Install bushing stud connectors in accordance with NEMA.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 20 Wire and Box Connectors 0-1000V.

1.2 REFERENCES

.1 CSA C22.2 No .0.3 96, Test Methods for Electrical Wires and Cables.

.2 CAN/CSA C22.2 No. 131 M89(R1994), Type TECK 90 Cable.

1.3 PRODUCT DATA

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

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Meet requirements of Section 01 74 19 - Waste Management and Disposal.

.2 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

Part 2 Products

2.1 BUILDING WIRES

.1 All conductors shall be copper, minimum No. 12 gauge, 75 degrees C unless specifically noted otherwise.

.2 All conductors # 12 AWG to # 8 AWG shall be rated for minimum 600V RW-90 XLPE. Conductors # 6 AWG and larger shall be rated for minimum 1000V RW-90 XLPE. All conductor for motor feeds from variable frequency drives, shall be rated for minimum 1000V RW-90 XLPE. Wiring in channel back of fluorescent fixtures shall be 600 volt Type GTF or TEW. Size, grade of insulation, voltage and manufacturer's name shall be marked at regular intervals.

.3 Wiring for major feeders may be NUAL aluminum and shall be installed only where specifically noted on the drawings.

.4 Conductor utilized in conduit run under slab on grade or in conduit underground shall be Type 'RWU-90’.

.5 Wire shall be as manufactured by Nexans, Alcan, Pirelli, BICC General Wire or Superior Essex.

2.2 TECK CABLE

.1 Cable: to CAN/CSA C22.2 No. 131.

.2 Conductors:

.1 Grounding conductor: copper.
.2 Circuit conductors: copper, size as indicated.

.3 Insulation:

.1 Chemically cross linked thermosetting polyethylene rated type RW90, 600V to 1000V as noted above.

.4 Fastenings:

.1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
.2 Channel type supports for two or more cables.
.3 Threaded rods: 6 mm dia. to support suspended channels.

.5 Connectors:

.1 Watertight approved for TECK cable.

2.3 MINERAL INSULATED CABLES

.1 Conductors: solid bare soft annealed copper, size as indicated.

.2 Insulation: compressed powdered magnesium oxide to form compact homogeneous mass throughout entire length of cable.

.3 Two hour fire rating.

Part 3 Execution

3.1 INSTALLATION OF BUILDING WIRES

.1 Termination for #8 AWG and larger shall be by means of approved solderless connector lug. For parallel conductors, a common lug with separate termination for each conductor shall be employed.

.2 Conductor splices shall be made in accordance with specifications. Provide sufficient length for joint remake, and no less than 200 mm spare length. On through wiring, leave 300 mm loop.

.3 Wiring in cabinets, pull boxes, panels and junction boxes shall be neatly trained and held with nylon cable ties.

.4 Conductors shall be tag identified where passing through junction boxes.

3.2 INSTALLATION OF TECK CABLE 0 1000 V

.1 Install cables.

.1 Group cables wherever possible on channels.

.2 Terminate cables in accordance with Section 26 05 20 Wire and Box Connectors 0-1000V.

.3 All cables shall be terminated and spliced with suitable compression type connectors, as recommended by the cable manufacturer. The connectors shall satisfy the bonding and grounding requirements at the supply end.

.4 All cables shall be single conductor and copper, unless otherwise specified.

.5 All cable shall be rated for 1000 volts, insulated with cross-linked polyethylene and rated for operation at 75 degrees C. Cable shall have a FT6 rated outer jacket.

.6 All cable shall meet the CSA requirements for cold bend and impact testing at minus 40 degrees C.

.7 All cable shall be protected by a corrugated aluminum sheath or by interlocked aluminum armour. PVC jackets shall be required on all metallic sheathed cables.

.8 The jackets shall meet the FT6 flame spread requirements and be identified on the P.V.C. jacket.

.9 All cables shall be installed in accordance with the manufacturers recommendations, in suitable cable tray as specified within the specifications.

.10 The cables shall be terminated at the supply end on a non-ferrous metallic plate and at the load end on a non-metallic rigid fibre board plate. The cable sheaths shall be bonded at the supply end only.

.11 All cable installed in cable tray shall be installed at one diameter spacing.

.12 When single conductor cables are direct earth buried they shall be spaced 150 mm apart.

.13 Cables shall be manufactured by Nexans, Alcan, Superior Essex, General Wire or Pirelli.

3.3 INSTALLATION OF ARMOURED CABLES

.1 Group cables wherever possible.

.2 Terminate cables in accordance with Section 26 05 20 Wire and Box Connectors 0 1000 V.

.3 Conductors: insulated, copper, size as indicated.

.4 Type: AC90 - Armour: interlocking type fabricated from aluminum strip.

.5 Type: ACWU90 jacket over armour meeting requirements of Vertical Tray Fire Test of CSA C22.2 No. 0.3 with maximum flame travel of 1.2 m.

.6 Connectors: as required.

.7 Multi conductor cables shall be color coded during manufacture. Single conductor cables shall be color coded with adhesive colour coding tape. The tape shall be applied for a minimum of 75 mm at all terminations. Cables shall not be painted under any condition. Color coding shall be as follows:

Phase 'A' - RedNeutral - White
Phase 'B' - BlackGround - Green or Bare
Phase 'C' - Blue

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

.2 Section 26 05 01 - Common Work Results - Electrical.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)

.1 ANSI/IEEE 837 1989 (R1996), Qualifying Permanent Connections Used in Substation Grounding.

.2 Canadian Standards Association, (CSA International)

.3 CAN/CSA Z32 1999, Electrical Safety and Essential Electrical Systems in Health Care Facilities.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Meet requirements of Section 01 74 19 - Waste Management and Disposal.

.2 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

Part 2 Products

2.1 EQUIPMENT

.1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.

.2 All ground rods shall be 20 mm diameter by 3000 mm long, copper clad.

.3 Grounding conductors: bare stranded copper.

.4 Insulated grounding conductors: green

.5 Ground bus: copper, complete with insulated supports, fastenings, connectors.

.6 Non corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:

.1 Grounding and bonding bushings.
.2 Protective type clamps.

.3 Bolted type conductor connectors.
.4 Thermit welded type conductor connectors.
.5 Bonding jumpers, straps.
.6 Pressure wire connectors.

.7 All ground conductors shall be bare or insulated, stranded, medium hard drawn copper wire. All insulated ground wires shall be green.

.8 Exposed copper shall be cleaned to a bright surface, and shall be finished with two coats of clean, insulating varnish.

.9 Connect ground conductor to copper water pipe at least twice (minimum 40 mm diameter), utilizing a Burndy Type GAR pipe clamp. Provide jumper across water meter.

.10 All connections to the ground bus or risers shall be thermowelded, or shall utilize the Burndy Hy-Ground compression connections. Clamp type connections shall only be allowed to individual pieces of equipment.

.11 Where bonds are covered with soil, the conductors are to be coated with anti-corrosion compound "Kopr-Shield" (Thomas & Betts Co.) before compression connector is applied. All bonding shall be done with 'C' tap and lug compression connectors.

Part 3 Execution

3.1 INSTALLATION GENERAL

.1 Electrical equipment and wiring shall be grounded in accordance with the Canadian Electrical Code, and local inspection authority's rules and regulations.

.2 Provide a complete building grounding network and separate isolated equipment grounding network. The main busses shall be AWG #3/0 bare copper conductor. Copper clad ground rods shall be installed adjacent to the building and where shown on the drawings and connected to the ground busses with AWG #3/0 bare copper conductor.

.3 All metallic raceways and conduits for communications, cable and conductors shall be grounded.

.4 All motors with flexible connections shall have separate ground wire run bridging the flexible connections. This ground wire shall be run from the motor back to the nearest junction box or motor control centre where the termination can be readily inspected. Insulation for this wire shall be green.

.5 Lay-in trays and feeder conduits shall be connected to the ground bus.

.6 All 347/600 volt wiring shall be run in rigid conduit, or may be run in EMT if a separate ground wire is run from the panel or switch to each piece of equipment. The ground conductor shall be connected to the housing of each piece of equipment and the outlet box. Where rigid conduit is employed, all terminations of these conduit runs are to be with double locknuts, grounding bushings with jumper wires run between the bushing lug

and the box or panel enclosure. Care shall be taken in conduit runs to ensure that all rigid pipe couplings and fittings are wrench tight.

.7 All panel feeds at 600 volt and 208 volt shall include a building network ground conductor.

.8 All grounding conductors outside the electrical rooms and closets shall be insulated and installed in conduits, unless otherwise noted.

.9 Install connectors in accordance with manufacturer's instructions.

.10 Protect exposed grounding conductors from mechanical injury.

.11 Use mechanical connectors for grounding connections to equipment provided with lugs.

.12 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

.13 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

.14 Structural steel and metal siding to ground by welding copper to steel.

.15 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections unless indicated otherwise.

.16 Make buried connections using copper welding by thermit process, and connections to conductive water main, electrodes, using permanent mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837.

.17 Use mechanical connectors for grounding connections to equipment provided with lugs.

.18 Soldered joints not permitted.

.19 Install separate ground conductor to outdoor lighting standards.

.20 Make grounding connections in radial configuration only. Avoid loop connections.

.21 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non metallic entry plate at load end.

.22 Ground secondary service pedestals.

3.2 ELECTRODES

.1 Make ground connections to continuously conductive underground water pipe on street side of water meter.

.2 Install water meter shunt.

.3 Bond separate, multiple electrodes together.

.4 Use size #3/0 AWG copper conductors for connections to electrodes.

.5 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

3.3 SYSTEM AND CIRCUIT GROUNDING

.1 Install system and circuit grounding connections to neutral of secondary systems.

3.4 EQUIPMENT GROUNDING

.1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, duct systems, frames of motors, starters, control panels, structure steel work, and distribution panels.

3.5 GROUNDING BUS

.1 Install copper grounding bus mounted on insulated supports on wall of electrical room.

.2 The ground bus in each switchboard, motor control centre, etc., shall be connected to the grounding network by two AWG #3/0 bare copper conductors.

.3 All non-current carrying metallic parts of equipment in electrical rooms shall have a direct #3/0 copper connection run to the ground bus in each.

.4 All non-current carrying metallic parts of equipment electrical rooms and mechanical equipment rooms shall have a direct copper connection run to the ground bus in each. Minimum size shall be AWG #3/0. Increase size where required by the Canadian Electrical Code. Most of these rooms will have motor control centres or electrical distribution centres that will be equipped with ground buses that can be utilized for terminations.

3.6 COMMUNICATION SYSTEMS

.1 Install grounding connections for telephone, fire alarm, Data systems as follows:

.1 Telephones: make telephone grounding system in accordance with SaskTel's requirements.

.2 Fire alarm, Data systems as indicated and as recommended by system manufacturer.

3.7 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Perform tests before energizing electrical system.

.3 Disconnect ground fault indicator during tests.

.4 All grounding conductors outside the electrical rooms and closets shall be insulated and installed in conduits, unless otherwise noted.

.5 Connections to neutral points and equipment shall be made with thermowelds or brass, bronze or copper bolts and connectors.

.6 Equipment grounds and transformer system grounds shall be connected to the building grounding network. All non-current carrying metallic parts of equipment shall be connected to the ground network.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Meet requirements of Section 01 74 19 - Waste Management and Disposal.

.2 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

Part 2 Products

2.1 SUPPORT CHANNELS

.1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted suspended or set in poured concrete walls and ceilings.

Part 3 Execution

3.1 INSTALLATION

.1 Secure equipment to poured concrete with expandable inserts.

.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 50 mm and smaller.
.2 Two hole steel straps for conduits and cables larger than 50 mm.
.3 Beam clamps to secure conduit to exposed steel work.

.6 Suspended support systems.

.1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
.2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.

.7 For surface mounting of two or more conduits, use channels spaced as required by C22.1.

.8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.10 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Engineer.

.12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data for cabinets in accordance with Section 01 33 00 Submittal Procedures.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Meet requirements of Section 01 74 19 - Waste Management and Disposal.

.2 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

Part 2 Products

2.1 SPLITTERS

.1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.

.3 At least three spare terminals on each set of lugs in splitters.

2.2 JUNCTION AND PULL BOXES

.1 Welded steel construction with screw on flat covers for surface mounting.

.2 Covers with 25 mm minimum extension all around, for flush mounted pull and junction boxes.

2.3 CABINETS

.1 Sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.

Part 3 Execution

3.1 SPLITTER INSTALLATION

.1 Install splitters and mount plumb, true and square to the 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.

.3 Install terminal / bix block where indicated in cabinets.

.4 Only main junction and pull boxes are indicated. Provide others as required by code. Install pull boxes so as not to exceed 30m of conduit run between pull boxes.

3.3 IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Install size 2 identification labels indicating system name, voltage and phase, Emergency, or Normal power, if applicable.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 CSA C22.1 2002, Canadian Electrical Code, Part 1.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Meet requirements of Section 01 74 19 - Waste Management and Disposal.

.2 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

.1 Size boxes in accordance with CSA C22.1.

.2 102 mm square or larger outlet boxes as required for special devices.

.3 Gang boxes where wiring devices are grouped.

.4 Provide blank cover plates for boxes without wiring devices.

.5 Provide combination boxes with barriers where outlets for more than one system are grouped.

.6 Each outlet box installed in steel stud and gyproc walls shall be mounted on Caddy #BHA, series SGB or TSGB screw gun brackets. Wood strapping with steel studs shall not be utilized for supporting outlet boxes

.7 Use condulets where 90° turn required on wall mounted conduit. They shall be of the type where cover screws do not enter the wire chamber and covers are left accessible.

.8 Each outlet box installed in acoustic tile ceilings shall be mounted on double Caddy "Tee Bar Hanger" #512 in such a manner that the outlet box will not twist in any direction.

.9 Where boxes are surface mounted in unfinished areas, such as furnace or boiler rooms, stamped galvanized steel 100 mm square box to accept #8300 series raised covers shall be used.

.10 Where surface wiring methods are allowed and approved in finished areas, use Hubbell or Wiremold boxes as per drawings c/w suitable adapter for wireway entrance.

.11 Outdoors or damp locations, boxes shall be cast Feraloy or aluminum type 'FS', with threaded hubs and vapourproof covers.

.12 Indoors, stamped zinc cadmium plated steel boxes shall be provided and set for each fixture, switch, wall receptacle or other types of outlets, adapted to suit its respective location and designed to accept its particular components.

.13 Standard octagon boxes shall be 100 mm diameter, 53 mm deep minimum. Increase depth where area fill requires. Equip each box used for fixture hanging with a fixture stud.

.14 Two gang or larger shall be solid type with raised cover for tile, block or gyproc finish.

.15 Wood strapping with steel studs shall not be utilized for supporting outlet boxes.

.16 Set boxes plumb and level within 6 mm of finished surface. Mats not permitted.

.17 Where required, provide voltage separation barriers.

2.2 SHEET STEEL OUTLET BOXES

.1 Electro galvanized steel 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.

.2 Standard octagon boxes shall be 100 mm diameter, 53 mm deep minimum. Increase depth where area fill requires. Equip each box used for fixture hanging with a fixture stud.

.3 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished walls.

.4 102 mm square or octagonal outlet boxes for lighting fixture outlets.

.5 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster walls.

2.3 MASONRY BOXES

.1 Electro galvanized steel masonry single and multi-gang boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

.1 Electro glavanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 CONDUIT BOXES

.1 Outdoors or damp locations, boxes shall be cast Feraloy or aluminum type 'FS', with threaded hubs and vapourproof covers.

.2 Indoors, stamped zinc cadmium plated steel boxes shall be provided and set for each fixture, switch, wall receptacle or other types of outlets, adapted to suit its respective location and designed to accept its particular components.

.3 Standard octagon boxes shall be 100 mm diameter, 53 mm deep minimum. Increase depth where area fill requires. Equip each box used for fixture hanging with a fixture stud.

.4 Two gang or larger shall be solid type with raised cover for tile, block or gyproc finish.

.5 Wood strapping with steel studs shall not be utilized for supporting outlet boxes.

.6 Set boxes plumb and level within 6 mm of finished surface. Mats not permitted.

.7 Where required, provide voltage separation barriers.

2.6 FITTINGS GENERAL

.1 Bushing and connectors with nylon insulated throats.

.2 Knock out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

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. Reducing washers are not allowed.

.5 Outlet boxes shall be supported independently of conduit capable of supporting weight of fixture or other device. Conduit entering the back of a box shall not enter the centre knockout.

.6 For recessed fixtures in suspended ceilings, outlet box shall be accessible when fixture is removed.

.7 Flexible conduit to fixture shall be minimum 12 mm diameter, and shall not emanate from outlet box cover. Maximum length of flexible conduit from outlet box to fixture

shall be 3000 mm. Outlet box for fixture shall not be located above ducts, pipes, etc. Outlet box shall be within 750 mm (vertically) of the fixture.

.8 Provide and set all special communications type back boxes associated with systems specified under Electrical Divisions.

.9 In placing outlets, allow for overhead pipes, ducts, etc., and for variation in wall and ceiling finishes, door and window trim, paneling, etc.

.10 Location of receptacle outlets in equipment rooms shall be finalized during construction to give optimum arrangement. Consultant to approve locations before installation.

.11 Multigang boxes for use with 347 volt switches shall have each gang fully barriered from the next, or multiple single gang boxes may be used, provided they are installed in a neat, orderly fashion. Barriers shall be steel and shall be firmly held in place.

Attention is directed to special outlet box locations for 347 volt switches requiring wider mount spacing rejection feature.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Latest Edition of the following Canadian Standards Association (CSA) documents

- .1 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.
- .2 CSA C22.2 No. 45, Rigid Metal Conduit.
- .3 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid Tight Flexible Metal Conduit.
- .4 CSA C22.2 No. 83, Electrical Metallic Tubing.
- .5 CSA C22.2 No. 211.2, Rigid PVC (Unplasticized) Conduit.
- .6 CAN/CSA C22.2 No. 227.3, Flexible Nonmetallic Tubing.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Meet requirements of Section 01 74 19 - Waste Management and Disposal.

.2 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

Part 2 Products

2.1 CONDUITS

.1 Rigid metal conduit: to CSA C22.2 No. 45, hot dipped 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.

.6 Flexible PVC conduit: to CAN/CSA C22.2 No. 227.3

.7 Conduit for use in corrosive atmospheres shall be rigid PVC or rigid steel with extruded PVC jacketed. Refer to drawings for areas requiring PVC.

.8 Condulets shall be of a type wherein cover screws do not enter the wire chamber.

.9 Flexible conduit connections to all mechanical equipment shall be of 'Sealtite' manufacture.

.10 Flexible conduit connectors shall be of the insulated throat type.

.11 Condulets with suitable covers shall be used where condulets are exposed. Each conduit fitting shall be of a type suitable to its particular use, and of a type which will allow installation of future conduits without blocking covers of existing condulets.

.12 Expansion joints shall be installed with ground jumper.

.13 All conduits shall be terminated with a suitable bushing.

.14 Flexible conduit and Rigid conduit entering boxes or enclosures shall be terminated with nylon insulated steel threaded bushings, grounded type.

2.2 CONDUIT FASTENINGS

.1 One hole steel straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits at 1.5 m oc.

.4 Threaded rods, 6 mm dia., to support suspended channels.

2.3 CONDUIT FITTINGS

.1 Fittings: manufactured for use with conduit / raceway specified. Coating: same as conduit / raceway.

.2 Factory "ells" where 90º bends are required for 25 mm and larger conduits / raceways.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

.1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.

.2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.

.3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 FISH CORD

.1 Polypropylene.

Part 3 Execution

3.1 INSTALLATION

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Conduits and cables shall be supported, at regular intervals, with corrosion resisting clamps. Lead anchors or expansion bolts shall be used to attach clamps to masonry walls.

.3 Conduit and cables shall be installed to avoid proximity to water and heating pipes. They shall not run within 150 mm of such pipes, except where crossings are unavoidable, in which case they shall be kept at least 25 mm from covering of pipe crossed.

.4 Cap ends of all conduits to prevent entrance of foreign matter during construction. Manufactured caps shall be employed.

.5 Conduit shall be installed as close to building structure as possible so that where concealed, necessary furring can be kept to a minimum.

.6 Empty conduits, installed under this Division but in which wiring will be installed by others, shall be swabbed out with "Jet Line" foam packs, and be c/w Polypropylene pull wire or polytwine.

.7 Conduits shall be installed at right angles or parallel to building lines, accurate in line and level.

.8 Conduit shall not be bent over sharp objects. Improperly formed bends and running threads will not be accepted. Bends and fittings shall not be used together. Proper supports of manufactured channels shall be provided where exposed conduits and cable runs are grouped.

.9 Under no condition will EMT be allowed exposed within 1200 mm of floor, outdoors, or in areas where explosive, corrosive or moist atmosphere exists.

.10 Not more than four (4) 90 degree bends or equivalent offsets will be permitted between pull boxes. When maximum number of bends are used, the total run between pull boxes shall not exceed 18000 mm.

.11 PVC conduit shall not pass through a fire partition or floor separation. Where it is necessary for PVC conduits to pass through a fire barrier, a transition to rigid steel conduit shall be provided for 2000 mm on either side of the fire barrier.

.12 Surface mount conduits except where noted otherwise.

.13 Use rigid PVC conduit in corrosive areas or as indicated on plans.

.14 Use flexible metal conduit or Teck90 for connection to motors.

.15 Use liquid tight flexible metal conduit or Teck90 for connection to motors or vibrating equipment in damp, wet or corrosive locations.

.16 Use explosion proof flexible connection for connection to explosion proof motors.

.17 Minimum conduit size for lighting and power circuits: 21 mm.

.18 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter. Mechanically bend steel conduit over 21 mm dia.

.19 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.20 Install pull-twine in all empty conduits / raceways and conduits / raceways that are less than 40% filled.

.21 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.

.22 Dry conduits out before installing wire.

Conduits/Cabling/raceways are not to be run within concrete floors/ceilings. Any conduits/cabling/raceways required to be run along the concrete slabs shall be surface run and not recessed into the concrete. Any instances where cabling is required to be run vertically within concrete poured walls, coreline may be used as the raceway but it shall be transitioned to EMT or Rigid Steel (where required) with interfacing connectors or junction boxes being provided as required. This specification contains references to cast in place conduits. This is only applicable where specifically called for in certain locations within the documents.

3.2 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on surface channels.

.5 Do not pass conduits through structural members except as indicated.

.6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.3 CONCEALED CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Do not install horizontal runs in masonry walls.

.3 Do not install conduits in terrazzo or concrete toppings.

3.4 CONDUITS IN CAST IN PLACE CONCRETE

.1 Locate to suit reinforcing steel. 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. Use cold mastic between sleeve and conduit.

.5 Do not place conduits is slabs in which slab thickness is less than 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.

.8 All joints shall be made watertight and stub-ups protected against mechanical damage. Misaligned stub-ups shall be chiselled out and rebent to conform.

.9 Expansion joints shall be provided in conduit runs where they cross building expansion joints.

3.5 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.

3.6 CONDUITS UNDERGROUND

.1 Slope conduits to provide drainage.

.2 Waterproof joints (pvc excepted) with heavy coat of bituminous paint.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 Submittal Procedures.

.2 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSAC22.2No.26, Construction and Test of Wireways, Auxiliary Gutters and Associated Fittings.

1.3 PRODUCT DATA

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

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Meet requirements of Section 01 74 19 - Waste Management and Disposal.

.2 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

Part 2 Products

2.1 WIREWAYS

.1 Wireways and fittings: to CSA C22No.26.

.2 Sheet steel with hinged cover to give uninterrupted access.

.3 Finish: baked grey enamel.

.4 Elbows, tees, couplings and hanger fittings manufactured as accessories to wireway supplied.

Part 3 Execution

3.1 INSTALLATION

.1 Install wireways and auxiliary gutters.

.2 Keep number of elbows, offsets, connections to minimum.

.3 Install supports, elbows, tees, connectors, fittings.

.4 Install barriers where required.

.5 Install gutter to full length of equipment.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Switches, receptacles, wiring devices, cover plates and their installation.

1.2 RELATED SECTIONS

.1 Section 01 33 00 Submittal Procedures.

.2 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

.3 Section 26 05 01 - Common Work Results - Electrical.

1.3 REFERENCES

.1 Latest Edition of the following Canadian Standards Association (CSA International) documents:

.1 CSA C22.2 No.42, General Use Receptacles, Attachment Plugs and Similar Devices.
.2 CSA C22.2 No.42.1, Cover Plates for Flush Mounted Wiring Devices (Bi national standard, with UL 514D).
.3 CSA C22.2 No.55, Special Use Switches.
.4 CSA C22.2 No.111, General Use Snap Switches (Bi national standard, with UL 20, twelfth edition).

1.4 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 01 33 00 Submittal Procedures.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Meet requirements of Section 01 74 19 - Waste Management and Disposal.

.2 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

Part 2 Products

2.1 SWITCHES

.1 15 A, 120 V, single pole, three way switches where required on drawings.

.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 molding for parts subject to carbon tracking.
.4 Suitable for back and side wiring.
.5 White toggle.

.3 Toggle operated fully rated for tungsten filament and fluorescent lamps.

.4 All wiring devices specified shall be of the same manufacture throughout the project.

.5 Switches controlling motors shall be K.W. (H.P.) rated and approved for motor control service.

.6 Set switches flush in all finished areas, or in surface box where conduit or wireway is exposed.

.7 Refer to drawing symbol schedule for further requirements.

.8 Switches and receptacles shall comply with requirements of CSA and NEMA Standards.

.9 Switches shall be specification grade from one of the following manufacturers: Cooper, Leviton, Hubbell or Pass & Seymour.

2.2 RECEPTACLES

.1 Duplex receptacles, CSA type 5 15 R, 125 V, 15 A, U ground, with following features:

.1 White high impact chemical resistant molded nylon or polycarbonate face.
.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 riveted grounding contacts.
.6 Specification grade from one of the following manufacturers: Cooper, Leviton, Hubbell or Pass & Seymour.

.2 Single receptacles CSA type 5 15 R, 125 V, 15 A, U ground with following features:

.1 White high impact chemical resistant molded nylon or polycarbonate face.
.2 Suitable for No. 10 AWG for back and side wiring.
.3 Four back wired entrances, 2 side wiring screws.
.4 Specification grade from one of the following manufacturers: Cooper, Leviton, Hubbell or Pass & Seymour.

.3 Other receptacles with ampacity and voltage as indicated.

.4 Receptacles shall be of one manufacturer throughout project.

.5 Set receptacles flush in all finished areas, or in surface box where conduit or wireway is exposed

.6 If applicable, all emergency powered convenience outlets shall be red but as specified above.

2.3 SPECIAL WIRING DEVICES

.1 Ground Fault Circuit Interrupter - shall have a nylon face and a thermoplastic backbody. They must have a feed-through capability for protecting receptacles downstream on the same circuit. They must be Class A rated with a 5 milliampere ground fault trip level and a 20 ampere feed through rating. GFCI receptacles shall have 'Safe Lock' protection such if critical components are damaged and ground fault protection is lost, power to the receptacle is disconnected. GFCI receptacles shall be equipped with LED trip indicator light, NEMA configuration 5-15R, side wired and one of the following manufacturers: Cooper #XGF15-V, Leviton #8599-I or Pass & Seymour #1594-I, Hubbell 'Autoguard' GFR Series

.2 Pilot Light Switches - shall be quiet specification grade and rated 15A, 120 volts, back and side wiring with toggle lit red in the "ON" position, accepting up to #10 copper conductor and of one of the following manufacturers: Cooper, Leviton, Hubbell or Pass & Seymour.

.3 Slider Dimmers - to be white specification grade, 120 volts, 600W for controlling in full range, incandescent lighting. Run separate neutral for dimmers and keep on one phase. Dimmer to be voltage compensated c/w positive RFI filtering. Dimmers to be manufactured by one of the following: Cooper, Leviton, Hubbell or Pass & Seymour.

.4 Fractional HP/KW Manual Starters - to be non-reversing, toggle operated, suitable for mounting in a surface or flush box, single or two pole to suit 120 or 208 volt application, c/w pilot light and thermal overload to adequately protect motor. Flush mount to have stainless steel or white cover plates to match other flush mount wiring devices. To be of one of the following manufacturers: Cooper, Leviton, Hubbell or Pass & Seymour.

.5 Illuminated Switches - shall be quiet specification grade, 120 volts, back and side wiring with toggle lit in the "OFF" position, accepting up to #10 copper conductor and of one of the following: Cooper, Leviton, Hubbell or Pass & Seymour.

.6 Fluorescent Dimmer Switches: Dimmer switches for linear fluorescent and compact fluorescent lighting fixtures equipped with electronic dimming ballasts shall be specification grade, slide type control, load rated for 1200 VA (900 watts), 120-volt AC, with decora style screwless snap-on wall plate. Run separate neutral for dimmers and keep on one phase. Each dimmer shall be voltage compensated c/w positive RFI filtering. Fluorescent dimmer switches shall be of one of the following:

Leviton #26666-31, for use with Advance Mark X ballasts

Lutron #NF-10-WH, for use with Lutron Hi-Lume or Compact SE ballasts

.7 Wall Vacancy Sensors, 120-Volt: Wall vacancy sensors shall be specification grade dual technology (PIR/Microphonics) wall sensor switch, white finish. Manual ON/OFF switch with automatic time delay off operation (adjustable from 30 seconds to 30 minutes) after activation. Adjustable PIR unit sensitivity from 20% to 100%. Coverage limited to 180° field of view, 900 square feet, rated for minimum 800 watt for ballast load at 120-volt.

Wall vacancy sensor switch shall be compatible with all electronic fluorescent non-dimming ballasts and shall mount in a standard single 120-volt single gang switch box. Set delay off to 5 minutes after activated. Wall vacancy sensors shall be of one of the following manufacturers:

Hubbell, Leviton, Sensorswitch, Wattstopper, Cooper

.8 Ceiling Occupancy Sensors, 120-Volt: Designated as 'OC' on drawings - Ceiling occupancy sensors for controlling the room lighting shall be multi-technology occupancy sensor switch, passive infrared (PIR/Microphonics) and ultrasonic sensor (40kHz ultrasonic frequency), 360° coverage within a 92.9 square meter area. Automatic ON/OFF control, with delay off set at 5 minutes after momentary occupancy.

Hubbell, Leviton, Sensorswitch, Wattstopper, Cooper

2.4 COVER PLATES

.1 Cover plates for wiring devices.

.2 Cover plates from one manufacturer throughout project.

.3 Wall plates shall be designed and manufactured in accordance with performance and dimensional requirements of the following industry standards:

CSA Standard C22-2 No. 42

U.S. Federal Specification WP455

NEMA Standard WD-1

.4 Wall plates shall be manufactured by one of the following:

Cooper, Arrow Hart, Eagle, Hubbell, Leviton or Pass & Seymour.

.5 Blank cover plates in finished ceiling areas shall be Columbia Electric #9002 baked white enamel for white ceilings, or painted to match colored finishes.

.6 Unbreakable Nylon wall plates shall be provided for all switches, receptacles, blanks, telephone and special purpose outlets. The wall plates shall be of suitable configuration for the device for which it is to cover with color matched mounting screws. Use ganged plate where more than one device occur at one location. Any specific locations calling for Metal wall plates shall be stainless steel.

.7 Where surface wiring methods need to be employed in a high finish area because of renovations to existing structure, wall plates shall be used in conjunction with Wiremold surface box to suit the device.

.8 Where outlets occur in an unfinished area such as boiler or furnace room and surface conduit and boxes are specified, stamped galvanized steel wall plates shall be used to suit configuration.

.9 Exterior outlets shall be fitted with weatherproof die cast aluminum cover plates to suit wiring device, c/w rubber gasket to provide positive seal. Duplex cover plates shall have

two independent flaps. Weatherproof covers shall provide protection in wet and damp locations.

2.5 PAC POLES

.1 Pac poles shall have clear anodized aluminum finish, and shall have a minimum cross sectional dimension of 64 x 64mm. The pac pole shall have separate compartments for power and communications.

.2 The compartment with power shall be used as a raceway to run both power and communications cabling, in respective compartments.

.3 Provide knock outs with grommet openings for straight through power and communication cable access, requirements as shown on drawings;

.4 Pac poles shall include all accessories and fittings necessary to provide a complete and fully furnished product that includes the following:

.5 Entrance end fitting at top of electrical channel;

.6 Ceiling trim plate, pole mounting bracket and adjustable t-bar assembly;

.7 Velcro carpet gripper pad and adhesive pad.

.8 Pac poles shall be of one of the following manufacturers:

Emergi-lite s-series, Thomas & betts ‘omnilink’ pd series, Wiremold #np-600 series

Part 3 Execution

3.1 INSTALLATION

.1 Switches:

.1 Install single throw switches with handle in "UP" position when switch closed.
.2 Install switches in gang type outlet box when more than one switch is required in one location.
.3 Switches shall be as located on the drawings, mounted up 1200 mm, and ganged where more than one occurs in the same location.

.2 Receptacles:

.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
.2 Convenience outlets shall be as located on the drawings, and mounted up 450 mm, unless otherwise noted.
.3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
.4 Outlets over counter tops shall be mounted 150 mm above counter, or immediately above backsplash. Co-ordinate with architectural drawings for

location of all counter tops, millwork and feature walls, to ensure proper location and mounting height.

.5 Coordinate with the location of all mechanical convectors and mount convenience outlets up 100 mm above heating convectors.

.6 All convenience outlets shall meet tension tests as per CSA requirements, and will be subjected to 'on site' tests during final inspection.

.3 All plug-in type receptacles shall be identified by means of a Lamecoid label fixed with self-tapping screws on the cover plate. Each cover plate shall contain the panel and circuit number. Those receptacles fed from ground fault interrupters shall have 'GFI' labeled adjacent to the panel and circuit number. Those receptacles designated for housekeeping purposes shall have ‘HOUSEKEEPING’ labeled adjacent to the panel and circuit number.

.4 The circuits controlled by all switches on all levels, shall be neatly printed with waterproof ink on the side of the switch outlet box so that the panel and circuit number are clearly legible when the cover plate is removed. It shall not be necessary to remove the switch from the outlet box in order to read the panel or circuit number.

.5 Cover plates:

.1 Protect cover plate finish with paper or plastic film until painting and other work is finished.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not use cover plates meant for flush outlet boxes on surface mounted boxes.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 01 - Common Work Results - Electrical.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CSA C22.2No.248.12 94 , Low Voltage Fuses Part 12: Class R (Bi National Standard with, UL 248 12 (1st Edition).

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 01 33 00 Submittal Procedures.

.2 Submit fuse performance data characteristics for each fuse type and size above 50 A. Performance data to include: average melting time current characteristics.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Meet requirements of Section 01 74 19 - Waste Management and Disposal.

.2 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

1.5 DELIVERY AND STORAGE

.1 Ship fuses in original containers.

.2 Do not ship fuses installed in switchboard.

.3 Provide in the main electrical room a wall mounted metal storage cabinet 600 mm wide by 600 mm high by 300 mm deep c/w one shelf, to house all spare fuses.

.4 Provide a typed list of all spare fuses and mount behind clear 1 mm thick plastic on inside of door. Cabinet shall be equipped with lock.

1.6 MAINTENANCE MATERIALS

.1 Provide maintenance materials in accordance with Section 01 78 00 Closeout Submittals.

.2 Three (3) spare fuses of each type and size installed.

Part 2 Products

2.1 FUSES GENERAL

.1 Fuses: product of one manufacturer for entire project.

.2 Fuse interrupting rating shall be 200,000 amperes RMS symmetrical, unless otherwise noted.

.3 Time delay fuses shall carry 500% of rated current for a minimum of 10 seconds and shall be labeled "Time Delay" by the manufacturer.

2.2 FUSE TYPES

.1 HRC fuses rated above 600 amperes shall be CSA certified HRC-L fuses and shall be in accordance with CSA Specification C22-2 No. 106-M-1985.

.2 HRC fuses rated 600 amperes and smaller shall be CSA certified HRC1-J time delay and shall be in accordance with CSA Specification C22-2 No. 106-M92. HRC-1 fuse dimensions and current limiting performance shall be in accordance with the UL Standard 198C

Part 3 Execution

3.1 INSTALLATION

.1 Install fuses in mounting devices immediately before energizing circuit.

.2 Ensure correct fuses fitted to physically matched mounting devices.

.3 Ensure correct fuses fitted to assigned electrical circuit.

.4 Application of all fuses shall comply with the Canadian Electrical Code - Part 1 and local inspection authority regulations.

.5 Unless otherwise noted on the drawings, Time Delay fuses for overcurrent protection of motor circuits shall be rated at 150% of full-load current and

.6 Time Delay fuses for overcurrent protection of transformer circuits shall be rated at 125% of full-load current.

.7 All fuses shall be manufactured by Littlefuse, Buss, Ferraz Shawmut, or Edison.

.8 An overcurrent study and the final testing, cleaning and calibration of protective relays, meters and circuit breaker trips shall be carried out by a local testing facility. Provide all necessary technical information and support to the testing facility to assist them in coordinating study and testing.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials for moulded-case circuit breakers, and ground-fault circuit-interrupters.

.2 Text to complete:

.1 Section 26 23 00 - Low Voltage Switchboard.
.2 Section 26 24 02 - Service Entrance Board.

1.2 RELATED SECTIONS

.1 Section 01 33 00 Submittal Procedures.

.2 Section 01 74 19 Construction/Demolition Waste Management and Disposal.

.3 Section 26 23 00 - Low Voltage Switchboard.

.4 Section 26 24 02 - Service Entrance Board.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CSA-C22.2 No. 5-02, Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

1.4 SUBMITTALS

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

.2 Include time current characteristic curves for breakers with ampacity of 50 A and over and with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Meet requirements of Section 01 74 19 - Waste Management and Disposal.

.2 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

Part 2 Products

2.1 BREAKERS GENERAL

.1 Bolt on moulded case circuit breaker: quick make, quick break type, for manual and automatic operation with temperature compensation for 40 deg C ambient.

.2 Common trip breakers: with single handle for multi pole applications.

.3 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips.

.4 Circuit breakers with interchangeable trips as indicated.

.5 Circuit breakers to have minimum of 10,000 A symmetrical rms interrupting capacity rating in breaker panelboards.

.6 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.

.1 Trip settings on breakers to have adjustable trips.

2.2 THERMAL MAGNETIC BREAKERS

.1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.3 SOLID STATE TRIP BREAKERS

.1 Moulded case circuit breaker to operate by means of solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long time, short time, instantaneous, tripping for ground fault short circuit protection.

.2 The main service breaker and all breakers over 400 amps shall have solid-state trip units. All other breakers shown shall be thermal magnetic breakers.

Part 3 Execution

3.1 INSTALLATION

.1 Install circuit breakers as indicated.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for fused and non-fused disconnect switches.

1.2 RELATED SECTIONS

.1 Section 01 33 00 Submittal Procedures.

.2 Section 01 35 30 - Health and Safety Requirements.

.3 Section 01 74 19 Construction/Demolition Waste Management and Disposal.

.4 Section 26 05 01 Common Work Results - Electrical.

.5 Section 26 23 00 - Low Voltage Switchboard.

.6 Section 26 24 02 - Service Entrance Board.

.7 Section 26 28 14 - Fuses Low Voltage.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CAN/CSA C22.2 No.4-M89 (R2000), Enclosed Switches.
.2 CSA C22.2 No.39-M89 (R2003), Fuseholder Assemblies.

1.4 SUBMITTALS

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

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Meet requirements of Section 01 74 19 - Waste Management and Disposal.

.2 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

Part 2 Products

2.1 DISCONNECT SWITCHES

.1 Fusible and non-fusible disconnect switch in CSA Enclosure, size as indicated.

.2 Mechanically interlocked door to prevent opening when handle in ON position.

.3 Fuses: size as indicated, in accordance with Section 26 28 14 Fuses Low Voltage. Switch fuse units shall be available in 30 through 1200 amp standard industry sizes. They shall be readily removable and interchangeable without modification to bus work or mounting rails

.4 Fuseholders: suitable without adaptors, for type and size of fuse indicated.

.5 Quick make, quick break action.

.6 Fusible switches shall be quick-make, quick-break, visible blades, integral handle mechanism, deionizing arc quenchers, front operation, high pressure fuse clips and recessed live parts.

.7 Operating handles to have provision for padlocking in either 'on' or 'off' position.

.8 Handle to be marked to clearly indicate switch contact positions.

.9 Switch fuse units shall be available in 30 through 1200 amp standard industry sizes.

.10 Shall be readily removable and interchangeable without modification to bus work or mounting rails.

.11 All switches shall be manufactured by General Electric, Siemens, Cutler Hammer or Schneider Electric.

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01 Common Work Results - Electrical.

.2 Lamecoid nameplates, approximately 75 mm x 25 mm, shall be provided on front doors of each switch for identification, showing the name and rating.

Part 3 Execution

3.1 INSTALLATION

.1 Install disconnect switches complete with fuses if applicable.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 01 - Common Work Results - Electrical.

1.2 REFERENCES

.1 National Electrical Manufacturers Association (NEMA)

1.3 SHOP DRAWINGS AND PRODUCT DATA

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

.2 Indicate:

.1 Mounting method and dimensions.
.2 Starter size and type.
.3 Layout of identified internal and front panel components.
.4 Enclosure types.
.5 Wiring diagram for each type of starter.
.6 Interconnection diagrams.

1.4 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for motor starters for incorporation into manual specified in Section 01 78 00 Closeout Submittals.

.2 Include operation and maintenance data for each type and style of starter.

1.5 EXTRA MATERIALS

.1 Provide maintenance materials in accordance with Section 01 78 00 Closeout Submittals.

.2 Provide listed spare parts for each different size and type of starter:

.1 2 contacts, auxiliary.
.2 1 operating coil.
.3 2 fuses.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Meet requirements of Section 01 74 19 - Waste Management and Disposal.

.2 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

Part 2 Products

2.1 MATERIALS

.1 For all motors, provide circuit and thermal protection on all lines except neutral.

.2 All magnetic starters located outside of motor control centres shall contain hour meters.

.3 All contactors shall be NEMA rated contactors.

2.2 MANUAL MOTOR STARTERS

.1 Single or Three phase manual motor starters as shown of size, type, rating, and enclosure type as indicated, with components as follows:

.1 Switching mechanism, quick make and break.
.2 Overload heater(s) for each phase, manual reset, trip indicating handle.
.3 Thermal switches for small fractional KW motors shall be single or 2 pole as required.
.4 In all cases, locate within 9000 mm and in sight of motor

.2 Accessories:

.1 Toggle switch: industrial standard type labelled as indicated.
.2 Indicating light: standard neon type and colour as indicated.
.3 Locking tab to permit padlocking in "ON" or "OFF" position.
.4 thermal relay

2.3 FULL VOLTAGE MAGNETIC STARTERS

.1 Combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:

.1 Contactor solenoid operated, rapid action type.
.2 Motor overload protective device in each phase, manually reset from outside enclosure.
.3 Wiring and schematic diagram inside starter enclosure in visible location.
.4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
.5 All starters shall be combination starters c/w quick-make, quick-break, switch, fuse and magnetic starter c/w red and green indicator lights
.6 H.O.A. switch operator controls
.7 Provide primary fuse for control transformer.
.8 Starters shall not be equipped with an automatic thermal overload reset.
.9 Tin plated stab on connectors are acceptable.

.2 Combination type starters to include fused disconnect switch with operating lever on outside of enclosure to control disconnect, and provision for:

.1 Locking in "OFF" position with up to 3 padlocks.
.2 Independent locking of enclosure door.

.3 Provision for preventing switching to "ON" position while enclosure door open.
.4 Fusing shall be Form I, NEMA "J", HRC, 200,000 amps current limiting type.

.3 Accessories:

.1 Pushbuttons and Selector switches: standard labelled as indicated.
.2 Indicating lights: standard type and color as indicated.
.3 1 N/O and 1 N/C spare auxiliary contacts unless otherwise indicated.
.4 The overload relays shall be the ambient temperature compensated type, and the trip rating of a specific heater element shall be field adjustable over a range of approximately 85% + 115% of its respective rating.

2.4 CONTROL TRANSFORMER

.1 Single phase, dry type, control transformer with primary voltage as indicated and 120V secondary, complete with secondary fuse, installed in with starter as indicated.

.2 Size control transformer for control circuit load plus 20% spare capacity.

2.5 FINISHES

.1 Apply finishes to enclosure in accordance with Section 26 05 01 - Common Work Results - Electrical.

2.6 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.

.3 The plates shall be attached with two self-tapping metal screws.

Part 3 Execution

3.1 INSTALLATION

.1 Install starters, connect power and control as indicated.

.2 Ensure correct fuses and overload devices elements installed.

.3 Each manufacturer shall have a local Saskatchewan service capability.

.4 All motor control equipment shall be of the same manufacture.

.5 Install starters, connect power and control as indicated.

.6 Ensure correct fuses and overload devices elements installed.

.7 The drives shall be cleared of all ambient construction dust prior to commissioning or the energizing of the drive.

.8 Provide a disconnect for each motor within the room or area that the motor is located. All disconnects shall be sized in accordance with kilowatt ratings of the motor being isolated and shall be quick-make, quick-break type, equipped with lock-off feature.

.9 Within 900 mm of each motor, provide flexible Sealtite conduit. Provide a separate ground wire bridging the flexible connections.

.10 All conduit entering top of motor starter shall be c/w water tight connectors with silicone based caulking.

.11 Control wiring shall be stranded TEW 105°C (220°F) rise.

.12 Terminal blocks for remote interface shall be Weidmueller SAK6N or approved equal.

.13 Provide wire markers at both ends of all control wires, Electrovert Type Z or approved equal

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical and manufacturer's instructions.

.2 Provide factory certified copies of production test results to the Consultant prior to shipment of the equipment.

.3 Operate switches, contactors to verify correct functioning.

.4 Perform starting and stopping sequences of contactors and relays.

.5 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute (ANSI)

- .1 ANSI C82.1, Electric Lamp Ballasts Line Frequency Fluorescent Lamp Ballast.
- .2 ANSI C82.4, Ballasts for High Intensity Discharge and Low Pressure Sodium Lamps.
- .3 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
- .4 ANSI/IEEE C62.41, Surge Voltages in Low Voltage AC Power Circuits.
- .5 American Society for Testing and Materials (ASTM)
- .6 ASTM F1137, Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- .7 United States of America, Federal Communications Commission (FCC)
- .8 FCC (CFR47) EM and RF Interference Suppression.

1.2 RELATED SECTIONS

.1 Section 01 33 00 Submittal Procedures.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings in accordance with Section 01 33 00 Submittal Procedures and 26 05 01 – Common Work Results.

.2 Shop drawing shall include but not be limited to, lamps, ballasts, fixture cuts, custom colors, and special mounting details.

Part 2 Products

2.1 LAMPS

.1 Provide in wattages and types to properly suit the specified fixtures.

.2 T5 Linear Fluorescent Lamps:

- .1 Miniature Bi-pin, slim 5/8” diameter for operating with high frequency electronic programmed start ballasts
- .2 Colour Rendering Index (CRI) of 85
- .3 Colour Temperature: 4000/4100°K
- .4 Nominal Life Rating: 20,000 hours

.3 T8 Linear Fluorescent Lamps:

- .1 Medium Bi-pin, 1-inch or 25mm diameter for operating with high frequency instant start, programmed start and dimming electronic ballasts

.2 Colour Rendering Index (CRI) of 85
.3 Colour Temperature: 4000/4100°K
.4 Nominal Life Rating @ 3 hours/start: 36,000 hours
.5 Nominal Life Rating @ 12 hours/start: 42,000 hours

.4 Compact Fluorescent Lamps:

.1 4-pin lamp base for dimming and electronic ballast systems
.2 End-of-Life (EOL) shutdown protection
.3 Flicker free start on electronic ballast systems
.4 Colour Rendering Index (CRI) of 82
.5 Colour Temperature: 4000/4100°K
.6 Nominal Life Rating: 12,000 hours

.5 Incandescent lamps shall be 1,000 hr. nominal rating, I.F., or as otherwise specified on the drawings. This is the only item that a one-year guarantee does not apply to. Guarantee period for incandescent lamps shall be four months from date of final acceptance.

.6 Halogen Lamps:

.1 Halogen PAR lamps
.2 Base: Medium Skirt
.3 Average Life Rating: 4,000 hours
.4 Beam angles as listed with light fixture specification

.7 HID Lamps:

.1 Metal halide lamps 1000 watts and smaller shall be phosphor coated and colour corrected, ED17.
.2 150 watt pulse start metal halide lamps shall have an initial Lumen rating of 12000.
.3 High pressure sodium lamps shall be colour corrected.

.8 Lamps for T5, T8 linear fluorescent, compact fluorescent, incandescent and HID lighting fixtures shall be manufactured by Osram-Sylvania or Philips.

.9 Led Lighting – Lamp Modules And Drivers:

.1 Colour temperature of 4000/4100°K.
.2 Solid-State Lighting (LED luminaires) shall comply with ENERGY STAR® SSL test standards for the following qualification requirements:

1. Testing: SSL testing standards including IES LM-79-2008 and LM-80-2008 as performed by an independent test lab.
2. Efficacy: The luminaire test data and submitted report shall demonstrate a minimum of 35 lumens per watt and 575 lumens for the least efficient LED for apertures $\geq$ 4.5" (345 lumens for apertures $\leq$ 4.5"), lowest efficient optic, and hottest luminaire configuration for the product group submitted for qualification.

3. Colour: LED luminaire shall demonstrate colour uniformity across the aperture.
4. Power: The driver/power supply must have a power factor of > 0.90 for all non-residential products, meet FCC requirements, sound rating of A and provide transient protection.
5. Reliability: The LED luminaire shall demonstrate 70% lumen maintenance at 35,000 hours for non-residential products, as calculated using the DOE's linear extrapolation model.

.3 Tight chromaticity specification and LED colour binning process shall ensure LED colour uniformity, sustainable Colour Rendering Index (CRI) and Correlated Colour Temperature (CCT) consistency over the useful life of the LED. Consistent colour uniformity and tight colour control shall be maintained even during dimming.

.4 LED modules shall be InGaN (Indium Gallium Nitride) semiconductor material, absent of UV and minimal IR wavelengths. The conglomeration of diodes covered with remote phosphor technology shall provide consistent colour uniformity and tight colour control.

.5 LED Light Engine (Driver)

1. Over-voltage, over-current and short-circuit protected
2. Thermal management of the LED system shall be designed to yield 70% lumen maintenance after 50,000 hours of operation
3. Total Harmonic Distortion: < 20% THD

.6 LED fixtures where specified as dimmable, shall have a dimming range of 100% to 10% unless otherwise noted.

.7 Warranty: The light engine and power components of LED luminaires installed for indoor applications shall be free from defects in material and workmanship for a minimum period of three (3) years from date of original purchase. Warranty shall cover only product failure due to defective material or workmanship, and does not include labour to remove or install fixtures. Defective LED's shall be considered if a minimum of 5% of LEDs per luminaire are non-operative in the fixture or module.

2.2 BALLASTS

.1 Ballasts for fluorescent and HID fixtures shall be supplied with the fixtures, pre-wired for operation with the compatible lamps and quantity of lamps specified for the fixture. Provide ballasts in the voltage noted with the fixture specification.

.2 Fluorescent ballast systems shall include:

.1 Operate lamps for maximum efficacy, high lumen output operation and operate for full lamp life
.2 Eliminate lamp flicker
.3 UL Listed Class P, Type 1 Outdoor
.4 CSA Certified
.5 70°C Maximum Case Temperature
.6 FCC 47CFR Part 18 Non-Consumer for EMI and RFI filtering

.7 Class A Sound Rating
.8 ANSI C62.41 Category A Transient Protection
.9 CFCI Compatible

.3 Ballasts for Linear T5 Lamps

.1 Starting Method: Programmed Rapid Start
.2 Stepped Switching Ballast System
.3 Ballast Factor (BF): 1.00
.4 Circuit Type: Series
.5 Lamp Frequency: >40kHz to reduce potential interference with infrared control systems
.6 Lamp Current Crest Factor (CCF): less than 1.6
.7 Total Harmonic Distortion: <10% THD
.8 Power Factor: >98%
.9 End of Lamp Life Sensing
.10 Manufacturer:
Advance 'IOP' series
Sylvania 'Quicktronic PROStart'

.4 Ballasts for Linear T8 Lamps

.1 Starting Method: Instant Start or Programmed start where specified
.2 Ballast Factor (BF): 0.88 – Normal Ballast Factor
.3 Circuit Type: Parallel
.4 Lamp Frequency: >42kHz to reduce potential interference with infrared control systems
.5 Lamp Current Crest Factor (CCF): less than 1.7
.6 Total Harmonic Distortion: <10% THD
.7 Power Factor: >98%
.8 Manufacturer (Instant Start):
Advance 'ICN' series for 120-volt; 'GCN' series for 347-volt
Sylvania 'Quicktronic' T8 Instant Start Professional Series
Universal Lighting Technologies
.9 Manufacturer (Programmed Start):
Advance 'IOP' series
Sylvania 'Quicktronic PROStart'

.5 Ballasts for T4 Compact Fluorescent Lamps

.1 Starting Method: Programmed Rapid Start System
.2 Ballast Factor (BF): 1.00 – Normal Ballast Factor
.3 Circuit Type: Series
.4 Lamp Frequency: >40kHz to reduce potential interference with infrared control systems
.5 Lamp Current Crest Factor (CCF): less than 1.7
.6 Total Harmonic Distortion: <10% THD
.7 Power Factor: >98%
.8 End of Lamp Life Sensing
.9 Compatible with 4-pin lamp types

.10 Manufacturer:
Advance 'ICF' series
Sylvania 'Quicktronic PROStart' CF Professional series
Universal Lighting Technologies

.6 Dimming Fluorescent Ballasts for T5, T8 and Compact Fluorescent Lamps

.1 Starting Method: Programmed Rapid Start System
.2 Ballast Factor (BF): 1.00 – Normal Ballast Factor
.3 Circuit Type: Series
.4 Lamp Frequency: >40kHz to reduce potential interference with infrared control systems
.5 Lamp Current Crest Factor (CCF): less than 1.7
.6 Total Harmonic Distortion: <10% THD
.7 Power Factor: >98%
.8 Dimming Range: 100 to 5%
.9 1 – 10 Volt Control
.10 Anti-Flash Circuitry turns on in dimmed mode
.11 End of Lamp Life Sensing for T4 and T5 lamps
.12 Compatible with 4-pin compact fluorescent lamp types
.13 Manufacturers:
Lutron 'Hi-Lume' series
Sylvania 'Quicktronic – Powersense' series

.7 Ballasts for HID lamps including metal halide, high pressure sodium and mercury vapour, 120 and 347 volt shall be constant wattage, auto transformer type, suitable for the specific application for the fixture specification. All ballasts shall be fully potted, encapsulated type.

.8 Fluorescent ballasts shall have inrush current limiting capability to assure compatibility with all lighting systems controls.

.9 Ballast Warranty: All fluorescent ballasts shall include a written manufacturer's warranty against defects in materials and workmanship for 60 months from date of substantial completion and include a nominal replacement labour allowance. Except high ambient 90°C for T5 lamps/ballasts for 36 months.

2.3 LUMINAIRES

.1 Contractor is responsible for all required mounting details for all lighting fixtures. If mounting of fixture is uncertain, contractor shall confirm prior to finalizing pricing.

.2 Lighting fixtures shall be of the makes indicated. Similar types of fixtures shall be by one manufacturer.

.3 Only clean luminaires and lamps will be accepted at time of final inspection.

.4 Recessed fixtures shall generally be supplied complete with trim, plaster frame or ring and mounting brackets where installed in plaster, or without plaster frame in acoustic ceilings.

.5 Fixtures shall bear appropriate CSA labels.

.6 Cooperate with all other trades for the proper installation of all lighting fixtures.

.7 Verify the quantity of fixtures before placing orders.

.8 Verify all ceiling types with architectural drawings and the General Contractor before ordering fixtures.

.9 All incandescent and H.I.D. fixtures shall be pre-wired.

.10 Fluorescent lighting fixtures shall be so designed that the temperature on the ballast case shall not exceed a maximum of 70°C in an ambient temperature of 25°C.

.11 Coordinate with drawings to ensure that all fluorescent and H.I.D. fixtures are equipped with ballasts of a suitable voltage to match branch circuitry.

.12 All fluorescent fixtures such as troffers, specified as being equipped with flat acrylic lens, shall be provided with lens not less than 3.175 mm thick, regardless of catalogue numbers specified.

.13 All fluorescent troffers specified as being installed in inverted T-bar ceilings shall be painted on bottom face of fixture to match the T-bar splines unless otherwise noted.

.14 A self-adhesive small circular label coloured blue shall be placed on a T-bar spline adjacent to each fixture housing the ballast to facilitate its location.

.15 All 347 volt fixtures shall be clearly labelled in 20 mm lettering on ballast cover: "CAUTION - 347 VOLTS".

.16 All fluorescent luminaires installed on branch circuits with voltages exceeding 150 volts-to-ground shall be provided with a disconnecting means integral with the luminaire that simultaneously opens all circuit conductors between the branch circuit conductors and the conductors supplying the ballast(s), and shall be marked in a conspicuous and permanent manner adjacent to the disconnecting means so as to identify the disconnect.

.17 The new light fixture lamps shall not be used during construction. The contractor may use their own temporary lamps during construction at their own expense with the Owner’s approval. Construction lamps shall be clearly marked with a permanent ink “CL” in a location that is easily distinguishable for inspection purposes. The contractor shall replace temporary lamps with new lamps following substantial completion. All fixtures shall be cleaned inside and outside prior to substantial completion.

.18 Provide lighting fixtures of type and quality as specified in the following schedule. Fixtures shall be complete with necessary accessories and lamps. The contractor shall advise of any restrictions on providing luminaire, lamp or ballast as specified during the tender period. Any substitutions must be approved in writing as part of the addendum.

.19 The lighting fixtures shall be as specified in the following schedule, and the manufacturer's numbers shown shall not reduce or amend the requirements as outlined under the description of each fixture type.

.20 Fixture Schedule:

Fixture type 'AA' – Owner supplied, contractor installed, 2 x 2 recessed fluorescent fixture.

Fixture type 'BB' – Owner supplied, contractor installed, 1 x 4 surface mounted fluorescent fixture.

.21 Emergency lighting battery units shall be battery contained units with a combination of integral and remote heads interconnected as indicated on the drawings, including wiring to a dc terminal block in the exit light fixtures.

.22 All emergency battery units shall be surface wall mounted up 2100mm above finished floor unless otherwise noted. Remote emergency lighting fixtures shall be either surface ceiling mounted or wall mounted up 2100mm unless otherwise noted.

.23 Emergency lighting battery units shall be directed connected and connected to the room's 120-volt light circuit, non-switched.

.24 Emergency battery operated lighting fixtures shall be of the type as specified herein:

Fixture type 'EMA' – Surface mounted emergency light. 2 x 12 watt MR16 lamps, 120VAC/12VDC, 108W battery, 385mm (W) x 241mm (H) x 105mm (D). Battery shall be complete with auto-test/diagnostics, 20 gauge steel cabinet white finish, universal mounting pattern, battery shall provide minimum 30minutes of run time. Mount up 2100mm.

Beghelli Nova Series
Ready-lite LDX Series
Emergi-lite ESL Series

Fixture type 'ER1' – Surface mounted emergency light. Single head 1 x 12 watt MR16 lamps, 12VDC, white finish, universal mounting pattern, mechanically adjusted swivel. Mount up 2100mm, unless otherwise noted on drawings.

Beghelli LR Series
Ready-lite LH Series
Emergi-lite EF Series

Fixture type 'ER2' – Surface mounted emergency light. Single head 2 x 12 watt MR16 lamps, 12VDC, white finish, universal mounting pattern, mechanically adjusted swivel. Mount up 2100mm, unless otherwise noted on drawings.

Beghelli LR Series
Ready-lite LH Series
Emergi-lite EF Series

Part 3 Execution

3.1 INSTALLATION

.1 The contractor under this Division shall be responsible for expediting the delivery and installation of the fixtures to suite the construction schedule and the work of other trades.

.2 Remove packing material and debris from the job site immediately after installation of fixtures and lamps. Debris shall not be allowed to accumulate more than a reasonable amount.

.3 Industrial fixtures, where suspended, shall have 12 mm conduit hangers and ball aligners, the length and location shall clear equipment ducts and pipes.

.4 Lighting fixture diffusers are not to be installed until the area is completely finished in order to minimize the amount of dirt collection on these units.

.5 Exit lights shall be wired in a separate conduit system.

.6 Conduit installation shall conform to the specifications.

.7 All fluorescent strip fixtures mounted in architectural valances or enclosures shall be installed with a 12 mm metallic spacer so that back of fixture is 12 mm from architectural finish.

3.2 WIRING

.1 Each fixture shall be fed with minimum #12 AWG separate flex or AC-90 drop. Looping between fixtures or wiring rows through ballast channel will not be accepted.

3.3 LUMINAIRE SUPPORTS

.1 Lighting fixtures shall be supported independent of plasterboard or acoustic tile. Support from structural members of the building or ceiling.

3.4 LUMINAIRE ALIGNMENT

.1 Luminaires shown in continuous lines or rows shall be carefully aligned so that all rows appear as straight lines.

.2 Fixtures shall be installed accurately in line and level. Any fixtures which are not installed properly shall be taken down and re-installed at no change to the contract sum. Plaster frames and rings required for recessed fixtures shall be supplied under this section, and installed under the lathing and plaster or acoustic ceiling divisions. The work of the electrical division shall include the necessary co-ordination with the above divisions in regard to the correct location and installation of the plaster frame and rings.

END OF SECTION

Part 1 General

1.1 GENERAL CONDITIONS

.1 The General Conditions of the Contract, Supplementary General Conditions and General Requirements are hereby made part of the Section.

1.2 WORK INCLUDED

.1 Bored friction piles with reinforcing steel as detailed.

.2 Establish and/or verify required cut-off elevations.

.3 Correct as directed all piles not meeting requirements of this specification at no expense to Owner.

.4 Leave site neat, tidy, free of plant and/or equipment and in safe condition. Remove excavation material from site or deposit on site as directed.

1.3 RELATED WORK

.1	Concrete Reinforcing	Section 03 20 00
.2	Cast-in-Place Concrete	Section 03 30 00

1.4 REFERENCE STANDARDS

.1 CAN/CSA A23.1-09 - "Concrete Materials and Methods of Concrete Construction".
.2 CAN/CSA A23.2-09 - "Methods of Test for Concrete".
.3 CAN/CSA G30.18-09 - "Billet Steel Bars for Concrete Reinforcement".

1.5 CONCRETE TESTING

.1 Testing of concrete is to be performed by an independent Inspection and Testing Firm approved by the Consultant and paid for by the Contractor. Required retesting will be paid for by the Contractor. Unless approved otherwise, the testing agency must perform all aspects of testing including cylinder preparation.

.2 Provide free access to all portions of work and co-operate with appointed firm.

.3 Submit proposed mix design to Inspection and Testing Firm and Consultant two weeks prior to commencement of work.

.4 Tests for cement and aggregate may be performed to ensure conformance with requirements stated herein.

.5 One set of three (3) concrete test cylinders will be taken for each day's pour, or for each 50 cubic metres, whichever is lesser. One cylinder shall be tested at 7 days, the remaining two cylinders shall be tested at 28 days.

.6 One (1) additional test cylinder shall be taken during cold weather concreting, and be cured on job site under same conditions of concrete it represents.

.7 One slump test and one air content test will be taken for each set of test cylinders taken.

.8 Testing of concrete will be performed in accordance with CAN/CSA A23.2-09.

1.6 FIELD RECORDS/DRAWINGS

.1 Maintain accurate records of all piles poured. Records are to include the following incorporated on the Contractor's record drawings:

.1 Date and time of casting.
.2 Sizes, depths and location of piles.
.3 Sequence of placing.
.4 Final cut-off elevation.
.5 Reinforcement, size and length.

.2 Submit three (3) copies of record drawings to the Consultant.

.3 Drawing to be the same scale and line reference as the contract drawings.

Part 2 Products

2.1 REINFORCING STEEL

.1 Reinforcing Steel: deformed steel bars conforming to requirements of CAN/CSA G30.18-09; 400 MPa yield strength.

.2 Reinforcement to conform to standards specified under Section 03 20 00 Concrete Reinforcement. Submit shop drawings of reinforcing steel to Consultant in accordance with the requirements of Section 03 20 00.

.3 Length of reinforcement to be as shown on drawings.

.4 No splicing in reinforcement permitted unless specifically shown on drawings or approved by Consultant. Where splices permitted length = 36 bar diameters minimum; adjacent splices staggered minimum full lap length.

.5 Welding ties to main reinforcement not permitted.

2.2 CONCRETE MATERIALS

.1 *Cement*: Sulphate Resistant Symbol 50 Portland, conforming to CSA A3000-08.

.2 *Coarse and Fine Aggregates:* Standard concrete type, conforming to CSA A23.1-09.

.3 *Water:* Clean and free of injurious amounts of oil, alkali, organic matter of other deleterious material.

2.3 ADMIXTURES

.1 *Air Entrainment:* to ASTM C260-06 "Air Entraining Admixtures for Concrete."

.2 *Chemicals:* to ASTM C494-08a - M78 "Chemical Admixtures for Concrete"; water reducing, strength increasing Type WN -normal setting.

.3 *Pozzolanic Mineral:* to CSA A3000-08 "Supplementary Cementing Materials and Their Use in Concrete Construction." Type "C" or Type "F" fly ash permitted to a maximum to 15% by weight of cementitious materials.

.4 Use of calcium chloride in concrete permitted only as approved by Consultant.

2.4 CONCRETE MIX

.1 Mix concrete in accordance with Section 03 30 00 Cast-In-Place Concrete.

2.5 CASING

.1 Removable steel protective casing adequate for its function.

Part 3 INSTALLATION

3.1 LAYOUT

.1 Maximum permissible error in location 40 mm in any direction. Place piles not more than 2% of their lengths out of plumb or batter called for on drawings. Elevation of top of piles to be within 25 mm of elevation called for on drawings. Reinforcing steel clearances within 15 mm of dimension called for on drawings.

.2 Minimum pile diameter as per drawings.

.3 Piles placed outside above tolerances may be rejected by the Consultant. Place additional piles and pile caps as directed by the Consultant to replace rejected piles entirely at the Contractor's expense.

3.2 PROCEDURE FOR BORING PILES

.1 Bore piles using power augers to suit diameters and lengths of piles indicated on drawings. Where called for on drawings, enlarge bottom of shaft using only personnel well experienced in this Trade. Provide to the Consultant on request experience record of personnel actually engaged in the work.

.2 Boulders encountered in drilling shall be removed and pile continued to full depth. Should removal of boulders be impractical, consult with Consultant.

.3 Casings shall be installed in shafts as required to prevent sloughing during drilling and for the retention of ground water. If casing is required, advise Engineer prior to placing concrete in shaft.

.4 Provide de-watering as necessary before any concrete is placed.

.5 Remove all tailings and debris from area of bore holes prior to casting concrete. Cover bore hole to prevent loose materials falling in during removal.

.6 After hole drilled, place reinforcing steel and concrete. Do not drill any holes which cannot be reinforced and filled with concrete the same day as drilled.

3.3 PLACING REINFORCING STEEL

.1 Place reinforcing steel in such a manner to prevent loose earth and debris from falling into the hole.

.2 Place reinforcing at proper elevation and hold during course of placing concrete. Placing of steel will not be allowed after concrete poured.

3.4 PLACING CONCRETE

.1 De-water holes, sleeves or not, before any concrete is placed.

.2 Before commencing placing concrete obtain Consultant's approval of proposed method of transporting and placing concrete.

.3 Form piles projecting above grade with removable steel sleeves or wax coated cardboard fibre forms.

.4 Place concrete continuously to final cut-off elevation as soon as possible after hole drilled, cleaned out and reinforcing steel secured in position. Take every care to ensure that hole is completely filled with concrete. *CONCRETE MUST BE PLACED IN THE DRY. UNDER NO CIRCUMSTANCES WILL TREMIE CONCRETE BE PERMITTED.*

.5 Where steel casings are used they shall be withdrawn as the concrete is deposited, keeping the concrete at a level above bottom of the sleeve.

.6 Vibrate top 3 M of concrete in shaft.

.7 Protect tops of piles against loss of moisture.

.8 Cold weather provisions of CAN/CSA A23.1-09 shall apply. Protect tops of piles against freezing during curing period with adequate insulation and covering. Provide supplementary heat as temperatures dictate.

.9 When concrete is being placed through a frozen ground surface, the diameter of the portion of the pile surface passing through the frozen ground shall be increased by 100 mm.

3.5 CUTOFF AND LENGTH

.1 Length of friction piles indicated on drawings to be from cutoff elevation.

END OF SECTION