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PWGSC Ontario  
Region Project  
Number R.048689.003

SPECIFICATION  
TITLE SHEET

Section 00 00 00  
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2012-08-10

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PROJECT TITLE                    KITCHEN REDEVELOPMENT  
    Bath Institution, Bath, Ontario

PROJECT NUMBER                R.048689.003

PROJECT DATE                    2012-08-10



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PART 1 - GENERAL

- 1.1 PRECEDENCE .1 For Federal Government projects, Division 01 Sections take precedence over technical specification sections in other Divisions of this Project Manual.
- 1.2 WORK COVERED BY CONTRACT DOCUMENTS .1 The Work of this Contract comprises the renovation of the existing kitchen facility of approximately 2050 sq.m. and the addition of approximately 210 sq.m. building at Bath Institution, Bath Ontario further identified as PWGSC Project Number R.048689.003.
- .2 The new addition is one storey.
- .3 The work includes the addition of a new loading dock and foundations for cooler/refrigeration units. Interior renovations will include the rough in and coordination for all new electrical and mechanical equipment for new kitchen equipment.
- 1.3 COST BREAKDOWN .1 Within 48 hours of notification of acceptance of bid furnish a cost breakdown by Section aggregating contract price.
- .2 Show separately cost of equipment purchased exempt from Ontario Retail Sales Tax under your Ontario Sales Tax licence number.
- .3 Within 48 hours of acceptance of bid submit a list of subcontractors.
- 1.4 WORK SEQUENCE .1 Construct the Work to facilitate the continuous use of the premises and to maintain security during construction.
- .2 Co-ordinate the Progress Schedule and coordinate with Owner occupancy during construction.
- .3 Do not close off public usage of facilities until, temporary kitchen facility is operational. Project will be broken into 3 phases; phase 1: Completion of the SGMP
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- 1.4 WORK SEQUENCE (Cont'd) .3  
(Cont'd)
- .3 addition, phase 2: Completion of the new inmate dining space, phase 3: completion of food service preparation space.
- .4 Maintain fire access/control.
- 1.5 OWNER OCCUPANCY.1
- .1 The Owner will occupy the premises during the entire construction period, a temporary kitchen will be provided under separate contract to facilitate the ongoing preparation of food for the Bath inmate population during kitchen renovations. The construction will need to be completed in 3 phases; phase 1 will complete the SGMP, phase 2 will complete the dining space, this work shall be completed prior to the start of other kitchen demolition and renovation and should be made operational and ready for occupancy prior to the start of the 3rd phase work that completes the new food preparation areas within the kitchen existing kitchen space.
- .2 Co-operate with the Owner in scheduling operations to minimize conflict and to facilitate the Owner's usage.
- 1.6 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING .1
- .1 Execute the Work with the least possible interference or disturbance to occupants, the public and normal use of the premises. Arrange with the Departmental Representative to facilitate the execution of the Work.
- .2 Remove and recycle, compost, anaerobic digest, sell material for reuse or dispose of:
- .1 Concrete
  - .2 Glass
  - .3 Metals
  - .4 Mechanical and electrical items as indicated.
- .3 Remove in good order, turn over to Department, and store at new location on Bath institution site where designated by Departmental Representative:
- .1 All existing kitchen equipment to be removed..
- .4 Provide new openings required in existing construction.
-

1.6 ALTERATIONS, .5 Block in openings where items removed with  
ADDITIONS OR material and finish to match existing  
REPAIRS TO EXISTING adjoining construction, or as indicated on  
BUILDING drawings.  
(Cont'd)

1.7 DOCUMENTS .1 Maintain at the job site, one copy each  
REQUIRED document as follows:  
.1 Contract Drawings.  
.2 Specifications.  
.3 Amenda.  
.4 Reviewed Shop Drawings.  
.5 List of Outstanding Shop Drawings.  
.6 Change Orders.  
.7 Other Modifications to Contract.  
.8 Field Test Reports.  
.9 Copy of Approved Work Schedule.  
.10 Health and Safety Plan and Other Safety  
Related Documents.  
.11 Other documents as specified.

PART 2 - PRODUCTS

2.1 NOT USED .1 Not used.

PART 3 - EXECUTION

3.1Not USED .1 Not used.





PART 1 - GENERAL

- 1.1 ACCESS AND EGRESS .1 Design, construct and maintain temporary "access to" and "egress from" work areas, including stairs, runways, ramps or ladders and scaffolding, independent of finished surfaces and in accordance with relevant municipal, provincial and other regulations.
- 1.2 USE OF SITE AND FACILITIES .1 Coordinate the use of the site with the Departmental Representative to conform to the security requirements specified in Section 01 35 13 - Special Procedures for Correctional Service Canada Security Requirements.
- .2 Execute work with least possible interference or disturbance to building operations, occupants, public and normal use of premises.
- .3 Limit the use of premises for the Work, for storage, and for access, to allow Owner-occupancy and to maintain security.
- .4 Maintain existing services to building and provide for personnel and vehicle access.
- .5 Keep within limits of work and avenues of ingress and egress.
- .6 Where security is reduced by work provide temporary means to maintain security.
- .7 Departmental Representative will assign sanitary facilities for use by Contractor's personnel. Keep facilities clean.
- .8 Closures: protect work temporarily until permanent enclosures are completed.
- .9 Obtain and pay for the use of additional storage or work areas needed for operations under this Contract.
- .10 Remove or alter existing work to prevent injury or damage to portions of the existing work which remain.
- .11 Repair or replace portions of the existing work which have been altered during construction operations to match existing or
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1.2 USE OF SITE AND FACILITIES  
(Cont'd)

.11 (Cont'd)  
adjoining work, as directed by the  
Departmental Representative.

- .12 At the completion of operations, the  
condition of existing work shall be equal to  
or better than that which existed before new  
work started.

1.3 EXISTING SERVICES

.1 Notify, Departmental Representative 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.  
Keep duration of interruptions minimum. Carry  
out interruptions after normal working hours  
of occupants, preferably on weekends.

.3 Provide for pedestrian and vehicular traffic.

.4 Construct barriers in accordance with Section  
01 56 00.

1.4 SECURITY

.1 Refer to Section 01 35 13.

1.5 BUILDING SMOKING ENVIRONMENT

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

1.6 OPERATIONAL RESTRICTIONS

.1 Perform the work with utmost regard to  
safety. Plan and schedule all work activities  
with this in mind. Do not disturb any portion  
of the site without providing temporary  
facilities as necessary to ensure safe and  
direct passage through disturbed or otherwise  
affected areas.

.2 Meet with the Departmental Representative on  
a weekly basis to identify intended work  
areas, activities and scheduling for the  
coming week.

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- 1.6 OPERATIONAL RESTRICTIONS (Cont'd) .3 See Section 01 35 13 in regards to the required security requirements during the work of this contract at the institution.
- .4 Ensure Contractor's personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.

PART 2 - PRODUCTS

- 2.1 NOT USED. .1 Not Used.

PART 3 - EXECUTION

- 3.1 NOT USED. .1 Not Used.



PART 1 - GENERAL

- 1.1 ADMINISTRATIVE
- .1 Schedule and administer project meetings at two-week intervals throughout the progress of the work and at the call of Departmental Representative.
  - .2 Prepare agenda for meetings.
  - .3 Distribute written notice of each meeting four business days in advance of meeting date to Departmental Representative.
  - .4 Provide physical space and make arrangements for meetings.
  - .5 Preside at meetings.
  - .6 Record the meeting minutes. Include significant proceedings and decisions. Identify actions by parties.
  - .7 Reproduce and distribute copies of minutes within three business days after meetings and transmit to meeting participants, affected parties not in attendance and Departmental Representative.
  - .8 Representative of Contractor, Subcontractors and Suppliers attending meetings shall be qualified and authorized to act on behalf of party each represents.
- 1.2 PRECONSTRUCTION MEETING
- .1 Within 5 business days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
  - .2 Senior representatives of Departmental Representative, Consultant, Contractor, major Subcontractors, field inspectors and supervisors shall be in attendance.
  - .3 Establish time and location of meeting and notify parties concerned minimum 5 business days before meeting.
  - .4 Incorporate mutually agreed variations to Contract Documents into Agreement, prior to signing.
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1.2 PRECONSTRUCTION .5  
MEETING  
(Cont'd)

Agenda to include:

- .1 Appointment of official representative of participants in the Work.
- .2 Schedule of Work: in accordance with Section 01 32 16.
- .3 Schedule of submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00.
- .4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences in accordance with Section 01 52 00.
- .5 Delivery schedule of specified equipment.

.6 Site security in accordance with Section 01 56 00.

.7 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.

.8 Owner provided products.

.9 Record drawings and maintenance manuals in accordance with Section 01 78 00.

.10 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00.

.11 Monthly progress claims, administrative procedures, photographs, hold backs.

.12 Appointment of inspection and testing agencies or firms.

.13 Insurances, transcript of policies.

1.3 PROGRESS  
MEETINGS

.1 During course of Work schedule progress meetings at 2 week intervals and at the call of the Departmental Representative.

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

.3 Establish the date of each meeting prior to the end of the preceding meeting. Notify parties not in attendance at the preceding meeting a minimum of 4 business days prior to the next meeting.

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1.3 PROGRESS  
MEETINGS  
(Cont'd)

- .4 If it is necessary to convene an emergency meeting, notify all parties a minimum of 4 business days prior to the meeting.
- .5 Record minutes of meetings and circulate to attending parties and affected parties not in attendance within 3 business days after meeting.
- .6 Agenda to include the following:
  - .1 Review, approval of minutes of previous meeting.
  - .2 Review of Work progress since previous meeting.
  - .3 Field observations, problems, conflicts.
  - .4 Problems which impede construction schedule.
  - .5 Review of off-site fabrication delivery schedules.
  - .6 Corrective measures and procedures to regain projected schedule.
  - .7 Revision to construction schedule.
  - .8 Progress schedule, during succeeding work period.
  - .9 Review submittal schedules: expedite as required.
  - .10 Maintenance of quality standards.
  - .11 Review proposed changes for affect on construction schedule and on completion date.
  - .12 Other business.

PART 2 - PRODUCTS

- 2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

- 3.1 NOT USED .1 Not Used.





PART 1 - GENERAL

- 1.1 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
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- 1.1 DEFINITIONS .9 (Cont'd)  
(Cont'd)  
monitoring of project work in relation to established milestones.
- 1.2 REQUIREMENTS .1 Schedule the work in cooperation with the Departmental Representative. The Departmental Representative's decision is final in regards to time and order of work. Incorporate within the Work Schedule, items identified by the Departmental Representative during review of the schedule.
- .2 The work schedule must take into consideration and reflect the work phasing, special conditions and operational restrictions set out below.
- .3 Ensure Master Plan and Detail Schedules are practical and remain within specified Contract duration.
- .4 Plan to complete Work in accordance with prescribed milestones and time frame.
- .5 Limit activity durations to maximum of approximately 10 working days, to allow for progress reporting.
- .6 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.
- .2 Submit to Departmental Representative within 5 working days of Award of Contract Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of project progress.
- .3 Submit Project Schedule to Departmental Representative within 5 working days of receipt of acceptance of Master Plan.
-

- 1.4 MASTER PLAN
- .1 Structure schedule to allow orderly planning, organizing and execution of Work as Bar Chart (GANTT).
  - .2 Departmental Representative will review and return revised schedules within 5 working days.
  - .3 Revise schedule and in accordance with Departmental Representative's recommendations and resubmit within 5 working days.
  - .4 Accepted revised schedule will become Master Plan and be used as baseline for updates.
- 1.5 PROJECT SCHEDULE
- .1 Develop detailed Project Schedule derived from Master Plan.
  - .2 Ensure detailed Project Schedule includes as minimum milestone and activity types as follows:
    - .1 Award.
    - .2 Shop Drawings, Samples.
    - .3 Permits.
    - .4 Mobilization.
    - .5 Hoarding.
    - .6 Excavation.
    - .7 Backfill.
    - .8 Building footings.
    - .9 Slab on grade.
    - .10 Structural Steel.
    - .11 Exterior Building Envelope (walls and roofing).
    - .12 Interior Architecture (Walls, Floors and Ceiling).
    - .13 Plumbing.
    - .14 Lighting.
    - .15 Electrical.
    - .16 Piping.
    - .17 Controls.
    - .18 Heating, Ventilating, and Air Conditioning.
    - .19 Millwork.
    - .20 Fire Systems.
    - .21 Testing and Commissioning.
    - .22 Supplied equipment long delivery items.
-

1.6 PROJECT SCHEDULE REPORTING .1 Update Project Schedule on weekly basis reflecting activity changes and completions, as well as activities in progress.

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

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

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

PART 2 - PRODUCTS

2.1 NOT USED .1 Not used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not used.

PART 1 - GENERAL

1.1 RELATED  
REQUIREMENTS

.1 Section 01 45 00 - Quality Control

1.2 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.
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- 1.2 ADMINISTRATIVE (Cont'd)
- .10 Keep one reviewed copy of each submission on site.
- .11 Submit number of hard copies specified for each type and format of submittal and in also submit in electronic format as pdf files. Forward pdf files on CD or through email.
- 1.3 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.
- .1 Where called for in the respective specification sections, submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .2 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.
- .3 Allow 10 days for Departmental Representative's review of each submission.
- .4 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.
- .5 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.
- .6 Accompany submissions with transmittal letter, in duplicate, containing:
- .1 Date.
  - .2 Project title and number.
  - .3 Contractor's name and address.
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- 1.3 SHOP DRAWINGS AND PRODUCT DATA  
(Cont'd)
- .6 (Cont'd)
- .4 Identification and quantity of each shop drawing, product data and sample.
- .5 Other pertinent data.
- .7 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.
- .8 After Departmental Representative's review, distribute copies.
- .9 Submit electronic copy and 1 print of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.
- .10 Submit electronic copy and 1 print 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.
- .11 Submit electronic copy and 1 print 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
-

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- 1.3 SHOP DRAWINGS .11 (Cont'd)  
AND PRODUCT DATA .1 (Cont'd)  
(Cont'd)
- 
- .2 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.
- .12 Submit electronic copy and 1 print 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.
- .13 Submit electronic copy and 1 print of manufacturers instructions for requirements requested in specification Sections and as requested by Departmental Representative.
- .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
- .14 Submit electronic copy and 1 print of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.
- .15 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .16 Submit electronic copy and 1 print 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
-



1.3 SHOP DRAWINGS  
AND PRODUCT DATA  
(Cont'd)

- .19 (Cont'd)  
only minor corrections are made, a noted copy 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 Public Works and Government Services Canada (PWGSC) is for sole purpose of ascertaining conformance with general concept.
- .1 This review shall not mean that PWGSC approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.
- .2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

1.4 SAMPLES

- .1 Submit for review samples in triplicate 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.

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- 1.4 SAMPLES  
(Cont'd)
- .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.
  - .8 Erect mock-ups in accordance with 01 45 00 - Quality Control.
- 1.5 PHOTOGRAPHIC DOCUMENTATION
- .1 Submit electronic and hard copy of colour digital photography in jpg format, fine resolution monthly with progress statement and as directed by Departmental Representative.
  - .2 Project identification: name and number of project and date of exposure indicated.
  - .3 Number of viewpoints: 12 locations.
    - .1 Viewpoints and their location as determined by Departmental Representative.
  - .4 Frequency of photographic documentation: as directed by Departmental Representative.
    - .1 Upon completion of: excavation, foundation, framing and services before concealment, and Work as directed by Departmental Representative.
- 1.6 CERTIFICATES AND TRANSCRIPTS
- .1 Immediately after award of Contract, submit Workers' Compensation Board Experience Report.
  - .2 Submit transcription of insurance immediately after award of Contract.
- 1.7 FEEES, PERMITS AND CERTIFICATES
- .1 Provide authorities having jurisdiction with information requested.
  - .2 Pay fees and obtain certificates and permits required.
  - .3 Furnish certificates and permits.
  - .4 Submit acceptable certificate stating that suspended ceiling systems provide adequate support for electrical fixtures, as required
-

1.7 FEES, PERMITS .4 (Cont'd)  
AND CERTIFICATES by current bulletin of Electrical Inspection  
(Cont'd) Department of Ontario Hydro.

PART 2 - PRODUCTS

2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not Used.



PART 1 - GENERAL

- 1.1 PURPOSE .1 To ensure that both the construction project and the institutional operations may proceed without undue disruption or hindrance and that the security of the Institution is maintained at all times.
- 1.2 DEFINITIONS .1 "Contraband" means:
- .1 An intoxicant, including alcoholic beverages, drugs and narcotics.
  - .2 A weapon or a component thereof, ammunition for a weapon, and anything that is designed to kill, injure or disable a person or that is altered so as to be capable of killing, injuring or disabling a person, when possessed without prior authorisation.
  - .3 An explosive or a bomb or a component thereof.
  - .4 Currency over any applicable prescribed limit (\$25.00) when possessed by an inmate without prior authorisation.
  - .5 Any item not described in paragraphs 1.2.1.1 to 1.2.1.4 that could jeopardize the security of a Penitentiary or the safety of persons, when that item is possessed without prior authorisation.
- .2 "Unauthorized Smoking and Related Items" means all smoking items including, but not limited to, cigarettes, cigars, tobacco, chewing tobacco, cigarette making machines, matches and lighters.
- .3 "Commercial Vehicle" means any motor vehicle used for the shipment of material, equipment and tools required for the construction project.
- .4 "CSC" means Correctional Service Canada.
- .5 "Director" means Director, Warden or Superintendent of the Institution as applicable.
- .6 "Construction Employees" means persons working for the General Contractor, the Subcontractors, equipment operators, material suppliers, testing and inspection companies and regulatory agencies.
-

- 1.2 DEFINITIONS (Cont'd)
- .7 "Departmental Representative". means the project manager from Public Works and Government Services Canada.
  - .8 "Perimeter" means the fenced or walled area of the Institution that restrains the movement of the inmates.
  - .9 "Construction Limits" means the area as shown on the contract drawings that the Contractor will be allowed to work in. This area may or may not be isolated from the security area of the Institution.
- 1.3 PRELIMINARY PROCEEDINGS
- .1 Prior to the commencement of work, the Contractor shall meet with the Director or his representative to:
    - .1 Discuss the nature and extent of all activities involved in the Project.
    - .2 Establish mutually acceptable security procedures in accordance with this instruction and the Institution's particular requirements.
  - .2 Contractor shall:
    - .1 Ensure that all Construction Employees are aware of the security requirements.
    - .2 Ensure that a copy of the security requirements is always prominently on display at the job site.
  - .3 Co-operate with institutional personnel in ensuring that security requirements are observed by all Construction Employees.
- 1.4 CONSTRUCTION EMPLOYEES
- .1 Submit to the Director a list of the names with date of birth of all Construction Employees on the construction site and a security clearance form for each employee.
  - .2 Allow two (2) weeks for processing of security clearances. Employees will not be admitted to the Institution without a valid security clearance in place and a recent picture identification such as a provincial driver's licence. Security clearances obtained from other CSC Institutions are not valid at this Institution.
  - .3 The Director may require that facial photographs may be taken of Construction
-

- 1.4 CONSTRUCTION EMPLOYEES  
(Cont'd)
- .3 (Cont'd)  
Employees and these photographs may be displayed at appropriate locations in the Institution or in an electronic database for identification purposes. The Director may require that these photographs be displayed prominently on the Construction Employees' clothing while employees are in the Institution.
- .4 Entry to Institutional Property will be refused to any person there may be reason to believe may be a security risk.
- .5 Any person employed on the construction site will be subject to immediate removal from Institutional Property if they:
- .1 Appear to be under the influence alcohol, drugs or narcotics.
  - .2 Behave in an unusual or disorderly manner.
  - .3 Are in possession of contraband.
- 1.5 VEHICLES
- .1 All unattended vehicles on CSC property shall have windows closed; doors and trunks shall be locked and keys removed. The keys shall be securely in the possession of the owner or an employee of the company that owns the vehicle.
- .2 The Director may limit at any time the number and type of vehicles allowed within the Institution.
- .3 Drivers of delivery vehicles for material required by the project will not require security clearances but must remain with their vehicle the entire time that the vehicle is in the Institution. The Director may require that these vehicles be escorted by Institutional Staff or Commissionaires while in the Institution.
- .4 If the Director permits trailers to be left inside the secure perimeter of the Institution, these trailer doors shall be locked at all times. All windows shall be securely locked when left unoccupied. All trailer windows shall be covered with expanded metal mesh. All storage trailers inside and outside the perimeter must be locked when not in use.
-

- 1.6 PARKING .1 Parking areas to be used by Construction Employees will be designated by the Director. Parking in other locations will be prohibited and vehicles may be subject to removal.
- 1.7 SHIPMENTS .1 All shipments of project material, equipment and tools shall be addressed in the Contractor's name to avoid confusion with the Institution's own shipments. The Contractor must have his/her own employees on site to receive any deliveries or shipments. CSC staff will NOT accept receipt of deliveries or shipments of any material equipment or tools.
- 1.8 TELEPHONES .1 The installation of telephones, facsimile machines and computers with internet connections requires the prior approval of the Director.
- .2 The Director will ensure that approved telephones, facsimile machine and computers with internet connections are located where they are not accessible to inmates. All computers shall have an approved password protection that will stop an internet connection to unauthorised personnel.
- .3 Wireless cellular and digital telephones, including but not limited to devices for telephone messaging, pagers, Blackberries, telephones used as 2-way radios are not permitted within the Institution unless approved by the Director. If wireless cellular telephones are permitted, the user shall not permit their use by any inmate.
- .4 The Director may approve but limit the use of 2-way radios.
- 1.9 WORK HOURS .1 Work hours within the Institution are: Monday to Friday 0800 hrs to 1600 hrs except as noted below.
- .2 Work hours at the Sally Port are: Monday to Thursday 0800 hrs to 1200 hrs, and 1230 hrs to 1600 hrs. Workers can access the site on foot through the front entrance.
-



- 1.9 WORK HOURS .3 Work will not be permitted during weekends and statutory holidays without the permission of the Director. A minimum of seven days advance notice will be required to obtain the required permission.  
(Cont'd)
- 1.10 OVERTIME WORK .1 No overtime work will be allowed without permission of the Director. Give a minimum forty-eight (48) hours advance notice when overtime work on the construction project is necessary and approved. If overtime work is required because of an emergency such the completion of a concrete pour or work to make the construction safe and secure, the Contractor shall advise the Director as soon as this condition is known and follow the directions given by the Director. After normal work hours, personnel shall leave the Institution by the North Gate. Costs to the Crown for such events may be attributed to the Contractor. When overtime work, weekend statutory holiday work is required and approved by the Director, extra staff members may be posted by the Director or his designate, to maintain the security surveillance. The Departmental Representative may post extra staff for inspection of construction activities. The actual cost of this extra staff may be subject to reclamation by the Crown.
- 1.11 TOOLS AND EQUIPMENT .1 Maintain a complete list of all tools and equipment to be used during the construction project. Make this inventory available for inspection when required.
- .2 Throughout the construction project maintain up-to-date the list of tools and equipment specified above.
- .3 Keep all tools and equipment under constant supervision, particularly power-driven tools, files, saw blades, rod saws, wire, rope, ladders and any sort of jacking device. Cartridge driven tools are not permitted.
- .4 Store all tools and equipment in approved secure locations. Tool storage will be allowed inside the heating plant in locked boxes.
-

1.11 TOOLS AND  
EQUIPMENT  
(Cont'd)

- .5 A large equipment and material storage container will be allowed outside the fence only, in a location across the road from the Sally Port or as directed by the departmental representative. This storage can be accessed during the day from the Sally Port.
- .6 Lock all tool boxes when not in use. Keys to remain in the possession of the employees of the Contractor. Scaffolding shall be secured and locked when not erected and when erected, must be secured in a manner agreed upon with the Director.
- .7 All missing or lost tools or equipment shall be reported immediately to the Director.
- .8 The Director will ensure that the security staff members carry out checks of the Contractor's tools and equipment against the list provided by the Contractor. These checks may be carried out at the following intervals:
  - .1 At the beginning and conclusion of every construction project. Weekly, when the construction project extends longer than a one week period.
- .9 Certain tools/equipment such as hacksaw blades are highly controlled items. The Contractor will be given at the beginning of the day, a quantity that will permit one day's work. Used blades shall be returned to the Director's representative at the end of each day.
- .10 If propane or natural gas is used for heating the construction, the Institution will require that an employee supervise the construction site during non-working hours.

1.12 KEYS

- .1 Security Hardware Keys:
  - .1 The Contractor shall arrange with the security hardware supplier/installer to have the keys for the security hardware to be delivered directly to Institution, specifically the Security Maintenance Officer (SMO). a minimum of 3 keys for each individule peice of hardware is required unless otherwise specified.

- 1.12 KEYS  
(Cont'd)
- .1 (Cont'd)
  - .2 The Security Maintenance Officer (SMO) will provide a receipt to the Contractor for security hardware keys.
  - .3 The Contractor shall provide a copy of the above-mentioned receipt to the Departmental Representative.
- .2 Other Keys:
- .1 The Contractor shall use standard construction cylinders for locks for his use during the construction period.
  - .2 The Contractor shall issue instructions to his employees and sub-trades, as necessary, to ensure safe custody of the set of construction keys.
  - .3 Upon completion of each phase of the construction, the CSC representative will, in conjunction with the lock manufacturer:
    - .1 Prepare an operational keying schedule.
    - .2 Accept the operational keys and cylinders directly from the lock manufacturer.
    - .3 Arrange for removal and return of the construction cores and install the operational core in all locks.
- .3 Upon putting operational security keys into use, the CSC construction escort shall obtain these keys as they are required from the Security Maintenance Officer (SMO) and open doors as required by the Contractor. The Contractor shall issue instructions to his employees advising them that all security keys shall always remain with the CSC construction escort.
- 1.13 SECURITY  
HARDWARE
- .1 Turn over all removed security hardware to the Director of the Institution for disposal or for safekeeping until required for re-installation.
- 1.14 PRESCRIPTION  
DRUGS
- .1 Employees of the Contractor who are required to take prescription drugs during the workday shall obtain approval of the Director to bring a one day supply only into the Institution.
-

1.15 SMOKING  
RESTRICTIONS

- .1 Contractors and Construction Employees are not permitted to smoke inside correctional facilities or outdoors within the perimeter of a correctional facility and must not possess unauthorised smoking items within the perimeter of a correctional facility.
- .2 Contractors and construction employees who are in violation of this policy will be requested to immediately cease smoking or dispose of any unauthorised smoking items and, if they persist, will be directed to leave the Institution.
- .3 Smoking is permitted only outside the perimeter of a correctional facility in an area to be designated by the Director.

1.16 CONTRABAND

- .1 Weapons, ammunition, explosives, alcoholic beverages, drugs and narcotics are prohibited on Institutional Property.
- .2 Discovery of Contraband on the site and the identification of the person(s) responsible for the Contraband shall be reported immediately to the Director.
- .3 Contractors shall be vigilant with both their staff and the staff of their Subcontractors and Suppliers that the discovery of Contraband may result in cancellation of the security clearance of the affected employee. Serious infractions may result in the removal of the company from the Institution for the duration of the construction.
- .4 Presence of arms and ammunition in vehicles of Contractors, Subcontractors and Suppliers or employees of these will result in the immediate cancellation of security clearances for the driver of the vehicle.

1.17 SEARCH

- .1 All vehicles and persons entering Institutional property may be subject to search.
  - .2 When the Director suspects, on reasonable grounds, that an employee of the Contractor is in possession of Contraband, he may order that person to be searched.
-

- 1.17 SEARCH (Cont'd) .3 All employees entering the Institution may be subject to screening of personal effects for traces of Contraband drug residue.
- 1.18 ACCESS TO AND REMOVAL FROM INSTITUTION PROPERTY .1 Construction personnel and commercial vehicles will not be admitted to the Institution after normal working hours, unless approved by the Director.
- 1.19 MOVEMENT OF VEHICLES .1 Escorted commercial vehicles will be allowed to enter or leave the Institution through the vehicle access gate during the following hours:  
.1 8:00 to 12:00 hours.  
.2 12:30 to 16:00 hours.
- .2 Construction vehicles shall not leave the Institution until an inmate count is completed.
- .3 The Contractor shall advise the Director twenty four (24) hours in advance of the arrival on the site of heavy equipment such as concrete trucks, cranes, etc.
- .4 Vehicles being loaded with soil or other debris, or any vehicle considered impossible to search, must be under continuous supervision by CSC Staff or Commissionaires working under the authority of the Director.
- .5 Commercial vehicles will be allowed access to Institutional Property only when their contents are certified by the Contractor or his/her representative as being strictly necessary to the execution of the construction project.
- .6 Vehicles will be refused access to Institutional Property if, in the opinion of the Director, they contain any article which may jeopardise the security of the Institution.
- .7 Private vehicles of Construction Employees will not be allowed within the security wall or fence of medium or maximum security Institutions without the permission of the Director.
-

- 1.19 MOVEMENT OF VEHICLES  
(Cont'd)
- .8 With prior approval of the Director, a vehicle may be used in the morning and evening to transport a group of employees to the work site. This vehicle will not remain within the Institution the remainder of the day.
- .9 With the approval of the Director, certain equipment may be permitted to remain on the construction site overnight or over the weekend. This equipment must be securely locked, with the battery removed. The Director may require that the equipment be secured with a chain and padlock to another solid object.
- 1.20 MOVEMENT OF CONSTRUCTION EMPLOYEES ON  
INSTITUTIONAL PROPERT
- .1 Subject to the requirements of good security, the Director will permit the Contractor and his employees as much freedom of action and y movement as is possible.
- .2 However, notwithstanding paragraph above, the Director may:
- .1 Prohibit or restrict access to any part of the Institution.
- .2 Require that in certain areas of the Institution, either during the entire construction project or at certain intervals, Construction Employees be allowed access only when accompanied by a member of the CSC security staff.
- .3 During the lunch and coffee/health breaks, all employees shall remain within the construction site. Employees are not permitted to eat in the officer's lounge and dining room.
- 1.21 SURVEILLANCE  
AND INSPECTION
- .1 Construction activities and all related movement of personnel and vehicles will be subject to surveillance and inspection by CSC security staff members to ensure that established security requirements are met.
- .2 CSC staff members will ensure that an understanding of the need to carry out surveillance and inspections, as specified above, is established among Construction Employees and maintained throughout the construction project.
-

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

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

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

PART 2 - PRODUCT

- 2.1 NOT USED.
- .1 Not used.

PART 3 - EXECUTION

3.1 NOT USED. .1 Not used.



PART 1 - GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA): Canada
  - .1 CSA S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.
- .2 National Building Code 2010 (NBC):
  - .1 NBC 2010, Division B, Part 8 Safety Measures at Construction and Demolition Sites.
- .3 National Fire Code 2010 (NFC):
  - .1 NFC 2010, Division B, Part 5 Hazardous Processes and Operations, subsection 5.6.1.3 Fire Safety Plan.
- .4 Province of Ontario:
  - .1 Occupational Health and Safety Act Revised Statutes of Ontario 1990, Chapter O.1 as amended, and Regulations for Construction Projects, O. Reg. 213/91 as amended.
  - .2 O. Reg. 490/09, Designated Substances.
  - .3 Workplace Safety and Insurance Act, 1997.
  - .4 Municipal statutes and authorities.
- .5 Treasury Board of Canada Secretariat (TBS):
  - .1 Treasury Board, Fire Protection Standard April 1, 2010  
[www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=17316&section=text](http://www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=17316&section=text).
- .6 Fire Commissioner of Canada (FCC):
  - .1 FC-301 Standard for Construction Operations, June 1982.
  - .2 FC-302 Standard for Welding and Cutting, June 1982.

Labour Program  
Fire Protection Engineering Services  
4900 Yonge Street 8th Floor  
North York, Ontario M2N 6A8

and copies may be obtained from:

Human Resources and Social Development Canada  
Labour Program  
Fire Protection Engineering Services  
Ottawa, Ontario K1A 0J2

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- 1.2 SUBMITTALS
- .1 Make submittals in accordance with Section 01 33 00.
  - .2 Submit site-specific Health and Safety Plan: Within 7 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
    - .1 Results of site specific safety hazard assessment.
    - .2 Results of safety and health risk or hazard analysis for site tasks and operations found in work plan.
    - .3 Measures and controls to be implemented to address identified safety hazards and risks.
    - .4 Provide a Fire Safety Plan, specific to the work location, in accordance with NBC, Division B, Article 8.1.1.3 prior to commencement of work. The plan shall be coordinated with, and integrated into, the existing Building, Facility, Tenant's Emergency Procedures and Evacuation Plan in place at the site. Departmental Representative will provide Building, Facility, Tenant's Emergency Procedures and Evacuation Plan. Deliver two copies of the Fire Safety Plan to the Departmental Representative not later than 14 days before commencing work.
    - .5 Contractor's and Sub-contractors' Safety Communication Plan.
    - .6 Contingency and Emergency Response Plan addressing standard operating procedures specific to the project site to be implemented during emergency situations. Coordinate plan with existing Building, Facility, Tenant's Emergency Response requirements and procedures provided by Departmental Representative.
  - .3 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 4 days after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative within 4 days after receipt of comments from Departmental Representative.
  - .4 Departmental Representative's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.
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- 1.2 SUBMITTALS  
(Cont'd)
- .5 Submit names of personnel and alternates responsible for site safety and health.
  - .6 Submit records of Contractor's Health and Safety meetings when requested.
  - .7 Submit 2 copies of Contractor's authorized representative's work site health and safety inspection reports to Departmental Representative, weekly.
  - .8 Submit copies of orders, directions or reports issued by health and safety inspectors of the authorities having jurisdiction.
  - .9 Submit copies of incident and accident reports.
  - .10 Submit Material Safety Data Sheets (MSDS).
  - .11 Submit Workplace Safety and Insurance Board (WSIB)- Experience Rating Report.
- 1.3 FILING OF NOTICE
- .1 File Notice of Project with Provincial authorities prior to commencement of Work.
- 1.4 WORK PERMIT
- .1 Obtain building permits related to project prior to commencement of Work.
  - .2 Obtain Hot Work Permit from Works Department.
- 1.5 SAFETY ASSESSMENT
- .1 Perform site specific safety hazard assessment related to project.
- 1.6 MEETINGS
- .1 Schedule and administer Health and Safety meeting with Departmental Representative prior to commencement of Work.
- 1.7 REGULATORY REQUIREMENTS
- .1 Comply with the Acts and regulations of the Province of Ontario.
  - .2 Comply with specified standards and regulations to ensure safe operations at site.
-

1.8 GENERAL  
REQUIREMENTS

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

1.9 COMPLIANCE  
REQUIREMENTS

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

1.10 RESPONSIBILITY

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

1.11 UNFORSEEN  
HAZARDS

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

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- 1.11 UNFORSEEN HAZARDS  
(Cont'd) .2 Follow procedures in place for Employees Right to Refuse Work as specified in the Occupational Health and Safety Act for the Province of Ontario.
- 1.12 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 abatement of lead and asbestos containing materials.
  - .2 Have working knowledge of occupational safety and health regulations.
  - .3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.
  - .4 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.
  - .5 Be on site during execution of Work and report directly to and be under direction of site supervisor.
- 1.13 POSTING OF DOCUMENTS .1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Province of Ontario, and in consultation with Departmental Representative.
- .1 Contractor's Safety Policy.
  - .2 Constructor's Name.
  - .3 Notice of Project.
  - .4 Name, trade, and employer of Health and Safety Representative or Joint Health and Safety Committee members (if applicable).
  - .5 Ministry of Labour Orders and reports.
  - .6 Occupational Health and Safety Act and Regulations for Construction Projects for Province of Ontario.
  - .7 Address and phone number of nearest Ministry of Labour office.
  - .8 Material Safety Data Sheets.
  - .9 Written Emergency Response Plan.
  - .10 Site Specific Safety Plan.
  - .11 Valid certificate of first aider on duty.
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- 1.13 POSTING OF DOCUMENTS  
(Cont'd)
- .1 (Cont'd)  
.12 WSIB "In Case of Injury At Work" poster.  
.13 Location of toilet and cleanup facilities.
- 1.14 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.
- 1.15 BLASTING
- .1 Blasting or other use of explosives is not permitted.
- 1.16 POWDER ACTUATED DEVICES
- .1 Use powder actuated devices only after receipt of written permission from Departmental Representative.
- 1.17 WORK STOPPAGE
- .1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.
- .2 Assign responsibility and obligation to Health and Safety Coordinator to stop or start Work when, at Health and Safety Coordinator's discretion, it is necessary or advisable for reasons of health or safety. Departmental Representative may also stop Work for health and safety considerations.
-

PART 2 - PRODUCTS

2.1 NOT USED .1 Not used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not used.





PART 1 - GENERAL

- 1.1 DEFINITIONS .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade environment aesthetically, culturally and/or historically.
- .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction. Control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS .1 Provide submittals in accordance with Section 01 33 00.
- .2 Prior to commencing construction activities or delivery of materials to site, provide Environmental Protection Plan for review and approval by Departmental Representative.
- .3 Ensure Environmental Protection Plan includes comprehensive overview of known or potential environmental issues to be addressed during construction.
- .4 Address topics at level of detail commensurate with environmental issue and required construction tasks.
- .5 Include in Environmental Protection Plan:
- .1 Name of person responsible for ensuring adherence to Environmental Protection Plan.
  - .2 Name and qualifications of person responsible for manifesting hazardous waste to be removed from site.
  - .3 Names and qualifications of person responsible for training site personnel.
  - .4 Descriptions of environmental protection personnel training program.
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1.2 ACTION AND  
INFORMATIONAL  
SUBMITTALS  
(Cont'd)

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- .5 (Cont'd)
- .5 Erosion and sediment control plan identifying type and location of erosion and sediment controls to be provided including monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.
- .6 Drawings showing locations of proposed excavations, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on site.
- .7 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use. Ensure plan includes measures for marking limits of use areas and methods for protection of features to be preserved within authorized work areas.
- .8 Spill Control Plan including procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.
- .9 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.
- .10 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, are contained on project site.
- .11 Contaminant Prevention Plan identifying potentially hazardous substances to be used on job site; intended actions to prevent introduction of such materials into air, water, or ground; and detailing provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.
- .12 Waste Water Management Plan identifying methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines.
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- 1.2 ACTION AND INFORMATIONAL SUBMITTALS (Cont'd)
- .13 Historical, archaeological, cultural resources plan that defines procedures for identifying and protecting historical, archaeological, cultural resources.
- 1.3 FIRES
- .1 Fires and burning of rubbish on site not permitted.
- 1.4 DRAINAGE
- .1 Provide Storm Water Pollution Prevention Plan (SWPPP).
- .2 Provide temporary drainage and pumping required to keep excavations and site free from water.
- .3 Ensure pumped water into waterways, sewer or drainage systems is free of suspended materials.
- .4 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.
- 1.5 POLLUTION CONTROL
- .1 Maintain temporary erosion and pollution control features installed under this Contract.
- .2 Control emissions from equipment and plant to local authorities' emission requirements.
- .3 Prevent extraneous materials from contaminating air and waterways beyond application area.
- .1 Provide temporary enclosures where directed by Departmental Representative.
- .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for roads.
- 1.6 HISTORICAL/ ARCHEOLOGICAL CONTROL
- .1 Provide historical, archaeological and cultural resources plan that defines procedures for identifying and protecting historical, archaeological and cultural resources known to be on project site: and/or identifies procedures to be followed if
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- 1.6 HISTORICAL/  
ARCHEOLOGICAL CONTROL  
(Cont'd)
- .1 (Cont'd)  
historical archaeological or cultural  
resources not previously known to be onsite or  
in area are discovered during construction.
  - .2 Plan: include methods to assure protection of  
known or discovered resources and identify  
lines of communication between Contractor  
personnel and Departmental Representative.
- 1.7 NOTIFICATION
- .1 Departmental Representative will notify  
Contractor in writing of observed  
noncompliance with Federal, Provincial or  
Municipal environmental laws or regulations,  
permits, and other elements of Contractor's  
Environmental Protection plan.
  - .2 Contractor: after receipt of such notice,  
inform Departmental Representative of proposed  
corrective action and take such action for  
approval by Departmental Representative.
    - .1 Do not take action until after receipt  
of written approval by Departmental  
Representative.
  - .3 Departmental Representative will issue stop  
order of work until satisfactory corrective  
action has been taken.
  - .4 No time extensions granted or equitable  
adjustments allowed to Contractor for such  
suspensions.

PART 2 PRODUCTS

- 2.1 NOT USED
- .1 Not Used.
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PART 3 - EXECUTION

- 3.1 CLEANING
- .1 Clean in accordance with Section 01 74 11.
  - .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
  - .3 Do not bury rubbish and waste materials on site.
  - .4 Ensure public waterways, storm and sanitary sewers remain free of waste and volatile materials disposal.



PART 1 - GENERAL

- 1.1 INSPECTION
- .1 Allow Departmental Representative access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
  - .2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Departmental Representative instructions, or law of Place of Work.
  - .3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.
  - .4 Departmental Representative 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 will pay cost of examination and replacement.
- 1.2 INDEPENDENT INSPECTION AGENCIES
- .1 Independent Inspection/Testing Agencies will be engaged by Departmental Representative for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by Departmental Representative.
  - .2 Provide equipment required for executing inspection and testing by appointed agencies.
  - .3 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
  - .4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Departmental Representative at no cost to
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- 1.2 INDEPENDENT INSPECTION AGENCIES (Cont'd) .4 (Cont'd)  
Departmental Representative. Pay costs for retesting and reinspection.
- 1.3 ACCESS TO WORK .1 Allow inspection/testing agencies access to Work, off site manufacturing and fabrication plants.
- .2 Co-operate to provide reasonable facilities for such access.
- 1.4 PROCEDURES .1 Notify appropriate agency and Departmental Representative in advance of requirement for tests, in order that attendance arrangements can be made.
- .2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in Work.
- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.
- 1.5 REJECTED WORK .1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Departmental Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .2 Make good other Contractor's work damaged by such removals or replacements promptly.
- .3 If in opinion of Departmental Representative it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Departmental Representative 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.
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- 1.6 REPORTS
- .1 Submit 4 copies of inspection and test reports to Departmental Representative.
  - .2 Provide copies to subcontractor of work being inspected or tested and/or manufacturer or fabricator of material being inspected or tested as applicable.
- 1.7 TESTS AND MIX DESIGNS
- .1 Furnish test results and mix designs as requested.
  - .2 Cost of tests and mix designs beyond those called for in Contract Documents or beyond those required by law of Place of Work will be appraised by Departmental Representative and may be authorized as recoverable.
- 1.8 MOCK-UPS
- .1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of Sections required to provide complete mock-ups.
  - .2 Construct in locations acceptable to Departmental Representative.
  - .3 Prepare mock-ups for Departmental Representative review with reasonable promptness and in orderly sequence, to not cause delays in Work.
  - .4 Failure to prepare mock-ups in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
  - .5 If requested, Departmental Representative will assist in preparing schedule fixing dates for preparation.
  - .6 Specification section identifies whether mock-up may remain as part of Work or if it is to be removed and when.
- 1.9 MILL TESTS
- .1 Submit mill test certificates as required of specification Sections.
-

- 1.10 EQUIPMENT AND SYSTEMS .1 Submit adjustment and balancing reports for mechanical, electrical and building equipment systems.
- .2 Refer to mechanical and electrical specifications for definitive requirements.

PART 2 - PRODUCTS

- 2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

- 3.1 NOT USED .1 Not Used.

PART 1 - GENERAL

- 1.1 INSTALLATION AND REMOVAL .1 Provide temporary utilities controls in order to execute work expeditiously.
- .2 Remove from site all such work after use.
- 1.2 DEWATERING .1 Provide temporary drainage and pumping facilities to keep excavations and site free from standing water.
- 1.3 WATER SUPPLY .1 Contractor to provide supply of potable water for construction use, no water will be provided by the institution.
- 1.4 TEMPORARY HEATING AND VENTILATION .1 Provide temporary heating required during construction period, including attendance, maintenance and fuel.
- .2 Construction heaters used inside building must be vented to outside or be non-flameless type. Solid fuel salamanders are not permitted.
- .3 Provide temporary heat and ventilation in enclosed areas as required to:
- .1 Facilitate progress of Work.
- .2 Protect Work and products against dampness and cold.
- .3 Prevent moisture condensation on surfaces.
- .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
- .5 Provide adequate ventilation to meet health regulations for safe working environment.
- .4 Maintain temperatures of minimum 10 degrees C in areas where construction is in progress.
- .5 Ventilating:
- .1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.
- .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous



1.5 TEMPORARY POWER.2  
AND LIGHT  
(Cont'd)

Arrange for connection with appropriate utility company. Pay costs for installation, maintenance and removal.

- .3 Temporary power for equipment requiring in excess of above is responsibility of the Contractor.
- .4 Provide and maintain temporary lighting throughout project. Ensure level of illumination on all floors and stairs is not less than 162 lx.
- .5 Electrical power and lighting systems installed under this Contract may be used for construction requirements only with prior approval of Departmental Representative provided that guarantees are not affected. Make good damage to electrical system caused by use under this Contract. Replace lamps which have been used for more than 3 months.

1.6 FIRE PROTECTION.1

Provide and maintain temporary fire protection equipment during performance of Work required by insurance companies having jurisdiction and governing codes, regulations and bylaws.

- .2 Burning rubbish and construction waste materials is not permitted on site.

PART 2 - PRODUCTS

2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not Used.



PART 1 - GENERAL

1.1 REFERENCES

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

1.1 SUBMITTALS

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

1.2 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.

- 1.2 INSTALLATION AND REMOVAL (Cont'd) .5 Remove from site all such work after use.
- 1.3 SCAFFOLD .1 Scaffolding in accordance with CAN/CSA-S269.2.
- .2 Provide and maintain scaffolding ramps ladders and platforms.
- 1.4 HOISTING .1 Provide, operate and maintain hoists required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for their use of hoists.
- .2 Hoists to be operated by qualified operator.
- 1.5 SITE STORAGE/LOADING .1 Confine work and operations of employees to areas designated by Contract Documents and as directed by the Departmental Representative. 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.
- 1.6 CONSTRUCTION PARKING .1 Parking will be permitted on site only in areas designated by the Departmental Representative.
- .2 Provide and maintain adequate access to project site.
- 1.7 SECURITY .1 Provide and pay for responsible security personnel to guard site and contents of site after working hours and during holidays.
- 1.8 OFFICES .1 Provide office heated to 22 degrees C, lighted 750 lx and ventilated, of sufficient size to accommodate site meetings and furnished with drawing laydown table.
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|---|----|--|
| <u>1.8 OFFICES<br/>(Cont'd)</u>                           | .2 | Provide marked and fully stocked first-aid case in a readily available location.   |
| <br>  |    |  |
| <u>1.9 EQUIPMENT,<br/>TOOL AND MATERIALS<br/>STORAGE</u>  | .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.   |
|   | .3 | The Departmental Representative will designate location of sheds and materials storage areas.  |
| <br>  |    |  |
| <u>1.10 SANITARY<br/>FACILITIES</u>                       | .1 | Provide sanitary facilities for work force in accordance with governing regulations and ordinances.  |
|   | .2 | Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.   |
| <br>  |    |  |
| <u>1.11 CONSTRUCTION<br/>SIGNAGE</u>                      | .1 | No signs or advertisements, other than warning signs, are permitted on site.   |
|   | .2 | Signs and notices for safety and instruction in both official languages Graphic symbols to CAN/CSA-Z321.   |
|   | .3 | Maintain approved signs and notices in good condition for duration of project, and dispose of off site on completion of project or earlier if directed by Departmental Representative. |
| <br>  |    |  |
| <u>1.12 PROTECTION AND<br/>MAINTENANCE OF<br/>TRAFFIC</u> | .1 | Provide access and temporary relocated roads as necessary to maintain traffic.   |
|   | .2 | Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by Departmental Representative.                                    |
|   | .3 | Provide measures for protection and diversion of traffic, including provision of watch-persons and flag-persons, erection of   |
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1.12 PROTECTION AND MAINTENANCE OF TRAFFIC  
(Cont'd)

(Cont'd)  
barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs

- .4 Protect travelling public from damage to person and property.
- .5 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.
- .6 CSC patrol vehicles shall have priority over construction vehicles, equipment, and personnel at all times.
- .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.
- .9 Dust control: adequate to ensure safe operation at all times.
- .10 Provide snow removal during period of Work.

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.
- .3 Store materials resulting from demolition activities that are salvageable.
- .4 Stack stored new or salvaged material not in construction facilities.
- .5 Locate stored materials where designated by the Departmental Representative.

PART 2 - PRODUCTS

2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not Used.



PART 1 - GENERAL

- 1.1 REFERENCES .1 Master Painters Institute (MPI):
- .1 MPI Architectural Specification Manual, (referred to herein as "MPI Manual")
  - .2 MPI Green Standard Products List - products meeting the following performance standards:
    - .1 MPI GPS-1, MPI Green Performance Standard.
    - .2 MPI GPS-2, MPI Green Performance Standard.
  - .2 Canadian Standards Association (CSA International)
    - .1 CSA-O121-08, Douglas Fir Plywood.
- 1.2 INSTALLATION AND REMOVAL .1 Provide temporary controls in order to execute Work expeditiously.
- .2 Remove from site all such work after use.
- 1.3 HOARDING .1 Erect a temporary site enclosure where indicated using a 2.4 m high steel, modular, temporary construction fence system. Provide a lockable truck gate and a pedestrian door as directed and conforming to applicable traffic restrictions on adjacent streets. Equip gates with locks and keys. Maintain fence in good repair.
- .2 Provide barriers around trees and plants designated to remain. Protect from damage by equipment and construction procedures.
- 1.4 GUARD RAILS AND BARRICADES .1 Provide secure, rigid guard rails and barricades around deep excavations.
- .2 Provide as required by governing authorities.
- 1.5 WEATHER ENCLOSURES .1 Provide weather tight closures to unfinished door and window openings, and other openings.
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- 1.5 WEATHER ENCLOSURES (Cont'd) .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.
- 1.6 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. Coordinate with the Departmental Representative to maintain security.
- .2 Maintain and relocate protection until such work is complete.
- 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 20.
-

PART 2 - PRODUCTS

2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not Used.





PART 1 - GENERAL

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

1.2 QUALITY  
(Cont'd)

- .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 and other products where specified in the respective specification sections 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 to comply 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.
-

- 1.11 FASTENINGS (Cont'd) .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 and pedestrian and vehicular traffic.
- .2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.
-

PART 2 - PRODUCTS

2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not Used.

PART 1 - GENERAL

- 1.1 SURVEY REQUIREMENTS
- .1 Establish lines and levels, locate and lay out, by instrumentation.
  - .2 Stake for grading and fill placement.
  - .3 Establish pipe invert elevations.
  - .4 Stake batter boards for foundations.
  - .5 Establish foundation and floor elevations.
  - .6 Establish lines and levels for mechanical and electrical work.
- 1.2 EXISTING SERVICES
- .1 Before commencing work, establish location and extent of service lines in area of Work and notify Departmental Representative of findings.
  - .2 Remove abandoned service lines within 2 m of structures. Cap or otherwise seal lines at cut-off points as directed by Departmental Representative.
- 1.3 LOCATION OF EQUIPMENT AND FIXTURES
- .1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.
  - .2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.
  - .3 Inform Departmental Representative of impending installation and obtain approval for actual location.
  - .4 Submit field drawings to indicate relative position of various services and equipment when required by Departmental Representative.
-

- 1.4 RECORDS
- .1 Maintain a complete, accurate log of control and survey work as it progresses.
  - .2 On completion of foundations and major site improvements, prepare a certified survey showing dimensions, locations, angles and elevations of Work.
  - .3 Record locations of maintained, re-routed and abandoned service lines.
- 1.5 SUBMITTALS
- .1 Submit name and address of Surveyor to Departmental Representative.
  - .2 On request of Departmental Representative submit documentation to verify accuracy of field engineering work.
  - .3 Submit certificate signed by surveyor certifying and noting those elevations and locations of completed Work that conform and do not conform with Contract Documents.
- 1.6 SUBSURFACE CONDITIONS
- .1 Promptly notify Consultant in writing if subsurface conditions at Place of Work differ materially from those indicated in Contract Documents, or a reasonable assumption of probable conditions based thereon.
  - .2 After prompt investigation, should Consultant determine that conditions do differ materially, instructions will be issued for changes in Work as provided in Changes and Change Orders.



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 MATERIALS
- .1 Required for original installation.
  - .2 Change in Materials: Submit request for substitution in accordance with Section 01 33 00 - Submittal Procedures.
- 1.3 PREPARATION
- .1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
  - .2 After uncovering, inspect conditions affecting performance of Work.
  - .3 Beginning of cutting or patching means acceptance of existing conditions.
-

- 
- 1.3 PREPARATION  
(Cont'd)
- .4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.
- .5 Provide protection from elements for areas which are to be exposed by uncovering work; maintain excavations free of water.
- 1.4 EXECUTION
- .1 Execute cutting, fitting, and patching including excavation and fill, as required 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 Remove samples of installed Work for testing.
- .6 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.
- .7 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.
- .8 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
- .9 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.
- .10 Restore work with new products in accordance with requirements of Contract Documents.
- .11 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .12 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.
-

- 1.4 EXECUTION                      .13    Conceal pipes, ducts and wiring in floor,  
(Cont'd)
- 1.5 WASTE                              .1      Separate waste materials for reuse and  
MANAGEMENT AND                      recycling in accordance with Section 01 74 20.  
DISPOSAL

PART 2 - PRODUCTS

- 2.1 NOT USED                      .1      Not Used.

PART 3 - EXECUTION

- 3.1 NOT USED                      .1      Not Used.



PART 1 - GENERAL

1.1 PROJECT  
CLEANLINESS

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris, including that caused by Owner or other Contractors.
  - .2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site.
  - .3 Ensure all sidewalks and roadways between the main parking lot and the temporary entrance are kept clear of dirt, mud and debris. Clean at least once per day, more often if directed by the Departmental Representative.
  - .4 Clear snow and ice from access to building, bank/pile snow in designated areas only.
  - .5 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
  - .6 Provide on-site dump containers for collection of waste materials and debris.
  - .7 Provide and use marked separate bins for recycling. Refer to Section 01 74 20.
  - .8 Dispose of waste materials and debris off site.
  - .9 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.
  - .10 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
  - .11 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
  - .12 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
-

1.1 PROJECT  
CLEANLINESS  
(Cont'd)

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

1.2 FINAL CLEANING

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- .1 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
  - .2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
  - .3 Prior to final review remove surplus products, tools, construction machinery and equipment.
  - .4 Remove waste products and debris.
  - .5 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site.
  - .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
  - .7 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.
  - .8 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, floors and ceilings.
  - .9 Clean lighting reflectors, lenses, and other lighting surfaces.
  - .10 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
  - .11 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.
  - .12 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
-

- 1.2 FINAL CLEANING (Cont'd)
- .13 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
  - .14 Remove dirt and other disfiguration from exterior surfaces.
  - .15 Clean and sweep roofs, gutters, areaways, and sunken wells.
  - .16 Sweep and wash clean paved areas.
  - .17 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.
  - .18 Clean roofs, downspouts, and drainage systems.
  - .19 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.
  - .20 Remove snow and ice from access to building.
- 1.3 WASTE MANAGEMENT AND DISPOSAL
- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

PART 2 - PRODUCTS

- 2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

- 3.1 NOT USED .1 Not Used.





PART 1 - GENERAL

- 1.1 CONSTRUCTION & DEMOLITION WASTE
- .1 Carefully deconstruct and source separate materials/equipment and divert, from D&C waste destined for landfill to maximum extent possible. Target for this project is 50% diversion from landfill. Reuse, recycle, compost, anaerobic digest or sell material for reuse except where indicated otherwise. On site sales are not permitted.
  - .2 Source separate waste and maintain waste audits in accordance with the Environmental Protection Act, Ontario Regulation 102/94 and Ontario Regulation 103/94.
    - .1 Provide facilities for collection, handling and storage of source separated wastes.
    - .2 Source separate the following waste:
      - .1 Brick and portland cement concrete.
      - .2 Corrugated cardboard.
      - .3 Wood, not including painted or treated wood or laminated wood.
      - .4 Gypsum board, unpainted.
      - .5 Steel.
  - .3 Submit a waste reduction workplan indicating the materials and quantities of material that will be recycled and diverted from landfill.
    - .1 Indicate how material being removed from the site will be reused, recycled, composted or anaerobically digested.
  - .4 Submit proof that all waste is being disposed of at a licensed land fill site or waste transfer site. A copy of the disposal/waste transfer site's license and a letter verifying that said landfill site will accept the waste must be supplied to Departmental Representative prior to removal of waste from the demolition site.
- 1.2 WASTE PROCESSING SITES
- .1 Province of: Ontario.
    - .1 Ministry of Environment and Energy, 135 St. Clair Avenue West, Toronto, ON, M4V 1P5.
    - .2 Telephone: 800-565-4923 or 416-323-4321.
    - .3 Fax: 416-323-4682.
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1.2 WASTE .2 Recycling Council of Ontario: 215 Spadina  
PROCESSING SITES Avenue, #225, Toronto, ON, M5T 2C7.  
(Cont'd) .1 Telephone: 416-657-2797  
.2 Fax: 416-960-8053  
.3 Email: rco@rco.on.ca.  
.4 Internet: http://www.rco.on.ca/.

PART 2 - PRODUCTS

2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

3.1 CANADIAN .1 Government Chief Responsibility for the  
GOVERNMENTAL Environment.  
DEPARTMENTS CHIEF  
RESPONSIBILITY FOR  
THE ENVIRONMENT

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

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS .1 Section 01 74 11 - Cleaning.

1.2 ADMINISTRATIVE REQUIREMENTS .1 Acceptance of Work Procedures:

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

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- 1.2 ADMINISTRATIVE REQUIREMENTS .1 (Cont'd)  
(Cont'd)
- .6 Final Inspection:(Cont'd)  
.1 (Cont'd)  
Departmental Representative and Contractor.  
.2 When Work is incomplete according to Departmental Representative complete outstanding items and request re-inspection.
- 1.3 FINAL CLEANING .1 Clean in accordance with Section 01 74 11 - Cleaning.  
.1 Remove surplus materials, excess materials, rubbish, tools and equipment.  
.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

PART 2 - PRODUCTS

- 2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

- 3.1 NOT USED .1 Not Used.

PART 1 - GENERAL

- 1.1 RELATED REQUIREMENTS
- .1 Section 01 79 00 - Demonstration and Training
  - .2 Section 01 91 00 - General Commissioning (Cx) Requirements
- 1.2 ADMINISTRATIVE REQUIREMENTS
- .1 Pre-warranty Meeting:
    - .1 Convene meeting one week prior to contract completion with Contractor's representative and Departmental Representative in accordance with Section 01 31 19 - Project Meetings to:
      - .1 Verify Project requirements.
      - .2 Review manufacturer installation instructions and warranty requirements.
    - .2 Departmental Representative to establish communication procedures for:
      - .1 Notifying construction warranty defects.
      - .2 Determine priorities for type of defects.
      - .3 Determine reasonable response time.
    - .3 Contact information for bonded and licensed company for warranty work action: provide name, telephone number and address of company authorized for construction warranty work action.
    - .4 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work action.
- 1.3 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Two weeks prior to Substantial Performance of the Work, submit to the Departmental Representative four final copies of operating and maintenance manuals in English as well as 1 digital copy of all material found in the operating and maintenance manuals on a CD.
  - .3 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.

1.3 ACTION AND  
INFORMATIONAL  
SUBMITTALS  
(Cont'd)

- .4 Provide evidence, if requested, for type, source and quality of products supplied.

1.4 FORMAT

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

1.5 CONTENTS -  
PROJECT RECORD  
DOCUMENTS

- .1 Table of Contents for Each Volume: provide title of project;
  - .1 Date of submission; names.
  - .2 Addresses, and telephone numbers of Consultant and Contractor with names of responsible parties.
  - .3 Schedule of products and systems, indexed to content of volume.

1.5 CONTENTS -  
PROJECT RECORD  
DOCUMENTS  
(Cont'd)

- .2 For each product or system:
  - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
  - .3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
  - .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
  - .5 Typewritten Text: as required to supplement product data.
    - .1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00.
  - .6 Training: refer to Section 01 79 00.

1.6 AS-BUILT  
DOCUMENTS AND  
SAMPLES

- .1 Maintain, at site for Departmental Representative one record copy of:
    - .1 Contract Drawings.
    - .2 Specifications.
    - .3 Amendments.
    - .4 Change Orders and other modifications to Contract.
    - .5 Reviewed shop drawings, product data, and samples.
    - .6 Field test records.
    - .7 Inspection certificates.
    - .8 Manufacturer's certificates.
  - .2 Store record documents and samples in field office apart from documents used for construction.
    - .1 Provide files, racks, and secure storage.
  - .3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual.
    - .1 Label each document "PROJECT RECORD" in neat, large, printed letters.
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- 1.7 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS  
(Cont'd)
- .6 Other Documents:(Cont'd)  
field test records, required by individual specifications sections.
  - .7 Provide digital photos, if requested, for site records.
- 1.8 FINAL SURVEY
- .1 Submit final site survey certificate in accordance with Section 01 71 00, certifying that elevations and locations of completed Work are in conformance, or non-conformance with Contract Documents.
- 1.9 EQUIPMENT AND SYSTEMS
- .1 For each item of equipment and each system include description of unit or system, and component parts.
    - .1 Give function, normal operation characteristics and limiting conditions.
    - .2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
  - .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
  - .3 Include installed colour coded wiring diagrams.
  - .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.
    - .1 Include regulation, control, stopping, shut-down, and emergency instructions.
    - .2 Include summer, winter, and any special operating instructions.
  - .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
  - .6 Provide servicing and lubrication schedule, and list of lubricants required.
  - .7 Include manufacturer's printed operation and maintenance instructions.
-



- 
- 1.11 MAINTENANCE MATERIALS .1 Spare Parts:
- .1 Provide spare parts, in quantities specified in individual specification sections.
  - .2 Provide items of same manufacture and quality as items in Work.
  - .3 Deliver to site location as directed; place and store.
  - .4 Receive and catalogue items.
    - .1 Submit inventory listing to Departmental Representative.
    - .2 Include approved listings in Maintenance Manual.
  - .5 Obtain receipt for delivered products and submit prior to final payment.
- .2 Extra Stock Materials:
- .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
  - .2 Provide items of same manufacture and quality as items in Work.
  - .3 Deliver to site location as directed; place and store.
  - .4 Receive and catalogue items.
    - .1 Submit inventory listing to Departmental Representative.
    - .2 Include approved listings in Maintenance Manual.
  - .5 Obtain receipt for delivered products and submit prior to final payment.
- .3 Special Tools:
- .1 Provide special tools, in quantities specified in individual specification section.
  - .2 Provide items with tags identifying their associated function and equipment.
  - .3 Deliver to site location as directed; place and store.
  - .4 Receive and catalogue items.
    - .1 Submit inventory listing to Departmental Representative.
    - .2 Include approved listings in Maintenance Manual.
- 1.12 DELIVERY, STORAGE AND HANDLING .1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.
- .2 Store in original and undamaged condition with manufacturer's seal and labels intact.
-



1.13 WARRANTIES AND .7  
BONDS  
(Cont'd)

Except for items put into use with Departmental Representative's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.

.8 Conduct joint 4 month and 9 month warranty inspection, measured from time of acceptance, by Departmental Representative.

.9 Include information contained in warranty management plan as follows:

.1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, subcontractors, manufacturers or suppliers involved.

.2 Listing and status of delivery of Certificates of Warranty for extended warranty items, to include roofs, and commissioned systems such as fire protection, alarm systems, sprinkler systems, lightning protection systems,.

.3 Provide list for each warranted equipment, item, feature of construction or system indicating:

.1 Name of item.

.2 Model and serial numbers.

.3 Location where installed.

.4 Name and phone numbers of manufacturers or suppliers.

.5 Names, addresses and telephone numbers of sources of spare parts.

.6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.

.7 Cross-reference to warranty certificates as applicable.

.8 Starting point and duration of warranty period.

.9 Summary of maintenance procedures required to continue warranty in force.

.10 Cross-Reference to specific pertinent Operation and Maintenance manuals.

.11 Organization, names and phone numbers of persons to call for warranty service.

.12 Typical response time and repair time expected for various warranted equipment.

1.13 WARRANTIES AND .9  
BONDS  
(Cont'd)

- (Cont'd)  
.3 (Cont'd)  
.13 Contractor's plans for attendance at 4 and 9 month post-construction warranty inspections.  
.14 Procedure and status of tagging of equipment covered by extended warranties.  
.4 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.
- .10 Respond in timely manner to oral or written notification of required construction warranty repair work.
- .11 Written verification to follow oral instructions.  
.1 Failure to respond will be cause for the Departmental Representative to proceed with action against Contractor.

1.14 WARRANTY TAGS .1

- Tag, at time of installation, each warranted item. Provide durable, oil and water resistant tag approved by Departmental Representative.
- .2 Attach tags with copper wire and spray with waterproof silicone coating.
- .3 Leave date of acceptance until project is accepted for occupancy.
- .4 Indicate following information on tag:  
.1 Type of product/material.  
.2 Model number.  
.3 Serial number.  
.4 Contract number.  
.5 Warranty period.  
.6 Inspector's signature.  
.7 Construction Contractor.
-

PART 2 - PRODUCTS

2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not Used.





PART 1 - GENERAL

- 1.1 ADMINISTRATIVE REQUIREMENTS
- .1 Demonstrate operation and maintenance of equipment and systems to Departmental Representative's personnel two weeks prior to date of interim completion.
  - .2 The Departmental Representative will provide list of personnel to receive instructions, and co-ordinate their attendance at agreed-upon times.
  - .3 Preparation:
    - .1 Verify conditions for demonstration and instructions comply with requirements.
    - .2 Verify designated personnel are present.
    - .3 Ensure equipment has been inspected and put into
    - .4 Ensure testing, adjusting, and balancing has been performed in accordance with Section 01 91 00 and equipment and systems are fully operational.
  - .4 Demonstration and Instructions:
    - .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at agreed upon times, at the equipment location.
    - .2 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.
    - .3 Review contents of manual in detail to explain aspects of operation and maintenance.
    - .4 Prepare and insert additional data in operations and maintenance manuals when needed during instructions.
  - .5 Time Allocated for Instructions: ensure amount of time required for instruction of each item of equipment is adequate for complete instruction.
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Provide submittals in accordance with Section 01 33 00.
  - .2 Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to designated
-

- 1.2 ACTION AND INFORMATIONAL SUBMITTALS (Cont'd)
- .2 (Cont'd) dates, for Departmental Representative's approval.
  - .3 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
  - .4 Give time and date of each demonstration, with list of persons present.
  - .5 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.
- 1.3 QUALITY ASSURANCE
- .1 When specified in individual Sections requiring manufacturer to provide authorized representative to demonstrate operation of equipment and systems:
    - .1 Instruct Owner's personnel.
    - .2 Provide written report that demonstration and instructions have been completed.

PART 2 - PRODUCTS

- 2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

- 3.1 NOT USED .1 Not Used.

PART 1 - GENERAL

- 1.1 SECTION INCLUDES .1 Includes general requirements for commissioning facilities and facility systems.
- 1.2 QUALITY ASSURANCE .1 Provide testing organization services System Commissioning Administrator under provisions specified in Section 01 45 00.
- .2 System Commissioning Administrator: current member in good standing of AABC, NEBB certified to perform specified services.
- .3 Comply with applicable procedures and standards of the certification sponsoring association.
- .4 Perform services under direction of supervisor qualified under certification requirements of sponsoring association.
- 1.3 REFERENCES .1 Associated Air Balance Council (AABC): National Standards For Field Measurements and Instrumentation, Total Systems Balance, Air Distribution-Hydronics Systems, 2002.
- .2 ASHRAE Guideline 1.1-2007, HVAC&R Technical Requirements for the Commissioning Process.
- .3 ASHRAE Guideline 4-2008, Preparation of Operating and Maintenance Documentation for Building System.
- .4 NEBB Procedural Standards for Building Systems Commissioning (1999).
- .5 NETA Standard for Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems 2009.
- 1.4 SUBMITTALS .1 Within 15 working days of Award of Contract, submit name of Testing organization, System Commissioning Administrator proposed to perform services who has managerial
-

1.3 REFERENCES  
(Cont'd)

- .1 (Cont'd)  
responsibilities for coordination of all  
commissioning activities.
- .2 Submit documentation to confirm Testing  
organization, System Commissioning  
Administrator compliance with quality  
assurance provision.
- .3 Submit 3 preliminary specimen copies of each  
type of startup checklist, product information  
and performance verification report forms  
proposed for use.
- .4 Submit completed report forms within 3 days  
after completion of each testing to Consultant  
for review and verification.
- .5 Fifteen days prior to Substantial  
Performance, submit 3 copies of final reports  
on applicable forms for functional performance  
verification.
- .6 Submit post-commissioning reports of testing,  
adjusting, and balancing postponed due to  
seasonal, climatic, occupancy, or other  
reasons beyond Contractor's control, promptly  
after execution of those services.

1.5 REPORT FORMS

- .1 Testing organization, System Commissioning  
Administrator shall make reports.
- .2 Report forms shall include:
  - .1 Startup Checklists.
  - .2 Product Information (PI) Report forms.
  - .3 Performance Verification (PV) Report  
forms.
- .3 Ensure each form bears signature of recorder,  
and that of supervisor of reporting  
organization.
- .4 Submit signed form to Departmental  
Representative for review, approval and  
signature.
- .5 Identify each instrument used for testing,  
adjusting and balancing and its latest date of  
calibration.

1.6 CONTRACTOR'S  
RESPONSIBILITIES

- .1 Prepare each system for testing and balancing.
- .2 Cooperate with testing organization and provide access to equipment and systems.
- .3 Provide personnel and operate systems at designated times, and under conditions required for proper testing, adjusting, and balancing.
- .4 Notify testing organization and Departmental Representative 7 days prior to time project will be ready for testing, adjusting, and balancing.
- .5 Accurately record data for each step.
- .6 Report to Departmental Representative any deficiencies or defects noted during performance of services.
- .7 Correct deficiencies identified in accordance with Departmental Representative's written instructions.

1.7 PREPARATION

- .1 Provide instruments required for testing, adjusting, and balancing operations.
  - .2 Make instruments available to Departmental Representative to facilitate spot checks during testing and functional performance verification.
  - .3 Retain possession of instruments and remove at completion of services.
  - .4 Verify systems installation is complete and in continuous operation.
  - .5 Verify lighting is turned on when lighting is included in cooling load.
  - .6 Verify equipment such as computers, laboratory and electronic equipment are in full operation when these equipment are included in cooling load.
-

1.8 EXECUTION

- .1 Test equipment, balance distribution systems, and adjust devices for HVAC & kitchen exhaust systems.
- .2 Test all hydronic systems, adjust and record liquid flow at each piece of equipment.

1.9 SCHEDULE OF  
SYSTEMS REQUIRING  
TESTING, ADJUSTING,  
AND BALANCING

- .1 Section [23 33 14 - Dampers-Balancing].

SERVICES

PART 2 - PRODUCTS

- 2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

- 3.1 NOT USED .1 Not Used.

PART 1 - GENERAL

- 1.1 SUMMARY .1 Section Includes:
- .1 Description of overall structure of Cx Plan and roles and responsibilities of Cx team.
- 1.2 REFERENCES .1 American Water Works Association (AWWA)
- .2 National Fire Protection Association (NFPA)
    - .1 NFPA 13-2010, Standard for the Installation of Sprinkler Systems.
    - .2 NFPA 14-2010, Standard for the Installation of Standpipe and Systems.
    - .3 NFPA 20-2010, Standard for the Installation of Stationary Fire Pumps for Fire Protection.
  - .3 Public Works and Government Services Canada (PWGSC)
    - .1 PWGSC - Commissioning Guidelines CP.4 -3rd edition-03.
  - .4 Underwriters' Laboratories of Canada (ULC)
- 1.3 GENERAL .1 Provide a fully functional facility:
- .1 Systems, equipment and components meet user's functional requirements before date of acceptance, and operate consistently at peak efficiencies and within specified energy budgets under normal loads.
  - .2 Complete documentation relating to installed equipment and systems.
- .2 Term "Cx" in this section means "Commissioning".
- .3 Use this Cx Plan as master planning document for Cx:
- .1 Outlines organization, scheduling, allocation of resources, documentation, pertaining to implementation of Cx.
  - .2 Communicates responsibilities of team members involved in Cx Scheduling, documentation requirements, and verification procedures.
  - .3 Sets out deliverables relating to O&M, process and administration of Cx.
-

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- 1.3 GENERAL (Cont'd)
- .3 (Cont'd)
- .4 Describes process of verification of how built works meet design requirements.
  - .5 Produces a complete functional system prior to issuance of Certificate of Occupancy.
  - .6 Management tool that sets out scope, standards, roles and responsibilities, expectations, deliverables, and provides:
    - .1 Overview of Cx.
    - .2 General description of elements that make up Cx Plan.
    - .3 Process and methodology for successful Cx.
- .4 Acronyms:
- .1 Cx - Commissioning.
  - .2 BMM - Building Management Manual.
  - .3 EMCS - Energy Monitoring and Control Systems.
  - .4 MSDS - Material Safety Data Sheets.
  - .5 PI - Product Information.
  - .6 PV - Performance Verification.
  - .7 TAB - Testing, Adjusting and Balancing.
  - .8 WHMIS - Workplace Hazardous Materials Information System.
- .5 Commissioning terms used in this Section:
- .1 Bumping: short term start-up to prove ability to start and prove correct rotation.
  - .2 Deferred Cx - Cx activities delayed for reasons beyond Contractor's control due to lack of occupancy, weather conditions, need for heating/cooling loads.
- 1.4 DEVELOPMENT OF CX PLAN
- .1 Submit completed Cx Plan to Departmental Representative and obtain written approval.
- 1.5 REFINEMENT OF CX PLAN
- .1 During construction phase, revise, refine and update Cx Plan to include:
- .1 Changes resulting from Client program modifications.
  - .2 Approved design and construction changes.
- .2 Submit each revised Cx Plan to Departmental Representative for review and obtain written approval.
-



- 1.5 REFINEMENT OF CX PLAN  
(Cont'd)
- .3 Include testing parameters at full range of operating conditions and check responses of equipment and systems.
- 1.6 COMPOSITION, ROLES AND RESPONSIBILITIES OF CX TEAM
- .1 Departmental Representative to maintain overall responsibility for project and is sole point of contact between members of commissioning team.
- .2 Project Manager will select Cx Team consisting of following members:
- .1 PWGSC Design Quality Review Team: during construction, will conduct periodic site reviews to observe general progress.
- .2 PWGSC Quality Assurance Commissioning Manager: ensures Cx activities are carried out to ensure delivery of a fully operational project including:
- .1 Review of Cx documentation from operational perspective.
- .2 Review for performance, reliability, durability of operation, accessibility, maintainability, operational efficiency under conditions of operation.
- .3 Protection of health, safety and comfort of occupants and O&M personnel.
- .4 Monitoring of Cx activities, training, development of Cx documentation.
- .5 Work closely with members of Cx Team.
- .3 Departmental Representative is responsible for:
- .1 Organizing Cx.
- .2 Monitoring operations Cx activities.
- .3 Witnessing, certifying accuracy of reported results.
- .4 Witnessing and certifying TAB and other tests.
- .5 Developing BMM.
- .6 Ensuring implementation of final Cx Plan.
- .7 Performing verification of performance of installed systems and equipment.
- .8 Implementation of Training Plan.
- .4 Construction Team: contractor, sub-contractors, suppliers and support disciplines, is responsible for
-

1.6 COMPOSITION,  
ROLES AND  
RESPONSIBILITIES OF  
CX TEAM  
(Cont'd)

- .2 (Cont'd)
- .4 Construction Team:(Cont'd)  
construction/installation in accordance  
with contract documents, including:
  - .1 Testing.
  - .2 TAB.
  - .3 Performance of Cx activities.
  - .4 Delivery of training and Cx  
documentation.
  - .5 Assigning one person as point of  
contact with Consultant and PWGSC Cx  
Manager for administrative and  
coordination purposes.
- .5 Contractor's Cx agent implements  
specified Cx activities including:
  - .1 Demonstrations.
  - .2 Training.
  - .3 Testing.
  - .4 Preparation, submission of test  
reports.
- .6 Property Manager: represents lead role  
in Operation Phase and onwards and is  
responsible for:
  - .1 Receiving facility.
  - .2 Day-to-day operation and  
maintenance of facility.

1.7 CX PARTICIPANTS

- .1 Employ the following Cx participants to  
verify performance of equipment and systems:
  - .1 Installation contractor/subcontractor:
    - .1 Equipment and systems except as  
noted.
  - .2 Equipment manufacturer: equipment specified  
to be installed and started by manufacturer.
    - .1 To include performance verification.
  - .3 Specialist subcontractor: equipment and  
systems supplied and installed by specialist  
subcontractor.
  - .4 Client: responsible for intrusion and access  
security systems.
  - .5 Ensure that Cx participant:
    - .1 Could complete work within scheduled  
time frame.
    - .2 Available for emergency and  
troubleshooting service during first year  
of occupancy by user for adjustments and

- 
- 1.6 COMPOSITION, ROLES AND RESPONSIBILITIES OF CX TEAM  
(Cont'd)
- .5 Ensure that Cx participant:(Cont'd)
    - .2 (Cont'd)  
modifications outside responsibility of O&M personnel, including:
      - .1 Modify ventilation rates to meet changes in off-gassing.
      - .2 Changes to heating or cooling loads beyond scope of EMCS.
      - .3 Changes to EMCS control strategies beyond level of training provided to O&M personnel.
      - .4 Redistribution of electrical services.
      - .5 Modifications of fire alarm systems.
      - .6 Modifications to voice communications systems.
  - .6 Provide names of participants to Departmental Representative and details of instruments and procedures to be followed for Cx 3 months prior to starting date of Cx for review and approval.
- 1.8 EXTENT OF CX
- .1 Cx Structural and Architectural Systems:
    - .1 Architectural and structural:
      - .1 Equipment:
        - .1 Dock levellers.
        - .2 Kitchen equipment installed under contract.
    - .2 Commission mechanical systems and associated equipment:
      - .1 Plumbing systems:
        - .1 Domestic CWS and HWS.
        - .2 Regular sanitary waste systems.
        - .3 Storm water systems.
      - .2 HVAC and exhaust systems:
        - .1 HVAC systems.
        - .2 General exhaust systems.
        - .3 Exhaust systems and related systems.
      - .3 Fire and life safety systems:
        - .1 Special fire suppression systems.
        - .2 Wet pipe sprinkler systems.
        - .3 Dry pipe sprinkler systems.
        - .4 Standpipe and hose systems.
        - .5 Total flooding fire extinguishing systems.
        - .6 Fire extinguishers.
-

- 1.8 EXTENT OF CX .3 Commission electrical systems and equipment:  
(Cont'd)
- .1 High voltage:
    - .1 High voltage switch gear and transformation equipment.
    - .2 High voltage distribution systems.
  - .2 Low voltage below 750 V:
    - .1 Voice communications systems.
  - .3 Lighting systems:
    - .1 Lighting equipment.
    - .2 Distribution systems.
    - .3 Emergency lighting systems, including battery packs.
    - .4 Fire exit emergency signage.
  - .4 Fire alarm systems, equipment:
    - .1 Annunciators.
    - .2 Control panels.
    - .3 Fire alarm battery banks.
  - .5 Other systems and equipment:
    - .1 Intrusion and access security and safety systems as follows:
      - .1 Door contacts and kitchen alarms.
- 1.9 DELIVERABLES .1 General requirements:  
RELATING TO O&M  
PERSPECTIVES
- .1 Compile English documentation.
  - .2 Documentation to be computer-compatible format ready for inputting for data management.
- .2 Provide deliverables:
- .1 Warranties.
  - .2 Project record documentation.
  - .3 Inventory of spare parts, special tools and maintenance materials.
  - .4 Maintenance Management System (MMS) identification system used.
  - .5 WHMIS information.
  - .6 MSDS data sheets.
  - .7 Electrical Panel inventory containing detailed inventory of electrical circuitry for each panel board. Duplicate of inventory inside each panel.
- 1.10 DELIVERABLES .1 General:  
RELATING TO THE CX  
PROCESS
- .1 Start-up, testing and Cx requirements, conditions for acceptance and specifications form part of relevant technical sections of these specifications.
-

- 1.10 DELIVERABLES RELATING TO THE CX PROCESS  
(Cont'd)
- .2 Definitions:  
.1 Cx as used in this section includes:  
.1 Cx of components, equipment, systems, subsystems, and integrated systems.  
.2 Factory inspections and performance verification tests.
- .3 Deliverables: provide:  
.1 Cx Specifications.  
.2 Startup, pre-Cx activities and documentation for systems, and equipment.  
.3 Completed installation checklists (ICL).  
.4 Completed product information (PI) report forms.  
.5 Completed performance verification (PV) report forms.  
.6 Results of Performance Verification Tests and Inspections.  
.7 Description of Cx activities and documentation.  
.8 Description of Cx of integrated systems and documentation.  
.9 Training Plans.  
.10 Cx Reports.  
.11 Prescribed activities during warranty period.
- 1.11 INSTALLATION CHECK LISTS (ICL) .1 Refer to Section [01 91 33].
- 1.12 PRODUCT INFORMATION (PI) REPORT FORMS .1 Refer to Section [01 91 33].
- 1.13 PERFORMANCE VERIFICATION (PV) REPORT .1 Refer to Section [01 91 33].
- 1.14 CX SCHEDULES .1 Prepare detailed critical path Cx Schedule and submit to Departmental Representative for review and approval same time as project Construction Schedule. Include:  
.1 Milestones, testing, documentation, training and Cx activities of components,
-

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- 1.14 CX SCHEDULES .1 (Cont'd)  
(Cont'd)
- .1 (Cont'd)  
equipment, subsystems, systems and integrated systems, including:
- .1 Design criteria, design intents.
  - .2 Pre-TAB review: 28 days after contract award, and before construction starts.
  - .3 Cx agents' credentials: 60 days before start of Cx.
  - .4 Cx procedures: 3 months after award of contract.
  - .5 Cx Report format: 3 months after contract award.
  - .6 Discussion of heating/cooling loads for Cx: 3 months before start-up.
  - .7 Submission of list of instrumentation with relevant certificates: 21 days before start of Cx.
  - .8 Notification of intention to start TAB: 21 days before start of TAB.
  - .9 TAB: after successful start-up, correction of deficiencies and verification of normal and safe operation.
  - .10 Notification of intention to start Cx: 14 days before start of Cx.
  - .11 Notification of intention to start Cx of integrated systems: after Cx of related systems is completed 14 days before start of integrated system Cx.
  - .12 Identification of deferred Cx.
  - .13 Implementation of training plans.
  - .14 Cx of smoke management/control systems: after Cx of related systems is completed and 7 days before proposed date of Cx these systems.
  - .15 Cx reports: immediately upon successful completion of Cx..
- .2 Detailed training schedule to demonstrate no conflicts with testing, completion of project and hand-over to institution.
- .2 After approval, incorporate Cx Schedule into Construction Schedule.
- .3 Consultant, Contractor, Contractor's Cx agent, and Departmental Representative will monitor progress of Cx against this schedule.
-

1.15 CX SCHEDULE  
FOR MECHANICAL  
SYSTEMS

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- .1 Produce schedule of Cx activities in bar chart format to a scale that will ensure legibility. Bar chart to indicate:
    - .1 Sequences of testing equipment and systems, interrelationship between tests, duration of tests and training periods.
    - .2 Cx resources which will be committed to this project to ensure completion by prescribed dates.
    - .3 Training Plan.
    - .4 Cx Documentation Plan.
  
  - .2 Fire and hose standpipe systems:
    - .1 Temporary fire hose cabinets to be provided by Contractor.
    - .2 Install and provide fire protection during construction, but to be commissioned after building has been closed in.
    - .3 Test completed systems in accordance with NFPA 14.
  
  - .3 Wet pipe and dry pipe sprinkler systems:
    - .1 Test completed systems in accordance with NFPA 13.
  
  - .4 Energy meters on steam, chilled water and electrical services:
    - .1 Commission meters after energy-consuming systems have been commissioned to permit changes to ranges and adjustments to reflect actual requirements.
  
  - .5 Plumbing systems:
    - .1 To be filled, pressure booster pumps "bumped" in a stand-alone mode and pre-start-up inspections completed. Then proceed with flushing, cleaning and disinfection processes.
    - .2 Test plumbing and piping systems.
  
  - .6 HVAC systems:
    - .1 Ductwork, piping and conduit systems to be concealed and 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.
-

- 1.15 CX SCHEDULE FOR MECHANICAL SYSTEMS (Cont'd)
- .6 HVAC systems:(Cont'd)
    - .4 Start HVAC to replace temporary heating systems after Departmental Representative'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 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. Departmental Representative to witness tests as part of Quality Assurance role.
    - .7 Full-scale emergency evacuation tests of entire facility:
      - .1 To be carried out during early stages of Warranty Period using procedures and protocols developed during Cx phase.
    - .8 Indoor Air Quality (IAQ):
      - .1 Tests to be carried out where identified.
    - .9 Final Cx activities:
      - .1 Upon completion of Cx to satisfaction of Departmental Representative lock control devices in their final positions, indelibly mark settings and include in TAB and PV Reports.
- 1.16 CX SCHEDULE FOR ELECTRICAL SYSTEMS
- .1 Systems to be tested as required by codes:
    - .1 Where testing is required as part of a regulatory process and where Cx procedures are developed and are appropriate to project, perform tests as required by such codes.
    - .2 Departmental Representative to witness these tests as part of Quality Assurance role.
-



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- 1.16 CX SCHEDULE FOR ELECTRICAL SYSTEMS  
(Cont'd)
- 
- .2 Produce a schedule of Cx activities in a bar chart format to a scale that will ensure legibility. Bar chart to indicate:
    - .1 Sequences of testing equipment and systems, interrelationship between tests, duration of tests and training periods.
    - .2 Cx resources which will be committed to this project to ensure completion by prescribed dates.
    - .3 Training plan.
    - .4 Cx documentation plan.
  - .3 Main distribution system:
    - .1 Testing and Cx to be defined in construction specifications.
    - .2 Contractor to conduct "megger" tests of feeders.
    - .3 Cx to utilize services of an independent testing agency to perform a series of pre-energization and post-energization tests.
  - .4 Low voltage systems:
    - .1 These include clock, PA communications, low voltage lighting and data communications systems.
  - .5 Emergency power systems:
    - .1 Testing and Cx of emergency generator, transfer switch and controllers to be included in construction specification.
    - .2 Test transfer switches by simulating loss of normal power.
    - .3 Verify power available at equipment requiring emergency power.
  - .6 Uninterruptible power systems:
    - .1 Test these systems under load in accordance with procedures prescribed in construction specifications.
  - .7 Emergency lighting systems:
    - .1 Perform tests by interrupting normal power.
    - .2 Thereafter verify adequacy of coverage.
  - .8 Fire alarm systems:
    - .1 Verify operation of these systems after aspects of life safety and security systems are complete.
    - .2 Testing to be monitored by Departmental Representative and include complete verification in accordance with ULC requirements.
-

- 1.16 CX SCHEDULE FOR ELECTRICAL SYSTEMS (Cont'd) .8 Fire alarm systems:(Cont'd)  
.3 After receipt by Departmental Representative of Cx Report, Cx specialist to demonstrate devices and zones to Cx Manager, Project Manager and Property Manager.
- 1.17 CX REPORTS .1 Submit reports of tests, witnessed and certified by Departmental Representative to Departmental Representative who will verify reported results.  
.2 Include completed and certified PV reports in properly formatted Cx Reports.  
.3 Before reports are accepted, reported results to be subject to verification by Departmental Representative.
- 1.18 ACTIVITIES DURING WARRANTY PERIOD .1 Cx activities must be completed before issuance of Interim Certificate, it is anticipated that certain Cx activities may be necessary during Warranty Period, including:  
.1 Fine tuning of HVAC systems.  
.2 Adjustment of ventilation rates to promote good indoor air quality and reduce deleterious effects of kitchen fumes.
- 1.19 TESTS TO BE PERFORMED BY OWNER/USER .1 None is anticipated on this project.
- 1.20 FINAL SETTINGS .1 Upon completion of Cx to satisfaction of Departmental Representative lock control devices in their final positions, indelibly mark settings marked and include in Cx Reports.
-

PART 2 - PRODUCTS

2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not Used.



SPEC NOTE: This section establishes requirements for the provision and use of installation/start-up check lists, product information and performance verification and commissioning report forms..

SPEC NOTE: For PWGSC projects, a listing of commissioning forms can be found in the PWGSC Commissioning Guidelines, all of which are available at the Documentation Reference Centre.

PART 1 - GENERAL

1.1  
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 will 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 Building Maintenance Manual (BMM) 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.
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- 1.2 PRODUCT INFORMATION (PI) REPORT FORMS
- .1 Product Information (PI) forms compile 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 BMM at completion of work.
  - .2 Prior to Performance Verification (PV) of systems complete items on PI forms related to systems and obtain Departmental Representative's approval.
- 1.3 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 records measured data and readings taken during functional testing and Performance Verification procedures.
  - .3 Prior to PV of integrated system, complete PV forms of related systems and obtain Departmental Representative's approval.
- 1.4 SAMPLES OF COMMISSIONING FORMS
- .1 Departmental Representative will develop and provide to Contractor required project-specific Commissioning forms in electronic format complete with specification data.
- 1.5 COMMISSIONING FORMS
- .1 Use Commissioning forms to verify installation and record performance when starting equipment and systems.
  - .2 Strategy for Use:
    - .1 Departmental Representative provides Contractor project-specific Commissioning forms with Specification data included.
    - .2 Contractor will provide required shop drawings information and verify correct
-

- 1.5 COMMISSIONING FORMS (Cont'd) .2 Strategy for Use:(Cont'd)
- .2 (Cont'd)  
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 Verify reported results.
  - .8 Form to bear signatures of recording technician and reviewed and signed off by Departmental Representative.
  - .9 Submit immediately after tests are performed.
  - .10 Reported results in true measured SI unit values.
  - .11 Provide Departmental Representative with originals of completed forms.
  - .12 Maintain copy on site during start-up, testing and commissioning period.
  - .13 Forms to be both hard copy and electronic format with typed written results in Building Management Manual.

PART 2 - PRODUCTS

- 2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

- 3.1 NOT USED .1 Not Used.





PART 1 - GENERAL

- 1.1 SECTION INCLUDES .1 Methods for removal of existing asphalt pavement.
- 1.2 RELATED SECTIONS .1 Section 017419 - Construction/Demolition Waste Management and Disposal.  
.2 Section 024113 - Selective Site Demolition.
- 1.3 WASTE MANAGEMENT AND DISPOSAL .1 Separate waste materials for reuse and recycling in accordance with Section 017421 - Construction/Demolition Waste Management and Disposal.  
.2 Divert unused asphalt materials from landfill to a site to be approved by the Departmental Representative.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

- 3.1 PREPARATION .1 Before removing existing asphalt the contractor shall record the exact location, width and lengths of all pavement markings, location of existing signs. Contractor shall reinstate all the markings and signs to its original location after the paving operation have been completed. Contractor shall provide a copy of the markings to the Departmental Representative.  
.2 Prior to beginning removal operation, inspect and verify with Departmental Representative areas, depths and lines of asphalt pavement to be removed.
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- 3.2 PROTECTION .1 Protect existing pavement not designated for removal, light standards, signs and structures from damage. In event of damage, immediately replace or make repairs to approval of Departmental Representative at no additional cost.
- 3.3 REMOVAL .1 Remove existing asphalt pavement to lines and grades as indicated on the drawings.
- .2 Use equipment and methods of removal and hauling which do not damage or disturb underlying pavement.
- .3 Prevent contamination of removed asphalt pavement by topsoil, underlying gravel or other materials.
- .4 Provide for suppression of dust generated by removal process.
- 3.4 STOCKPILING OF MATERIAL .1 Dispose of removed asphalt pavement by stock piling in locations designated by Departmental Representative.
- .2 Removed asphalt pavement which is to be recycled in hot mix asphalt concrete under this contract may be stockpiled at designated asphalt plant site.
- .3 The asphaltic concrete layer may be pulverized and re-used as subgrade fill, provided the content of recycled asphalt material does not exceed 30%.
- 3.5 SWEEPING .1 Sweep remaining asphalt pavement surfaces clean of debris resulting from removal operations using rotary power brooms and hand brooming as required.

PART 1 - GENERAL

- 1.1 REFERENCES
- .1 Canada Council of Ministers of the Environment (CCME)
    - .1 PN 1326-July 2005, Environmental Code of Practice for above ground and underground tank systems containing petroleum products and allied petroleum products.
  - .2 CSA International
    - .1 CSA S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.
  - .3 U.S. Environmental Protection Agency (EPA)/Office of Water
    - .1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Submit in accordance with Section 01 33 00 and 01 74 20.
  - .2 Submit demolition drawings:
    - .1 Submit for review and approval by Departmental Representative shoring and underpinning drawings stamped and signed by professional engineer registered or licensed in the Province of Ontario Canada, showing proposed method.
    - .2 Before proceeding with demolition of load bearing walls or of other walls and where required by authority having jurisdiction submit for review by Departmental Representative shoring and underpinning drawings prepared by qualified professional engineer registered or licensed in the Province of Ontario in Canada showing proposed method.
  - .3 Prior to beginning of Work on site submit detailed Waste Reduction Workplan in accordance with Section 01 74 20 and indicate:
    - .1 Descriptions of and anticipated quantities in percentages of materials to be salvaged reused, recycled and landfilled.
    - .2 Schedule of selective demolition.
-

- 1.2 ACTION AND INFORMATIONAL SUBMITTALS (Cont'd)
- .2 Submit demolition drawings:(Cont'd)
    - .3 (Cont'd)
      - .3 Number and location of dumpsters.
      - .4 Anticipated frequency of tippage.
      - .5 Name and address of waste receiving organizations.
    - .4 Erosion and Sedimentation Control:  
submit erosion and sedimentation control plan in accordance with EPA 832/R92-005 authorities having jurisdiction.

- 1.3 DELIVERY, STORAGE AND HANDLING
- .1 Waste Management and Disposal:
    - .1 Separate waste materials for reuse and recycling in accordance with Section 01

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

PART 2 - PRODUCTS

- 2.1 EQUIPMENT
- .1 Leave equipment and machinery running only while in use, except where extreme temperatures prohibit shutting down.
  - .2 Demonstrate that tools and machinery are being used in manner which allows for salvage of materials in best condition possible.
-

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Inspect building and site with Departmental Representative and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.
- .2 Locate and protect utilities. Preserve active utilities traversing site in operating condition.
- .3 Notify and obtain approval of utility companies before starting demolition.
- .4 Disconnect, cap, plug or divert, as required, existing public utilities within the property where they interfere with the execution of the work, in conformity with the requirements of the authorities having jurisdiction. Mark the location of these and previously capped or plugged services on the site and indicate location (horizontal and vertical) on the record drawings. Support, shore up and maintain pipes and conduits encountered.
  - .1 Immediately notify Departmental Representative and utility company concerned in case of damage to any utility or service, designated to remain in place.
  - .2 Immediately notify the Departmental Representative should uncharted utility or service be encountered, and await instruction in writing regarding remedial action.

3.2 PROTECTION

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

- 3.2 PROTECTION  
(Cont'd)
- .5 Do Work in accordance with Section 01 35 29.
- 3.3 DEMOLITION,  
SALVAGE AND  
DISPOSAL
- .1 Remove parts of existing building to permit new construction. Sort materials into appropriate piles for reuse and recycling.
- .2 Refer to demolition drawings and specifications for items to be salvaged for reuse.
- .3 Remove items to be reused, store as directed by Departmental Representative and re-install under appropriate section of specification.
- .4 Trim edges of partially demolished building elements to tolerances as defined by Departmental Representative to suit future use.
- .5 Dispose of removed materials, to appropriate recycling and/or reuse facilities except where specified otherwise, in accordance with authority having jurisdiction.
- .6 Removal of Pavements, Curbs and Gutters:  
.1 Square up adjacent surfaces to remain in place by saw cutting or other method approved by Departmental Representative.  
.2 Protect adjacent joints and load transfer devices.  
.3 Protect underlying and adjacent granular materials.
- 3.4 STOCKPILING
- .1 Label stockpiles, indicating material type and quantity.
- .2 Designate appropriate security resources/measures to prevent vandalism, damage and theft.
- .3 Locate stockpiled materials convenient for use in new construction in areas designated by Departmental Representative. Eliminate double handling wherever possible.
- .4 Stockpile materials designated for alternate disposal in location which facilitates removal
-

- 3.4 STOCKPILING .4 (Cont'd)  
(Cont'd)
- from site and examination by potential end markets, and which does not impede disassembly, processing, or hauling procedures.
- 3.5 REMOVAL FROM .1 Transport material designated for alternate  
SITE
- disposal to approved receiving organizations listed in waste reduction workplan and in accordance with applicable regulations. Do not deviate from receiving organizations listed in waste reduction workplan without prior written authorization from Departmental Representative.
- .2 Dispose of materials not designated for alternate disposal in accordance with applicable regulations. Disposal facilities must be approved of and listed in waste reduction workplan. Do not deviate from disposal facilities listed in waste reduction workplan without prior written authorization from Departmental Representative.
- 3.6 CLEANING .1 Progress Cleaning: clean in accordance with  
Section 01 74 11.
- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.





PART 1 - GENERAL

- 1.1 RELATED SECTIONS .1 Section 07 92 00 - Joint Sealing.
- 1.2 MEASUREMENT PROCEDURES .1 n/a
- 1.3 REFERENCES .1 Canadian Standards Association (CSA)
- .1 CSA-A23.1-09/A23.2-09, Concrete materials and methods of concrete construction/Test methods and standard practices for concrete.
  - .2 CSA-O86-09, Consolidation-Engineering Design in Wood (Limit States Design).
  - .3 CSA 0121-08, Douglas Fir Plywood.
  - .4 CSA 0151-09, Canadian Softwood Plywood.
  - .5 CSA 0153-M1980(R2008), Poplar Plywood.
  - .6 CAN3-O188.0-[M78], Standard Test Methods for Mat-Formed Wood Particleboards and Waferboard.
  - .7 CSA 0437 Series-93(R2006), Standards for OSB and Waferboard.
  - .8 CSA S269.1-1975(R2003), Falsework for Construction Purposes.
  - .9 CAN/CSA-S269.3-M92(R2008), Concrete Formwork.
- .2 Council of Forest Industries of British Columbia (COFI)
- .1 COFI Exterior Plywood for Concrete Formwork.
- 1.4 SHOP DRAWINGS .1 Submit shop drawings for formwork and falsework in accordance with Section 01 33 00.
- .2 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. Comply with CSA S269.1, for falsework drawings, Comply with CAN/CSA-S269.3 for formwork drawings.
-

- 1.4 SHOP DRAWINGS (Cont'd)
- .3 Indicate formwork design data, such as permissible rate of concrete placement, and temperature of concrete, in forms.
  - .4 Indicate sequence of erection and removal of formwork/falsework as directed by Departmental Representative.
  - .5 Each shop drawing submission shall bear stamp and signature of qualified professional engineer registered or licensed in Province of Ontario, Canada.

- 1.5 WASTE MANAGEMENT AND DISPOSAL
- .1 Separate and recycle waste materials in accordance with Section 01 74 20 and 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.
  - .4 Use sealers, form release and stripping agents that are non-toxic, biodegradable and have zero or low VOC's.

PART 2 - PRODUCTS

- 2.1 MATERIALS
- .1 Formwork materials:
    - .1 For concrete without special architectural features, use wood and wood product formwork materials to CSA-0121, CSA-086, CSA 0437 Series, CSA-0153.
  - .2 Pan forms: removable, steel, or reinforced plastic, or aluminum as indicated.
  - .3 Tubular column forms: round, spirally wound laminated fiber forms, internally treated with release material. Spiral pattern to show in hardened concrete.
  - .4 Form ties:
    - .1 For concrete not designated 'Architectural', use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm dia. in concrete surface.

- 2.1 MATERIALS  
(Cont'd)
- .4 Form ties:(Cont'd)
    - .2 For Architectural concrete, use snap ties complete with plastic cones and light grey concrete plugs.
  - .5 Form liner:
    - .1 Plywood: high density overlay Canadian Softwood Plywood to CSA 0151, 1 grade, square edge, 20 mm thick, urea formaldehyde free.
    - .2 Waferboard: to CAN3-0188.0, 1 grade, 20 mm thick.
  - .6 Form release agent: non-toxic, biodegradable, low VOC.
  - .7 Falsework materials: to CSA-S269.1.
  - .8 Sealant: to Section 07 92 00.

PART 3 - EXECUTION

- 3.1 FABRICATION AND  
ERECTION
- .1 Verify lines, levels and centers before proceeding with formwork/falsework and ensure dimensions agree with drawings.
  - .2 Obtain Departmental Representative's approval for use of earth forms framing openings not indicated on drawings.
  - .3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
  - .4 Fabricate and erect falsework in accordance with CSA-S269.1 and COFI Exterior Plywood for Concrete Formwork.
  - .5 Refer to architectural drawings for concrete members requiring architectural exposed finishes.
  - .6 Do not place shores and mud sills on frozen ground.
  - .7 Provide site drainage to prevent washout of soil supporting mud sills and shores.
  - .8 Fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions,

3.1 FABRICATION AND  
ERECTION  
(Cont'd)

- .8 (Cont'd)  
locations and levels indicated within  
tolerances required by CSA-A23.1/A23.2.
- .9 Align form joints and make watertight. Keep  
form joints to minimum.
- .10 Locate horizontal form joints for exposed  
columns 2400 mm above finished floor  
elevation.
- .11 Use 25 mm chamfer strips on external corners  
and/or 25 mm fillets at interior corners ,  
joints, unless specified otherwise.
- .12 Form chases, slots, openings, drips,  
recesses, expansion and control joints as  
indicated.
- .13 Construct forms for architectural concrete,  
and place ties as indicated and/or as  
directed. Joint pattern not necessarily based  
on using standard size panels or maximum  
permissible spacing of ties.
- .14 Build in anchors, sleeves, and other inserts  
required to accommodate Work specified in  
other sections. Assure that all anchors and  
inserts will not protrude beyond surfaces  
designated to receive applied finishes,  
including painting.
- .15 Clean formwork in accordance with CSA-A23.1/  
A23.2, before placing concrete.

3.2 REMOVAL AND  
RESHORING

- .1 Leave formwork in place for following minimum  
periods of time after placing concrete.
- .1 3 days for walls and sides of beams.
- .2 3 days for columns.
- .3 28 days for beam soffits, slabs, decks  
and other structural members, or 7 days  
when replaced immediately with adequate  
shoring to standard specified for  
falsework.
- .4 2 days for footings and abutments.
- .2 Remove formwork when concrete has reached 75%  
of its design strength or minimum period noted  
above, whichever comes later, and replace  
immediately with adequate reshoring until 28  
days for curing has occurred.
-

3.2 REMOVAL AND  
RESHORING  
(Cont'd)

- .3 Provide all necessary reshoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.
- .4 Space reshoring in each principal direction at not more than 1850 mm apart.
- .5 Re-use formwork and falsework subject to requirements of CSA-A23.1/A23.2.



PART 1 - GENERAL

- 1.1 RELATED REQUIREMENTS .1 Section 031000.  
.2 Section 033000.
- 1.2 PRICE AND PAYMENT PROCEDURES .1 Measurement and Payment:  
.1 No measurement will be made under this Section.  
.1 Include reinforcement costs in items of concrete work in Section 03 30 00.
- 1.3 REFERENCES .1 American Concrete Institute (ACI)  
.1 SP-66-[04], ACI Detailing Manual 2004.
- .2 ASTM International  
.1 ASTM A82/A82M-[07], Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.  
.2 ASTM A123/A123M-09, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.  
.3 ASTM A143/A143M-[07], Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.  
.4 ASTM A185/A185M-[07], Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.  
.5 ASTM A775/A775M-[07b], Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
- .3 CSA International  
.1 CSA-A23.1-[09]/A23.2-[09], Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.  
.2 CAN/CSA-A23.3-[04(R2010)], Design of Concrete Structures.  
.3 CSA-G30.18-[09], Carbon Steel Bars for Concrete Reinforcement.  
.4 CSA-G40.20-04(R2009)/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

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- 1.3 REFERENCES (Cont'd)
- .3 (Cont'd)
- .5 CSA W186-[M1990(R2007)], Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .4 Reinforcing Steel Institute of Canada (RSIC)
- .1 RSIC-[2004], Reinforcing Steel Manual of Standard Practice.
- 1.4 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Submit in accordance with Section 01 33 00.
- .2 Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice and SP-66.
- .3 Shop Drawings:
- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .1 Indicate placing of reinforcement and:
- .1 Bar bending details.
- .2 Lists.
- .3 Quantities of reinforcement.
- .4 Sizes, spacings, locations of reinforcement and mechanical splices if approved by Departmental Representative, with identifying code marks to permit correct placement without reference to structural drawings.
- .5 [Indicate sizes, spacings and locations of chairs, spacers and hangers].
- .2 Detail lap lengths and bar development lengths to CAN/CSA-A23.3.
- .1 Provide type B tension lap splices min. unless otherwise indicated.
- .4 When Chromate solution is used as replacement for galvanizing non-prestressed reinforcement, provide product description for review by Departmental Representative prior to its use.
- 1.5 QUALITY ASSURANCE
- .1 Submit in accordance with Section 01 45 00 and as described in PART 2 - SOURCE QUALITY CONTROL.
- .1 Mill Test Report: upon request, provide Departmental Representative with certified copy of mill test report of
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- 1.5 QUALITY ASSURANCE  
(Cont'd)
- .1 (Cont'd)
- .1 Mill Test Report:(Cont'd)  
reinforcing steel, minimum 4 weeks prior  
to beginning reinforcing work.
- .2 Submit in writing to Departmental  
Representative proposed source of  
reinforcement material to be supplied.
- 1.6 DELIVERY,  
STORAGE AND  
HANDLING
- .1 Deliver, store and handle materials in  
accordance with Section 01 61 00 and with  
manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver  
materials to site in original factory  
packaging, labelled with manufacturer's name  
and address.
- .3 Storage and Handling Requirements:
- .1 Store materials off ground in dry  
location and in accordance with  
manufacturer's recommendations in clean,  
dry, well-ventilated area.
- .2 Replace defective or damaged materials  
with new.
- .4 Develop Construction Waste Management Plan  
related to Work of this Section and in  
accordance with Section 01 74 20.

PART 2 - PRODUCTS

- 2.1 MATERIALS
- .1 Substitute different size bars only if  
permitted in writing by Departmental  
Representative.
- .2 Reinforcing steel: billet steel, grade 400,  
deformed bars to CSA-G30.18, unless indicated  
otherwise, minimum 30% recycled content.
- .3 Reinforcing steel: weldable low alloy steel  
deformed bars to CSA-G30.18, minimum 30%  
recycled content.
- .4 Cold-drawn annealed steel wire ties: to ASTM  
A82/A82M, minimum 30% recycled content.
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- 2.1 MATERIALS  
(Cont'd)
- .5 Welded deformed steel wire fabric: to ASTM A82/A82M, minimum 30% recycled content.  
.1 Provide in flat sheets only.
- .6 Epoxy coating of non-prestressed reinforcement: to ASTM A775/A775M.
- .7 Galvanizing of non-prestressed reinforcement: to ASTM A123/A123M, Coating Grade 85, minimum zinc coating 610 g/m<sup>2</sup>.  
.1 Protect galvanized reinforcing steel with chromate treatment to prevent reaction with Portland cement paste.  
.2 If chromate treatment is carried out immediately after galvanizing, soak steel in aqueous solution containing minimum 0.2% by weight sodium dichromate or 0.2% chromic acid.  
.1 Temperature of solution equal to or greater than 32 degrees and galvanized steels immersed for minimum 20 seconds.  
.3 If galvanized steels are at ambient temperature, add sulphuric acid as bonding agent at concentration of 0.5% to 1%.  
.1 In this case, no restriction applies to temperature of solution.  
.4 Chromate solution sold for this purpose may replace solution described above, provided it is of equivalent effectiveness.  
.1 Provide product description as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .8 Chairs, bolsters, bar supports, spacers: to CSA-A23.1/A23.2.
- .9 Mechanical splices: subject to approval of Departmental Representative.
- .10 Plain round bars: to CSA-G40.20/G40.21.
- 2.2 FABRICATION
- .1 Fabricate reinforcing steel in accordance with CSA-A23.1/A23.2 SP-66 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.  
.1 SP-66 unless indicated otherwise.  
.2 Obtain Departmental Representative's written approval for locations of reinforcement splices other than those shown on placing drawings.
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- 2.2 FABRICATION .1 (Cont'd)  
(Cont'd)
- .3 Upon approval of Departmental Representative, weld reinforcement in accordance with CSA W186.
  - .4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.
    - .1 Ship epoxy coated bars in accordance with ASTM A775A/A775M.

- 2.3 SOURCE QUALITY CONTROL .1 Provide Departmental Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 4 weeks prior to beginning reinforcing work.
- .2 Inform Departmental Representative of proposed source of material to be supplied.

PART 3 - EXECUTION

- 3.1 PREPARATION .1 Galvanizing to include chromate treatment.
  - .1 Duration of treatment: 1 hour per 25 mm of bar diameter.
- .2 Conduct bending tests to verify galvanized bar fragility in accordance with ASTM A143/A143M.

- 3.2 FIELD BENDING .1 Do not field bend or field weld reinforcement except where indicated or authorized by Departmental Representative.
- .2 When field bending is authorized, bend without heat, applying slow and steady pressure.
  - .3 Replace bars, which develop cracks or splits.

- 3.3 PLACING REINFORCEMENT .1 Place reinforcing steel as indicated on placing drawings and in accordance with CSA-A23.1/A23.2.

3.3 PLACING  
REINFORCEMENT  
(Cont'd)

- .2 Use plain round bars as slip dowels in concrete.
  - .1 Paint portion of dowel intended to move within hardened concrete with [one coat of asphalt paint].
  - .2 When paint is dry, apply thick even film of mineral lubricating grease.
- .3 Prior to placing concrete, obtain Departmental Representative's approval of reinforcing material and placement.
- .4 Ensure cover to reinforcement is maintained during concrete pour.
- .5 Protect epoxy and paint coated portions of bars with covering during transportation and handling.

3.4 FIELD TOUCH-UP

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

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 0174 11.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 0174 11.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

PART 1 - GENERAL

- 1.1 Related Section .1 Section 03 1 000  
.2 Section 03 20 00  
.3 section 03 35 05  
.4 Section 03 35 00  
.5 Section 05 12 23

1.2 REFERENCES

- .1 Abbreviations and Acronyms:  
.1 Portland Cement: hydraulic cement, blended hydraulic cement (XXb - b denotes blended) and Portland-limestone cement.  
.1 Type GU, GUb and GUL - General use cement.  
.2 Type MS and MSb - Moderate sulphate-resistant cement.  
.3 Type MH, MHb and MHL - Moderate heat of hydration cement.  
.4 Type HE, HEb and HEL - High early-strength cement.  
.5 Type LH, LHb and LHL - Low heat of hydration cement.  
.6 Type HS and HSb - High sulphate-resistant cement.  
.2 Fly ash:  
.1 Type CH - with CaO greater than 20%.  
.3 GGBFS - Ground, granulated blast-furnace slag.  
.2 Reference Standards:  
.1 ASTM International  
.1 ASTM C260/C260M-10a, Standard Specification for Air-Entraining Admixtures for Concrete.  
.2 ASTM C309-11, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.  
.3 ASTM C494/C494M-11, Standard Specification for Chemical Admixtures for Concrete.  
.4 ASTM C1017/C1017M-07, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.  
.5 ASTM D412-06ae2, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
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- 1.2 REFERENCES .2 Reference Standards:(Cont'd)
- (Cont'd)
- .1 (Cont'd)
- .6 ASTM D624-00(2007), Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.
- .7 ASTM D1751-04(2008), Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
- .8 ASTM D1752-04a(2008), Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
- .2 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-37.2-M88, Emulsified Asphalt, Mineral Colloid-Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings.
- .2 CAN/CGSB-51.34-M86(R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .3 Canada Green Building Council (CaGBC)
- .1 LEED Canada For New Construction and Major Renovations 2009.
- .2 CSA A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- .3 CSA A283-06(R2011), Qualification Code for Concrete Testing Laboratories.
- .4 CAN/CSA-A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
- 1.3 ADMINISTRATIVE .1 Pre-installation Meetings: in accordance with REQUIREMENTS .1 convene pre-installation meeting one week prior to beginning concrete works.
- .1 Ensure Departmental Representative attend.
- .1 Verify project requirements.
- 1.4 ACTION AND .1 Provide submittals in accordance with Section INFORMATIONAL 01 33 00. SUBMITTALS
- .2 At least 4 weeks prior to beginning Work, provide Departmental Representative with
-

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- 1.4 ACTION AND INFORMATIONAL SUBMITTALS  
(Cont'd)
- 
- .2 (Cont'd)  
samples of materials proposed for use as follows:  
.1 5 L of curing compound.  
.2 1 m length of each type of joint filler.
- .3 Provide reports for review by Departmental Representative and do not proceed without written approval when deviations from mix design or parameters are found.
- .4 Concrete pours: provide accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described in PART 3 - FIELD QUALITY CONTROL.
- .5 Concrete hauling time: provide for review by Departmental Representative deviations exceeding maximum allowable time of 90mins Work and discharged after batching.
- 1.5 QUALITY ASSURANCE
- 
- .1 Quality Assurance: in accordance with Section 01 45 00.
- .2 Provide Departmental Representative, minimum 4 weeks prior to starting concrete work, with valid and recognized certificate from plant delivering concrete.  
.1 Provide test data and certification by qualified independent inspection and testing laboratory that materials and mix designs used in concrete mixture will meet specified requirements.
- .3 Minimum 4 weeks prior to starting concrete work, provide proposed quality control procedures for review by Departmental Representative on following items:  
.1 Falsework erection.  
.2 Hot weather concrete.  
.3 Cold weather concrete.  
.4 Curing.  
.5 Finishes.  
.6 Formwork removal.  
.7 Joints.
- .4 Quality Control Plan: provide written report to Departmental Representative verifying compliance that concrete in place meets performance requirements of concrete as established in PART 2 - PRODUCTS.
-

- 1.6 DELIVERY, STORAGE AND HANDLING
- .1 Delivery and Acceptance Requirements:
    - .1 Concrete hauling time: deliver to site of Work and discharged within 90 minutes maximum after batching.
      - .1 Do not modify maximum time limit without receipt of prior written agreement from Departmental Representative and concrete producer as described in CSA A23.1/A23.2.
      - .2 Deviations to be submitted for review by Departmental Representative.
    - .2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.
  - .2 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 20.

PART 2 - PRODUCTS

- 2.1 DESIGN CRITERIA
- .1 Performance: to CSA A23.1/A23.2, and as described in MIXES of PART 2 - PRODUCTS.
- 2.2 PERFORMANCE CRITERIA
- .1 Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established by Departmental Representative and provide verification of compliance as described in PART 1 - QUALITY ASSURANCE.
- 2.3 MATERIALS
- .1 Portland Cement: to CAN/CSA-A3001, Type MS or MSb
    - .1 Recycled content: 25% in accordance with Section 01 35 21.
    - .2 Reduction in cement from Base Mix to Actual Supplementary Cementing Materials (SCMs) Mix, as percentage.
  - .2 Blended hydraulic cement: Type GUB to CAN/CSA-A3001.
  - .3 Portland-limestone cement: Type CSA A23.1/A23.2. For full types of supplementary cementing materials refer to CSA A23.1/A23.2: N - Natural pozzolan, F - Fly ash (low calcium content), CI - Intermediate calcium content,



2.3 MATERIALS  
(Cont'd)

- .3 Portland-limestone cement:(Cont'd)  
CH - High calcium content, S - Ground  
granulated blast-furnace slag, and SF - Silica  
fume.
- .4 Supplementary cementing materials: with  
minimum 25% GGBFS, by mass of total  
cementitious materials to CSA A3001.
- .5 Water: to CSA A23.1/A23.2.
- .6 Aggregates: to CSA A23.1/A23.2.
- .7 Admixtures:
  - .1 Air entraining admixture: to ASTM C260.
  - .2 Chemical admixture: to ASTM C494/C494M  
Departmental Representative to approve  
accelerating or set retarding admixtures  
during cold and hot weather placing.
  - .3 Shrinkage-reducing admixture (SRA): to  
manufacturers requirements.
- .8 Shrinkage compensating grout: premixed  
compound consisting of non-metallic aggregate,  
Portland cement, water reducing and  
plasticizing agents to CSA A23.1/A23.2.
  - .1 Compressive strength: 40 MPa at 28 days.
  - .2 Net shrinkage at 28 days: maximum 0.05%  
by volume.
- .9 Non premixed dry pack grout: composition of  
non metallic aggregate Portland cement with  
sufficient water for mixture to retain its  
shape when made into ball by hand and capable  
of developing compressive strength of 35 MPa  
at 28 days.
- .10 Post-Tensioning Ducts: to CSA A23.1/A23.2.
- .11 Curing compound: to CSA A23.1/A23.2 white  
ASTM C309,
- .12 Premoulded joint fillers:
  - .1 Bituminous impregnated fiber board: to  
ASTM D1751.
  - .2 Sponge rubber: to ASTM D1752, Type I,  
flexible grade.
  - .3 Self-expanding Standard cork: to ASTM  
D1752, Type III.
- .13 Weep hole tubes: plastic.
- .14 Dovetail anchor slots: minimum 0.6 mm thick  
galvanized steel with insulation filled slots.

2.3 MATERIALS  
(Cont'd)

- .15 Dampproofing on Foundation walls:
  - .1 Emulsified asphalt, mineral colloid type, unfilled: to CAN/CGSB-37.2.
- .16 Polyethylene film: 10 mil thickness to CAN/CGSB-51.34.
- .17 Bonding adhesive: Supply ST-433 by sternson, Sika-Dur by Sika Chemical or Bondlok by W.R. Meadows of Canada ltd.. SBR Latex by Euclid Chemical or Acrylic Adhesive by CC Chemicals Limited.

2.4 MIXES

- .1 Performance Method for specifying concrete: to meet Departmental Representative performance criteria to CSA A23.1/A23.2.
  - .1 Ensure concrete supplier meets performance criteria as established below, provide verification of compliance as in Quality Control Plan, and to g
  - .2 Provide concrete mix to meet following for Ready-mix concrete and concrete proportions shall be in accordance with CSA A32.1, Clause 12 and as follows:
    - .1 Minimum allowable compressive strength shall be 25 MPa at 28 Days of age, unless otherwise noted or shown.
    - .2 If Blended normal Portland cement/cementitious hydraulic slab is used except for floor mixes, slag content shall not be more than 25% of total mass of cement. Total Volume of cement in concrete floor mixes shall be 100% Portland Cement
    - .3 Provide certification that mix proportions selected will produce concrete of specified quality and yield and that strength will comply with CAN/CSA A23.1-08, Clause 17.5
    - .4 Use of calcium chloride not permitted.
    - .5 Do not change concrete mix without prior approval of consultant. Should change in material source be proposed, new mix design to be approved by Consultant.
- .4 Provide quality management plan to ensure verification of concrete quality to specified performance.

2.4 MIXES  
(Cont'd)

.5 Concrete supplier's certification: both batch plant and materials meet CSA A23.1/A23.2 requirements.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Obtain Departmental Representative's written approval before placing concrete.  
.1 Provide 48 hours minimum notice prior to placing of concrete.

.2 Place concrete reinforcing in accordance with Section 03 20 00 and contract documents.

.3 During concreting operations:  
.1 Development of cold joints not allowed.  
.2 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.

.4 Pumping of concrete is permitted only after approval of equipment and mix.

.5 Ensure reinforcement and inserts are not disturbed during concrete placement.

.6 Prior to placing of concrete obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing in adverse weather.

.7 Protect previous Work from staining.

.8 Clean and remove stains prior to application for concrete finishes.

.9 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.

.10 In locations where new concrete is dowelled to existing work, drill holes in existing concrete.  
.1 Place steel dowels of deformed steel reinforcing bars and pack solidly with epoxy grout to anchor and hold dowels in positions as indicated. Embed bars 150 mm.

.11 Do not place load upon new concrete until authorized by Departmental Representative.

3.2 INSTALLATION/  
APPLICATION

- .1 Do cast-in-place concrete work to CSA A23.1/A23.2.
  - .2 Sleeves and inserts:
    - .1 Do not permit penetrations, sleeves, ducts, pipes or other openings to pass through joists, beams, column capitals or columns, except where indicated or approved by Departmental Representative.
    - .2 Where approved by Departmental Representative, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere.
    - .3 Sleeves and openings greater than 100 x 100 mm not indicated, must be reviewed by Departmental Representative.
    - .4 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain written approval of modifications from Departmental Representative before placing of concrete.
    - .5 Confirm locations and sizes of sleeves and openings shown on drawings.
    - .6 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.
  - .3 Anchor bolts:
    - .1 Set anchor bolts to templates in co-ordination with appropriate trade prior to placing concrete.
    - .2 Grout anchor bolts in preformed holes or holes drilled after concrete has set only after receipt of written approval from Departmental Representative.
      - .1 Formed holes: 100 mm minimum diameter.
      - .2 Drilled holes: 25 mm minimum diameter larger than bolts used to manufacturers' recommendations.
    - .3 Protect anchor bolt holes from water accumulations, snow and ice build-ups.
    - .4 Set bolts and fill holes with epoxy grout.
    - .5 Locate anchor bolts used in connection with expansion shoes, rollers and rockers with due regard to ambient temperature at time of erection.
  - .4 Drainage holes and weep holes:
    - .1 Form weep holes and drainage holes in accordance with Section 03 10 00. If wood
-

- 3.2 INSTALLATION/  
APPLICATION  
(Cont'd)
- .4 Drainage holes and weep holes:(Cont'd)
- .1 (Cont'd)  
forms are used, remove them after  
concrete has set.
- .2 Install weep hole tubes and drains as  
indicated.
- .5 Dovetail anchor slots: in accordance with  
Section 04 05 10.
- .1 Install continuous vertical anchor slot  
to forms where masonry abuts concrete  
wall or columns.
- .2 Install continuous vertical anchor slots  
at 800 mm on centre where concrete walls  
are masonry faced.
- .6 Grout under base plates and machinery using  
procedures in accordance with manufacturer's  
recommendations which result in 100 % contact  
over grouted area.
- .7 Finishing and curing:
- .1 Finish concrete to CSA A23.1/A23.2.
- .2 Use procedures as reviewed by  
Departmental Representative or those  
noted in CSA A23.1/A23.2 to remove excess  
bleed water. Ensure surface is not  
damaged.
- .3 Use curing compounds compatible with  
applied finish on concrete surfaces.  
Provide written declaration that  
compounds used are compatible.
- .4 Finish concrete floor to CSA  
A23.1/A23.2. Class A.
- .5 Provide swirl-trowelled finish where  
bonded floor tile is to be applied.  
Provide depression to accommodate floor  
tile.
- .6 Provide swirl-trowelled finish unless  
otherwise indicated.
- .7 Rub exposed sharp edges of concrete with  
carborundum to produce 3 mm minimum  
radius edges unless otherwise indicated.
- .8 Toppings:
- .1 Topping mixture to meet minimum  
requirements as follows: Bonded overlay  
as indicated on drwgs.
- .2 Make allowance for bonded overlay  
topping thickness when pouring base  
course.
- .3 Apply latex bonding agent modified to  
base course to CSA A23.1/A23.2.
-

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- 3.2 INSTALLATION/  
APPLICATION  
(Cont'd)
- .8 Toppings:(Cont'd)
- .4 Place bonded topping to CSA A23.1/A23.2 and topping manufacturer's recommendations.
- .5 Ensure that joints in topping are of same material as those in base course. Also ensure that their locations precisely match those in base course.
- .9 Waterstops:
- .1 Install waterstops to provide continuous water seal.
- .2 Do not distort or pierce waterstop in way as to hamper performance.
- .3 Do not displace reinforcement when installing waterstops.
- .4 Use equipment to manufacturer's requirements to field splice waterstops.
- .5 Tie waterstops rigidly in place.
- .6 Use only straight heat sealed butt joints in field.
- .7 Use factory welded corners and intersections unless otherwise approved by Departmental Representative.
- .10 Joint fillers:
- .1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by Departmental Representative.
- .2 When more than one piece is required for joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.
- .3 Locate and form isolation, construction, and expansion joints as indicated.
- .4 Install joint filler.
- .5 Use 12 mm thick joint filler to separate slabs-on-grade from vertical surfaces and extend joint filler from bottom of slab to within 12 mm of finished slab surface unless indicated otherwise.
- .11 Dampproof membrane:
- .1 Install dampproof membrane under concrete slabs-on-grade inside building.
- .2 Lap dampproof membrane minimum 150 mm at joints and seal.
- .3 Seal punctures in dampproof membrane before placing concrete.
- .4 Use patching material at least 150 mm larger than puncture and seal.
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- 3.3 SURFACE TOLERANCE .1 Concrete tolerance to CSA A23.1/A23.2 Straightedge Method to tolerance Class A, Table 22 A23.1-09 and clause 7.5.1.4.1 to 7.5.1.4.4
- 3.4 FIELD QUALITY CONTROL .1 Site tests: conduct tests as follows in accordance with Section 01 45 00 and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .1 Concrete pours.
  - .2 Slump.
  - .3 Air content.
  - .4 Compressive strength at 7 and 28 and 56 days.
  - .5 Air and concrete temperature.
- .2 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory designated by Departmental Representative for review to CSA A23.1/A23.2.
- .1 Ensure testing laboratory is certified to CSA A283.
- .3 Ensure test results are distributed for discussion at pre-pouring concrete meeting between testing laboratory and Departmental Representative.
- .4 The Owner will pay for costs of tests as specified in Section 01 29 83.
- .5 Contractor will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.
- .6 Non-Destructive Methods for Testing Concrete: to CSA A23.1/A23.2.
- .7 Inspection or testing by Consultant will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.
- 3.5 CLEANING .1 Clean in accordance with Section 01 74 11.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
- .1 Divert unused concrete materials from landfill to local quarry after receipt of
-

3.5 CLEANING  
(Cont'd)

- .2 Waste Management:(Cont'd)
- .1 (Cont'd)  
written approval from Departmental Representative.
  - .2 Provide appropriate area on job site where concrete trucks and be safely washed.
  - .3 Divert unused admixtures and additive materials (pigments, fibres) from landfill to official hazardous material collections site as approved by Departmental Representative.
  - .4 Do not dispose of unused admixtures and additive materials into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.
  - .5 Prevent admixtures and additive materials from entering drinking water supplies or streams.
  - .6 Using appropriate safety precautions, collect liquid or solidify liquid with inert, noncombustible material and remove for disposal.
  - .7 Dispose of waste in accordance with applicable local, Provincial/Territorial and National regulations.



PART 1 - GENERAL

- 1.1 REFERENCES .1 Building Council (CaGBC)
- .1 LEED Canada For New Construction and Major Renovations 2009.
  - .2 LEED Canada For Core and Shell 2009.
  - .3 LEED Canada-CI Version 1.0-2007, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
- .2 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-25.20-95, Surface Sealer for Floors.
- .3 CSA International
- .1 CSA A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .4 South Coast Air Quality Management District (SCAQMD), California State
- .1 SCAQMD Rule 1168-A2005(June 2006), Adhesives and Sealants Applications.
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS .1 Submit submittals in accordance with Section 01 33 00.
- .2 Product Data:
- .1 Provide manufacturer's printed product literature and data sheets for concrete finishes and include product characteristics, performance criteria, physical size, finish and limitations.
    - .1 Provide two copies of WHMIS MSDS. WHMIS MSDS acceptable to Labour Canada and Health and Welfare Canada for concrete floor treatment materials. Indicate VOC content in g/L.
    - .2 Include application instructions for concrete floor treatments.
- 1.3 ENVIRONMENTAL REQUIREMENTS .1 Temporary lighting:
- .1 Minimum 1200 W light source, placed 2.5 m above floor surface, for each 40 sq m of floor being treated.
-

- 1.3 ENVIRONMENTAL REQUIREMENTS  
(Cont'd)
- .2 Electrical power:  
.1 Provide sufficient electrical power to operate equipment normally used during construction.
- .3 Work area:  
.1 Make work area water tight protected against rain and detrimental weather conditions.
- .4 Temperature:  
.1 Maintain ambient temperature of not less than 10 degrees C from 7 days before installation to at least 48 hours after completion of work and maintain relative humidity not higher than 40% during same period.
- .5 Moisture:  
.1 Ensure concrete substrate is within moisture limits prescribed by flooring manufacturer.
- .6 Safety:  
.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.
- .7 Ventilation:  
.1 Ventilate area of work as directed by Departmental Representative by use of approved portable supply and exhaust fans.  
.2 Ventilate enclosed spaces in accordance with Section 01 51 00.  
.3 Provide continuous ventilation during and after coating application.
- 1.4 DELIVERY, STORAGE AND HANDLING
- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:  
.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 20.
-

PART 2 - PRODUCTS

- 2.1 PERFORMANCE REQUIREMENTS .1 Product quality and quality of work in accordance with Section 01 61 00.
- .2 Submit written declaration that components used are compatible and will not adversely affect finished flooring products and their installation adhesives.
- 2.2 CHEMICAL HARDENERS None to be used .2 Sealants: maximum VOC limit 250 g/L to SCAQMD Rule 1168.
- .3 Surface sealers are not manufactured or formulated with aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium and their compounds.
- 2.4 CURING COMPOUNDS .1 Select low VOC, water-based, organic-solvent free curing compounds.
- 2.5 CONCRETE STAINS .1 Select low VOC, water-based concrete stains.
- 2.6 MIXES .1 Mixing ratios in accordance with manufacturer's written instructions.

PART 3 - EXECUTION

- 3.1 EXAMINATION .1 Verify that slab substrate site conditions surfaces are ready to receive work and elevations are as indicated on shop drawings recommended by manufacturer's written instructions.
-

- 3.2 PREPARATION OF EXISTING SLAB
- .1 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radiused edges unless otherwise indicated.
  - .2 Saw cut control joints to CSA A23.1/A23.2, 18 hours maximum after placing of concrete.
  - .3 Use mechanical stripping to remove chlorinated rubber or existing surface coatings.
  - .4 Use protective clothing, eye protection, respiratory equipment during stripping of chlorinated rubber or existing surface coatings.
- 3.3 APPLICATION
- .1 Apply concrete finishing floor hardener in accordance with manufacturer's written instructions.
  - .2 After floor treatment is dry, seal control joints and joints at junction with vertical surfaces with sealant.
  - .3 Apply floor treatment in accordance with Sealer manufacturer's written instructions.
  - .4 Clean over spray. Clean sealant from adjacent surfaces.
- 3.4 CLEANING
- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
    - .1 Leave Work area clean at end of each day.
  - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
  - .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20 and 01 35 21.
- 3.5 PROTECTION
- .1 Protect finished installation in accordance with manufacturer's instructions.
-





PART 1 - GENERAL

1.1 RELATED  
REQUIREMENTS

- .1 Section 01 29 83 - Payment Procedures:  
Testing Laboratory Services.
- .2 Section 03 30 00 - Cast-in-Place Concrete.
- .3 Section 04 05 12 - Mortar and Masonry Grout.
- .4 Section 04 05 19 - Masonry Anchorage and  
Reinforcing.
- .5 Section 04 22 00 - Concrete Unit Masonry.
- .6 Section 05 50 00 - Metal Fabrications.
- .7 Section 07 95 14 - Expansion Joints.
- .8 Section 07 21 00 - Building Insulation.
- .9 Section 07 92 00 - Joint Sealing.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA  
International)
  - .1 CAN/CSA-A165 Series-04(R2009), Standards  
on Concrete Masonry Units.
  - .2 CAN/CSA-A179-04(R2009), Mortar and Grout  
for Unit Masonry.
  - .3 CAN/CSA-A371-04(R2009), Masonry  
Construction for Buildings.
- .2 International Masonry Industry All-Weather  
Council (IMIAC)
  - .1 Recommended Practices and Guide  
Specification for Hot and Cold Weather  
Masonry Construction.

1.3 ADMINISTRATIVE  
REQUIREMENTS

- .1 Pre-installation meetings: comply with  
Section 01 31 19. Conduct pre-installation  
meeting one week prior to commencing work of  
this Section and on-site installations to:
    - .1 Verify project requirements, including  
mock-up requirements.
    - .2 Verify substrate conditions.
    - .3 Co-ordinate products, installation  
methods and techniques.
    - .4 Sequence work of related sections.
-

- 1.3 ADMINISTRATIVE REQUIREMENTS  
(Cont'd)
- .1 (Cont'd)
    - .5 Co-ordinate with other building subtrades.
    - .6 Review manufacturer's installation instructions.
    - .7 Review masonry cutting operations, methods and tools and determine worker safety and protection from dust during cutting operations.
    - .8 Review warranty requirements.
  - .2 Sequencing: sequence with other work in accordance with Section 01 32 16.07. Comply with manufacturer's written recommendations for sequencing construction operations.
  - .3 Scheduling: schedule with other work in accordance with 01 32 16.07.
- 1.4 ACTION SUBMITTALS
- .1 Provide submittals in accordance with Section 01 33 00.
  - .2 Product Data:
    - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, limitations and colours.
    - .2 Provide two copies of Workplace Hazardous Materials Information System (WHMIS) - Material Safety Data Sheets (MSDS) in accordance with Section 01 35 29.06 and 01 35 43.
  - .3 Samples:
    - .1 Provide samples as follows:
      - .1 Six of each type of concrete masonry unit specified, including special shapes.
      - .2 Two cured, samples of mortar and grout, illustrating mortar colour and colour range, supplemented with specific requirements in Section 04 05 12.
      - .3 Two of each type of masonry accessory and flashing specified.
      - .4 Two of each type of masonry anchorage, reinforcement and connector proposed for use, supplemented by specific requirements in Section 04 05 19.
      - .5 Samples: used for testing and when accepted become standard for material used.
-



1.4 ACTION  
SUBMITTALS  
(Cont'd)

- .4 Shop Drawings:
  - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
  - .2 Provide shop drawings detailing temporary bracing required, designed to resist wind pressure and lateral forces during installation.

1.5 INFORMATION  
SUBMITTALS

- .1 Certificates: provide manufacturer's product certificates certifying materials comply with specified requirements.
- .2 Test and Evaluation Reports:
  - .1 Provide certified test reports in accordance with Section 01 29 83.
  - .2 Test reports to certify compliance of masonry units and mortar ingredients with specified performance characteristics and physical properties.
  - .3 Provide data for masonry units, in addition to requirements set out in referenced CSA and ASTM Standards, indicating initial rates of absorption.
- .3 Manufacturer's Reports: provide written reports prepared by manufacturer's on-site personnel to include:
  - .1 Verification of compliance of work with Contract.
  - .2 Site visit reports providing detailed review of installation of work, and installed work.

1.6 CLOSEOUT  
SUBMITTALS

- .1 Provide manufacturer's instructions for care, cleaning and maintenance of prefaced masonry units for incorporation into manual specified in Section 01 78 00.

1.7 MAINTENANCE  
MATERIAL SUBMITTALS

- .1 Provide manufacturer's instructions in accordance with Section 001 78 00 covering maintenance requirements and parts catalogue, with cuts and identifying numbers.
-

1.8 QUALITY  
ASSURANCE

- .1 Qualifications:
  - .1 Manufacturer: capable of providing field service representation during construction and approving application method.
  - .2 Installer: experienced in performing work of this section who has specialized in installation of work similar to that required for this project.
  - .3 Masons: company or person specializing in masonry installations with 5 years documented experience with masonry work similar to this project.
    - .1 Masons employed on this project must demonstrate ability to reproduce mock-up standards.
- .2 Mock-ups:
  - .1 Construct mock-ups in accordance with Section 01 45 00.
  - .2 Construct mock-up panel of exterior and interior masonry wall construction 1200 x 1800 mm showing masonry colours and textures, use of reinforcement, ties, through-wall flashing, weep holes, jointing, coursing, mortar and workmanship.
  - .3 Mock-up used:
    - .1 To judge workmanship, substrate preparation, operation of equipment and material application.
    - .2 For testing to determine compliance with performance requirements. Perform following tests.
      - .1 For clay units, in addition to requirements set out in referenced CSA and ASTM Standards include data indicating initial rate of absorption.
  - .4 Construct mock-up where directed by Departmental Representative.
  - .5 Allow 24 hours for inspection of mock-up by Departmental Representative before proceeding with work.
  - .6 When accepted by Departmental Representative, mock-up will demonstrate minimum standard for this work. Mock-up may remain as part of finished work.
  - .7 Start work only upon receipt of written acceptance of mock-up by Departmental Representative.

1.9 DELIVERY,  
STORAGE, AND  
HANDLING

- .1 Deliver materials in accordance with Section 01 61 00.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .3 Storage and Handling Protection:
  - .1 Keep materials dry until use except where wetting of bricks is specified.
  - .2 Store under waterproof cover on pallets or plank platforms held off ground by means of plank or timber skids.
  - .3 Packaging Waste Management:
    - .1 Remove for reuse and return of pallets, crates in accordance with Section 01 74 20.

1.10 SITE  
CONDITIONS

- .1 Ambient Conditions: assemble and erect components when temperatures are above 5°C.
- .2 Weather Requirements: to CAN/CSA-A371 to IMIAC - Recommended Practices and Guide Specifications for Hot and Cold Weather Masonry Construction.
- .3 Cold weather requirements:
  - .1 To CAN/CSA-A371 with following requirements:
    - .1 Maintain temperature of mortar between 5°C and 50°C until batch is used or becomes stable.
    - .2 Maintain ambient temperature of masonry work and it's constituent materials between 5°C and 50°C and protect site from windchill.
    - .3 Maintain temperature of masonry above 0°C for minimum of 3 days, after mortar is installed.
    - .4 Preheat unheated wall sections in enclosure for minimum 72 hours above 10°C, before applying mortar.
  - .2 Hot weather requirements:
    - .1 Protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.
    - .2 Keep masonry dry using waterproof, non-staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until masonry work is completed and protected by flashings or other permanent construction.

- 1.10 SITE CONDITIONS (Cont'd) .3 Cold weather requirements:(Cont'd)  
.3 Spray mortar surface at intervals and keep moist for maximum of three days after installation.

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS .1 Ensure manufacturer has minimum 5 years experience in manufacturing components similar to or exceeding requirements of project.

- 2.2 MATERIALS .1 Masonry materials are specified elsewhere in related Sections:  
.1 Section 040512 Masonry Mortar and Grout.  
.2 Section 040519 masonry Anchorage and Reinforcing.  
.3 Section 04 22 00 Concrete Unit Masonry

PART 3 - EXECUTION

- 3.1 INSTALLERS .1 Experienced and qualified masons to carry out erection, assembly and installation of masonry work.

- 3.2 MANUFACTURER'S INSTRUCTIONS .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

- 3.3 EXAMINATION .1 Examine conditions, substrates and work to receive work of this Section.  
.1 Co-ordinate with Section 01 71 00.  
.2 Examine openings to receive masonry units. Verify opening size, location, and that opening is square and plumb, and ready to receive work of this Section.  
.1 Inform Departmental Representative of unacceptable conditions immediately upon discovery.  
.2 Proceed with installation after receipt of written approval from Departmental Representative.
-

- 3.3 EXAMINATION .1 (Cont'd)  
(Cont'd) .3 Verification of Conditions:
- .1 Verify that:
    - .1 Substrate conditions which have been previously installed under other sections or contracts, are acceptable for product installation in accordance with manufacturer's instructions prior to installation of concrete block.
    - .2 Field conditions are acceptable and are ready to receive work.
    - .3 Built-in items are in proper location, and ready for roughing into masonry work.
  - .2 Commencing installation means acceptance of existing substrates.
- 
- 3.4 PREPARATION .1 Surface Preparation: prepare surface in accordance with manufacturer's written recommendations and co-ordinate with Section 01 71 00.
- .2 Establish and protect lines, levels, and coursing.
  - .3 Protect adjacent materials from damage and disfiguration.
- 
- 3.5 INSTALLATION .1 Do masonry work in accordance with CAN/CSA-A371 except where specified otherwise.
- .2 Build masonry plumb, level, and true to line, with vertical joints in alignment, respecting construction tolerances permitted by CAN/CSA-A371.
  - .3 Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimum of cutting.
- 
- 3.6 CONSTRUCTION .1 Exposed masonry:
- .1 Remove chipped, cracked, and otherwise damaged units, in accordance with CAN/CSA-A165, in exposed masonry and replace with undamaged units.
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- 3.6 CONSTRUCTION (Cont'd)
- .2 Jointing:
    - .1 Allow joints to set just enough to remove excess water, then tool with round jointer to provide smooth, joints true to line, compressed, uniformly concave joints where concave joints are indicated.
    - .2 Strike flush joints concealed in walls and joints in walls to receive plaster, tile, insulation, or other applied material except paint or similar thin finish coating.
  - .3 Cutting:
    - .1 Cut out for electrical switches, outlet boxes, and other recessed or built-in objects.
    - .2 Make cuts straight, clean, and free from uneven edges.
  - .4 Building-In:
    - .1 Build in items required to be built into masonry.
    - .2 Prevent displacement of built-in items during construction. Check plumb, location and alignment frequently, as work progresses.
    - .3 Brace door jambs to maintain plumb. Fill spaces between jambs and masonry with mortar.
  - .5 Wetting of bricks:
    - .1 Except in cold weather, wet bricks having initial rate of absorption exceeding 1 g/minute/1000 mm<sup>2</sup>: wet to uniform degree of saturation, 3 to 24 hours before laying, and do not lay until surface dry.
    - .2 Wet tops of walls built of bricks qualifying for wetting, when recommencing work on such walls.
  - .6 Support of loads:
    - .1 Use 20 MPa concrete to Section 03 30 00, where concrete fill is used in lieu of solid units.
    - .2 Use grout to CAN/CSA-A179 where grout is used in lieu of solid units.
    - .3 Install building paper below voids to be filled with concrete or grout; keep paper 25 mm back from faces of units.
  - .7 Provision for movement:
    - .1 Leave 6 mm space below shelf angles.
-

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- 3.6 CONSTRUCTION (Cont'd)
- .7 Provision for movement:(Cont'd)
    - .2 Leave 12.7 mm space between top of non-load bearing walls and partitions and structural elements. Do not use wedges.
    - .3 Built masonry to tie in with stabilizers, with provision for vertical movement.
  - .8 Loose steel lintels:
    - .1 Install loose steel lintels. Centre over opening width.
  - .9 Construction Joints: at 9 min or as detailed on drwgs.
    - .1 Construct continuous construction joints as indicated on drwgs
  - .10 Movement joints:
    - .1 Build-in continuous movement joints as indicated on drwgs.
  - .11 Interface with other work:
    - .1 Cut openings in existing work as indicated.
    - .2 Openings in walls: reviewed by Departmental Representative.
    - .3 Make good existing work. Use materials to match existing.
- 3.7 SITE TOLERANCES
- .1 Tolerances in notes to CAN/CSA-A371 apply.
- 3.8 FIELD QUALITY CONTROL
- .1 Site Tests, Inspection:
    - .1 Perform field review and testing in accordance with Section 01 45 00.
  - .2 Notify inspection agency minimum of 24 hours in advance of requirement for tests.
- 3.9 CLEANING
- .1 Clean in accordance with Section 01 74 11.
  - .2 Progress Cleaning: in accordance with related masonry sections.
  - .3 Final Cleaning:
    - .1 Perform cleaning after installation to remove construction and accumulated environmental dirt.
    - .2 Upon completion of installation and verification of performance of
-

- 3.9 CLEANING (Cont'd) .3 Final Cleaning:(Cont'd)
- .2 (Cont'd)  
installation, remove surplus materials,  
rubbish, tools and equipment barriers.
  - .4 Waste Management: separate waste materials  
for reuse and recycling in accordance with  
Section 01 74 20.
    - .1 Divert unused or damaged masonry units  
and glass block from landfill as  
specified in Section 01 74 20.
- 3.10 PROTECTION .1 Temporary Bracing:
- .1 Provide temporary bracing of masonry  
work during and after erection until  
permanent lateral support is in place.
  - .2 Bracing to be designed Licensed  
Professional Engineer in Ontario,  
Contractor to provide stamped details  
prior to commencement of work.
  - .3 Brace masonry walls as necessary to  
resist wind pressure and lateral forces  
during construction.
- .2 Moisture Protection:
- .1 Keep masonry dry using waterproof,  
nonstaining coverings that extend over  
walls and down sides sufficient to  
protect walls from wind driven rain,  
until completed and protected by flashing  
or other permanent construction.
  - .2 Cover completed and partially completed  
work not enclosed or sheltered with  
waterproof covering at end of each work  
day. Anchor securely in position.
  - .3 Air Temperature Protection: protect  
completed masonry as recommended in 1.10  
SITE CONDITIONS.



PART 1 - GENERAL

- 1.1 REFERENCES .1 Canadian Standards Association (CSA International)
- .1 CSA-A23.1-09/A23.2-09, Concrete materials and methods of concrete construction/Test methods and standard practices for concrete.
  - .2 CAN/CSA-A179-04(R2009), Mortar and Grout for Unit Masonry.
  - .3 CAN/CSA-A371-04(R2009), Masonry Construction for Buildings.
  - .4 CAN/CSA-A3000-08, Cementitious Materials Compendium; CAN/CSA-A3002-08, Masonry and Mortar Cement.
- .2 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD)
- .1 SCAQMD Rule 1168-05, Adhesive and Sealant Applications.
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS .1 Product Data:
- .1 Provide submittals in accordance with Section 01 33 00.
  - .2 Provide manufacturer's printed product literature, specifications and datasheets. Include product characteristics, performance criteria, and limitations.
  - .3 Provide two copies of Workplace Hazardous Materials Information System (WHMIS) - Material Safety Data Sheets (MSDS) in accordance with Section 01 35 29 and 01 35 43. Indicate VOC's mortar, grout, parging, colour additives and admixtures. Expressed as grams per litre (g/L).
- .2 Samples:
- .1 Samples: provide unit samples in accordance with Section 04 05 10, supplemented as follows:
    - .1 Provide two 50x50 mm size samples of mortar.
    - .2 Provide confirmation of source or product data sheet, prior to mixing or preparation of mortars, to Departmental Representative of:
      - .1 Aggregate: course aggregate and sand.
      - .2 Cement.
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- 1.2 ACTION AND INFORMATIONAL SUBMITTALS (Cont'd)
- .2 Samples:(Cont'd)
- .1 Samples:(Cont'd)
- .2 (Cont'd)
- .3 Lime.
- .4 Colour pigment samples.
- .3 Manufacturer's Instructions:
- .1 Provide manufacturer's installation instructions.
- 1.3 QUALITY ASSURANCE
- .1 Test Reports: certified test reports including sand gradation tests in accordance with CAN/CSA- A179 showing compliance with specified performance characteristics and physical properties, and in accordance with Section 04 05 10 supplemented as follows:
- .1 Submit laboratory test reports in accordance with Section 01 29 8.
- .2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Mock-ups:
- .1 Construct mock-ups in accordance with Section 01 45 00 and requirements of Section 04 05 10 supplemented as follows:
- .1 Construct mock-up sample panel of pointing.
- .2 Sample panel: 1200x1200mm using proposed procedures, colours, texture, finish and workmanship.
- 1.4 DELIVERY, STORAGE, AND HANDLING
- .1 Deliver, store and handles masonry mortar and grout materials in accordance with Section 01 61 00, supplemented as follows:
- .1 Deliver prepackaged, dry-blended mortar mix to project site in labelled plastic-lined bags each bearing name and address of manufacturer, production codes or batch numbers, and colour or formula numbers.
- .2 Maintain mortar, grout and packaged materials clean, dry, and protected against dampness, freezing, traffic and contamination by foreign materials.
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- 1.5 SITE CONDITIONS .1 Ambient Conditions: maintain materials and surrounding air temperature to:
- .1 Minimum 10degrees C prior to, during, and 48 hours after completion of masonry work.
  - .2 Maximum 32 degrees C prior to, during, and 48 hours after completion of masonry work.
- .2 Weather Requirements: CAN/CSA-A371 and International Masonry Industry All-Weather Council (IMIAC) - Recommended Practices and Guide Specifications for Hot and Cold Weather Masonry Construction.

PART 2 - PRODUCTS

- 2.1 MATERIALS .1 Use same brands of materials and source of aggregate for entire project.
- .2 Cement:
- .1 Portland Cement: to CAN/CSA-A3000, Type GU - General use hydraulic cement (formerly Type 10) gray colour.
    - .1 Use low VOC products in compliance with SCAQMD Rule 1168.
  - .2 Masonry Cement: to CAN/CSA-A3002 and CAN/CSA-A179, Type S.
  - .3 Mortar Cement: to CAN/CSA-A3002 and CAN/CSA-A179, Type S.
    - .1 Use low VOC products in compliance with SCAQMD Rule 1168.
  - .4 Packaged Dry Combined Materials for mortar: to CAN/CSA-A179, Type S, using gray colour cement.
- .3 Aggregate: supplied by one supplier.
- .1 Fine Aggregate: to CAN/CSA-A179, natural sand
  - .2 Course Aggregate: to CAN/CSA-A179.
- .4 Water: clean and potable.
- .5 Lime:
- .1 Quick Lime: to CAN/CSA-A179, Type S.
  - .2 Hydrated Lime: to CAN/CSA-A179, Type S
- .6 Bonding Agent: latex type.
- .7 Polymer Latex: organic polymer latex admixture of butadiene-styrene type non-emulsifiable bonding admixture.
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2.2 COLOUR  
ADDITIVES N/A

- 2.3 ADMIXTURES
- .1 Water Repellent Agents: powdered
    - .1 Use low VOC products in compliance with SCAQMD Rule 1168. Use hydrated lime if possible, and avoid adding air entrainment agents due to difficulty in maintaining site quality control.
  - .2 Air Entrainment Agents: acceptable percent added to mix 15.
    - .1 Use low VOC products in compliance with SCAQMD Rule 1168.

- 2.4 MORTAR MIXES
- .1 Mortar for exterior masonry above grade:
    - .1 Loadbearing: type S based on property specifications.
    - .2 Non-Loadbearing: S based on property specifications.
  - .2 Mortar for interior masonry:
    - .1 Loadbearing: type S based on property specifications.
    - .2 Non-Loadbearing: N based on property specifications.
  - .3 Parging mortar: type s to CAN/CSA-A179.
  - .4 Mortar for foundation walls, manholes, sewers, pavements, walks, patios and other exterior masonry at or below grade: type M based on property specifications, CAN/CSA-A179 table.
  - .5 Following applies regardless of mortar types and uses specified above:
  - .6 Mortar for calcium silicate brick and concrete brick: type O based on proportion specifications.
  - .7 Mortar for grouted reinforced masonry: type S based on property specifications.

- 2.5 MORTAR MIXING
- .1 Use pre-blended, pre-coloured mortar prepackaged under controlled factory conditions. Ingredients batching limitations to be within 1% accuracy.
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- 2.5 MORTAR MIXING (Cont'd)
- .2 Mix mortar ingredients in accordance with CAN/CSA-A179 in quantities needed for immediate use.
  - .3 Maintain sand uniformly damp immediately before mixing process.
  - .4 Do not use anti-freeze compounds including calcium chloride or chloride based compounds.
  - .5 Do not add air entraining admixture to mortar mix.
  - .6 Use a batch type mixer in accordance with CAN/CSA-A179.
  - .7 Pointing mortar: prehydrate pointing mortar by mixing ingredients dry, then mix again adding just enough water to produce damp unworkable mix that will retain its form when pressed into ball. Allow to stand for not less than 1 hour no more than 2 hours then remix with sufficient water to produce mortar of proper consistency for pointing.
  - .8 Re-temper mortar only within two hours of mixing, when water is lost by evaporation.
  - .9 Use mortar within 2 hours after mixing at temperatures of 32°C, or 2-1/2 hours at temperatures under 5°C.
- 2.6 GROUT MIXES
- .1 Bond Beams: grout mix 20 MPa strength at 28 days; 200-250mm slump; premixed type in accordance with CAN/CSA-A23.1/A23.2.
  - .2 Lintels: grout mix 20 MPa strength at 28 days; 200-250mm slump; premixed type in accordance with CAN/CSA-A23.1/A23.2
  - .3 Grout: Minimum compressive strength of 20 MPa at 28 days. Maximum aggregate size and grout slump: CAN/CSA-A179.
- 2.7 GROUT MIXING
- .1 Mix batched and delivered grout in accordance with CAN/CSA-A23.1/A23.2 transit mixed.
  - .2 Mix grout ingredients in quantities needed for immediate use in accordance with CAN/CSA-A179 fine grout.
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- 2.6 GROUT MIXES (Cont'd)
- .3 Add admixtures in accordance with manufacturer's instructions; mix uniformly.
  - .4 Do not use calcium chloride or chloride based admixtures.
- 2.8 MIX TESTS
- .1 Testing Mortar Mix:
    - .1 Test mortar to requirements of Section 01 45 00, and in accordance with CAN/CSA-A179, for mortar based on property specification. Test prior to construction and during construction for:
      - .1 Compressive strength.
      - .2 Consistency.
      - .3 Mortar aggregate ratio.
      - .4 Sand/cement ratio.
      - .5 Water content and water/cement ratio.
      - .6 Air content.
      - .7 Splitting tensile strength.
  - .2 Testing Grout Mix:
    - .1 Test grout to requirements of Section 01 45 00, and in accordance with CAN/CSA-A179, for grout based on property specification. Test prior to construction and during construction for:
      - .1 Compressive strength.
      - .2 Sand/cement ratio.
      - .3 Water content and water/cement ratio.
      - .4 Slump.

PART 3 - EXECUTION

- 3.1 EXAMINATION
- .1 Request inspection of spaces to be grouted.
- 3.2 PREPARATION
- .1 Apply bonding agent to existing concrete surfaces.
  - .2 Plug clean-out holes with block masonry units. Brace masonry for wet grout pressure.
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- 3.3 MANUFACTURER'S INSTRUCTIONS .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- 3.4 CONSTRUCTION .1 Do masonry mortar and grout work in accordance with CAN/CSA-A179 except where specified otherwise.
- .2 Apply parging in uniform coating not less than total 10 mm thick.
- 3.5 MIXING .1 All pointing mortar can be mixed using a regular paddle mixer. Only electric motor mixers are permissible. Mixers run on hydrocarbons are not permitted, due to fumes. Mixing by hand must be pre-approved by the Departmental Representative.
- .2 Clean all mixing boards and mechanical mixing machine between batches.
- .3 Mortar must be weaker than the units it is binding.
- .4 Contractor to appoint one individual to mix mortar, for duration of project. In the event that this individual must be changed, mortar mixing must cease until the new individual is trained, and mortar mix is tested.
- 3.6 MORTAR PLACEMENT .1 Install mortar to requirements of CAN/CSA-A179.
- .2 Remove excess mortar from grout spaces.
- 3.7 GROUT PLACEMENT .1 Install grout in accordance with CAN/CSA-A179.
- .2 Work grout into masonry cores and cavities to eliminate voids.
- .3 Do not install grout in lifts greater than 400 mm, without consolidating grout by rodding.
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- 3.7 GROUT PLACEMENT.4 (Cont'd) Do not displace reinforcement while placing grout.
- 3.8 FIELD QUALITY CONTROL .1 Site Tests, Inspection: in accordance with Section 04 05 10 supplemented as follows:  
.1 Test and evaluate mortar prior to construction and during construction in accordance with CAN/CSA-A179.  
.2 Test and evaluate grout prior to construction and during construction to CAN/CSA-A179; test in conjunction with masonry unit sections specified.  
.2 Manufacturer's Field Services: in accordance with Section 04 05 10.
- 3.9 CLEANING .1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.  
.2 Remove droppings and splashings using clean sponge and water.  
.3 Clean masonry with low pressure clean water and soft natural bristle brush.  
.4 Waste Management: separate waste materials for reuse and recycling.
- 3.10 PROTECTION OF COMPLETED WORK .1 Cover completed and partially completed work not enclosed or sheltered with waterproof covering at end of each work day. Anchor securely in position.
- 3.11 SCHEDULE .1 Grout following masonry components All walls solid.



PART 1 - GENERAL

- 1.1 REFERENCES .1 ASTM International Inc.
- .1 ASTM A36/A36M-08, Standard Specification for Carbon Structural Steel.
  - .2 ASTM A82/A82M-07, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
  - .3 ASTM A167-99(R2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
  - .4 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
  - .5 ASTM A580/A580M-08, Standard Specification for Stainless Steel Wire.
  - .6 ASTM A641/A641M-09a, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
  - .7 ASTM A666-03, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- .2 Canadian Standards Association (CSA International)
- .1 CSA-A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - .2 CAN/CSA-A179-04(R2009), Mortar and Grout for Unit Masonry.
  - .3 CAN/CSA-A370-04(R2009), Connectors for Masonry.
  - .4 CAN/CSA-A371-04(R2009), Masonry Construction for Buildings.
  - .5 CAN/CSA-G30.18-09, Carbon Steel Bars for Concrete Reinforcement.
  - .6 CSA S304.1-04, Design of Masonry Structures.
  - .7 CSA W186-M1990(R2007), Welding of Reinforcing Bars in Reinforced Concrete Construction.
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS .1 Provide submittals in accordance with Section 01 33 00.
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1.2 ACTION AND  
INFORMATIONAL  
SUBMITTALS  
(Cont'd)

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

1.3 QUALITY  
ASSURANCE

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- .1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements. Comply with Section 04 05 10.

1.3 QUALITY  
ASSURANCE  
(Cont'd)

- .4 Mock-ups:
  - .1 Construct mock-ups in accordance with Section 01 45 00 and requirements of Section 04 05 10 supplemented as follows:
    - .1 Construct mock-ups panel of anchorage installation and reinforcement installation.
    - .2 Sample panel: 3000 mm x 3000 mm using proposed procedures, anchorage material, connectors, reinforcement material, and workmanship.

1.4 FIELD  
MEASUREMENTS

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

1.5 DELIVERY,  
STORAGE, AND  
HANDLING

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

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Bar reinforcement: Steel to CAN/CSA-A371 and CSA-G30.18, Grade 400.
- .2 Connectors: to CAN/CSA-A370 and CSA S304.1.
- .3 Corrosion protection: to CSA S304.1, galvanized to CSA S304.1 and CAN/CSA-A370.
- .4 Fasteners: installed post-construction:
  - .1 Screw Shields and Plugs: plastic, water-resistant placed directly into grouted concrete block units
  - .2 Bolts and Screws: size and type to suit application, locate where indicated.
  - .3 Nails: case-hardened cut or spiral nails, size and type to suit fastening application.
  - .4 Powder-Driven Fasteners: pin styles and lengths to suit fastening application in

- 
- 2.1 MATERIALS  
(Cont'd)
- .4 Fasteners:(Cont'd)
- .4 Powder-Driven Fasteners:(Cont'd)  
accordance with manufacturers use, load  
and hold recommendations.
- .5 Adhesives: epoxies, mastics and contact  
cements for fastening applications, use  
in accordance with manufacturers'  
recommendations.
- .5 Ties: hot dip galvanized to CAN/CSA-A370  
Table 5.2 steel finish.
- .1 Corrugated to CAN/CSA-A370.
- .2 Unit ties, to CAN/CSA-A370: rectangular  
fabricated form cold-drawn steel size to  
suit application.
- .3 Adjustable Unit Ties: to CAN/CSA-A370:  
proprietary type ties, type, style and  
size to suit application in accordance  
with manufacturer's recommendations.
- .4 Joint Reinforcement Ties: to  
CAN/CSA-A370:
- .1 Single Wythe Joint Reinforcement:  
truss type:
- .1 Steel wire, hot dip  
galvanized: to ASTM A641, Class 3  
after fabrication.
- .2 Cold drawn steel wire  
conforming to ASTM A82/A82M.
- .3 Stainless steel conforming to  
ASTM A580, Type 304, 4.8 mm side  
rods with cross ties.
- .5 Multiple Wythe Joint Reinforcement:  
truss type: without moisture drip;  
adjustable:
- .1 Steel wire, hot dip galvanized: to  
ASTM A641 Class 3 after fabrication.
- .2 Cold drawn steel wire conforming to  
ASTM A82/A82M.
- .3 Stainless steel conforming to ASTM  
A580 Type 304, 4.8 mm side rods with  
cross rods.
- .6 Anchors: to CAN/CSA-A370:
- .1 Conventional Anchors: type steel bolts  
with bent bar anchors, plate anchors,  
through bolts, shape J and/or L, sized to  
suit application.
- .2 Wedge Anchors: expansion anchors type  
wedge and bolt, sized to suit  
application.
- .3 Sleeve Anchors: type sleeve and bolt,  
sized to suit application.
- .4 Self-Contained Anchors: type  
double-glass/plastic vial system, with  
epoxy resin and hardener.
-

2.1 MATERIALS  
(Cont'd)

- .6 Anchors:(Cont'd)
  - .5 Dovetail Anchors: bent steel strap, 38 mm size x 6.4 mm thick, galvanized to CAN/CSA- A370 Table 5.2 coated finish.
  - .6 Spiral Anchors: 8 mm stainless steel spiral anchors to Grade 304.
  - .7 Stone Anchors: series 300 stainless steel to ASTM A666. Anchors to be manufactured as per drawings.
  - .8 Anchor Bolts: conventional anchors, steel, galvanized to CAN/CSA-A370 Table 5.2.
- .7 Conventional Bolts:
  - .1 Bolts: to ASTM A36/A36M, bar stock shop threaded, straight bolts with square or hex-headed nuts, bent bar anchors, J and/or L shaped.
  - .2 Plate anchors: steel to ASTM A36/A36M, weld square of circular steel plate perpendicular to axis of steel bar threaded on opposite end.
  - .3 Through bolt rods: to ASTM A307 threaded rod or threaded ASTM A36/A36M bar stock.
- .8 Adhesive Anchors: proprietary systems, pre-mixed, self-contained system with double glass vial system to contain epoxy, consisting of resin, hardener and aggregate or measure and mix system where epoxy materials are hand-measured and mixed in accordance with manufacturers' written instructions.

2.2 FABRICATION

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

- 2.3 SOURCE QUALITY CONTROL
- .1 Upon request, provide Departmental Representative with certified copy of mill test report of reinforcement steel and connectors, showing physical and chemical analysis, minimum 4 weeks prior to commencing reinforcement work.
  - .2 Upon request inform Departmental Representative of proposed source of material to be supplied.

PART 3 - EXECUTION

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

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

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

- 3.4 BONDING AND TYING
- .1 Bond walls of two or more wythes using metal connectors in accordance with CSA S304.1, CAN/CSA-A371 and as indicated.
  - .2 Tie masonry veneer to backing in accordance with NBC 2010, CSA S304.1, CAN/CSA-A371 and as indicated.
  - .3 Install unit, adjustable, single wythe and multiple wythe joint reinforcement where indicated and in accordance with CAN/CSA-A370

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- 3.4 BONDING AND TYING (Cont'd) .3 (Cont'd)  
and CAN/CSA-A371 and manufacturer's instructions.
- .1 Bond walls of two or more wythes using metal connectors in accordance with CAN/CSA-A371 and as indicated.
  - .2 Install horizontal joint reinforcement as per structural drwgs, min 400 and 200 mm alternating.
  - .3 Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 400 mm each side of opening.
  - .4 Place joint reinforcement continuous in first second joint below top of walls.
  - .5 Lap joint reinforcement ends minimum 200 mm.
  - .6 Connect stack bonded unit joint corners and intersections with strap anchors 400 mm on centre.
- 3.5 REINFORCED LINTELS AND BOND BEAMS .1 Reinforce masonry beams, masonry lintels and bond beams as indicated.  
BEAMS
- .2 Place and grout reinforcement in accordance with CSA S304.1, CAN/CSA-A371, and CAN/CSA-A179.
  - .3 Support and position reinforcing bars in accordance with CAN/CSA-A371.
- 3.6 GROUTING .1 Grout masonry in accordance with CSA S304.1, CAN/CSA-A371 and CAN/CSA-A179 and as indicated.  
GROUTING
- 3.7 ANCHORS .1 Supply and install metal anchors in accordance with CAN/CSA-A370 and CAN/CSA-A371 and as indicated on drwgs  
ANCHORS
- 3.8 LATERAL SUPPORT AND ANCHORAGE .1 Supply and install lateral support and anchorage in accordance with CSA S304.1 and as indicated.  
LATERAL SUPPORT AND ANCHORAGE
-

- 3.9 MOVEMENT JOINTS .1 Reinforcement will not be continuous across movement joints unless otherwise indicated.
- 3.10 FIELD BENDING .1 Do not field bend reinforcement and connectors except where indicated or authorized by Departmental Representative.
- .2 When field bending is authorized, bend without heat, applying a slow and steady pressure.
- .3 Replace bars and connectors which develop cracks or splits.
- 3.11 FIELD QUALITY CONTROL .1 Site inspections in accordance with Section 04 05 10.
- .2 Obtain Departmental Representative approval of placement of reinforcement and connectors, prior to placing grout.
- 3.12 FIELD TOUCH-UP .1 Touch up damaged and cut ends of epoxy coated or galvanized reinforcement steel and connectors with compatible finish to provide continuous coating.
- 3.13 CLEANING .1 Clean in accordance with Section 01 74 11.
- .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.



PART 1 - GENERAL

- 1.1 RELATED REQUIREMENTS
- .1 Section 04 05 12 - Mortar and Masonry Grout.
  - .2 Section 04 05 19 - Masonry Anchorage and Reinforcing.
- 1.2 REFERENCES
- .1 ASTM International Inc.
    - .1 ASTM E336-11, Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings.
  - .2 Canada Green Building Council (CaGBC)
    - .1 LEED Canada For New Construction and Major Renovations 2009.
    - .2 LEED Canada For Core and Shell 2009.
    - .3 LEED Canada-CI Version 1.0-2007, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
  - .3 Canadian Standards Association (CSA International)
    - .1 CAN/CSA-A165 Series-04(R2009), CSA Standards on Concrete Masonry Units (covers: A165.1, A165.2, A165.3).
    - .2 CAN/CSA-A371-04(R2009), Masonry Construction for Buildings.
    - .3 CSA S304.1-04(R2010), Design of Masonry Structures.
  - .4 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD)
    - .1 SCAQMD Rule 1168-05, Adhesives and Sealants Applications.
  - .5 Underwriters' Laboratories of Canada (ULC)
    - .1 CAN-ULC-S101-07, Standard Methods of Fire Endurance Tests of Building Construction and Materials.
- 1.3 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Provide submittals in accordance with Section 01 33 00.
  - .2 Product Data:
    - .1 Product Data: provide product data, including manufacturer's printed data sheets and catalog pages illustrating

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- 1.3 ACTION AND INFORMATIONAL SUBMITTALS (Cont'd)
- .2 Product Data:(Cont'd)
    - .1 Product Data:(Cont'd) products to be incorporated into project for specified products.
  - .3 Samples:
    - .1 Provide unit samples in accordance with Section 04 05 10.
  - .4 Manufacturer's Written Instructions: provide in accordance with Section 04 05 10.
- 1.4 QUALITY ASSURANCE SUBMITTALS
- 
- .1 Certificates: provide in accordance with Section 04 05 10.
  - .2 Test and Evaluation Reports: provide certified test reports in accordance with Section 04 05 10.
  - .3 Mock-ups:
  - .4 Construct mock-ups in accordance with Section 01 45 00 and requirements of Section 04 05 10 supplemented as follows:
    - .1 Construct mock-up panel of exterior and interior concrete unit masonry construction 1200 x 1800 mm.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- .1 Deliver, store and handle concrete unit masonry in accordance with Section 04 05 10.
  - .2 Packaging Waste Management:
    - .1 Separate and recycle waste materials in accordance with Section 01 74 20.

PART 2 - PRODUCTS

- 
- 2.1 MATERIALS
- 
- .1 Standard concrete block units: to CAN/CSA-A165 Series (CAN/CSA-A165.1).
    - .1 Classification: H/15/A/M.
    - .2 Dimensions - Nominal: 200, 250, and 300 mm wide x 200 mm high x 400 mm long.
    - .3 Special shapes: provide square, bull-nosed and double bull-nosed units for exposed corners, where indicated. Provide purpose-made shapes for lintels, beams and bond beams. Provide additional special shapes as indicated.
-

- 2.2 REINFORCEMENT .1 Reinforcement in accordance with Section 04 05 19.
- 2.3 CONNECTORS .1 Connectors in accordance with Section 04 05 19.
- 2.4 FLASHING .1 Flashing: in accordance with Section 07 62 00.
- 2.5 MORTAR MIXES .1 Mortar and mortar mixes in accordance with Section 04 05 12.
- 2.6 GROUT MIXES .1 Grout and grout mixes in accordance with Section 04 05 12.
- 2.7 CLEANING COMPOUNDS .1 Use low VOC products in compliance with SCAQMD Rule 1168.
- .2 Compatible with substrate and acceptable to masonry manufacturer for use on products.
- .3 Cleaning compounds compatible with concrete unit masonry and in accordance with manufacturer's written recommendations and instructions.
- 2.8 TOLERANCES .1 Tolerances for standard concrete unit masonry tolerances in accordance with CAN/CSA-A165.1, supplemented as follows:
- .1 Maximum variation between units within specific job lot not to exceed 2 mm.
- .2 No parallel edge length, width or height dimension for individual unit to differ by more than 2 mm.
- .3 Out of square tolerance not to exceed 2 mm.
- .2 Tolerances for architectural concrete masonry units in accordance with CAN/CSA-A165.1, supplemented as follows:
- .1 Maximum variation in length or height between units within specific job lot for specified dimension not to exceed 2 mm.
-

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- 2.8 TOLERANCES .2 (Cont'd)  
(Cont'd)
- .2 No parallel edge length, width or height dimension for individual unit to differ by more than 2 mm.
  - .3 Out of square tolerance not to exceed 2 mm.
  - .4 Maximum variation in width between units within specific job lot for specified dimension not to exceed 2mm.

PART 3 - EXECUTION

- 3.1 EXAMINATION .1 Verify surfaces and conditions are ready to accept work of this Section.
- .2 Commencing installation means acceptance of existing substrates.
- 3.2 PREPARATION .1 Protect adjacent finished materials from damage due to masonry work.
- 3.3 INSTALLATION .1 Concrete block units:
- .1 Bond: running.
  - .2 Coursing height: 200 mm for one block and one joint.
  - .3 Jointing: concave where exposed or where paint or other finish coating is specified.
  - .4 Clean block faces using soft cloths before mortar hardens rake to 10 mm depth. After completion of block laying fill joints with pointing mortar then point to provide concave joints. Repeat cleaning of faces.
- .2 Special Shapes:
- .1 Install special units to form corners, returns, offsets, reveals and indents without cut ends being exposed and without losing bond or module.
  - .2 Install reinforced concrete block lintels over openings in masonry where steel or reinforced concrete lintels are not indicated.
  - .3 End bearing: not less than 200 mm.
  - .4 Install special site cut shaped units.
-

- 3.4 REINFORCEMENT .1 Install reinforcing in accordance with Section 04 05 19.
- 3.5 CONNECTORS .1 Install connectors in accordance with Section 04 05 19.
- 3.6 FLASHING .1 Install flashings: in accordance with Section 07 62 00.
- 3.7 MORTAR PLACEMENT .1 Place mortar in accordance with Section 04 05 12.
- 3.8 GROUT PLACEMENT .1 Place grout in accordance with Section 04 05 12.
- 3.9 CONSTRUCTION .1 Cull out masonry units, in accordance with CAN/CSA-A165 and reviewed range of colour samples, with chips, cracks, broken corners, excessive colour and texture variation.
- .2 Build in miscellaneous items such as bearing plates, steel angles, bolts, anchors, inserts, sleeves and conduits.
- .3 Construct masonry walls using running bond unless otherwise noted.
- .4 Build around frames previously set and braced. Fill behind hollow frames within masonry walls with mortar or grout and embed anchors.
- .5 Fit masonry closely against electrical and plumbing outlets so collars, plates and covers overlap and conceal cuts.
- .6 Install movement joints and keep free of mortar where indicated.
- .7 Hollow Units: spread mortar setting bed from outside edge of face shells. Gauge amount of mortar on top and end of unit to create full joints, equivalent to shell thickness. Avoid excess mortar. All units are to be grouted solid with 20 MPa grout.
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- 3.9 CONSTRUCTION  
(Cont'd)
- .8 Solid Units: apply mortar over entire vertical and horizontal surfaces. Avoid bridging of airspace between brick veneer and backup wall with mortar.
  - .9 Ensure compacted head joints. Use full or face-shell joint as indicated.
  - .10 Tamp units firmly into place.
  - .11 Do not adjust masonry units after mortar has set. Where resetting of masonry is required, remove, clean and reset units in new mortar.
  - .12 Tool exposed joints concave; strike concealed joints flush.
  - .13 After mortar has achieved initial set up, tool joints.
  - .14 Do not interrupt bond below or above openings.
- 3.10  
REPAIR/RESTORATION
- .1 Upon completion of masonry, fill holes and cracks, remove loose mortar and repair defective work.
- 3.11 FIELD QUALITY  
CONTROL
- .1 Site Tests, Inspection: in accordance with Section 04 05 10 supplemented as follows:
    - .1 Concrete masonry units will be sampled and tested by independent testing agency appointed and paid by Departmental Representative in accordance with CSA S304.1.
    - .2 Notify inspection agency minimum of 24 hours in advance of requirement for tests.
- 3.12 CLEANING
- .1 Clean in accordance with Section 01 74 11, supplemented as follows.
    - .1 Progress Cleaning:
      - .1 Standard Concrete Unit Masonry:
        - .1 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block. Clean wall surface with suitable brush or burlap.
-

3.12 CLEANING .1 (Cont'd)  
(Cont'd) .1 Progress Cleaning:(Cont'd)

.2 Waste Management: separate  
waste materials for reuse and  
recycling in accordance with Section  
0174 20.

3.13 PROTECTION .1 Brace and protect concrete unit masonry in  
accordance with Section 04 05 10.





PART 1 - GENERAL

1.1 RELATED  
SECTIONS

- .1 Section 05 21 00 - Steel Joist Framing.
- .2 Section 05 31 00 - Steel Decking.
- .3 Section 03 30 00 - Cast in Place Concrete

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
    - .1 ASTM A36/A36M-08, Standard Specification for Structural Steel.
    - .2 ASTM A123/A123M-09, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
    - .3 ASTM A193-11/A193M-11, Standard Specification for Alloy Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
    - .4 ASTM A307-10, Standard Specification for Carbon Steel Bolts and Studs, 410 MPa Tensile Strength.
    - .5 ASTM A325-10, Specification for Structural Bolts, Steel, Heat Treated, 830/725 MPa Minimum Tensile Strength.
    - .6 ASTM A325M-09, Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength (Metric).
    - .7 ASTM A490M-10a e1, Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, . 830 MPa Minimum Tensile Strength.
  - .2 Canadian General Standards Board (CGSB)
    - .1 CAN/CGSB-85.10-99, Protective Coatings for Metals.
  - .3 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturer's Association (CPMA).
    - .1 CISC/CPMA 1-73b, Quick-Drying One-Coat Paint for Use on Structural Steel.
    - .2 CISC/CPMA 2-75, Quick-Drying Primer for use on Structural Steel.
-

1.2 REFERENCES  
(Cont'd)

- .4 Canadian Standards Association (CSA International)
  - .1 CSA G40.20-04(R2009)/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .2 CSA S16-09, Design of Steel Structures.
  - .3 CAN/CSA-S136-07, North American Specification for the Design of Cold Formed Steel Structural Members.
  - .4 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel Structures.
  - .5 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.
  - .6 CSA W55.3-08, Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.
  - .7 CSA W59-03(R2008), Welded Steel Construction (Metal Arc Welding) Metric.
- .5 Master Painters Institute
  - .1 MPI-INT 5.1-98, Structural Steel and Metal Fabrications.
  - .2 MPI-EXT 5.1-98, Structural Steel and Metal Fabrications.
- .6 The Society for Protective Coatings (SSPC)
  - .1 SSPC SP 6/NACE No. 3-00, Commercial Blast Cleaning.

1.3 DESIGN REQUIREMENTS

- .1 Design details and connections in accordance with requirements of CSA S16 and CAN/CSA-S136 to resist forces, moments, shears and allow for movements indicated.
- .2 Shear connections:
  - .1 Select framed beam shear connections from an industry accepted publication such as "Handbook of the Canadian Institute of Steel Construction" when connection for shear only (standard connection) is required.
  - .2 Select or design connections to support reaction from maximum uniformly distributed load that can be safely supported by beam in bending, provided no point loads act on beam, when shears are not indicated.
- .3 Submit sketches and design calculations stamped and signed by qualified professional engineer licensed in Province of Ontario, Canada for non standard connections.

- 1.4 SHOP DRAWINGS .1 Submit shop drawings including fabrication and erection documents and materials list in accordance with Section 01 33 00.
- .2 Erection drawings: indicate details and information necessary for assembly and erection purposes including:
- .1 Description of methods.
  - .2 Sequence of erection.
  - .3 Type of equipment used in erection.
  - .4 Temporary bracings.
- .3 Ensure Fabricator drawings showing designed assemblies, components and connections are stamped and signed by qualified professional engineer licensed in the province of Ontario, Canada. Shop drawings noted above that are not stamped as noted will not be reviewed and this will not be claim for project delays as a result of lost time.
- 1.5 SAMPLES .1 Submit samples in accordance with Section 01 33 00.
- .2 Submit one type of each anchor bolt and shear connector for approval.
- 1.6 QUALITY ASSURANCE .1 Submit 1 copies of mill test reports 4 weeks prior to fabrication of structural steel.
- .1 Mill test reports to show chemical and physical properties and other details of steel to be incorporated in project.
  - .2 Provide mill test reports certified by metallurgists qualified to practice in province of Ontario, Canada.
- .2 Provide structural steel Fabricator's affidavit stating that materials and products used in fabrication conform to applicable material and products standards specified and indicated.
- 1.7 WASTE MANAGEMENT AND DISPOSAL .1 Separate and recycle waste materials in accordance with Section 01 74 20.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
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1.7 WASTE  
MANAGEMENT AND  
DISPOSAL  
(Cont'd)

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- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.
- .5 Divert unused paint material from landfill to official hazardous material collections site approved by Departmental Representative.
- .6 Do not dispose of unused paint materials into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Structural steel: to CSA G40.20/G40.21 Grade 350W and CAN/CSA-S136, minimum 30% recycled content.
  - .2 Anchor bolts: to CSA G40.20/G40.21, Grade 300W , minimum 30% recycled content.
  - .3 High strength anchor bolts: to ASTM A193/A93M, Grade B7, minimum 30% recycled content.
  - .4 Bolts, nuts and washers: to ASTM A325, Type 1 minimum 30% recycled content.
  - .5 Welding materials: to CSA W48 Series and CSA W59 and certified by Canadian Welding Bureau.
  - .6 Shop paint primer: to CISC/CPMA 2, Ecologo certified.
  - .7 Hot dip galvanizing: galvanize steel, for exterior exposed steel, to ASTM A123/A123M, minimum zinc coating of 600 g/m<sup>2</sup>, Coating Grade 85.
  - .8 Shear studs: to CSA W59, Appendix H.
-

2.2 FABRICATION

- .1 Fabricate structural steel in accordance with CSA S16 and CAN/CSA-S136 and in accordance with reviewed shop drawings.
- .2 Install shear studs in accordance with CSA W59.
- .3 Continuously seal members by continuous welds unless otherwise indicated, Grind smooth.
- .4 Provide holes in top flanges for attachment of wood nailers.
- .5 Exposed steel to be hot dipped galv.

2.3 SHOP PAINTING

- .1 Clean, prepare surfaces and shop prime structural steel in accordance with CSA S16 CPMA - 2 except where members to be encased in concrete.
  - .2 Clean members, remove loose mill scale, rust, oil, dirt and other foreign matter. Prepare surface according to SSPC-SP-6.
  - .3 Apply one coat of primer in shop to steel surfaces to achieve minimum dry film thickness of 0.065 to 0.08 mils, except:
    - .1 Surfaces to be encased in concrete.
    - .2 Surfaces to receive field installed stud shear connections.
    - .3 Surfaces and edges to be field welded.
    - .4 Faying surfaces of friction-type connections.
    - .5 Below grade surfaces in contact with soil.
  - .4 Apply paint under cover, on dry surfaces when surface and air temperatures are above 5 degrees C.
  - .5 Maintain dry condition and 5 degrees C minimum temperature until paint is thoroughly dry.
  - .6 Strip paint from bolts, nuts, sharp edges and corners before prime coat is dry.
-

PART 3 - EXECUTION

- 3.1 GENERAL
- .1 Structural steel work: in accordance with CSA S16 CAN/CSA-S136.
  - .2 Welding: in accordance with CSA W59.
  - .3 Companies to be certified under Division 01 or 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding of structural components.
- 3.2 CONNECTION TO EXISTING WORK
- .1 Verify dimensions and condition of existing work, report discrepancies and potential problem areas to Departmental Representative for direction before commencing fabrication.
- 3.3 MARKING
- .1 Mark materials in accordance with CSA G40.20/G40.21. Do not use die stamping. If steel is to be left in unpainted condition, place marking at locations not visible from exterior after erection.
  - .2 Match marking: shop mark for fit and match.
- 3.4 ERECTION
- .1 Erect structural steel, as indicated and in accordance with CSA S16 and CAN/CSA-S136 and in accordance with reviewed erection drawings.
  - .2 Field cutting or altering structural members: to approval of Departmental Representative.
  - .3 Clean with mechanical brush and touch up shop primer to bolts, rivets, welds and burned or scratched surfaces at completion of erection.
  - .4 Continuously seal members by continuous welds where indicated. Grind smooth.
- 3.5 FIELD QUALITY CONTROL
- .1 Inspection and testing of materials and workmanship will be carried out by testing laboratory designated by Departmental Representative and paid for by the owner.
-

- 3.5 FIELD QUALITY CONTROL  
(Cont'd)
- .2 Provide safe access and working areas for testing on site, as required by testing agency and as authorized by Departmental Representative.
  - .3 Submit test reports to Departmental Representative within 1 week of completion of inspection.
  - .4 Owner will pay costs of tests as specified in Section 01 29 83. First Visit, if Erection does not pass second visit General Contractor will pay for addition visits until structure passes inspection.
- 3.6 FIELD PAINTING
- .1 Paint in accordance with Section 09 91 99 and 09 91 00.
    - .1 Touch up damaged surfaces and surfaces without shop coat with primer to SSPC-SP-6 except as specified otherwise. Apply in accordance with CAN/CGSB-85.10.





PART 1 - GENERAL

- 1.1 REFERENCES
- .1 Canadian General Standards Board (CGSB)
    - .1 CAN/CGSB-85.10-99, Protective Coatings for Metals.
  - .2 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturer's Association (CPMA)
    - .1 CISC/CPMA 2-75-1975, Quick-Drying, Primer for Use on Structural Steel.
    - .2 CISC/CPMA 1-73a-1975, Quick-Drying, One-Coat Paint for Use on Structural Steel.
  - .3 CSA International
    - .1 CSA G40.20-04(R2009)/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
    - .2 CSA S16-09, Design of Steel Structures.
    - .3 CAN/CSA-S136-07, North American Specification for the Design of Cold Formed Steel Structural Members.
    - .4 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel.
    - .5 CSA W55.3-08, Certificate of Companies for Resistance Welding of Steel and Aluminum.
    - .6 CSA W59-M03(R2008), Welded Steel Construction (Metal Arc Welding) Metric.
  - .4 The Master Painters Institute (MPI)
    - .1 Architectural Painting Specification Manual - 2003.
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Submit in accordance with Section 01 33 00.
  - .2 Product Data:
    - .1 Submit manufacturer's instructions, printed product literature and data sheets for steel joist framing and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Shop Drawings:
    - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
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- 1.2 ACTION AND INFORMATIONAL SUBMITTALS (Cont'd)
- .3 Shop Drawings:(Cont'd)
- .2 Indicate on erection drawings, relevant details such as joist mark, depth, spacing, bridging lines, bearing, anchorage and details.
- .3 Indicate particulars, on shop drawings, relative to joist geometry, framed openings, splicing details, bearing and anchorage. Include member size, properties, specified and factored member loads, and stresses under various loadings, deflection and camber.
- 1.3 QUALITY ASSURANCE
- .1 Submit affidavit prepared by fabricator of structural steel joists stating that materials and products used in fabrication conform to this specification.
- 1.4 DELIVERY, STORAGE AND HANDLING
- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
- .1 Store materials off ground dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 74 20.
- .5 Packaging Waste Management: remove for reuse of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 20.
-

PART 2 - PRODUCTS

- 2.1 DESIGN CRITERIA
- .1 Design steel joists and bridging to carry loads indicated in joist schedule shown on drawings to CSA S16 and CAN/CSA-S136.
  - .2 Design joists and anchorages for uplift forces as indicated.
  - .3 Ensure joists are manufactured to consider load effects due to fabrication, erection and handling.
  - .4 Limit roof joist deflection due to specified live load to L/360 maximum of span and deflection due to specified total load to L/240 maximum of span.
  - .5 Limit floor joist deflection due to specified live load to L/480 of maximum span and deflection due to specified total load to L/240 maximum of span.
  - .6 Provide min. moment of Inertia in order to meet the requires of the deflection criteria set out above in this section.
  - .7 Joists do not need to be designed for roll over forces.
- 2.2 MATERIALS
- .1 Open web steel joists: to CSA S16 and CAN/CSA- S136.
  - .2 Structural steel: to CSA G40.20/G40.21 and CAN/CSA-S136.
  - .3 Welding materials: to CSA W59.
  - .4 Shop paint primer: to CISC/CPMA-2.
  - .5 Shear studs: to CSA W59, Appendix H.
- 2.3 FABRICATION
- .1 Fabricate steel joists and accessories as indicated in accordance with CSA S16 and CAN/CSA- S136 and in accordance with reviewed shop drawings.
  - .2 Weld in accordance with CSA W59.
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- 2.3 FABRICATION (Cont'd)
- .3 Provide top and bottom chord extensions where indicated.
- .4 Provide diagonal and horizontal bridgings and anchorages as indicated.
- 2.4 SHOP PAINTING in.
- .1 Clean, prepare and shop prime surfaces of steel joists to CSA S16.
- .2 Clean members of loose mill scale, rust, oil, dirt and other foreign matter. Prepare surfaces to SSPC SP1 brush blast.
- .3 Apply one coat of CISC/CPMA 2 primer to steel surfaces to achieve dry film thickness of .065 mm to .080 mm maximum except:
- .1 Surfaces to be encased in concrete.
  - .2 Surfaces to receive field installed stud shear connectors and steel decks.
  - .3 Surfaces and edges to be field welded.
  - .4 Faying surfaces of friction-type connections.
  - .5 Below grade surfaces in contact with soil.
- .4 Apply paint under cover, on dry surfaces when surface and air temperatures are above 5 degrees C.
- .5 Maintain dry condition and 5 degrees C minimum temperature until paint is thoroughly dry.
- .6 Strip paint bolts, nuts, sharp edges and corners before prime coat is dry.
- .7 Joist to be painted Grey.

PART 3 - EXECUTION

- 3.1 EXAMINATION
- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for steel joist framing installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Departmental Representative.
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- 3.1 EXAMINATION  
(Cont'd)
- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.
- 3.2 INSTALLATION
- .1 Do structural steel work: to CSA S16 and CAN/CSA-S136.
- .2 Do welding: in accordance with CSA W59.
- .3 Ensure installers are certified to CSA W47.1 for fusion welding and as required CSA W55.3 for resistance welding.
- .4 Submit certification that welded joints are qualified by Canadian Welding Bureau.
- 3.3 CONNECTION TO EXISTING WORK
- .1 Verify dimensions and condition of existing work; report discrepancies and potential problem areas to Departmental Representative for direction before commencing fabrication.
- 3.4 FIELD QUALITY CONTROL
- .1 Inspection and testing of materials and workmanship will be carried out by testing laboratory designated by Departmental Representative.
- .2 Testing laboratory will inspect representative joists for integrity, accuracy of fabrication and soundness of welds. Testing laboratory will also monitor test loading of joists used by manufacturer to verify design and check representative field connections. Departmental Representative will determine extent of and identify all inspections.
- .3 Submit test report to Departmental Representative within 3 days after completion of inspection.
- .4 Owner will pay costs of tests as specified in Section 01 29 83.
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- 3.5 ERECTION
- .1 Erect steel joists and bridging as indicated to CSA S16 and in accordance with reviewed erection drawings.
  - .2 Complete installation of bridging and anchorages before placing construction loads on joists.
  - .3 Field cutting or altering joists or bridging that are not shown on shop drawings: to approval of Departmental Representative.
  - .4 Clean and touch up shop primer to bolts, welds, burned or scratched surfaces at completion of erection.
- 3.6 FIELD PAINTING
- .1 Paint: in accordance with Section 09 91 99.
  - .2 Touch up all damaged surfaces and surfaces without shop coat CISC/CPMA-2 in accordance with manufacturers' recommendations.
- 3.7 CLEANING
- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
    - .1 Leave Work area clean at end of each day.
  - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
  - .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 201.
    - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
- 3.8 PROTECTION
- .1 Protect installed products and components from damage during construction.
  - .2 Repair damage to adjacent materials caused by steel joist framing installation.

PART 1 - GENERAL

1.1 RELATED  
SECTIONS

- .1 Section 09 91 99 - Painting.
- .2 Section 05 12 23 - Structural Steel for Buildings.
- .3 Section 05 21 00 - Steel Joist Framing.

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
    - .1 ASTM A653/A653M-10, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
    - .2 ASTM A792/A792M-10, Standard Specification for Steel Sheet, 55%Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
  - .2 Canadian General Standards Board (CGSB)
    - .1 CAN/CGSB-1.181-[99], Ready-Mixed Organic Zinc-Rich Coating.
  - .3 Canadian Standards Association (CSA International)
    - .1 CSA C22.2 No.79-1978(R2008), Cellular Metal and Cellular Concrete Floor Raceways and Fittings.
    - .2 CAN/CSA-S16-09, Design of Steel Structures.
    - .3 CAN/CSA-S136-07, North American Specification for the Design of Cold Formed Steel Structural Members.
    - .4 CSA W47.1-03, Certification of Companies for Fusion Welding of Steel Structures.
    - .5 CSA W55.3-1965(R2003), Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.
    - .6 CSA W59-03(R2008), Welded Steel Construction, (Metal Arc Welding) Metric.
  - .4 Canadian Sheet Steel Building Institute (CSSBI)
    - .1 CSSBI 10M-08, Standard for Steel Roof Deck.
    - .2 CSSBI 12M-08, Standard for Composite Steel Deck.
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- 1.3 SHOP DRAWINGS
- .1 Submit shop drawings erection and shoring drawings in accordance with Section 01 33 00.
  - .2 Indicate details of temporary shoring of steel deck, such as location, time and duration of placement and removal of shoring for concrete fill decks.

- 1.4 WASTE MANAGEMENT AND DISPOSAL
- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
  - .2 Divert unused metal from landfill to metal recycling facility approved by Departmental Representative.
  - .3 Dispose of unused paint material at official hazardous material collections site approved by Departmental Representative.
  - .4 Do not dispose of unused paint material into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.
  - .5 Dispose of unused caulking material at official hazardous material collections site approved by Departmental Representative.

PART 2 - PRODUCTS

- 2.1 MATERIALS
- .1 Zinc-iron Alloy (ZF) coated steel sheet: to ASTM A653/A653M structural quality Grade 230, minimum 30% recycled content, with ZF75 coating, for interior surfaces not exposed to weather, unpainted finish, 0.91 mm minimum base steel thickness.
  - .2 Decks to be painted: zinc-iron alloy coated decks suitable for finish painting.
  - .3 Zinc (Z) coated steel sheet: to ASTM A653/A653M structural quality Grade 230 minimum 30% recycled content, with ZF275, coating, regular spangle surface, chemically treated for unpainted finish, not chemically treated for paint finish, for exterior surfaces exposed to weather, 0.91 mm minimum base steel thickness.
-



2.1 MATERIALS  
(Cont'd)

- .4 Aluminum-zinc alloy (AZ) coated steel sheet: to ASTM A792/A792M structural quality grade 230 minimum 30% recycled content, with AZ150coating, surface, chemically treated for unpainted finish, not chemically treated for paint finish, for exterior surfaces exposed to weather, 0.91 mm minimum base steel thickness.
- .5 Closures: in accordance with manufacturer's recommendations.
- .6 Cover plates, cell closures and flashings: steel sheet with minimum base steel thickness of 0.91 mm, minimum 30% recycled content. Metallic coating same as deck material.
- .7 Primer: zinc rich, ready mix to CAN/CGSB-1.181, Ecologo certified.
- .8 Caulking: to division 7.

2.2 TYPES OF  
DECKING

- .1 Steel roof deck: 0.91 mm minimum base steel thickness, 38 mm maximum deep profile, cellular, interlocking side laps. Flat sheet for cellular deck, 0.91 mm minimum base steel thickness.
- .2 Steel floor deck: 0.91 mm minimum base steel thickness, 38 mm maximum deep profile, cellular, interlocking side laps. Flat sheet for cellular deck, 0.91 mm minimum base steel thickness.

PART 3 - EXECUTION

3.1 GENERAL

- .1 Structural steel work: in accordance with CAN/CSA-S136 and CSSBI 10M, and CSSBI 12M.
- .2 Welding: in accordance with CSA W59, except where specified otherwise.
- .3 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel and/or CSA W55.3 for resistance welding.

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- 3.2 ERECTION
- .1 Erect steel deck as indicated and in accordance with CAN/CSA-S136, CSSBI 10M, and CSSBI 12M and in accordance with reviewed erection drawings.
  - .2 Butt ends: to 1.5 to 3 mm gap. Install steel cover plates over gaps wider than 3 mm.
  - .3 Prior to concrete placement, steel deck to be free of soil, debris, standing water, loose mil scale and other foreign matter.
  - .4 Temporary shoring, if required, to be designed to support construction loads, wet concrete and other construction equipment. Do not remove temporary shoring until concrete attains 75% of its specified 28 day compression strength.
  - .5 Place and support reinforcing steel as indicated.
- 3.3 CLOSURES
- .1 Install closures in accordance with approved details.
- 3.4 OPENINGS AND AREAS OF CONCENTRATED LOADS
- .1 No reinforcement required for openings cut in deck which are smaller than 150 mm square.
  - .2 Frame deck openings with any one dimension between 150 to 300 mm as recommended by manufacturer, except as otherwise indicated.
  - .3 For deck openings with any one dimension greater than 300 mm and for areas of concentrated load, reinforce in accordance with structural framing details, except as otherwise indicated.
- 3.5 CONNECTIONS
- .1 Install connections in accordance with CSSBI recommendations as indicated.
  - .2 As indicated on drawings.

PART 1 - GENERAL

- 1.1 REFERENCES
- .1 ASTM International
    - .1 ASTM A53/A53M-10, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
    - .2 ASTM A123/A123M-09, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
    - .3 ASTM A269-10, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
    - .4 ASTM A307-10, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .2 CSA International
    - .1 CSA G40.20-04(R2009)/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
    - .2 CSA S16-09, Design of Steel Structures.
    - .3 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).
    - .4 CSA W59-M03(R2008), Welded Steel Construction (Metal Arc Welding) Metric.
  - .3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
    - .1 Material Safety Data Sheets (MSDS).
  - .4 The Master Painters Institute (MPI)
    - .1 Architectural Painting Specification Manual - current edition.
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Submit in accordance with Section 01 33 00.
  - .2 Product Data:
    - .1 Submit two copies of WHMIS MSDS - Material Data Safety Sheet in accordance with 01 33 00.
    - .2 For finishes, coatings, primers, and paints applied on site: indicate VOC concentration in g/L.
  - .3 Shop Drawings:

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- 1.2 ACTION AND INFORMATIONAL SUBMITTALS (Cont'd)
- .3 Shop Drawings:(Cont'd)
- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
  - .2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
- 1.3 QUALITY ASSURANCE
- .1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.
  - .2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
  - .3 Pre installation Meetings: Conduct pre-installation meetings to verify project requirement and manufacturer's installation instructions.
- 1.4 DELIVERY, STORAGE AND HANDLING
- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
  - .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
  - .3 Storage and Handling Requirements:
    - .1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
    - .2 Replace defective or damaged materials with new.
- 1.5 WASTE MANAGEMENT AND DISPOSAL
- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard
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1.5 WASTE  
MANAGEMENT AND  
DISPOSAL  
(Cont'd)  
PART 2 - PRODUCTS

- .3 (Cont'd)  
packaging material in appropriate on-site bins  
for recycling in accordance with Waste  
Management Plan.

2.1 MATERIALS

- .1 Steel sections and plates: to CSA  
G40.20/G40.21, Grade 300W, minimum 30%  
recycled content.
- .2 Hollow Structural Sections (HSS): to CSA-  
G40.20/G40.21, Grade 350W, Class H, minimum  
30% recycled content.
- .3 Steel pipe: to ASTM A53/A53M standard weight,  
black finish, minimum 30% recycled content.
- .4 Welding materials: to CSA W59.
- .5 Welding electrodes: to CSA W48 Series.
- .6 Bolts and anchor bolts: to ASTM A307.
- .7 Alkyd primer: to MPI# 79. Ecologo certified.
- .8 Galvanizing: hot dip, unpassivated, to ASTM  
A123/A123M, Coating Grade 85, minimum  
600 g/m<sup>2</sup>.
- .9 Zinc rich primer for galvanized surfaces:  
zinc rich, readymix to CAN/CGSB-1.181, Ecologo  
certified.
- .10 Grout: non-shrink, non-metallic, flowable, 15  
MPaat 24 hours.
- .11 Steel gratings welded: bearing bars, cross  
bars, bent connecting bars and anchors,  
welding quality, mild carbon steel to ASTM  
A1011/A1011M.
- .12 Steel floor plate(checker plate): to CSA-  
G40.20/G40.21, raised pattern, hot rolled  
steel, dimensional tolerances to ASTM  
A786/A786M.
- .13 Steel bar grating treads: to ANSI/NAAMM  
MBG 531, Type W-19-4 steel with checker plate  
nosing
- .14 Security fasteners:  
.1 Provide security screws, security nuts,  
rivets, spanner screws or other equally
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- 2.1 MATERIALS      .14 Security fasteners:(Cont'd)  
(Cont'd)
- .1 (Cont'd)  
secure approved devices for affixing various items, ie torx pin head, socket pin head, phillips pin head, hex pin head or equivalent.
  - .2 Spanner screws to have slots that require a special spanner tool to remove screws.
  - .3 Round head screws not acceptable except at locations approved where material is not thick enough to permit counter-sinking.
  - .4 Standard screws not acceptable.
- 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<sup>2</sup>, Coating Grade 85, to ASTM A123/A123M.
  - .2 Shop coat primer: MPI-APL #79, anti-corrosive metal primer or MPI-APL #76, quick drying alkyd metal primer.
  - .3 Touch up primer for galvanized with zinc coating 600 g/m<sup>2</sup> to ASTM A123/A123M.
- 2.4 SHOP PAINTING
- .1 Apply one shop coat of primer to metal items, with exception of galvanized or concrete encased items.
  - .2 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7 degrees C.
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- 2.4 SHOP PAINTING .3 Clean surfaces to be field welded; do not  
(Cont'd)
- 2.5 ANGLE LINTELS .1 Steel angles: galvanized, sizes indicated for  
openings. Provide 150 mm minimum bearing at  
ends.  
.2 Weld or bolt back-to-back angles to profiles  
as indicated.  
.3 Finish: shop painted.  
.1 Primer: VOC limit 250 g/L maximum to  
GS-11 when applied onsite.
- 2.6 PIPE RAILINGS .1 Fabricate steel pipe railings as indicated  
and as required. Include stair handrails and  
guards, miscellaneous guards to protect  
equipment, other railings as indicated and as  
required for a complete project.  
.2 Design handrails and guards to NBC vertical  
and horizontal live load and dimensional  
requirements.  
.3 Steel pipe: 38mm outside diameter, formed to  
shapes and sizes as indicated.  
.4 Cap exposed ends of pipe railings.  
.5 Terminate at abutting walls with end flanges.  
.6 Interior railings to be shop prime coated for  
paint finish by Section 09 91 99.
- 2.7 PIPE BOLLARDS .1 Bollards to consist of 150mm dia. HSS,  
imbedded minimum 900 deep into a 150mm deep  
concrete pier foundation, extending 1200mm  
high above grade and filled solid with  
concrete.  
.2 Bollards to be hot-dipped galvanized after  
fabrication.  
.3 Provide smooth radius for concrete top to  
prevent accumulation of rainwater. provide  
field painted finish.
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- 2.8 CORNER GUARDS .1 Corner guards:
- .1 Type 304, 1.9mm thick (14 ga.) stainless steel with satin finish.
  - .2 Countersunk Holes
  - .3 Angle to conform to wall requirements.
  - .4 Height: 1200 a.f.f.
  - .5 Fasteners: tamper proof screws.
- 2.9 ACCESS LADDERS .1 Fabricate access ladders as indicated and as follows:
- .1 Stringers: 65mm x 13mm thick steel bars, 457 mm apart, drilled to receive 20 mm diameter rungs.
  - .2 Rungs: 20 mm diameter steel rod, welded to stringer at 300mm o.c.
  - .3 Brackets: sizes and shapes as indicated, weld to stringers at 1200 mm on centre, complete with fixing anchors.
  - .4 Galvanize finish for exterior, prime paint for interior.
  - .5 Galvanize exterior ladders after fabrication.
- 2.10 FLOOR PIT AND TRENCH FRAMES AND COVERS .1 Provide pit and trench frames for casting into concrete by section 03 30 00.
- .2 Install soil and grating covers as applicable.
- 2.11 MISCELLANEOUS FRAMING AND SUPPORTS .1 General: Provide steel framing and supports for applications indicated or which are not a part of structural steel framework, as required to complete work.
- .2 Fabricate units to sizes, shapes, and profiles indicated and required to receive adjacent other construction retained by framing and supports. Fabricate from structural steel shapes, plates, and steel bars of welded construction using mitred joints for field connection. Cut, drill, and tap units to receive hardware, hangers, and similar items.
  - .3 Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be
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2.11 MISCELLANEOUS .3 (Cont'd)  
FRAMING AND SUPPORTS installed after concrete is placed. Spacing of  
(Cont'd) anchors shall not be more than 610 mm o.c.

2.12 METAL WORK .1 Coordinate with the appropriate other  
INTEGRATED INTO THE sections, work which is to be integrated into  
WORK OF OTHER the work of those Sections.  
SECTIONS

.2 Where appropriate, fabricate the work of this  
Section and hand over to others for  
installation.

PART 3 - EXECUTION

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

3.2 ERECTION .1 Do welding work in accordance with CSA W59  
unless specified otherwise.  
.2 Erect metalwork square, plumb, straight, and  
true, accurately fitted, with tight joints and  
intersections.  
.3 Provide suitable means of anchorage  
acceptable to Departmental Representative such  
as dowels, anchor clips, bar anchors,  
expansion bolts and shields, and toggles.  
.4 Exposed fastening devices to match finish and  
be compatible with material through which they  
pass.  
.5 Supply components for work by other trades in  
accordance with shop drawings and schedule.

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- 3.2 ERECTION  
(Cont'd)
- .6 Make field connections with bolts to CSA S16 or Weld field connection. Bolted connections to be spot welded after erection.
  - .7 Deliver items over for casting into concrete and building into masonry together with setting templates to appropriate location and construction personnel.
  - .8 Touch-up rivets, field welds, bolts and burnt or scratched surfaces with primer after completion of:
    - .1 Primer: maximum VOC limit 250 g/L to GS-11.
  - .9 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.
    - .1 Primer: maximum VOC limit 250 g/L to GS-11.
- 3.3 PIPE RAILINGS
- .1 Install pipe railings to stairs as indicated.
  - .2 Set railing standards in concrete. Grout to fill hole. Trowel surface smooth and flush with adjacent surfaces.
- 3.4 CORNER GUARDS
- .1 Install Corner Guards on all outside corners.
- 3.5 ACCESS LADDERS
- .1 Install access ladders in locations as indicated.
  - .2 Erect ladders 150 mm clear of wall on bracket supports.
  - .3 Fasten securely to building structure.
- 3.6 TRENCH COVERS
- .1 Install trench covers in locations as indicated.
- 3.7 LATERAL SUPPORT  
ANGLES FOR MASONRY  
PARTITIONS
- .1 Supply masonry section with steel angles to provide lateral support of masonry partitions where they abutt the underside of deck.
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.2 Apply alkyd primer.

3.8 LATERAL SUPPORT  
ANCHORS FOR MASONRY  
PARTITIONS

.1 Supply masonry section with one piece, galvanized steel anchors to provide lateral support of masonry partitions where they abutt the underside of deck.

3.9 OVERHEAD DOOR  
FRAME

.1 Supply steel overhead door frame.

.2 Apply alkyd primer.

.3 Install frame in opening and securely anchor in place.

3.10 ANGLE EDGE AT  
LOADING DOCK

.1 Supply concrete section with steel angle for mounting in concrete at loading dock edge.

.2 Weld required concrete anchors to back of angles.

.3 Galvanize angle.

3.11 CLEANING

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

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

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

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.12 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by metal fabrications installation.



PART 1 - GENERAL

- 1.2 REFERENCES
- .1 American National Standards Institute/National Association of Architectural Metal Manufacturers (ANSI/NAAMM)
    - .1 ANSI/NAAMM MBG 531-09, Metal Bar Grating Manual.
  - .2 ASTM International
    - .1 ASTM A53/A53M-10, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
    - .2 ASTM A123/A123M-09, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
    - .3 ASTM A307-10, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
    - .4 ASTM A325M-10, Standard Specification for Structural Bolts, Steel, Heat Treated, 830 MPa Minimum Tensile Strength Metric.
  - .3 Canadian General Standards Board (CGSB)
    - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
  - .4 CSA International
    - .1 CSA G40.20-04(R2009)/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
    - .2 CSA W59-03(R2008), Welded Steel Construction (Metal Arc Welding).
    - .3 CAN/CSA-S16-01 Limit States Design for Steel Structures.
  - .5 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
    - .1 Material Safety Data Sheets (MSDS).
  - .6 The Master Painters Institute (MPI) / Architectural Painting Specification Manual - July 2007.
    - .1 MPI #18 - Primer, Zinc Rich, Organic.
    - .2 MPI #23 - Primer, Metal, Surface Tolerant.
    - .3 MPI #79 - Primer, Alkyd, Anti-Corrosive for Metal.
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- 1.2 REFERENCES (Cont'd)
- .7 National Association of Architectural Metal Manufactures (NAAMM)
    - .1 NAAMM AMP 510-92, Metal Stair Manual.
  - .8 The Society for Protective Coatings (SSPC)
    - .1 Systems and Specifications Manual, Volume 2, 2008 Edition.
    - .2 SSPC-S.P.3-82, Surface Preparation Standard, Power Tools.
- 1.3 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Submit in accordance with Section 01 33 00.
  - .2 Product Data:
    - .1 Submit manufacturer's instructions, printed product literature and data sheets for stairs and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Shop Drawings:
    - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
    - .2 Indicate construction details, sizes of steel sections and thickness of steel sheet.
- 1.4 QUALITY ASSURANCE
- .1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.
  - .2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- 1.5 DELIVERY, STORAGE AND HANDLING
- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
  - .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
  - .3 Storage and Handling Requirements:
    - .1 Store materials off ground in dry location and in accordance with
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- 1.5 DELIVERY,  
STORAGE AND  
HANDLING  
(Cont'd)
- .3 Storage and Handling Requirements:(Cont'd)
- .1 (Cont'd)  
manufacturer's recommendations in clean,  
dry, well-ventilated area.
  - .2 Store and protect stairs from nicks,  
scratches, and blemishes.
  - .3 Replace defective or damaged materials  
with new.

PART 2 - PRODUCTS

- 2.1 SYSTEM  
DESCRIPTION
- .1 Design Requirements:
- .2 Design metal stair, balustrade and landing  
construction and connections to NBC vertical  
and horizontal live load requirements.
- .3 Detail and fabricate stairs to NAAMM Metal  
Stairs Manual.
- 2.2 MATERIALS
- .1 Steel sections: to CSA G40.20/G40.21 Grade  
300 W, minimum 30% recycled content.
- .2 Steel plate: to CSA G40.20/G40.21, Grade 260  
W, minimum 30% recycled content.
- .3 Floor plate: to CSA G40.20/G40.21, Grade 260  
W, minimum 30% recycled content.
- .4 Steel pipe: to ASTM A53/A53M, standard  
weight, schedule 40 seamless black for  
interior work, galvanized for exterior work.
- .5 Metal bar grating: to ANSI/NAAMM MBG 531,  
steel, Type W-19-4, with checkered plate  
nosings.
- .6 Welding materials: to CSA W59.
- .7 Bolts: to ASTM A307.
- .8 High strength bolts: to ASTM A325M.
- .9 Shop coat primer: MPI Approved Product No. 76  
or 79.
- .10 Grout: Non-shrinking, non-metallic, flowable,  
24h, MPa 15, pull-out strength 7.9 MPa.
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- 2.2 MATERIALS  
(Cont'd)
- .11 Concrete fill: As specified in Section 03 30 00 - Cast-in-Place Concrete.
- 2.3 FABRICATION
- .1 Fabricate in accordance with NAAMM, Metal Stair Manual.
- .2 Weld connections where possible, otherwise bolt connections. Countersink exposed fastenings, cut off bolts flush with nuts. Make exposed connections of same material, colour and finish as base material on which they occur. Spot weld connection.
- .3 Accurately form connections with exposed faces flush:
- .1 Make mitres and joints tight.
- .2 Make risers of equal height.
- .4 Grind or file exposed welds and steel sections smooth.
- .5 Shop fabricate stairs in sections as large and complete as practicable.
- 2.4 STEEL PAN STAIRS
- .1 Fabricate stairs with closed riser steel pan construction.
- .2 Coordinate with Section 03 30 00 - Cast-in-Place Concrete and provide concrete fill with reinforcing bars at 100 mm o.c.
- .3 Form stringers from steel channels, boxed with minimum 5 mm thick plate welded onto outside wherever exposed to sight.
- .4 Close ends of stringers where exposed to sight and where indicated.
- .5 Form landings from 38 mm metal decking supported on perimeter steel channels (stringers extended around landing). Refer to structural drawings. Coordinate with Section 03 30 00 - Cast-in-Place Concrete" and provide concrete topping. Provide steel angles at perimeter of topping, in accordance with reviewed and accepted shop drawings.
- .6 Provide clip angles for fastening of furring channels, where applied finish is indicated for underside of stairs and landings.
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- 2.4 STEEL PAN STAIRS  
(Cont'd)
- .7 Leave Concrete Topping ready to receive specified floor finish.
- 2.5 GRATING STAIR
- .1 Form steel grating treads and landings from metal bar grating to profile indicated and secure to stringers and supports as indicated. Form landings of steel grating and reinforce as required.
- .2 Form stringers from MC 310 x 15.8.
- 2.6 BALUSTRADES AND GUARDS
- .1 Construct balustrades, guards and handrails from steel pipe, as indicated.
- .2 Cap and weld exposed ends of balusters, guards and handrails.
- .3 Terminate at abutting wall with end flange.
- .4 Design the balusters, handrails and guards to conform to the requirements of the NBC.
- 2.7 FINISHES
- .1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m<sup>2</sup>, Coating Grade 85, to ASTM A123/A123M.
- .2 Shop coat primer: to MPI# 79. Ecologo certified.
- .3 Zinc primer: zinc rich, ready mix to CAN/CGSB-1.181.
- 2.8 SHOP PAINTING
- .1 Clean surfaces in accordance with Steel Structures Painting Council Manual Volume 2.
- .2 Apply one coat of shop primer except interior surfaces of pans.
- .3 Apply two coats of primer of different colours to parts inaccessible after final assembly.
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- 2.8 SHOP PAINTING (Cont'd) .4 Use primer as prepared by manufacturer without thinning or adding admixtures. Paint on dry surfaces, free from rust, scale, grease, do not paint when temperature is below 7 degrees C.
- .5 Do not paint surfaces to be field welded.

PART 3 - EXECUTION

- 3.1 EXAMINATION .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for metal stairs and ladders installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.
- 3.2 INSTALLATION OF STAIRS .1 Install in accordance with NAAMM, Metal Stair Manual.
- .2 Install plumb and true in exact locations, using welded connections wherever possible to provide rigid structure. Provide anchor bolts, bolts and plates for connecting stairs to structure.
  - .3 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.
  - .4 Do welding work in accordance with CSA W59 unless specified otherwise.
  - .5 Touch up shop primer to bolts, welds, and burned or scratched surfaces at completion of erection.
  - .6 Provide neatly fitted joints and intersections.
-

- 3.3 CLEANING
- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
    - .1 Leave Work area clean at end of each day.
    - .2 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.
  - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
  - .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20 and 01 35 21.
    - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
- 3.4 PROTECTION
- .1 Protect installed products and components from damage during construction.
  - .2 Repair damage to adjacent materials caused by metal stairs and ladders installation.



PART 1 - GENERAL

- 1.2 REFERENCES .1 American Wood-Preservers' Association (AWPA):  
.1 AWPA M2-07, Standard for Inspection of Treated Wood Products.  
.2 AWPA M4-06, Standard for the Care of Preservative-Treated Wood Products.
- .2 Canadian Standards Association (CSA):  
.1 CSA-080-Series-08, Wood Preservation.
- 1.3 SUBMITTALS .1 Submit Submittal submissions: in accordance with Section 01 33 00.
- .2 Quality assurance submittals:  
.1 Submit certificates in accordance with Section 01 33 00.  
.2 For products treated with preservative by pressure impregnation submit following information certified by authorized signing officer of treatment plant:  
.1 Information listed in AWPA M2 and revisions specified in CSA 080 Series, Supplementary Requirement to AWPA M2 applicable to specified treatment.  
.2 Moisture content after drying following treatment with water-borne preservative.  
.3 Acceptable types of paint, stain, and clear finishes that may be used over treated materials to be finished after treatment.
- 1.4 QUALITY ASSURANCE .1 Each piece of lumber and plywood for preserved wood foundations to be identified by CSA 0322 certified stamp.
- 1.5 DELIVERY, STORAGE, AND HANDLING .1 Waste Management and Disposal:  
.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.
-

PART 2 - PRODUCT

1.6 MATERIALS .1 Preservative: to CSA-080 Series, chemical,  
water-borne.

PART 3 - EXECUTION

3.1 APPLICATION:  
PRESERVATIVE .1 Treat wood associated with roofing to CSA 080  
Series using preservative to obtain minimum  
net retention of 6.4 kg/m3 of wood.

.2 Following water-borne preservative treatment,  
dry material to maximum moisture content of  
19%.

3.2 APPLICATION:  
FIELD TREATMENT .1 Comply with AWPA M4 and revisions specified  
in CSA 080 Series, Supplementary Requirements  
to AWPA M2.

PART 1 - GENERAL

- 1.1 REFERENCES .1 Canadian Standards Association (CSA):
- .1 CSA-B111-1974(R2003), Wire Nails, Spikes and Staples.
  - .2 CSA-O121-M1978(R2003), Douglas Fir Plywood.
  - .3 CSA-O141-05, Softwood Lumber.
  - .4 CSA-O151-04, Canadian Softwood Plywood.
  - .5 CAN/CSA-O325.0-92(R1998), Construction Sheathing.
- .2 National Lumber Grades Authority (NLGA)
- .1 Standard Grading Rules for Canadian Lumber, 2010.
- 1.2 QUALITY ASSURANCE .1 Lumber identification: by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.
- .2 Plywood identification: by grade mark in accordance with applicable CSA standards.
- .3 Plywood, and wood based composite panels in accordance with applicable CSA and ANSI standards.
- 1.3 WASTE MANAGEMENT AND DISPOSAL .1 Separate and recycle waste materials in accordance with Section 01 74 20.

PART 2 - PRODUCT

- 2.1 LUMBER .1 Lumber: unless specified otherwise, softwood, S4S, moisture content 19% (S-dry) or less in accordance with following standards:
- .1 CAN/CSA-O141.
  - .2 NLGA Standard Grading Rules for Canadian Lumber.
- .2 Furring, blocking, nailing strips, grounds, rough bucks, cants, and curbs:
- .1 S4S.
  - .2 Board sizes: "Standard" or better grade.
  - .3 Dimension sizes: "Standard" light framing or better grade.
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- 2.2 PANEL MATERIALS .1 Douglas fir plywood (DFP): to CSA-0121,  
standard construction.
- .2 Canadian softwood plywood (CSP): to CSA-0151,  
standard construction.
- .3 Gypsum sheathing: Refer to Section 09 21 16.
- 2.3 ACCESSORIES .1 Nails, spikes and staples: to CSA-B111.
- .2 Proprietary fasteners: toggle bolts,  
expansion shields and lag bolts, screws and  
lead or inorganic fibre plugs recommended for  
purpose by manufacturer. Explosive actuated  
fastening devices are not permitted.
- 2.4 FASTENER  
FINISHES .1 Galvanizing: to ASTM-A123/A123M. Use  
galvanized fasteners for exterior work and  
pressure-preservative treated lumber.
- 2.5 WOOD  
PRESERVATIVE .1 Refer to Section 06 05 73.
- PART 3 - EXECUTION
- 3.1 PREPARATION .1 Treat surfaces of material with wood  
preservative in accordance with Section  
06 05 73.
- .2 Re-treat surfaces exposed by cutting,  
trimming or boring with liberal brush  
application of preservative before  
installation.
- 3.2 INSTALLATION .1 Comply with requirements of NBC 2010, Part 9,  
supplemented by the following paragraphs.
- .2 Install members true to line, level and  
elevations, square and plumb.
- .3 Construct continuous members from pieces of  
longest practical length.
-



- 3.2 INSTALLATION  
(Cont'd)
- .4 Install spanning members with "crown edge" up.
  - .5 Install furring and blocking as required to space-out and support other work as required.
  - .6 Align and plumb faces of furring and blocking to tolerance of 1:600.
  - .7 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.
  - .8 Install wood cants, nailers, curbs and other wood supports associated with roofing as required. Use pressure-preservative treated lumber and secure using galvanized steel fasteners.
  - .9 Use dust collectors and high quality respirator masks when cutting or sanding wood products.
- 3.3 ERECTION
- .1 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.
  - .2 Countersink bolts where necessary to provide clearance for other work.



PART 1 - GENERAL

- 1.1 REFERENCES
- .1 American Society for Testing and Materials (ASTM):
    - .1 ASTM C1320-10, Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction.
  - .2 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD)
    - .1 SCAQMD Rule 1168-05, Mortar, Adhesives and Sealants Applications.
  - .3 Underwriters Laboratories of Canada (ULC)
    - .1 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Coverings.
    - .2 CAN/ULC-S702-97, Standard for Thermal Insulation, Mineral Fibre, for Buildings.
  - .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
    - .1 Material Safety Data Sheets (MSDS).
- 1.2 SUBMITTALS
- .1 Product Data:
    - .1 Submit manufacturer's printed product literature, specifications and data sheets in accordance with Section 01 33 00.
    - .2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 33 00 and Section 01 35 29. Indicate VOC's for insulation products and adhesives.
  - .2 Manufacturer's Instructions:
    - .1 Submit manufacturer's installation instructions.
- 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.
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- 1.3 QUALITY ASSURANCE  
(Cont'd)
- .3 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.
- .4 Comply with the requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous material; and regarding labelling and the provision of Material Safety Data Sheets.
- 1.4 WASTE MANAGEMENT AND DISPOSAL
- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Identify hazardous and related materials which cannot be reused, are regarded as hazardous products and are subject to regulations for disposal. Information on these controls can be obtained from the Provincial Ministries of Environment and Regional Levels of Government.
- .5 Safely store materials defined as hazardous or toxic waste, including emptied containers and application apparatus, in containers or areas designated for hazardous waste and dispose of contaminants in an approved legal manner.

PART 2 - PRODUCTS

- 2.1 BOARD INSULATION.1 Below Grade Insulation: Extruded polystyrene (XPS): to CAN/ULC-S701.
- .1 Type: 4.
- .2 Compressive strength:
- .1 Below grade foundation wall insulation: 210 kPa.
- .2 Under floor slab: 415 kPa.
- .3 Thickness: as indicated.
- .4 Edges: shiplapped.
-

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- 2.1 BOARD INSULATION.2  
(Cont'd)
- .2 Above Grade Wall Insulation: Semi-rigid mineral wool fibre insulation board made from basalt rock and steel slag, conforming to CAN/ULC-S702.
- .1 Type 1
  - .2 Density 72 kg/m3.
  - .3 Thickness: as indicated.
  - .4 Edges: square.
- .3 Roof Insulation: Refer to Section 07 52 00.
- 2.2 BATT AND  
BLANKET INSULATION
- .1 Mineral wool fibre batt insulation for steel stud and girt application made from basalt rock and steel slag, conforming to CAN/ULC-S702.
- .1 Type: 1.
  - .2 Thickness: Full thickness of stud or girt space.
  - .3 Minimum 40% recycled content.
- 2.3 ACCESSORIES
- .1 Adhesive for polystyrene: As recommended by the board insulation manufacturer. Use low VOC products in compliance with SCAQMD Rule 1168.
- .2 Attachment Devices:
- .1 Insulation clips: impale type, perforated 50 x 50 mm cold rolled carbon steel 0.8 mm thick, adhesive back, spindle of 2.5 mm diameter annealed steel, length to suit insulation, 25 mm diameter washers of self locking type.
  - .2 Insulation retaining devices: Purpose-made to retain above-grade board insulation in position against the air barrier substrate by attachment to the masonry ties.
-

PART 3 - EXECUTION

- 3.1 EXAMINATION .1 Examine substrates and immediately inform Departmental Representative in writing of defects.
- .2 Prior to commencement of work ensure:  
.1 Substrates are firm, straight, smooth, dry, free of snow, ice or frost, and clean of dust and debris.
- 3.2 MANUFACTURER'S INSTRUCTIONS .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- 3.3 WORKMANSHIP .1 Install insulation after building substrate materials are dry.
- .2 Install insulation to maintain continuity of thermal protection to building elements and spaces.
- .3 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.
- .4 Fit insulation tight around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows and other protrusions.
- .5 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures.
- .6 Do not enclose insulation until it has been inspected and approved by Departmental Representative.
-

- 3.4 BELOW-GRADE BOARD INSULATION INSTALLATION .1 Foundation wall application: Extend boards 600 mm vertically below the line adjacent grade, installed on inside face of perimeter foundation walls. Apply sufficient adhesive to retain boards in place until backfilling is in place. Imbed insulation boards into adhesive prior to skinning of adhesive.
- 3.5 ABOVE-GRADE WALL INSULATION INSTALLATION .1 Install mineral fibre insulation boards on outer surface of air barrier on masonry and wall sheathing surfaces.
- .2 Install boards with tight butt joints. Trim to fit and do not compress boards.
- .3 Retain boards in place with purpose-made insulation retaining devices.
- 3.6 BATT INSULATION .1 Install insulation to maintain continuity of thermal protection to building elements and spaces and to ASTM C1320.
- .2 Do not compress insulation to fit into spaces.
- 3.7 ROOF INSTALLATION .1 Refer to Section 07 52 00.
- 3.8 CLEANING .1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.





PART 1 - GENERAL

- 1.1 REFERENCES .1 American Society for Testing and Materials (ASTM)
- .1 ASTM E1643-10, Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs
  - .2 ASTM E1745-09, Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
- 1.2 SUBMITTALS .1 Product Data: Submit manufacturer's printed product literature, specifications and datasheet and include:
- .1 Product characteristics.
  - .2 Performance criteria.
  - .3 Limitations
- .2 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).
- .3 Quality assurance submittals:
- .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Laboratory Test Results: submit full set of actual test results as per paragraph 8.3 of ASTM E1745 (including all after conditioning permeance tests).
  - .3 Instructions: submit manufacturer's installation instructions and comply with written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- 1.3 DELIVERY, STORAGE AND HANDLING .1 Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- .2 Store materials in a clean, dry area in accordance with manufacturer's instructions.
-

1.3 DELIVERY,  
STORAGE AND HANDLING  
(Cont'd)

- .3 Stack membrane on smooth ground or wood platform to eliminate warping.
- .4 Protect materials during handling and application to prevent damage or contamination.
- .5 Ensure membrane is stamped with manufacturer's name, product name, and membrane thickness.

1.4 ENVIRONMENTAL  
REQUIREMENTS

- .1 Product not intended for uses subject to abuse or permanent exposure to the elements.
- .2 Do not apply on frozen ground.

PART 2 - PRODUCTS

2.1 SHEET VAPOUR  
BARRIER

- .1 Plastic Vapour Barrier: Vapour Barrier membrane must have the following properties:
  - .1 Permeance as tested after conditioning (ASTM E 1745 paragraphs 7.1.2 - 7.1.5): less than 0.01 perms (gr/ft<sup>2</sup>/hr/in-Hg).
  - .2 Strength: Class A, ASTM E 1745.
  - .3 Minimum thickness: 0.38 mm (15 mils).

2.2 ACCESSORIES

- .1 Seam tape: high-density polyethylene film and a rubber-based, pressure-sensitive adhesive, specially designed to seal seams and penetration, approximate width 100 mm, by vapour barrier manufacturer.
  - .2 Pipe Boots: Where slab penetrations occur, construct pipe boots from vapor barrier material and pressure sensitive tape per manufacturer's instructions.
  - .3 Vapour-Proofing Mastic: use mastic provided by vapour barrier manufacturer.
-

PART 3 - EXECUTION

- 3.1 EXAMINATION .1 Examine surfaces to receive membrane. Notify Departmental Representative if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected.
- 3.2 SURFACE PREPARATION .1 Prepare surfaces in accordance with manufacturer's instructions.
- .2 Level and tamp or roll aggregate.
- 3.3 INSTALLATION .1 Ensure services are installed and inspected prior to installation of vapour barrier.
- .2 Install in accordance with manufacturer's instructions and ASTM E1643.
- .3 Unroll vapour barrier over the entire area where the slab is to be poured. Unroll vapour barrier with the longest dimension parallel with the direction of the pour. Completely cover concrete placement area.
- .4 Lap vapour barrier over footings and seal to foundation walls.
- .5 Overlap all joints 150 mm and seal with manufacturer's tape.
- .6 Seal all penetrations (including but not limited to pipes, ducting, rebar) with manufacturer's pipe boot, or tape and mastic.
- .7 No penetration of the vapour barrier is allowed except for reinforcing steel and permanent utilities.
- .8 Inspect for continuity. Repair punctures and tears with sealing tape before work is concealed. Repair damaged areas by cutting patches of vapour barrier, overlapping damaged area 150mm. Clean all adhesion areas of dust, dirt and moisture. Tape all four sides with tape.
-

3.3 INSTALLATION .9 Do not proceed until repair work has been  
(Cont'd) inspected and approved by Departmental  
Representative.

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

PART 1 - GENERAL

- 1.1 REFERENCES .1 American Society for Testing and Materials (ASTM):
- .1 ASTM A666-03, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
  - .2 ASTM D412-06ae2, Standard Test methods for Vulcanized Rubber and Thermoplastic Elastomers.
  - .3 ASTM E96/E96M-05, Standard Test Methods for Water Vapor Transmission of Materials.
  - .4 ASTM E283-04, Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- .2 Canadian General Standards Board (CGSB)
- .1 CGSB-37-GP-56M-80(+Amdt.1985), Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing.
  - .2 CGSB-71-GP-24M-77(+Amdt.1983), Adhesive, Flexible, for Bonding Cellular Polystyrene Insulation.
- .3 Health Canada / Workplace Hazardous Materials Information System (WHMIS):
- .1 Material Safety Data Sheets (MSDS).
- 1.2 SUBMITTALS .1 Provide submittals in accordance with Section 01 33 00.
- .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 WHMIS MSDS - Material Safety Data Sheets in accordance with Sections 01 33 00 and 01 35 29. Indicate VOC's for air barrier materials and sealants.
  - .3 Submit drawings of special joint conditions.
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- 1.2 SUBMITTALS                    .2    Product Data:(Cont'd)  
    (Cont'd)
- .4    Quality Assurance Submittals: submit  
          following in accordance with Section  
          01 33 00.
- .1    Existing Substrate Condition:  
          report deviations, as described in the  
          article "Examination" in PART 3  
          -EXECUTION in writing to Departmental  
          Representative.
- .2    Certificates: submit certificates  
          signed by manufacturer certifying that  
          materials comply with specified  
          performance characteristics and physical  
          properties.
- .3    Manufacturer's Instructions: submit  
          manufacturer's installation instructions  
          and special handling criteria,  
          installation sequence, and cleaning  
          procedures.
- .4    Manufacturer's Field Reports:  
          submit manufacturer's written reports  
          within 3 days of review, verifying  
          compliance of Work, as described in the  
          article "Field Quality Control" in PART 3  
          - EXECUTION.
- 1.3 QUALITY                    .1    Qualifications:  
    ASSURANCE
- .1    Applicator:
- .1    Company specializing in performing  
          work of this section with minimum 5 years  
          documented successful experience with  
          installation of air/vapour barrier  
          systems.
- .2    Company currently licensed by  
          certifying organization. Must maintain  
          their license throughout the duration of  
          the project.
- .3    Completed installation must be  
          approved by the material manufacturer.
- .2    Mock-Up:
- .1    Construct mock-up in accordance with  
          Section 01 45 00.
- .2    Construct typical exterior wall panel,  
          1200 mm wide x full wall height,  
          incorporating connection to curtain wall,  
          insulation, and junction with roof  
          system; illustrating materials interface  
          and seals.
- .3    Locate where directed.
- .4    Mock-up may remain as part of finished  
          work.
-

1.3 QUALITY  
ASSURANCE  
(Cont'd)

- .2 Mock-Up: (Cont'd)
  - .5 Allow 24 hours for inspection of mock-up by Departmental Representative before proceeding with air barrier Work.
- .3 Site meetings: as part of manufacturer's services described in the article "Field Quality Control" in PART 3 - EXECUTION, schedule site visits, to review Work, at stages listed.
  - .1 After delivery and storage of products, and when preparatory Work is complete, but before installation begins.
  - .2 Twice during progress of Work at 25% and 60% complete.
  - .3 Upon completion of Work, after cleaning is carried out.

1.4 DELIVERY,  
STORAGE AND  
HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Protect air barrier material from freezing during storage, application and before material has cured.
- .3 Avoid spillage: immediately notify Departmental Representative if spillage occurs and start clean up procedures.
- .4 Clean spills and leave area as it was prior to spill.

1.5 AMBIENT  
CONDITIONS

- .1 Comply with the requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous material; and regarding labelling and the provision of Material Safety Data Sheets.
- .2 Avoid contact with eyes and skin.
- .3 Install solvent curing sealants and vapour release adhesive materials in open spaces with ventilation.
- .4 Ventilate enclosed spaces.
- .5 Close container after each use.

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- 1.5 AMBIENT  
CONDITIONS  
(Cont'd)
- .6 Maintain temperature and humidity recommended by materials manufactures before, during and after installation.
- 1.6 SEQUENCING
- .1 Sequence work in accordance with the construction schedule specified in 01 00 10 - General Instructions.
- .2 Sequence work to permit installation of materials in conjunction with related materials and seals.
- 1.7 WASTE  
MANAGEMENT AND  
DISPOSAL
- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.
- .2 Identify hazardous and related materials which cannot be reused, are regarded as hazardous products and are subject to regulations for disposal. Information on these controls can be obtained from the Provincial Ministries of Environment and Regional Levels of Government.
- .3 Safely store materials defined as hazardous or toxic waste, including emptied containers and application apparatus, in containers or areas designated for hazardous waste and dispose of contaminants in an approved legal manner.
- 1.8 WARRANTY
- .1 For the work of this Section 07 27 00 the 12 months warranty period is extended to 24 months.
- .2 Warranty: include coverage of installed sealant and sheet materials which:
- .1 Fail to achieve air tight and watertight seal.
  - .2 Exhibit loss of adhesion or cohesion.
  - .3 Do not cure.
-



PART 2 - PRODUCTS

- 2.1 AIR BARRIER .1 Air Barrier Membrane: One-component, liquid applied, non-asphaltic, vapour permeable, rubberized (elastomeric) membrane designed to provide an air barrier when applied to construction surfaces. Cures to a tough monolithic rubber-like membrane which resists air leakage. Characteristics as follows:
- .1 Air permeability to ASTM E2357, applied at 2.2 L/m<sup>2</sup> to a concrete block wall, tested at 21 deg.C:
- | <u>Pressure (Pa)</u> | <u>Air Leakage (L/s.m<sup>2</sup>)</u> |
|----------------------|--|
| 75                   | 0.00051                                |
| 250                  | 0.00071                                |
| 300                  | 0.00075                                |
- .2 Water vapour permeance to ASTM E96, procedure B: 1,201 ng/Pa.m<sup>2</sup>.s.
- .2 Transition Membrane: SBS modified bitumen, self adhering type, complete with cross-laminated polyethylene film on the upper surface and release film on the lower surface, characteristics as follows:
- .1 Thickness: 1.0 mm.
- .2 Air leakage to ASTM E283: <0.01 L/s.m<sup>2</sup> @ 75 Pa.
- .3 Vapour permeance to ASTM E96: 2.8 ng/Pa.m<sup>2</sup>.s.
- .4 Low temperature flexibility in accordance with the requirements of CGSB-37-GP-56M.
- .5 Elongation to ASTM D412: 200% minimum.
- .3 Primer for transition sheet: As recommended by manufacturer.
- .4 Glass fibre joint tape for gypsum sheathing board substrate: Refer to Section 09 21 16.
- 2.2 AIR BARRIER SUPPORT .1 Sheet metal back-up support for air barrier transition Sheet at wall / roof connection: Minimum 0.76 mm thick austenitic stainless steel sheet to ASTM A666, Type 304, soft, with type 2B/2D rolled, (unpolished) finish.

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 EXAMINATION
- .1 Verify that surfaces and conditions are ready to accept work of this section.
  - .2 Ensure surfaces are dry, sound, smooth, clean and free of oil, grease, dirt, excess mortar or other contaminants, continuous and comply with air barrier manufacturer's requirements.
  - .3 Report unsatisfactory conditions to Departmental Representative in writing.
  - .4 Do not start work until deficiencies have been corrected. Beginning of Work implies acceptance of conditions.
- 3.3 PREPARATION
- .1 Remove loose or foreign matter, which might impair adhesion of materials.
  - .2 Ensure substrates are clean of oil or excess dust; masonry joints struck flush, and open joints filled; and concrete surfaces free of large voids, spalled areas or sharp protrusions.
  - .3 Ensure substrates are free of surface moisture prior to application of membrane and primer.
  - .4 Fill spalled areas in substrate to provide an even plane.
  - .5 Prime substrate surfaces to receive transition sheet in accordance with manufacturer's instructions.
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3.4 PRIMER FOR  
TRANSITION SHEET

- .1 Apply primer for self-adhered transition membrane at the rate recommended by the manufacturer.
- .2 Apply primer to all areas to receive transition membrane, as indicated and as required to maintain the continuity of the air barrier.
- .3 Apply by roller or spray and allow minimum 30 minute open time.
- .4 Primed surface not covered by transition sheet in the same working day must be re-primed.

3.5 TRANSITION  
SHEET INSTALLATION

- .1 Install transition sheet in all locations recommended by the manufacturer and as required to ensure continuity of the air barrier throughout the entire building envelope.
- .2 Install transition sheet over joints or cracks in substrate which have not been taped or are wider than 6 mm. Lap membrane minimum 75 mm each side of the joint/crack. Provide loop in the transition sheet at control joints to allow for movement.
- .3 Position self-adhered transition membrane and remove protective film. Press firmly into place.
- .4 Ensure minimum 50 mm end and side laps. Promptly roll all laps with a countertop roller to effect seal.
- .5 Ensure all transition sheet work is complete before installing primary air barrier membrane.
- .6 Provide sheet metal back-up support at wall / roof transitions where necessary to provide complete support for membrane.

3.6 PRIMARY AIR  
BARRIER  
INSTALLATION

- .1 When the transition membrane has been installed and reviewed by the Departmental Representative, apply air barrier membrane by conventional air spray over the entire surface, as indicated on the drawings and as

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- 3.6 PRIMARY AIR BARRIER INSTALLATION (Cont'd)
- .1 (Cont'd) required for a continuous air seal to the building envelope.
- .2 Apply at a rate of 2.2 L/m<sup>2</sup> to provide a wet film thickness of 2.2 mm, in accordance with the manufacturer's instructions.
- .3 Ensure a complete and continuous air seal around all projections and penetrations.
- .4 Do not install board insulation until the air barrier membrane has been reviewed and accepted by the Departmental Representative.
- 3.7 FIELD QUALITY CONTROL
- .1 Manufacturer's Field Services:
- .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in the article "Submittals" in PART 1 - GENERAL.
- .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits, to review work, as directed in the article "Quality Assurance" in PART 1 - GENERAL.
- 3.8 CLEANING
- .1 Flush out spray equipment with water. Use mineral spirit to remove dried films.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- 3.9 PROTECTION OF WORK
- .1 Do not permit adjacent work to damage work of this section.
- .2 Ensure finished work is protected from climatic conditions.
- .3 Cover the installed membrane as soon as possible after the Departmental Representative's review and acceptance.
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3.9 PROTECTION OF WORK  
(Cont'd)

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.4 In no case leave air barrier exposed for more than 6 weeks (less in summer application).

3.10 SCHEDULING

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.1 Primary wall air barrier over outer surface of exterior wall sheathing. Seal masonry anchor penetrations airtight.

.2 Curtain wall frame perimeter:

.1 Lap transition membrane seal from wall surface with 75 mm of full contact over firm bearing to window frame with 25 mm of full contact.

.2 Lap wall primary air barrier over transition membrane minimum 25 mm.

.3 Wall and roof junction:

.1 Lap transition membrane from wall surface 150 mm of contact over firm bearing to roof vapour barrier with 100 mm of full contact.

.2 Lap wall primary air barrier over transition membrane minimum 25 mm.

.4 Roof system air/vapour barrier over roof deck: Refer to Section 07 52 00.



PART 1 - GENERAL

- 1.1 REFERENCES
- .1 American National Standards Institute (ANSI) - American Society of Mechanical Engineers (ASME)
    - .1 ANSI/ASME B18.6.4-1998(R2005), Thread Forming and Thread Cutting Tapping Screws and Metallic Drive Screws (Inch).
  - .2 American Society for Testing and Materials (ASTM)
    - .1 ASTM D2369-10, Standard Test Method for Volatile Content of Coatings.
    - .2 ASTM D2832-92(2005), Standard Guide for Determining Volatile and Nonvolatile Content of Paint and Related Coatings.
    - .3 ASTM D5116-10, Standard Guide For Small-Scale Environmental Chamber Determinations of Organic Emissions From Indoor Materials/Products.
    - .4 ASTM A792/A792M-09a, Standard Specification for Steel Sheets, 55% Aluminum-Zinc Alloy-Coated by the Hot Dip Process.
    - .5 ASTM A653/A653M-09a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
  - .3 Canadian Standards Association (CSA)
    - .1 CAN/CSA-S16-01 COLSOLIDATION (2007), Limit States Design of Steel Structures.
    - .2 CAN/CSA-S136-2007, North American Specification for the Design of Cold-Formed Steel Structural Members.
  - .4 Master Painters Institute (MPI):
    - .1 MPI Architectural Specifications Manual, 2004 (referred to herein as "MPI Manual")
    - .2 MPI Approved Product List (Referred to herein as "MPL APL")
  - .5 Canadian Sheet Steel Building Institute (CSSBI):
    - .1 CSSBI Bulletin Nos 5, 6, and 7.
    - .2 CSSBI Metric Standards.
- 1.2 DESIGN CRITERIA .1 Appearance: Exposed surfaces free of distortion, twist, waves and buckles. Exposed fasteners to be of the same finish and colour as the surrounding surface, equally spaced and in
-

- 1.2 DESIGN CRITERIA .1 Appearance:(Cont'd)  
(Cont'd) true alignment. Exposed fastener locations to be approved by the Consultant.
- .2 Structural loads: Resist positive and negative wind pressures expected in this geographical area with a maximum allowable deflection of 1/180 of span. Components shall not vibrate when subjected to the effects of wind.
- .3 Windload data for the location of the site to NBC 2005.
- .4 Moisture control: prevent infiltration of water and snow into siding system. Provide means of draining space between insulation and exterior skin, in accord with NRC Rain Screen Principles.
- .5 Thermal movement: Design metal siding system to allow for thermal movement of components caused by an ambient temperature range of 40oC to 40oC without causing buckling, failure of joint seals, undue stress on fasteners and other detrimental effects.
- .6 Structural movement: accommodate movement between siding system and building structure caused by structural movement, without permanent distortion, racking of joints, breakage of seals or water penetration.
- .7 Water penetration: provide continuous and uninterrupted barrier against water penetration, effectively sealed at laps, penetrations and terminations.
- 1.3 SAMPLES .1 Submit samples in accordance with Section 01 33 00.
- .2 Submit duplicate 300 x 300 mm samples of siding material, of colour and profile specified.
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- 1.4 SHOP DRAWINGS
- .1 Submit shop drawings in accordance with Section 01 11 0101 33 00.
  - .2 Clearly indicate all materials to be furnished as well as finishes to be applied.
  - .3 Drawings shall also serve as field directions and shall be complete with instructions for site application of products, periphery trim and all sealants, lapstrips and closure pieces to ensure a weathertight installation.
  - .4 Drawings shall include details and instructions for the installation of structural supports and anchorage requirements.
  - .5 Each drawing submitted shall bear the stamp and signature of a structural engineer licensed to practice in the Province of Ontario.
- 1.5 SAFETY DATA SHEETS
- .1 Submit manufacturer's material safety data sheets for the safe handling of the specified materials and products, in accordance with Workplace Hazardous Materials Information Service (WHMIS) requirements.
  - .2 Keep one copy on site for reserve by workers.
- 1.6 DELIVERY, STORAGE & HANDLING
- .1 Protect prefinished steel during fabrication, transportation, site storage and erection, in accordance with CSSBI Standards.
  - .2 When delivered to site, remove polyethylene wrapping to prevent condensation.
  - .3 Schedule delivery and installation to minimize on site storage time.
  - .4 Store under cover, off the ground, in a cool, dry, well ventilated area.
  - .5 Store away from chemically aggressive substances, such as salt, cement and fertilizer and away from materials which could contaminate the surface, such as diesel oil, paint and grease.
-

1.6 DELIVERY,  
STORAGE & HANDLING  
(Cont'd)

.5 (Cont'd)

1.7 WASTE  
MANAGEMENT AND  
DISPOSAL

- .1 Divert used metal cut-offs from landfill by disposal removed for disposal at the nearest metal recycling facility.
- .2 Divert reusable materials for reuse at nearest used building materials facility.
- .3 Divert unused caulking, sealants, and adhesive materials from landfill through disposal at hazardous material depot.
- .4 Separate and recycle waste materials in accordance with Section 01 74 20 and with Waste Reduction Workplan.
- .5 Place materials defined as hazardous or toxic waste in designated containers.
- .6 Ensure emptied containers are sealed and stored safely for disposal away from children.

PART 2 - PRODUCTS

2.1 STEEL CLADDING  
AND COMPONENTS

- .1 Preformed Metal Siding Panels: to ASTM A653 SS grade 33 steel.
  - .1 Finish coating: Series 10,000 (Kynar 500)
  - .2 Colour: Black.
  - .3 Gloss: medium.
  - .4 Thickness: .81 mm base metal thickness.
  - .5 Profile as indicated on the drawings: 305 mm x 38 mm deep, preformed interlocking joints.
  - .6 Profile (Refer to drawings for illustration):
    - .1 Raised interlocking panels with intermediate flute.
    - .2 Width: 300-305mm
    - .3 Concealed Fasteners.

2.2 ACCESSORIES

- .1 Exposed trim: inside corners, outside corners, cap strip, drip cap, undersill trim, starter strip and window/door trim of same material, colour and gloss as cladding.
- .2 Accessories, generally: Closures, cap pieces, etc. of same material and finish as panels, as indicated and as required for a complete installation. Where applicable, accessories to be factory prefabricated to suit siding profile. Use preformed corner pieces. Double back exposed edges. Minimum base steel thickness 0.76 mm (22 ga) and thicker as required to suit application to prevent oil-canning. .
- .3 Subgirts, clips, spacers: Minimum 1.52 mm (16 ga) thick and thicker to suit application, formed galvanized steel: ASTM 653/A 653M Grade A, zinc coating designation Z275. Provide z-bar subgirts 1.52 mm (16 ga) x depth to suit.
- .4 Flexible Flashing (transition strip membrane): Refer to Section 07 27 00 "Membrane Air Barrier".
- .5 Fastening devices: stainless steel with rubber or neoprene gaskets.
- .6 Sealants:
  - .1 Tape sealant as recommended by the siding system manufacturer, non skimming, non drying, butyl rubber.
  - .2 One part silicone sealant in accordance with Section 07 92 00, colour to match colour of siding panels, to the approval of the Departmental Representative.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Examine areas and conditions under which work is to be performed and notify the Consultant in writing of conditions detrimental to the proper and timely completion of the work.
- .2 Ensure that supporting elements are in place, complete and structurally sound, in compliance with reviewed shop drawings. Coordinate with applicable other Sections.
- .3 Do not proceed with the work until unsatisfactory conditions have been corrected in a manner satisfactory to the siding installer.
- .4 Commencement of the installation will be construed as acceptance of the site conditions and, thereafter, the Contractor shall be fully responsible for satisfactory work as specified herein.

3.2 PREPARATION

- .1 Install siding system framing as required. Install framing in accordance with the applicable requirements of CAN/CSA S16 and CSA-S136.

3.3 SUBGIRT  
INSTALLATION

- .1 Where applicable, install subgirts progressively with the thermal insulation.
  - .2 Install z-girts and miscellaneous system framing as required to provide proper support for the siding. Fasten z-girts to supporting structure. Provide additional framing at terminations, openings and penetrations.
  - .3 Touch up damaged galvanized surfaces with zinc rich primer.
-

3.4 INSULATION  
INSTALLATION

- .1 For the composite insulated metal exterior wall system, coordinate with Section 07 21 00 "Building Insulation" and install insulation progressively with the subgirts.
- .2 Retain with spindle anchors, glued or mechanically fastened to supporting work, spacing as recommended by the insulation manufacturer.
- .3 Use only insulation that is undamaged, dry, unsoiled, and has not been exposed at any time to ice and snow.
- .4 Fit insulation tight around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows and other protrusions.
- .5 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures.
- .6 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.
- .7 Do not enclose insulation until it has been reviewed and accepted by the Departmental Representative.

3.5 INSTALLATION  
OF EXTERIOR SIDING

- .1 After review and acceptance by the Departmental Representative of the subgirt and insulation installation, install siding in accordance with the manufacturer's instructions and the reviewed shop drawings.
  - .2 Install siding in true alignment, with joints accurately aligned and tight fitting. Fasten securely to supporting work.
  - .3 Locate exposed fasteners in true horizontal and vertical alignment and equally spaced.
  - .4 Provide sealants, flashings, closures, covers and trim as indicated and as required to render work complete and finished in accordance with specified requirements. Lock end joints and provide weathertight seal.
-

3.5 INSTALLATION  
OF EXTERIOR SIDING  
(Cont'd)

.4 (Cont'd)

.5 Seal in accordance with Section 07 92 00 "Joint Sealants".

3.6 CLEANING

.1 Neatly touch up minor paint abrasions with touch up paint recommended by manufacturer.

.2 Clean siding surfaces by dry-wiping.

.3 Remove from site all surplus material, rubbish and debris resulting from the work of this Section and leave the installation clean.

PART 1 - GENERAL

- 1.1 REFERENCES
- .1 American Society for Testing and Materials (ASTM):
    - .1 ASTM C1177/C1177M-08, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
    - .2 ASTM D412-06ae2, Standard Test methods for Vulcanized Rubber and Thermoplastic Elastomers.
    - .3 ASTM D903-98(2010), Standard Test Method for Peel or Stripping Strength of Adhesive Bonds.
    - .4 ASTM D1790-08, Standard Test Method for Brittleness Temperature of Plastic Sheeting by Impact.
    - .5 ASTM E96/E96M-10, Standard Test Methods for Water Vapor Transmission of Materials.
  - .2 Canadian General Standards Board (CGSB)
    - .1 CGSB-37-GP-56M-80(+Amdt.1985), Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing.
  - .3 Canadian Roofing Contractors Association (CRCA)
    - .1 CRCA Roofing Specifications Manual.
  - .4 Canadian Standards Association (CSA International)
    - .1 CSA A123.21-04, Standard Test Method for the Dynamic Wind Uplift Resistance of Mechanically Attached Membrane-Roofing Systems
    - .2 CSA A123.4-04, Asphalt for Constructing Built-Up Roof Coverings and Waterproofing Systems.
  - .5 Factory Mutual (FM Global)
    - .1 FM Approvals - Roofing Products.
  - .6 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
    - .1 Material Safety Data Sheets (MSDS).
  - .7 Underwriters Laboratories' of Canada (ULC)
    - .1 CAN/ULC S704-11, Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.
-

- 1.2 ADMINISTRATIVE REQUIREMENTS .1 Convene pre-installation meeting one week prior to beginning roofing work, with roofing contractor's representative and Departmental Representative in accordance with Section 01 32 16.
- .1 Verify project requirements.
  - .2 Review installation and substrate conditions.
  - .3 Co-ordination with other building subtrades.
  - .4 Review manufacturer's installation instructions and warranty requirements.
- 1.3 ACTION AND INFORMATIONAL SUBMITTALS .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
- .1 Provide two copies of most recent technical roofing components data sheets describing materials' physical properties and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Provide two copies of WHMIS MSDS in accordance with Sections 01 35 29 and 01 35 43, and indicate VOC content for:
    - .1 Primers.
    - .2 Asphalt.
    - .3 Sealers.
- .3 Provide shop drawings:
- .1 Indicate flashings, tapered insulation and curb details.
  - .2 Provide layout for tapered insulation.
- .4 Manufacturer's Certificate: certify that products meet or exceed specified requirements.
- .5 Test and Evaluation Reports: submit laboratory test reports certifying compliance of bitumens and membrane with specification requirements.
- .6 Manufacturer's Installation Instructions: indicate special precautions required for seaming the membrane.
- .7 Manufacturer's field report: in accordance with Section 01 45 0.
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- 1.3 ACTION AND INFORMATIONAL SUBMITTALS (Cont'd) .8 Reports: indicate procedures followed, ambient temperatures and wind velocity during application.
- 
- 1.4 QUALITY ASSURANCE .1 Installer qualifications: company or person specializing in application of modified bituminous roofing systems with 5 years documented experience and approved by manufacturer.
- 1.5 FIRE PROTECTION .1 Fire Extinguishers:  
.1 Maintain one cartridge operated type or stored pressure rechargeable type with hose and shut-off nozzle.  
.2 ULC labelled for A, B and C class protection.  
.3 Size as 9 kg on roof per torch applicator, within 6 m of torch applicator.  
.2 Maintain fire watch for 1 hour after each day's roofing operations cease.
- 1.6 DELIVERY, STORAGE, AND HANDLING .1 Deliver, store and handle materials in accordance with manufacturer's written instructions and Section 01 61 00.  
.2 Storage and Handling Requirements:  
.1 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of asphalt, sealing compounds, primers and caulking materials.  
.2 Provide and maintain dry, off-ground weatherproof storage.  
.3 Store rolls of felt and membrane in upright position. Store membrane rolls with salvage edge up.  
.4 Remove only in quantities required for same day use.  
.5 Place plywood runways over completed Work to enable movement of material and other traffic.  
.6 Store sealants at +5oC minimum.  
.7 Store insulation protected from daylight and weather and deleterious materials.
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1.6 DELIVERY,  
STORAGE, AND  
HANDLING  
(Cont'd)

- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
- .1 Remove and return to manufacturer for re-use, pallets, crates, padding and packaging materials in accordance with Section 01 74 20.
  - .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.
  - .4 Place materials defined as hazardous or toxic in designated containers.
  - .5 Clearly label location of salvaged material's storage areas and provide barriers and security devices.
  - .6 Ensure emptied containers are sealed and stored safely.
  - .7 Divert unused aggregate materials from landfill to local facility for reuse as reviewed by Departmental Representative.
  - .8 Unused coating material must be disposed of at official hazardous material collections site as reviewed by Departmental Representative.
  - .9 Unused adhesive, sealant and asphalt materials 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.
  - .10 Dispose of unused adhesive, sealant and asphalt material at official hazardous material collections site approved by Departmental Representative.
  - .11 Divert unused gypsum materials from landfill to recycling facility as reviewed by Departmental Representative.

1.7 FIELD CONDITIONS.1

- Ambient Conditions
- .1 Do not install roofing when temperature remains below -18 deg.C for torch application, or -5 deg.C or to manufacturers' recommendations for mop application.
  - .2 Minimum temperature for solvent-based adhesive is -5 deg.C.
- .2 Install roofing on dry deck, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture into roofing system.

1.8 WARRANTY .1 For Work of this Section 07 52 00, 12 months warranty period is extended to 24 months.

PART 2 - PRODUCTS

2.1 PERFORMANCE CRITERIA .1 Compatibility between components of roofing system is essential. Provide written declaration to Departmental Representative stating that materials and components, as assembled in system, meet this requirement.

.2 Roofing System: to CSA A123.21 for wind uplift resistance.

2.2 DECK COVERING .1 Glass mat gypsum board sheathing: To ASTM C1177, Type X, 13 mm thick.

2.3 DECK PRIMER .1 Asphalt primer: As recommended by roofing membrane manufacturer.

2.4 VAPOUR RETARDER .1 Thermofusible elastomeric bitumen (SBS modified bitumen) reinforced with a glass fibre reinforcement, top face lightly sanded, underside covered with a silicone release plastic film protecting the self-adhesive underface; conforming to CGSB 37-GP-56M. Thickness 3.0 mm.

.1 Apply membrane by self-adhesion on primed substrate.

.2 Components:

.1 Reinforcement: Polyester and glass fibre composite.

.2 Modified bitumen: Mix of selected bitumen and SBS thermoplastic polymer.

.3 Vapour retarder properties: to CGSB 37-GP-56M.

.1 Strain energy (longitudinal/transversal): MD 7.8 kN/m; XD 7.2 kN/m.

.2 Tensile strength (longitudinal/transversal): MD 15 kN/m; XD 13.5 kN/m.

.3 Ultimate elongation (longitudinal/transversal): MD 60%; XD 65%.

.4 Tear resistance: 125 N.

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- 2.4 VAPOUR RETARDER .1 (Cont'd)  
(Cont'd)
- .3 Vapour retarder properties:(Cont'd)
    - .5 Cold bending:Initial: -30oC : no cracking. 90 days @ 70oC :-30oC : no cracking.
    - .6 Static puncture resistance: > 560 N.
    - .7 Plastic flow: 115oC.
  - .4 ULC certification: Class A.
- 2.5 INSULATION .1 Board Insulation: Closed-cell polyisocyanurate foam insulation board, integrally laminated to inorganic/organic felt facers, to CAN/ULC S704, Type 3, CFC-free and conforming to Environment Canada Ozone-Depleting Substances regulations, minimum RSI 1.04 M2.oC/W per 25 mm thickness, flame spread classification less than 500, maximum board size 1219 mm x 1219 mm; thickness as indicated.
- .2 Overlay Board: Multi-ply, semi-rigid asphaltic roofing substrate board composed of a mineral-fortified asphaltic core formed between two asphaltic saturated fibreglass liners, 3.2 mm thick.
    - .1 Install over insulation to provide torch safe surface.
  - .3 Adhesive for securing insulation and overlay board: As recommended by roofing membrane manufacturer.
- 2.6 BITUMEN .1 Asphalt: to CAN/CSA A123.4, Type 2 with thermoplastic polymers and volatile solvents.
- 2.7 MEMBRANE MATERIALS .1 Base Sheet: Thermofusible elastomeric bitumen (SBS modified bitumen) reinforced with a non-woven polyester reinforcement, top face covered with a thermofusible plastic film, under face lightly sanded; conforming to CGSB 37-GP-56M. Thickness 2.2 mm.
- .1 Apply membrane by bonding with hot asphalt.
  - .2 Components:
    - .1 Reinforcement: Non-woven polyester 180 g/m2.
    - .2 Modified bitumen: Mix of selected bitumen and SBS thermoplastic polymer.
-

2.7 MEMBRANE  
MATERIALS  
(Cont'd)

- .1 Base Sheet:(Cont'd)
  - .2 Components:(Cont'd)
    - .3 Base sheet properties: to CGSB 37-GP-56M.
      - .1 Strain energy (longitudinal/transversal): MD 9.0 kN/m; XD 7.0 kN/m.
      - .2 Tensile strength (longitudinal/transversal): MD 17 kN/m; XD 12.5 kN/m.
      - .3 Ultimate elongation (longitudinal/transversal): MD 60%; XD 65%.
      - .4 Tear resistance: 60 N.
      - .5 Cold bending:Initial: -30oC : no cracking. 90 days @ 70oC :-30oC : no cracking.
      - .6 Static puncture resistance: > 400 N.
      - .7 Plastic flow: 115oC.
      - .8 Dimensional stability (longitudinal/transversal): MD 0.4%; XD 0.3%
      - .9 Tear resistance: 60 N
      - .10 Lap adhesion:Initial:13.8 14 days @ 70oC:14.2
      - .11 Water vapour permeance: (ASTM E96, Procedure B): <0.23 ng/Pa.s.m2.
    - .4 ULC certification: Class A.
  - .2 Base Sheet Stripping (flashing): Thermofusible elastomeric bitumen (SBS modified bitumen) reinforced with a glass fibre reinforcement, top face covered with a thermofusible plastic film, underside covered with a silicone release plastic film protecting the self-adhesive underface; conforming to CGSB 37-GP-56M. Thickness 2.6 mm.
    - .1 Apply membrane by self-adhesion to primed substrate.
    - .2 Components:
      - .1 Reinforcement: Glass fibre.
      - .2 Modified bitumen: Mix of selected bitumen and SBS thermoplastic polymer.
      - .3 Primer: As recommended by the system manufacturer.
      - .4 Base sheet stripping properties: to CGSB 37-GP-56M.
        - .1 Strain energy (longitudinal/transversal): MD 8.4 kN/m; XD 8.3 kN/m.
        - .2 Tensile strength (longitudinal/transversal): MD 18 kN/m; XD 16 kN/m.

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- 2.7 MEMBRANE MATERIALS (Cont'd)
- .2 Base Sheet Stripping (flashing):(Cont'd)
    - .2 Components:(Cont'd)
      - .4 (Cont'd)
        - .3 Ultimate elongation (longitudinal/transversal): MD 55%; XD 56%.
        - .4 Tear resistance: 120 N.
        - .5 Cold bending:Initial: -30oC : no cracking. 90 days @ 70oC :-30oC : no cracking.
        - .6 Static puncture resistance: > 380 N.
        - .7 Dimensional Stability: MD 0.1%; XD 0.4%
        - .8 Plastic flow: 105oC.
      - .5 ULC certification: Class A.
    - .3 Cap Sheet and Cap Sheet Stripping (Flashing): Heavy duty composite reinforced cap sheet with highly reflective white slate flakes. Topside self-protected with highly reflective white slate flakes, underside protected by a thermofusible plastic film, Thickness 3.5 mm.
      - .1 Apply membrane by torching only.
      - .2 Components:
        - .1 Reinforcement: Composite.
        - .2 Modified bitumen: Mix of selected bitumen and SBS thermoplastic polymer.
        - .3 Granular surface: Reflective white slate flakes.
      - .3 Cap sheet membrane properties with specified base sheet: to CGSB 37-GP-56M.
        - .1 Strain energy (longitudinal/transversal): MD 18.4 kN/m; XD 18.1 kN/m.
        - .2 Tensile strength (longitudinal/transversal): MD 31 kN/m; XD 31 kN/m.
        - .3 Ultimate elongation (longitudinal/transversal): MD 60%; XD 60%.
        - .4 Tear resistance: 205 N.
        - .5 Cold bending:Initial: -30oC : no cracking. 90 days @ 70oC :-30oC : no cracking.
        - .6 Static puncture resistance: > 540 N.
        - .7 Dimensional Stability: MD 0.2%; XD 0%
        - .8 Plastic flow: 105oC.
      - .4 ULC certification: Class A.

- 
- 2.8 FLEXIBLE FLASHINGS .1 Flexible vinyl flashing: 2 ply non-reinforced polymer flashing, 1.52 mm thick; properties as follows:
- .1 Tensile strength (ASTM D412): 9307 kPa
  - .2 Elongation (ASTM D412): 2%
  - .3 Tension set, 50% extension (ASTM D412): 5%
  - .4 Low Temperature (ASTM D1790): No cracks at -23°C.
  - .5 Adhesive strength:
    - .1 Shear - vinyl to vinyl (ASTM D903): 31.7 kg per 25 mm width.
    - .2 Peel - vinyl to vinyl (ASTM D903): 4.5 kg per 25 mm width.
- .2 Provide flashing widths to suit each application as indicated on the drawings. Provide integral metal strip where required.
- .3 Flashing adhesive: As recommended by the flashing material manufacturer.
- 2.9 SEALERS .1 Sealing compound: As recommended by the roofing membrane and flashing membrane manufacturers for each specific application.
- .2 Sealants: Caulking - refer to Section 07 92 00. Provide sealants as recommended by the roofing membrane and flashing membrane manufacturers for each specific application.
- 2.10 CARPENTRY .1 Refer to Section 06 10 00.
- 2.11 CANT STRIPS .1 Cut from pressure-treated wood, 38 mm thick material, to measure 140 mm on slope.
- 2.12 FASTENERS .1 Covering to steel deck: No. 10 flat head, self tapping, Type A or AB, cadmium plated screws. FM Approved screw and plate assemblies.
- .2 Insulation to deck: coated insulation fasteners and galvanized plates as recommended by insulation manufacturer and meeting FM Approval for wind uplift and corrosion resistance, .
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PART 3 - EXECUTION

- 3.1 QUALITY OF WORK
- .1 Do examination, preparation and roofing Work in accordance with Roofing Manufacturer's Specification Manual and CRCA Roofing Specification Manual, particularly for fire safety precautions, applicable FM requirements.
  - .2 Do priming in accordance with manufacturers written recommendations.
  - .3 The interface of the walls and roof assemblies will be fitted with durable rigid material providing connection point for continuity of air barrier.
  - .4 Assembly, component and material connections shall be made in consideration of appropriate design loads, with reversible mechanical attachments.
- 3.2 EXAMINATION OF ROOF DECKS
- .1 Verification of Conditions:
    - .1 Inspect with Departmental Representative deck conditions including parapets, construction joints, roof drains, plumbing vents and ventilation outlets to determine readiness to proceed.
  - .2 Evaluation and Assessment:
    - .1 Prior to beginning of work ensure:
      - .1 Decks are firm, straight, smooth, dry, free of snow, ice or frost, and swept clean of dust and debris. Do not use calcium or salt for ice or snow removal.
      - .2 Curbs have been built.
      - .3 Roof drains have been installed at proper elevations relative to finished roof surface.
      - .4 Plywood and lumber nailer plates have been installed to deck, walls and parapets as indicated.
  - .3 Do not install roofing materials during rain or snowfall.
-



3.3 PROTECTION OF  
IN-PLACE CONDITIONS

- .1 Cover walls, walks and adjacent work where materials hoisted or used.
- .2 Use warning signs and barriers. Maintain in good order until completion of Work.
- .3 Clean off drips and smears of bituminous material immediately.
- .4 Dispose of rain water off roof and away from face of building until roof drains or hoppers installed and connected.
- .5 Protect roof from traffic and damage. Comply with precautions deemed necessary by Departmental Representative.
- .6 At end of each day's work or when stoppage occurs due to inclement weather, provide protection for completed Work and materials out of storage.
- .7 Metal connectors and decking shall be treated with rust proofing or galvanization.

3.4 DECK SHEATHING

- .1 Install gypsum board sheathing to the steel deck, as indicated on the drawings and in accordance with the manufacturer's recommendations.
  - .2 Install sheathing boards over steel deck with long side perpendicular to deck flutes.
  - .3 Provide continuous support at ends of boards. Use galvanized sheet steel strip, spanning the deck flutes.
  - .4 Lay boards in parallel courses, butted together in moderate contact, without gaps and with staggered end joints.
  - .5 Cut and trim boards to provide plain butt joints at perimeter, parapets, curbs, etc.
  - .6 Fastening: Use reversible mechanical attachments to steel deck's upper rib surfaces. Conform to sheathing manufacturer's recommendations for Factory Mutual approved fastener spacing. Minimum requirement to be FM-I90.
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- 3.5 PRIMING DECK .1 Apply deck primer to gypsum board roofing substrate at the rate recommended by manufacturer.
- 3.6 VAPOUR RETARDER INSTALLATION .1 Coordinate with Section 06 10 00 and hand over starter strips of self-adhesive vapour retarder membrane for installation by Division 06 10 00 at the appropriate stage of the carpentry work for the roof assembly, in order to maintain complete continuity between the air/vapour barrier in the wall assembly and the vapour retarder in the roofing assembly.
- .2 Install the self-adhesive vapour retarder, in accordance with the manufacturer's instructions.
- .3 Install parallel to the long side of the underlying insulation cap sheet.
- .4 Roll the entire surface to make sure the membrane is properly adhered, without air pockets, wrinkles, fishmouths or tears.
- .5 After installation of the membrane, check all lap seams by running a trowel along the seam.
- .6 Maintain continuity with the building air/vapour barrier system as indicated on the drawings.
- 3.7 INSULATION INSTALLATION .1 Install insulation boards in two layers of the thicknesses indicated on the drawings.
- .2 Stagger all joints in the boards and set into a full mop coating of asphalt.
- .3 Install sloped insulation where required to maintain slope of roof to roof surface drains. In particular, provide water diverters on the upslope sides of HVAC equipment curbs to direct run-off from accumulating behind the units. Set sloped insulation in a full mop coating of bitumen.
- .4 Install a roof drain sump at each roof drain. Ensure that the sump is installed at the proper elevation to function correctly.
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- 3.7 INSULATION  
INSTALLATION  
(Cont'd)
- .5 Install protection board over the entire surface of the insulation. Set in a full mop coating of bitumen.
- 
- 3.8 BASE MEMBRANE  
APPLICATION
- .1 Commencing at the lowest point of the roof, embed the base sheet in a full mop coat of approximately 1.2 kg/m<sup>2</sup> of asphalt. Apply base sheet with 75 mm side laps and 150 mm end laps. Extend the base sheet up vertical surfaces, as indicated on the drawings, in a full mop of asphalt.
- .2 Ensure the base sheet is unrolled to enable the membrane to relax prior to installation. The time required for relaxation will vary according to weather conditions.
- .3 Torch-weld all lap joints by heat softening the membrane and pressing the edge of the membrane firmly with a roofing trowel.
- .4 Apply asphalt not more than 1.5 m ahead of the membrane as it is being applied, while ensuring complete bonding.
- .5 Ensure the base sheet membrane is installed parallel to the long side of the underlying insulation cap sheet.
- .6 After installation of the membrane, check all lap seams on the cap sheet by running a trowel along the seam.
- 
- 3.9 BASE SHEET  
STRIPPING  
(FLASHING) MEMBRANE  
APPLICATION
- .1 Ensure that primer coating is dry before application of the base sheet stripping.
- .2 Lay base sheet stripping in strips 1 metre wide to the vertical surfaces, extending on to the flat surface of the roof a minimum of 100 mm. Side laps shall be 75 mm and shall be staggered a minimum of 100 mm with the laps of the base sheet.
- .3 Install the self-adhesive base sheet stripping, in accordance with the manufacturer's instructions.
- .4 Roll the entire surface to make sure the membrane is properly adhered, without air pockets, wrinkles, fishmouths or tears.
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- 3.9 BASE SHEET STRIPPING (FLASHING) MEMBRANE APPLICATION (Cont'd)
- .5 After installation of the membrane, check all lap seams by running a trowel along the seam.
- .6 Nail the base sheet top edge to the substrate at 300 mm o.c. in accordance with the manufacturer's recommendations.
- 
- 3.10 CAP SHEET INSTALLATION
- .1 Ensure that base membrane and reinforcement membrane are in place and without defects.
- .2 Unroll the cap sheet membrane, starting from a low point of the roof. Reroll from both ends prior to torching. Take care to ensure good alignment of the first roll, parallel with the edge of the roof. Stagger joints at least 300 mm relative to reinforcement membrane and to base sheet membrane.
- .3 Torch-weld membrane to the base sheet in accordance with the membrane manufacturer's recommendations. During this application, melt the undersurfaces forming an asphalt bead that is pushed out in front of the base sheet as the work proceeds. recommendations.
- .4 Take care not to burn the membrane and its respective reinforcements.
- .5 Lap sides 75 mm and ends 150 mm. Stagger end laps so as to avoid 4 overlaps. Stagger laps at least 300 mm relative to laps in base membrane and in reinforcement membrane.
- .6 Avoid asphalt seepage at the seams greater than 5 mm..
- .7 Heat the surface granules on laps and imbed into the liquid bitumen prior to installation of following sheets.
- .8 Make sure the membrane is properly welded, without air pockets, wrinkles, fishmouths or tears.
- .9 After installation of the membrane, check all lap seams on the cap sheet by running a trowel along the seam.
-

3.11 CAP SHEET  
STRIPPING  
(FLASHING)  
INSTALLATION

- .1 Torch weld cap flashing membrane in place.
- .2 Lay membrane in strips one metre wide. Side laps to be 75 mm, staggered at least 300 mm relative to the cap sheet.
- .3 At parapets and curbs, membrane to extend 150 mm out onto the roof, up the back face of the parapet, over the top of the parapet and terminate 50 mm down the outer face of the parapet unless indicated otherwise.
- .4 At other vertical surfaces membrane to extend 150 mm out onto the roof, over the cant strip, up the back face of the parapet to the elevation indicated or where required for a complete, watertight installation.
- .5 Torch-weld reinforcement stripping directly onto its support from bottom to top. Torch-welding shall soften the underside of the reinforcement stripping without overheating, resulting in a uniform adhesion over the entire surface.
- .6 Take care not to burn the membrane and its respective reinforcements.
- .7 Make sure the membrane is properly welded, without air pockets, wrinkles, fishmouths or tears.
- .8 During installation, avoid asphalt seepage greater than 5 mm at seams.
- .9 Nail the top edge as per manufacturer's recommendations.
- .10 After installation of the membrane, check all lap seams by running a trowel along the seam.

3.12 FLEXIBLE  
FLASHINGS

- .1 Install flexible flashings as indicated on the drawings and in strict accordance with the manufacturer's printed instructions.
- .2 Install flashings progressively with the roofing membranes to ensure weathertight connections and to maintain the integrity of the entire roofing installation.
- .3 Refer to the drawings to verify the correct flashing width for each specific application.

- 
- 3.12 FLEXIBLE FLASHINGS  
(Cont'd)
- .3 (Cont'd)  
Use flashing products with integral sheet metal strip where indicated.
- 3.13 ROOF DRAINS
- .1 Coordinate with Division 22 to ensure proper seals to roof drains.
- 3.14 METAL FLASHINGS
- .1 For perimeter parapet flashings refer to Section 07 62 00.
- .2 Install other metal flashings as indicated on the drawings and as specified in Section 07 62 00.
- 3.15 FIELD QUALITY CONTROL
- .1 Inspection and testing of roofing application will be carried out by testing laboratory designated by Departmental Representative.
- .2 Departmental Representative will pay for tests as specified in Section 01 45 00.
- .3 Contractor shall pay for re-inspection and re-testing necessitated by failure to meet specification requirements on the initial inspection/test.
- 3.16 CLEANING
- .1 Remove bituminous markings from finished surfaces.
- .2 In areas where finished surfaces are soiled caused by work of this section, consult manufacturer of surfaces for cleaning advice and complying with their documented instructions.
- .3 Repair or replace defaced or disfigured finishes caused by work of this section.

PART 1 - GENERAL

- 1.1 REFERENCES
- .1 American Society for Testing and Materials International (ASTM)
    - .1 ASTM A653/A653M-10, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
    - .2 ASTM D523-08, Standard Test Method for Specular gloss.
    - .3 ASTM D822-01(2006), Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
  - .2 Canadian Roofing Contractors Association (CRCA)
    - .1 Roofing Specifications Manual 1997.
  - .3 Canadian Standards Association (CSA International)
    - .1 CSA A123.3-05(R2010), Asphalt Saturated Organic Roofing Felt.
    - .2 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
  - .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
    - .1 Material Safety Data Sheets (MSDS).
- 1.2 SUBMITTALS
- .1 Provide submittals in accordance with Section 01 33 00.
  - .2 Product Data:
    - .1 Submit manufacturer's printed product literature for sheet metal flashing systems materials, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
    - .2 Submit two copies WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 29.
  - .3 Shop Drawings:
    - .1 Include details of each type of flashing and trim showing materials, thicknesses, profiles, methods of attachment finishes and other pertinent information.
-

- 1.2 SUBMITTALS                      .4    Samples:  
    (Cont'd)
- .1    Submit duplicate 50 x 50 mm samples of  
          each type of sheet metal material,  
          finishes and colours.
- 
- 1.3 QUALITY                      .1    Pre-Installation Meetings: convene  
ASSURANCE
- .1    Pre-installation meeting one week prior to  
          beginning work of this Section and on-site  
          installation, with Contractor's representative  
          and Departmental Representative in accordance  
          with the construction schedule specified in  
          Section 01 32 16 to:  
    .1    Verify project requirements.  
    .2    Review installation and substrate  
          conditions.  
    .3    Co-ordinate with other building  
          subtrades.  
    .4    Review manufacturer's installation  
          instructions and warranty requirements.
- 
- 1.4 DELIVERY,                   .1    Deliver, store and handle materials in  
STORAGE AND  
HANDLING
- .2    Waste Management and Disposal:  
    .1    Separate waste materials for reuse and  
          recycling in accordance with Section 01  
          74 20.  
    .2    Identify hazardous and related materials  
          which cannot be reused, are regarded as  
          hazardous products and are subject to  
          regulations for disposal. Information on  
          these controls can be obtained from the  
          Provincial Ministries of Environment and  
          Regional Levels of Government.  
    .3    Safely store materials defined as  
          hazardous or toxic waste, including  
          emptied containers and application  
          apparatus, in containers or areas  
          designated for hazardous waste and  
          dispose of contaminants in an approved  
          legal manner.
-



PART 2 - PRODUCTS

2.1 SHEET METAL  
MATERIALS

- .1 Where not exposed to sight from ground level locations: Galvanized steel sheet to ASTM A653, commercial quality, Z275 zinc coating, minimum 0.76 mm base metal thickness.
- .2 Where exposed to sight from ground level locations: Prefinished steel sheet: Galvanized steel sheet with factory applied polyvinylidene fluoride.
  - .1 Class F1S.
  - .2 Colour: To match adjacent material.
  - .3 Specular gloss: 30 units +5 in accordance with ASTM D523.
  - .4 Coating thickness: not less than 200 micrometres.
  - .5 Resistance to accelerated weathering for chalk rating of 8, colour fade 5 units or less and erosion rate less than 20% to ASTM D822 as follows:
    - .1 Outdoor exposure period 5000 hours.
    - .2 Humidity resistance exposure period 5000 hours.

2.2 ACCESSORIES

- .1 Isolation coating: alkali resistant bituminous paint.
- .2 Underlay for metal flashing: No. 15 perforated asphalt felt to CSA A123.3.
- .3 Sealants: Refer to Section 07 92 00.
- .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.

2.3 FABRICATION

- .1 Fabricate metal flashings and other sheet metal work in general accordance with applicable CRCA 'FL' series details, as indicated and as required by site conditions.
-

- 
- 2.3 FABRICATION (Cont'd)
- .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 or to be in contact with dissimilar metals.
- 2.4 METAL FLASHINGS
- .1 Form flashings, copings and fascias to profiles indicated of 0.76 mm thick prefinished galvanized steel sheet.
- 2.5 REGLETS AND CAP FLASHINGS
- .1 Form recessed reglets and metal cap flashing of 0.76 mm thick prefinished galvanized steel sheet to be built-into existing masonry work for base flashings as detailed.
  - .2 Provide slotted fixing holes and steel/plastic washer fasteners.
- 2.6 PIPE PENETRATIONS
- .3 Provide and install 1.6 mm (16 ga) spun aluminum flashings and caps to all vent stacks.
  - .4 For flashing of miscellaneous mechanical and electrical items penetrating the roof membrane, provide:
    - .1 Factory prefabricated, insulated aluminium sleeve flashings, with matching aluminum collar, sized to suit item to be flashed.
    - .2 Sleeve and collar to be fabricated from aluminum, with premoulded urethane insulation on the inner side, interior surface bituminous painted to prevent galvanic action with dissimilar metals. Aluminum for sleeve to be 1.6 mm (16 ga) thick and for collar to be 1.4 mm (17 ga) thick.
    - .3 Provide deck flange, integral with sleeve aluminum.
-

- 2.6 SCUPPERS
- .1 Form scuppers from 1.22 mm thick galvanized steel sheet metal.
  - .2 Sizes and profiles as indicated.
  - .3 Provide necessary fastenings.
  - .4 Form 600 x 600 mm splash pans from 1.22 mm thick galvanized steel sheet metal.

PART 3 - EXECUTION

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

- 3.2 INSTALLATION
- .1 Install sheet metal work in general accordance with CRCA FL series details, as detailed and as required by site conditions.
  - .2 Use concealed fastenings except where approved before installation.
  - .3 Provide underlay under sheet metal. Secure in place and lap joints 100 mm.
  - .4 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.
  - .5 Lock end joints and caulk with sealant.
  - .6 Install reglets true and level, and caulk top of reglet with sealant.
  - .7 Insert metal flashing into reglets under cap flashing to form weathertight junction.
  - .8 Turn top edge of flashing into recessed reglet or mortar joint minimum of 25 mm. Lead wedge flashing securely into joint.
  - .9 Caulk flashing at reglet and cap flashing with sealant.
  - .10 Install scuppers as indicated.
-

3.3 CLEANING

- .1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Leave work areas clean, free from grease, finger marks and stains.

PART 1 - GENERAL

1.1 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .2 Underwriter's Laboratories of Canada (ULC)
  - .1 CAN/ULC-S101-07, Standard Methods of for Fire Endurance Tests of Building Construction and Materials.
  - .2 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
  - .3 CAN/ULC-S115-11, Standard Method of Fire Tests of Firestop Systems.

1.2 DEFINITIONS

- .1 Fire Stop Material: device intended to close off opening or penetration during fire or materials that fill openings in wall or floor assembly where penetration is by cables, cable trays, conduits, ducts and pipes and poke-through termination devices, including electrical outlet boxes along with their means of support through wall or floor openings.
  - .2 Single Component Fire Stop System: fire stop material that has Listed Systems Design and is used individually without use of high temperature insulation or other materials to create fire stop system.
  - .3 Multiple Component Fire Stop System: exact group of fire stop materials that are identified within Listed Systems Design to create on site fire stop system.
  - .4 Continuity of Fire Separations: NBC 2010, Division B, Parts 3.1.8 and 3.1.9.1, 9.10.9):
    - .1 Wall, partition or floor assemblies required to be a fire separation shall be: constructed as a continuous element; have a fire resistance rating; have openings protected by a closure; and have penetrations sealed by a firestop.
-

- 1.3 SUBMITTALS
- .1 Provide submittals in accordance with Section 01 33 00.
  - .2 Product Data:
    - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
    - .2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 33 00.
  - .3 Shop Drawings:
    - .1 Submit shop drawings to show location, proposed material, reinforcement, anchorage, fastenings and method of installation.
    - .2 Construction details should accurately reflect actual job conditions.
  - .4 Samples:
    - .1 Submit duplicate 300 x 300 mm samples showing actual fire stop material proposed for project.
  - .5 Quality assurance submittals: submit following in accordance with Section 01 45 00.
    - .1 Test reports: in accordance with CAN/ULC-S101 for fire endurance and CAN/ULC-S102 for surface burning characteristics.
      - .1 Submit certified test reports from approved independent testing laboratories, indicating compliance of applied fire stopping with specifications for specified performance characteristics and physical properties.
    - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
    - .3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.
    - .4 Manufacturer's Field Reports: submit to manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.
-

1.4 QUALITY  
ASSURANCE

- .1 Qualifications:
  - .1 Installer: company specializing in fire stopping with 5 years documented experience approved by manufacturer.
  - .2 All fire stopping material shall be from one manufacturer.
  - .3 All fire stopping installation work for entire project shall be by a single contractor experienced in firestopping. Individual disciplines shall NOT fire stop their own work.
- .2 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section, with contractor's representative and Departmental Representative in accordance with Section 01 32 16 to:
  - .1 Verify project requirements.
  - .2 Review installation and substrate conditions.
  - .3 Co-ordination with other building subtrades.
  - .4 Review manufacturer's installation instructions and warranty requirements.
- .3 Site Meetings: as part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.
  - .1 After delivery and storage of products, and when preparatory Work is complete, but before installation begins.
  - .2 Twice during progress of Work at 25% and 60% complete.
  - .3 Upon completion of Work, after cleaning is carried out.

1.5 DELIVERY,  
STORAGE AND  
HANDLING

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle materials in accordance with Section 01 61 00.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
  - .3 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, and ULC markings.
- .2 Storage and Protection:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's

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- 1.5 DELIVERY,  
STORAGE AND  
HANDLING  
(Cont'd)
- .2 Storage and Protection:(Cont'd)
    - .1 (Cont'd)  
recommendations in clean, dry,  
well-ventilated area.
    - .2 Replace defective or damaged materials  
with new.
  - .3 Waste Management and Disposal:
    - .1 Separate waste materials for reuse and  
recycling in accordance with Section  
01 74 20.

PART 2 - PRODUCTS

- 
- 2.1 MATERIALS
- .1 Fire stopping and smoke seal systems: in  
accordance with CAN/ULC-S115.
    - .1 Asbestos-free materials and systems  
capable of maintaining effective barrier  
against flame, smoke and gases in  
compliance with requirements of  
CAN/ULC-S115 and not to exceed opening  
sizes for which they are intended.
    - .2 Fire stop system rating: F.
  - .2 Service penetration assemblies: systems  
tested to CAN/ULC-S115.
  - .3 Service penetration fire stop components:  
certified by test laboratory to CAN/ULC-S115.
  - .4 Fire-resistance rating of installed fire  
stopping assembly in accordance with NBC.
  - .5 Fire stopping and smoke seals at openings  
intended for ease of re-entry such as cables:  
elastomeric seal.
  - .6 Fire stopping and smoke seals at openings  
around penetrations for pipes, ductwork and  
other mechanical items requiring sound and  
vibration control: elastomeric seal.
  - .7 Primers: to manufacturer's recommendation for  
specific material, substrate, and end use.
  - .8 Water (if applicable): potable, clean and  
free from injurious amounts of deleterious  
substances.
  - .9 Damming and backup materials, supports and  
anchoring devices: to manufacturer's  
recommendations, and in accordance with tested
-



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- 2.1 MATERIALS .9 (Cont'd)  
(Cont'd) assembly being installed as acceptable to  
authorities having jurisdiction.
- .10 Sealants for vertical joints: non-sagging.

PART 3 - EXECUTION

- 3.1 MANUFACTURER'S .1 Compliance: comply with manufacturer's  
INSTRUCTIONS 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.
-

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- 3.3 INSTALLATION  
(Cont'd)
- .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 Movement: 20%.
    - .2 Designed for re-entry, removable at location.
- 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.
  - .2 Manufacturer's Field Services:
    - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
    - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
    - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
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- 3.7 CLEANING .1 Proceed in accordance with Section 01 74 11.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .3 Remove temporary dams after initial set of fire stopping and smoke seal materials.
- 
- 3.8 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<sup>2</sup> : 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.



PART 1 - GENERAL

- 1.1 REFERENCES
- .1 American Society for Testing and Materials International, (ASTM):
    - .1 ASTM C834-10 Standard Specification for Latex Sealants.
    - .2 ASTM C920-11 Standard Specification for Elastomeric Joint Sealants.
  - .2 Department of Justice Canada (Jus)
    - .1 Canadian Environmental Protection Act, 1999 (CEPA).
  - .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
    - .1 Material Safety Data Sheets (MSDS).
  - .4 Transport Canada (TC)
    - .1 Transportation of Dangerous Goods Act, 1992 (TDGA).
  - .5 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD):
    - .1 SCAQMD Rule 1168-2005, Mortar, Adhesives and Sealants Applications.
  - .6 Submit product data in accordance with Section 01 33 00.
    - .1 Manufacturer's product literature to describe:
      - .1 Caulking compound.
      - .2 Primers.
      - .3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.
    - .2 Submit two copies of WHMIS MSDS Material Safety Data Sheets in accordance with Section 01 35 29 for each type of sealant and primer. Indicate VOC content.
  - .7 Submit samples in accordance with Section 01 33 00.
    - .1 Submit duplicate samples of each type of material and colour.
    - .2 Cured samples of exposed sealants for each colour where required to match adjacent material.
  - .8 Submit manufacturer's instructions in accordance with Section 01 33 00. Instructions to include installation instructions for each product used.
-

1.2 DELIVERY,  
STORAGE, AND  
HANDLING

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- .1 Deliver, handle, store and protect materials in accordance with Section 01 61 00.
- .2 Deliver and store materials in original wrappings and containers with manufacturer's seals and labels, intact. Protect from freezing, moisture, water and contact with ground or floor.

1.3 WASTE  
MANAGEMENT AND  
DISPOSAL

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- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
  - .4 Identify hazardous and related materials which cannot be reused, are regarded as hazardous products and are subject to regulations for disposal. Information on these controls can be obtained from the Provincial Ministries of Environment and Regional Levels of Government.
  - .5 Safely store materials defined as hazardous or toxic waste, including emptied containers and application apparatus, in containers or areas designated for hazardous waste and dispose of contaminants in an approved legal manner.
  - .6 Place materials defined as hazardous or toxic in designated containers.
  - .7 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.
  - .8 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.
  - .9 Divert unused joint sealing material from landfill to official hazardous material collections site approved by the Departmental Representative.
-

1.3 WASTE  
MANAGEMENT AND  
DISPOSAL  
(Cont'd)

- .10 Empty plastic joint sealer containers are not recyclable. Do not dispose of empty containers with plastic materials destined for recycling.
- .11 Fold up metal banding, flatten, and place in designated area for recycling.

1.4 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 deg.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.

1.5 ENVIRONMENTAL  
REQUIREMENTS

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

PART 2 - PRODUCTS

- 2.1 MATERIALS .1 Only products listed on the Canadian Food Inspection Agency, Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products are acceptable for this project. Refer to <http://active.inspection.gc.ca/scripts/fssa/reference/reference.ask?e>.
- 2.2 SEALANT MATERIALS .1 Use sealant materials with a maximum VOC emission level to SCAQMD Rule 1168.
- .2 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.
- .3 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.
- .4 Where sealants are qualified with primers use only these primers.
- 2.3 SEALANT MATERIAL DESIGNATIONS .1 Type A: Silicone, one-part to ASTM C920, Type S, Grade NS, Class 100/50, Use T, NT, M, G, A, O.
- .2 Type B: Siliconized acrylic latex, one-part, paintable, to ASTM C834.
- .3 Type C: Epoxy Security Sealant: interior
- .1 Pick-proof gunned flexible epoxy joint filler: two component 100% solids, gun-grade epoxy joint filler with flexible, pick-proof properties for sloped areas.
- .1 Shore A hardness: 90±5.
- .2 Shore D hardness: 50.
- .3 Elongation: 50%.
- .4 Tensile Strength: 6.2 MPa ±0.07 MPa (900 pounds per square inch ±10 pounds per square inch).
- .5 Slant shear strength: 6.0 MPa (865 pounds per square inch) to ASTM C882/C882M-05e1.
- .6 Mixing ratio: 1 to 1 by volume.
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- 2.3 SEALANT MATERIAL DESIGNATIONS (Cont'd)
- .3 Type C:(Cont'd)
    - .1 (Cont'd)
      - .7 Pot Life: 40 to 55 minutes at 24°C (75°F).
      - .8 Cure time foot traffic: 4 hours.
      - .9 Cure time vehicular traffic: 24 hours.
      - .10 Application temperature: minimum 13°C (55°F).
- 2.4 ACCESSORIES
- .1 Preformed Compressible and Non-Compressible back-up materials, compatible with sealant:
    - .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 Bond Breaker Tape.
      - .1 Polyethylene bond breaker tape which will not bond to sealant.
- 2.5 SEALANT SELECTION
- .1 Perimeters of exterior openings where frames meet brick masonry: Sealant Type A with primer where recommended by manufacturer.
  - .2 Sealant joints in sheet metal work: Sealant Type A.
  - .3 Interior perimeters of exterior frames against masonry: Sealant Type C.
  - .4 Perimeters of interior frames against masonry: Sealant Type C.
  - .5 Masonry control and expansion joints: Sealant Type C.
  - .6 Where not otherwise specified:
    - .1 Exterior work: Type A.
    - .2 Interior work: Type B.
- 2.6 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.



PART 1 - GENERAL

- 1.1 PRODUCT DATA, SHOP DRAWINGS, SAMPLES
- .1 Submit product data sheets for each item specified in accordance with Section s 01 33 00 and 01 78 00.
  - .2 Submit sample of each type of foam sealant/ expansion joint system before delivery to job site in accordance with Section s 01 33 00 and 01 78 00.
  - .3 Submit drawings in accordance with Section s 01 33 00 and 01 78 00:
    - .1 Indicating method of sealing expansion joint system to traffic bearing membrane system.
    - .2 Indicating method of handling upturns at columns and walls.
- 1.2 PRODUCT DELIVERY, STORAGE AND HANDLING
- .1 Deliver product to job site in manufacturer's original labelled containers and store in dry location at room temperature under cover until required. Do not store materials in direct sunlight.

PART 2 - PRODUCTS

- 2.1 MATERIALS
- .1 Roof to Roof and Roof to wall Expansion Joints:
    - .1 Expansion joint shall consist of a double reinforced PVC/Rubber alloy weathering membrane with neoprene foam insulated bellows, heat fused galvanized steel nailer strips and an asphalt compatible flashing membrane. Sized as recommended by manufacturer to suit application
    - .2 Expansion joint shall be supplied in minimum 15m lengths to minimize field splices and come complete with all necessary splicing material.
    - .3 Bellows:
      - .1 Twin, 40 mil layers of PVC/Rubber alloy reinforced with polyester scrim.
      - .2 Tensile Strength: (ASTM D412)12065 kPa / 1750 psi.
      - .3 Tear Strength: (FS-191-5136) 34 lg. / 75 lbs.
      - .4 Low Temperature Flexibility: excellent.
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- 2.1 MATERIALS (Cont'd)
- .1 (Cont'd)
    - .3 Bellows:(Cont'd)
      - .5 Dimensional Stability:(ASTM D1204 - Shrinkage) <5%.
    - .4 Insulation:
      - .1 Closed cell, flame retardant polyethylene foam.
      - .2 K-factor = 30 (ASTM C-518).
      - .3 R value: 3.84 / 25 mm.
    - .5 Nailing Strips:
      - .1 Two 38mm x 26 ga.(.4mm) galvanized steel nailing strips heat fused to twin bellows material.
    - .6 Splicing:
      - .1 Peel and stick Splice Strips provided by manufacturer of expansion joints.
  - .2 Vertical Expansion Joints:
    - .1 Provide watertight, energy-efficient exterior and interior joints in vertical-plane walls (above-grade).
    - .2 Performed sealant shall be silicone pre-coated, pre-formed, pre-compressed,self-expanding, sealant system.
    - .3 Expanding foam to be cellular foam impregnated with a water-based, non-drying, 100% acrylic dispersion.
    - .4 Seal shall combine factory-applied, low-modulus silicone and a backing of acrylic-impregnated expanding foam into a unified hybrid sealant system.
    - .5 Material shall be capable of movement of +25% / -25% (50% total) of nominal material size.
    - .6 Silicone external colour facing to be factory applied to the foam while it is partially pre-compressed to a width greater than maximum joint extension and cured before final compression.
    - .7 Directional changes and terminations into horizontal plane surfaces to be provided by factory-manufactured universal-90-degree single units containing minimum 300mm long leg and 150 mm long leg or custom leg on each side of the direction change.
    - .8 Physical properties and testing:
      - .1 Durometer Hardness (ASTM D2240): Silicone Coating - Shore A, 15 pts.
      - .2 Staining (ASTM C510): None
      - .3 Weatherometer (ASTM G26-77): Xenon Arch Weatherometer 2000 hrs - No visible deterioration.
-

- 2.1 MATERIALS  
(Cont'd)
- .2 Vertical Expansion Joints:(Cont'd)
- .8 (Cont'd)
- .4 Primary Surface Weathering (ASTM G26-77): Atlas Weatherometer 6000 hrs - minimal hardness change.
- .5 Temperature Range High Permanent (ASTM C711): 85°C
- .6 Temperature Range Low Permanent (ASTM C711): -40°C
- .7 Tensile Strength (ASTM D3575):145 kPa min.
- .8 Rate of Air Leakage through Curtain Wall (ASTM E283): Passed
- .9 Water penetration of curtain walls by uniform static air pressure diff. (ASTM E331): Up to 20.88 PSF -- pass
- .10 Structural performance of curtain walls by uniform air pressure diff. (Gust loads) )ASTM E330): +62.66 PSF, -56.39 PSF -- pass.

PART 3 - EXECUTION

- 3.1 INSTALLATION
- .1 Compliance: comply with manufacturer's written date, including product technical bulletins, product catalogue installation instruction, product carton installation instructions, and data sheets.
- .2 Ensure continuity of building envelope air barrier and vapour retarder systems.
- .3 Do not proceed with the installation of joint sealer under adverse weather conditions when joint to be sealed is damp, wet or frozen, or when temperatures are below or above the manufacturer's recommended limitations for installation. Consult the manufacturer for specific instructions before proceeding.
- .4 Install joint sealer/expansion joint material in strict accordance with the manufacturer's instructions and the advice of their official representative.
- .5 Remove all waste materials from site.
- .6 Clean seal of all foreign matter in accordance with manufacturer's recommendations.

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- 3.1 INSTALLATION (Cont'd)
- .7 Roof to Roof and Wall to Roof Expansion Joints:
- .1 Ensure roofing membrane or other weathering surface are applied over wood nailers as indicated.
- .2 Turn sealer/expansion joint material up at columns or abutting walls 100 mm minimum and heat weld.
- .8 Vertical Expansion Joints:
- .1 Preparation of the Work Area:
- .1 The contractor shall provide properly formed and prepared expansion joint openings constructed to the exact dimensions and elevations shown on manufacturer's standard system drawings or as shown on the contract drawings. Deviations from these dimensions will not be allowed without the written consent of the manufacturer.
- .2 The contractor shall clean the joint opening of all contaminants immediately prior to installation of expansion joint system. Repair spalled, irregular or unsound joint surfaces using accepted industry practices for repair of the substrates in question. Remove protruding roughness to ensure joint sides are smooth. Ensure that there is sufficient depth to receive the full depth of the size of the sealant being installed plus at least 6mm for the application of corner beads. Refer to Manufacturers Installation Guide for detailed step-by-step instructions.
- .3 No drilling, or screwing, or fasteners of any type are permitted to anchor the sealant system into the substrate.
- .9 Clean and Protect:
- .1 Protect the system and its components during construction. Subsequent damage to the expansion joint system will be repaired at the general contractor's expense. After work is complete, clean exposed surfaces with a suitable cleaner that will not harm or attack the finish.
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PART 1 - GENERAL

- 1.1 REFERENCES
- .1 American National Standards Institute (ANSI):
    - .1 ANSI/BHMA A156.16-2008, Auxiliary Hardware.
  - .2 American Society for Testing and Materials International (ASTM)
    - .1 ASTM A568-11a/A568M-11a, Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
    - .2 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
    - .3 ASTM E90-09, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
    - .4 ASTM E413-04, Classification for Rating Sound Insulation.
  - .3 Canadian General Standards Board (CGSB)
    - .1 CGSB 41-GP-19Ma-84, Rigid Vinyl Extrusions for Windows and Doors (Reaffirmation of September 1978).
    - .2 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
    - .3 CAN/CGSB-82.5-M88, Insulated Steel Doors.
  - .4 Canadian Steel Door Manufacturers Association (CSDMA) [www.csdma.org/english/publications.html](http://www.csdma.org/english/publications.html)
    - .1 Recommended Dimensional Standards For Commercial Steel Doors and Frames 2000.
    - .2 Recommended Selection and Usage Guide for Commercial Steel Door and Frame Products 2009.
    - .3 Recommended Specifications for Sound Retardant Steel Doors and Frames 2006.
    - .4 Fire Labelling Guide 2009.
  - .5 The Master Painters Institute (MPI)
    - .1 Architectural Painting Specification Manual - March 1998 (R2007).
  - .6 National Fire Protection Association (NFPA)
    - .1 NFPA 80-2010, Standard for Fire Doors and Other Opening Protectives.
    - .2 NFPA 252-2008, Standard Methods of Fire Tests of Door Assemblies.
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- 1.1 REFERENCES (Cont'd)
- .7 Underwriters Laboratories Canada (ULC)
    - .1 CAN/ULC-S104-10, Standard Method For Fire Tests of Door Assemblies.
    - .2 CAN/ULC-S105-09, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN/ULC-S104.
    - .3 CAN/ULC-S113-07, Standard Specification for Wood Core Doors Meeting the Performance Required by CAN/ULC-S104 for Twenty Minute Fire Rated Closure Assemblies.
    - .4 CAN/ULC-S702-09, Standard for Mineral Fibre Thermal Insulation for Buildings.
  - .8 Underwriters Laboratories Inc. (UL)
    - .1 UL10C Positive Pressure Fire Tests of Door Assemblies.
    - .2 UL10B 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<sup>0</sup>C to +35<sup>0</sup>C.
    - .2 Maximum deflection for exterior steel entrance screens under wind load of 1.2 kPa not to exceed 1/175th of span.
    - .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.
  - .2 Product Data:
    - .1 Provide complete manufacturer's product data for doors and frames.
    - .2 Include test and engineering data, and installation instructions.
  - .3 Shop Drawings:
    - .1 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, glazed openings, arrangement of hardware, and finishes.
-

- 1.3 SUBMITTALS (Cont'd) .3 Shop Drawings:(Cont'd)
- .2 Indicate each type frame material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings, reinforcing, and finishes.
- .4 Samples:
- .1 Submit one 300 x 300 mm corner sample of each type of frame.
  - .2 Show glazing stops and snap-on trim with clips.
- 1.4 QUALIFICATIONS .1 The manufacturer of steel doors and frames supplied under this section will be a member of the CSDMA - Canadian Steel Door Manufacturers Association.
- 1.5 REQUIREMENTS OF REGULATORY AGENCIES .1 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN/ULC-S104 ASTM E2074 NFPA 252 for ratings specified or indicated.
- .2 Provide fire labelled frame products for those openings requiring fire protection ratings, as scheduled. Test products in strict conformance with CAN/ULC-S104, or NFPA 252 and list by nationally recognized agency having factory inspection service and construct as detailed in Follow-Up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.

## PART 2 - PRODUCTS

- 2.1 MATERIALS .1 Metal: tension levelled sheet steel to ASTM A568/A568M, Class 1, with ZF075 zinc coating on both sides designation to ASTM A653/A653M, minimum 30% total recycled content.
- .2 Reinforcement: to CAN/CSA- G40.20/G40.21, Type 44W, coating designation to ASTM A653/A653M, ZF75.

- 2.2 DOOR CORE MATERIALS
- .1 Stiffened: face sheets welded, insulated core.
  - .2 Insulation: Polyurethane to CAN/ULC-S704, rigid, modified poly/isocyanurate, closed cell board, density 32 kg/m<sup>3</sup>.
- 2.3 ADHESIVES
- .1 Polyurethane core: heat resistant, epoxy resin based, low viscosity, contact cement.
- 2.4 PRIMER
- .1 Touch-up prime MPI #18, single component organic zinc-rich primer.
- 2.5 PAINT
- .1 Field paint steel doors and frames in accordance with Section 09 91 99. Protect weatherstrips from paint. Provide final finish free of scratches or other blemishes.
    - .1 Maximum VOC emission level to SCAQMD Rule 1113.
- 2.6 ACCESSORIES
- .1 Door silencers: single stud rubber/neoprene type.
  - .2 Top and bottom caps: rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19Ma or 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 Door bottom seal: Refer to Section 08 71 12 - Door Hardware..
  - .5 Metallic paste filler: to manufacturer's standard.
  - .6 Sealant: Refer to Section 07 92 00 - Joint Sealants.
  - .7 Glazing: Refer to Section 08 80 00 - Glazing.
  - .8 Make provisions for glazing as indicated and provide necessary glazing stops.
    - .1 Provide removable stainless steel glazing beads for dry glazing of snap-on type.
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- 2.6 ACCESSORIES .8 (Cont'd)  
(Cont'd) .2 Design exterior glazing stops to be  
tamperproof.
- 2.7 FRAMES .1 Fabricate frames in accordance with CSDMA  
FABRICATION GENERAL specifications.
- .2 Fabricate frames to profiles and maximum face  
sizes as indicated.
- .3 Frames: 1.6 mm, continuously welded, thermally  
broken type construction. Knock down or spot  
welded frames are not acceptable.
- .4 Blank, reinforce, drill and tap frames for  
mortised, templated hardware, and electronic  
hardware using templates provided by finish  
hardware supplier. Reinforce frames for surface  
mounted hardware.
- .5 Protect mortised cutouts with steel guard  
boxes.
- .6 Prepare frame for door silencers, 3 for single  
door.
- .7 Manufacturer's nameplates on frames and screens  
are not permitted.
- .8 Conceal fastenings except where exposed  
fastenings are indicated.
- .9 Provide factory-applied touch up primer at  
areas where zinc coating has been removed during  
fabrication.
- .10 Insulate exterior frame components with  
polyurethane insulation.
- 2.8 FRAME ANCHORAGE .1 Provide appropriate anchorage to floor and wall  
construction.
- .2 Locate each wall anchor immediately above or  
below each hinge reinforcement on hinge jamb and  
directly opposite on strike jamb.
- .3 Provide 2 anchors for rebate opening heights up  
to 1520 mm and 1 additional anchor for each  
additional 760 mm of height or fraction thereof.
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- 2.8 FRAME ANCHORAGE .4 Locate anchors for frames in existing openings  
(Cont'd) not more than 150 mm from top and bottom of each  
jambs and intermediate at 660 mm on centre  
maximum.
- 2.9 FRAMES: WELDED .1 Welding in accordance with CSA W59.  
TYPE .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 .1 Doors: swing type, flush, with provision for  
FABRICATION GENERAL glass and/or louvre openings as indicated.  
.2 Exterior doors: honeycomb hollow steel  
construction. Interior doors: honeycomb hollow  
steel construction.  
.3 Fabricate doors with longitudinal edges locked  
seamed, adhesive assisted. Seams: visible.  
.4 Blank, reinforce, drill doors and tap for  
mortised, templated hardware and electronic  
hardware.  
.5 Factory prepare holes 12.7 mm diameter and  
larger except mounting and through-bolt holes,  
on site, at time of hardware installation.  
.6 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.  
.7 Provide factory-applied touch-up primer at  
areas where zinc coating has been removed during  
fabrication.
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- 2.11 HOLLOW STEEL CONSTRUCTION
- .1 Form face sheets for doors from 1.6 mm sheet steel.
  - .2 Reinforce doors with vertical stiffeners, securely welded to face sheets at 150 mm on centre maximum.
  - .3 Fill voids between stiffeners with polyurethane core.

- 2.12 THERMALLY BROKEN FRAMES
- .1 Fabricate thermally broken frames separating exterior parts from interior parts with continuous interlocking thermal break.
  - .2 Thermal break: rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19Ma.
  - .3 Apply insulation.

PART 3 - EXECUTION

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

- 3.2 INSTALLATION GENERAL
- .1 Install 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.

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- 3.3 FRAME  
INSTALLATION  
(Cont'd)
- .5 Caulk perimeter of frames between frame and adjacent material on both exterior and interior sides. Refer to Section 07 92 00
  - .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 11.
  - .2 Provide even margins between doors and jambs and doors and thresholds as follows.
    - .1 Hinge side: 1.0 mm.
    - .2 Latchside and head: 1.5 mm.
    - .3 Finished floor and thresholds: 13 mm.
  - .3 Adjust operable parts for correct function.
- 3.5 FINISH REPAIRS
- .1 Touch up with primer finishes damaged during installation.
  - .2 Fill exposed frame anchors and surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish to receive paint finish specified in Section 09 91 99.
- 3.6 GLAZING
- .1 Install glazing for doors and frames in accordance with Section 08 80 00.

PART 1 - GENERAL

- 1.1 REFERENCES
- .1 National Fire Protection Agency (NFPA)
    - .1 NFPA 80-2010, Standard for Fire Doors and Other Opening Protectives.
  - .2 ASTM International
    - .1 ASTM A276-08a, Standard Specification
    - .2 ASTM A480/A480M-10, Standard Specification for General Requirements for Flat Rolled Stainless Steel and Heat-Resisting Steel Plate, Sheet and Strip.
    - .3 ASTM A653/A653M-10, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .3 Canadian General Standards Board (CGSB)
    - .1 CAN/CGSB-1.105-M91, Quick-Drying Primer.
  - .4 Environmental Choice Program (ECP)
    - .1 CCD-047-98(R2005), Architectural Surface Coatings.
    - .2 CCD-048-98(R2006), Surface Coatings - Recycled Water-borne.
  - .5 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
  - .6 Green Seal Environmental Standards (GS)
    - .1 GS-11-2008, 2nd Edition, Paints and Coatings.
    - .2 GS-36-00, Commercial Adhesives.
  - .7 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
    - .1 SCAQMD Rule 1113-A2007, Architectural Coatings.
    - .2 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.
  - .8 Underwriters Laboratories of Canada (ULC)
    - .1 CAN/ULC-S104-10, Standard Method for Fire Tests of Door Assemblies.
    - .2 CAN/ULC-S105-09, Standard Specification for Fire Door Frames.
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- 1.2 ADMINISTRATIVE REQUIREMENTS .1 Pre-Installation Meetings:
- .1 Convene pre-installation meeting 1 week prior to beginning work of this Section , with Contractor's Representative and Departmental Representative in accordance with Section 01 31 19 to:
    - .1 Verify project requirements.
    - .2 Review installation and substrate conditions.
    - .3 Co-ordination with other construction subtrades.
    - .4 Review manufacturer's written installation instructions and warranty requirements.
  - .2 Arrange for site visit with Departmental Representative prior to start of Work to examine existing site conditions adjacent to demolition Work.
- 1.3 ACTION AND INFORMATIONAL SUBMITTALS .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for door components and include product characteristics, performance criteria, physical size, finish and limitations
  - .3 Shop Drawings:
    - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
    - .2 Indicate each type of door, arrangement of hardware, required clearances, electrical characteristics including voltage, size of motors, auxiliary controls and wiring diagrams.
    - .3 Indicate assembly details and dimensions of fabrication, required clearances and electrical connections.
  - .4 Samples:
    - .1 Submit for review and acceptance of each unit.
    - .2 Samples will be returned for inclusion into work.
    - .3 Submit duplicate 300 mm long pieces of each type of slat.
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- 1.3 ACTION AND INFORMATIONAL SUBMITTALS .5 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- (Cont'd) .6 Manufacturers Reports:  
.1 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.
- 1.4 CLOSEOUT SUBMITTALS .1 Submit in accordance with Section 01 78 00.  
.2 Operation and Maintenance Data: submit operation and maintenance data for overhead coiling doors, and hardware for incorporation into manual.
- 1.5 QUALITY ASSURANCE .1 Regulatory Requirements:  
.1 Overhead coiling doors: labelled and listed by an organization accredited by Standards Council of Canada to CAN/ULC-S104 and CAN/ULC-S105 for ratings specified or indicated.  
.2 Fabricate and install overhead coiling doors to ANSI/NFPA 80 to suit fire protection rating required.  
.2 Certifications: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.  
.3 Qualifications:  
.1 Manufacturer Qualifications: ISO 9001:2008 registered and a minimum of five years experience in producing doors of the type specified.  
.2 Installer Qualifications: manufacturer's approval.
- 1.6 DELIVERY, STORAGE AND HANDLING .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.  
.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
-

- 1.6 DELIVERY, STORAGE AND HANDLING  
(Cont'd)
- .3 Storage and Handling Requirements:
- .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect overhead coiling doors from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

- 2.1 DESIGN CRITERIA .1 Design rolling door curtain and assembly to withstand wind load of 960 Pa within door opening area.

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- 2.2 MATERIALS .1 Rolling doors:
- .1 Galvanized steel sheet: commercial quality to ASTM A653/A653M.
  - .2 Rolling Fire Shutter:
    - .1 Stainless Steel no. 4 finish.

- 2.3 ROLLING DOORS .1 Door Curtain:
- .1 Interior Curtain:
    - .1 Slats: No. 5F, 24 gauge, Grade 40 steel, ASTM A 653 galvanized steel zinc coating.
  - .2 Exterior Curtain:
    - .1 Slat Material: No. 6F, (Listed Exterior/Interior), Galvanized Steel/  
Galvanized Steel: 24 /24 gauge, Grade 40, ASTM A 653 galvanized steel zinc coating.
    - .2 Front and back slat with polyurethane insulation providing a minimum R-value of 8.0.
  - .3 Bottom Bar: Two 50 x 50 x 3.2 mm structural steel angles.
  - .4 Fabricate interlocking sections with high strength nylon endlocks on alternate slats each secured with two 6.35 mm rivets. Provide windlocks as required to meet specified wind load.
  - .5 Slat Finish: Interior and exterior slats to be to ASTM A 653 galvanized base coating treated with dual process rinsing

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- 2.3 ROLLING DOORS (Cont'd)
- .1 Door Curtain:(Cont'd)
    - .5 Slat Finish:(Cont'd)

agents in preparation of a chemical bonding, light gray baked-on polyester base coat and baked-on polyester finish coat colour selected by Departmental Representative.
    - .6 Curtain Configuration: Standard curtain configuration.
    - .7 Bottom Bar Finish:
      - .1 Exterior Face: Match slats.
      - .2 Interior Face: Match slats.
  - .2 Guides:
    - .1 Fabricate with structural steel angles. Provide windlock bars of same material when windlocks are required to meet specified wind load. Top of inner and outer guide angles to be flared outwards to form bellmouth for smooth entry of curtain into guides. Provide removable guide stoppers to prevent over travel of curtain and bottom bar.
    - .2 Top 16 ½" (419.10 mm) of coil side guide angles to be removable for ease of curtain installation and as needed for future curtain service.
    - .3 Finish:
      - .1 Steel: Phosphate treatment followed by a baked-on polyester powder coat, colour as selected by Architect from Manufacturer's standard colour range, minimum 2.5 mils (0.065) cured film.thickness; ASTM D-3363 pencil hardness: H or better.
  - .3 Counterbalance Shaft Assembly
    - .1 Construct counterbalance assembly of heat treated torsion spring with 25% overload factor.
    - .2 Barrel: Steel pipe capable of supporting curtain load with maximum deflection of 1/360 of opening width.
    - .3 Spring Balance: Oil-tempered, heat-treated steel helical torsion spring assembly designed for proper balance of door to ensure that maximum effort to operate will not exceed 25 lbs (110 N). Provide wheel for applying and adjusting spring torque.
    - .4 Support counterbalance assembly on 5 mm minimum thickness steel plate brackets, forming end enclosures.
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2.3 ROLLING DOORS  
(Cont'd)

- .4 Brackets:
- .1 Fabricate from minimum 3/16 inch (5 mm) steel plate with permanently lubricated ball or roller bearings at rotating support points to support counterbalance shaft assembly and form end closures.
  - .2 Finish:
    - .1 Steel: Phosphate treatment followed by a baked-on polyester powder coat, colour as selected by Architect from Manufacturer's standard colour range, minimum 2.5 mils (0.065) cured film.thickness; ASTM D-3363 pencil hardness: H or better.
- .5 Hood:
- .1 24 gauge galvanized steel with reinforcing top and bottom edges. Provide minimum 6.35 steel intermediate support brackets as required to prevent excessive sag.
  - .2 Finish:
    - .1 Steel: Phosphate treatment followed by a baked-on polyester powder coat, colour as selected by Architect from Manufacturer's standard colour range, minimum 2.5 mils (0.065) cured film.thickness; ASTM D-3363 pencil hardness: H or better.
- .6 Weatherstripping:
- .1 Bottom Bar: weather edge with neoprene astragal extending full width of door bottom bar.
  - .2 Guides: Replaceable vinyl strip on guides sealing against fascia side of curtain.
  - .3 Lintel Seal: Nylon brush seal fitted at door header to impede air flow.
  - .4 Hood: Neoprene/rayon baffle to impede air floor above coil.
- .7 Locking: Masterkeyable cylinder operable from both sides of bottom bar.
- .8 Operation:
- .1 Manual Chain Hoist: Provide chain hoist operator with endless steel chain, chain pocket wheel and guard, geared reduction unit, hand chain tensioner and chain keeper secured to guide.
  - .2 On fire rated doors:
    - .1 Install fusible link activated automatic closing device to close door at



2.3 ROLLING DOORS .8  
(Cont'd)

Operation:(Cont'd)  
.2 On fire rated doors:(Cont'd)

controlled slow even speed in case of fire.

.2 Arrange automatic closing device to permit manual lifting of curtain for emergency exit after automatic closing with curtain returning to closed position when released.

.3 Connect automatic closing device to heat and smoke detection equipment.

2.4 ROLLING SHUTTER .1

Curtain:

.1 Slats: No. 10 (1-1/4" high by 3/8" deep), interlocked flat-faced slats constructed of 22 gauge AISI type 304 series stainless steel with tubular stainless steel bottom bar measuring 2" high by 1-1/4" deep. 2.

.2 Fabricate continuous interlocking slat sections with high strength galvanized steel endlocks riveted to slat ends per UL requirements.

.3 Slat Finish: Stainless Steel no. 4 Finish.

.4 Bottom Bar Finish: Stainless Steel no. 4 Finish.

.2 Head and Jamb Frame:

.1 Stainless Steel: 16 gauge stainless steel formed shapes.

.2 Finish: Stainless steel: No. 4 finish.

.3 Countertop: 14 gauge stainless steel formed shape; No. 4 finish.

.4 Counterbalance Shaft Assembly:

.1 Barrel: Steel pipe capable of supporting curtain load with maximum deflection of 0.03 inches per foot (2.5 mm per meter) of width.

.2 Spring Balance: Oil-tempered, heat-treated steel helical torsion spring assembly designed for proper balance of door. Provide wheel for applying and adjusting spring torque.

.5 Brackets: Fabricate from reinforced 11 gauge steel plate with bearings at rotating support

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- 2.4 ROLLING SHUTTER .5 Brackets:(Cont'd)  
(Cont'd)
- points to support counterbalance shaft  
assembly and form end closures for hood.
- .1 Finish: Stainless Steel No. 4 finish.
- .6 Hood and operator and governing mechanism  
covers: 24 gauge stainless steel with  
reinforced top and bottom edges.
- .1 Finish: Stainless Steel No. 4 finish.
- .7 Smoke Seals: 1. Bottom Bar: Combination smoke  
seal/sensing edge.
- .1 Guides and Head: Replaceable, UL Listed,  
nylon pile smoke seals sealing against  
fascia side of curtain.
- .8 Locking: Masterkeyable cylinder operable from  
both sides of bottom bar.
- .9 Operation:
- .1 Tube Motor Operated: Supply Electric  
Tube Motor Operator - rated for a maximum  
of 10 cycles per day, cULus recognized,  
rated (50nm) or (100nm) as recommended by  
door manufacturer for size and type of  
door, 115 Volts, 1 Phase, 60 Hertz.  
Provide complete with electric tube  
motor, maintenance free electric brake,  
emergency manual crank hoist and control  
station(s). Motor shall be protected  
against overload with an auto-reset  
thermal sensing device. Operator shall be  
equipped with an emergency manual crank  
hoist assembly that safely cuts operator  
power when engaged. A disconnect chain  
shall not be required to engage or  
release the manual crank hoist. Operator  
shall be capable of 10-14 RPM. Fully  
adjustable, mechanical internal worm  
limit switch mechanism shall synchronize  
the operator with the door.
- .2 Automatic closure shall be activated by  
a local smoke/fire detector.
- .3 Doors shall maintain an average closing  
speed of not more than 12" per second  
during automatic closing. When automatic  
closure is activated, electric sensing  
edge and push button are inoperable.
- .4 Doors shall be fail-safe and close upon  
power failure.
- .5 Resetting of spring tension or  
mechanical dropouts shall not be  
required. Upon restoration of power  
and/or clearing of the alarm signal,
-

2.4 ROLLING SHUTTER .9  
(Cont'd)

Operation:(Cont'd)

- .5 (Cont'd)  
doors shall immediately reset by opening with the push button.
- .6 The electrical contractor shall mount the control station(s) and supply the appropriate disconnect switch, all conduit and wiring per the overhead door wiring instructions.
- .7 Control Station: Flush mounted, "Open/Close" key switch with "Stop" push button; NEMA 1B.
- .8 Key Test Station: Flush mounted, NEMA 1.
- .9 Provide the following device to enable momentary contact close operation.
  - .1 Provide a 2-wire electric sensing/weather edge seal extending full width of door bottom bar. Contact before door fully closes shall cause door to immediately stop downward travel and reverse direction to the fully opened position. Provide a retracting safety cord and reel connection to control circuit.
- .10 Wall mounted electro-magnetic clutch control panel: Accepts 24 VDC from fire alarm control panel or 115 or 24 VAC input power and N/C contact from alarm system or local detector(s). Activation by alarm or power failure initiates automatic counter fire door closing.

2.5 FABRICATION

- .1 Fabricate rolling metal fire doors to ANSI/NFPA 80 with 3/4 hour and 1 hour fire rating for and bearing label, where indicated.
- .2 Attach to hood sheet metal flame and smoke baffle to drop in place automatically when activated by temperature rise and melting of fusible link on fire rated doors.

The electrical contractor shall mount the control station(s) and supply the appropriate disconnect switch, all conduit and wiring per the overhead door wiring instructions.

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PART 3 - EXECUTION

- 3.1 EXAMINATION .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for overhead coiling doors installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.
- 3.2 INSTALLATION .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 Install doors in accordance with manufacturer's printed instructions.
  - .3 Install masterkeyed cylinder specified in Section 08 71 11.
  - .4 Adjust door operating components to ensure smooth opening and closing of doors.
- 3.3 FIELD QUALITY CONTROL .1 Test labelled coiling doors for proper operation by activating fusible link. Test coiling door in presence of Departmental Representative.
- .2 Have manufacturer of products supplied under this Section review Work involved in handling, installation, protection and cleaning of its products, and submit written reports in acceptable format to verify compliance of Work with Contract.
-

- 3.3 FIELD QUALITY CONTROL  
(Cont'd)
- .3 Manufacturer's Field Services:
    - .1 Obtain written reports from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product within 3 days.
    - .4 Submit manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
    - .5 Ensure manufacturer's representative is present before and during critical periods of installation construction of field joints and testing.
    - .6 Schedule site visits to review Work at stages listed:
      - .1 After delivery and storage of products, and when preparatory Work on which Work of this Section depends is complete, but before installation begins.
      - .2 Twice during progress of Work at 25% and 60% complete.
      - .3 Upon completion of Work, after cleaning is carried out.
- 3.4 CLEANING
- .1 Perform cleaning of aluminum components in accordance with: AAMA 609.
  - .2 Progress Cleaning: clean in accordance with Section 01 74 11.
    - .1 Leave Work area clean at end of each day.
  - .3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
    - .1 Clean aluminum and stainless steel with damp rag and approved non-abrasive cleaner in accordance with manufacturer's instructions.
    - .2 Remove traces of primer, caulking; clean doors and frames.
    - .3 Clean glass and glazing materials with approved non-abrasive cleaner.
-

- 3.4 CLEANING  
(Cont'd)
- .4 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
- 
- 3.5 PROTECTION
- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by overhead coiling door and grille installation.

PART 1 - GENERAL

- 1.1 SHOP DRAWINGS
- .1 Submit shop drawings in accordance with Section 01 33 00 and 01 78 00.
  - .2 Indicate manufacturer's name, model number, size, thickness, material and finish, recycled content, component location and details of track, door construction and operating mechanism.

PART 2 - PRODUCTS

- 2.1 MATERIALS
- .1 Panels: flush, 50 mm thick, 1.6 mm galvanized steel face, flush back-up sheet, insulated core with fibreglass or polyurethane to achieve RSI 1.5, prime paint finish.
  - .2 Light: 6 mm thick clear plastic safety glazing to CAN/CGSB-12.12-M90, rubber mould frame, double glazed.
  - .3 Lock: built in deadlock.
  - .4 Latch: one point across door bar latch.
  - .5 Pull handle: provide pull handle on exterior of door.
  - .6 Weatherstripping: extruded neoprene at bottom and metal closure at jamb.
  - .7 Track: 75 x 2.5 mm galvanized steel.
  - .8 Brackets: 3.2 mm galvanized steel angle, adjustable, continuous.
  - .9 Hangers: perforated galvanized steel angle, 25 x 25 x 2.3 mm.
  - .10 Rollers: 75 mm diameter, ball bearing, solid tread, inner and outer ball races of hardened steel.
  - .11 Roller brackets: minimum 2.5 mm galvanized steel.
  - .12 Hinges: heavy duty, secure with rivets or self tapping screws.
-

- 2.1 MATERIALS  
(Cont'd)
- .13 Shaft: 25 mm cold rolled steel, slotted and keyed.
  - .14 Drums: to manufacturer's recommendations.
  - .15 Counterbalance: torsion springs, grooved.
  - .16 Operation: nylon pull rope.
  - .17 Track guard: 5 mm thick x 1500 mm high, formed steel, prime painted.

PART 3 - EXECUTION

- 3.1 INSTALLATION
- .1 Install door and hardware in accordance with manufacturer's instructions and templates.
  - .2 Adjust and lubricate hardware.



PART 1 - GENERAL

- 1.1 PRODUCT DATA SHEETS .1 Submit one copy of product data sheets in accordance with Sections 01 33 00 and 01 78 00.
- .2 Product data sheets shall consist of catalogue cuts, manufacturer's name and number, finish and reference identification to specified standard.
- 1.2 SCHEMATIC DIAGRAMS .1 Submit schematic diagrams of electrical components for inclusion in maintenance manual specified in Sections 01 33 00 and 01 78 00.
- 1.3 REFERENCES .1 Standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by CSDMA - Canadian Steel Door Manufacturers' Association and CAN/CSA-B651-04(R2010), Accessible Design for the Built Environment.
- .2 Use abbreviations and symbols recommended in "Abbreviations and Symbols as used in Architectural Door and Hardware Schedules and Specifications", 1983, published by the Door and Hardware Institute.
- .3 Use hardware schedule format recommended in "Sequence and Format for the Hardware Schedule", June, 1984, published by the Door and Hardware Institute.
- .4 Standards: All finish hardware shall conform to the following ANSI A156 Standards:
- .1 ANSI A156.1-2006 Hinges-Hardware Building
  - .2 ANSI A156.4-2008 Door Closers-Overhead surface Mounts
  - .3 ANSI A156.6-201 Door Hardware - Builders Miscellaneous
  - .4 ANSI A156.3-2008 Grade 1 - Exit Devices
  - .5 ANSI A156.8-2010 Heavy Duty Concealed and surface overhead stops + holders
  - .6 ANSI A156.22-2005 Weatherstrip - Sizes and Types
  - .7 ANSI A156.21-2009 Thresholds - Sizes to match products specified.
  - .8 ANSI A156.13-2005 Lock and Latch Sets - Mortise Heavy Duty, Lever trim series 1000, Grade 1.
-

1.4 DEFINITIONS

- .1 Master Key (MK):
  - .1 A key which operates all the master keyed locks or cylinders in a group, each lock or cylinder usually operated by its own change key.
  - .2 To combine a group of locks or cylinders such that each is operated by its own key as well as by a master key for the entire group.
- .2 Master Key System:
  - .1 Any keying arrangement which has two or more levels of keying.
  - .2 A keying arrangement which has exactly two levels of keying.
- .3 Grand Master Key (GMK): The key which operates two or more separate groups of locks, each operated by a different master key.
- .4 Grand Master Key System: A master key system which has exactly three levels of keying.
- .5 Great Grand Master Key (GGMK): The key which operates two or more separate groups of locks, which are each operated by a different grand master key.
- .6 Great Grand Master Key System: A master key system which has exactly four levels of keying.
- .7 Top Master Key (TMK): The highest level master key in a master key system.

1.5 REGULATORY REQUIREMENTS

- .1 Use ULC listed and labelled hardware for doors in fire rated partitions and fire exits.
- .2 Use UL 437 listed cylinders in locking devices.

1.6 HARDWARE LIST

- .1 Submit hardware schedule in accordance with Sections 01 33 00 and 01 78 00.
  - .2 Submit literature cuts, indicating hardware proposed, including make, model, base material, function, ANSI Function where ANSI used in this specification, Grade, Type, Series, BHMA finish, trim, ULC listing, UL listing, manufacturer and other pertinent information. Indicate which model or accessory is being provided where more than one model or accessory appears on a page.
-

PART 2 - PRODUCTS

2.1 KEYING,  
ACCESSORIES AND  
FINISH

- .1 All final Best / Stanley cores to be factory / keyed and shipped direct to site representative as designated by the departmental representative. Provide 3 keys per lock.
- .2 Provide all necessary accessories with hardware, cylinders and locks.
- .3 626 finish (satin chrome plated on brass or bronze) unless noted otherwise.
- .4 Finish fasteners to match the exposed surface on which they appear.
- .5 Provide temporary brass construction cores for every lock.
- .6 Provide 6 construction keys for every lock.
- .7 Provide lever handles of same style for bored and mortise locksets.
- .8 Door prep: to ANSI/BHMA-A156.115-2006 for steel doors and frames and ANSI/BHMA-A156.115-W-2006 for wood doors and frames.

2.2 MATERIALS

- .1 Hinge: to ANSI/BHMA-A156.1-2006, Grade indicated, 626 satin chrome, use anti-friction (ball) bearing hinges with closers, one hinge for each 750 mm of door height, 101 mm hinges for 38 mm doors, 115 mm hinges on 45 mm doors, 125 mm hinges on 50 mm doors, button tips, non-rising removable pins unless indicated NRP on hardware schedule.
  - .1 Interior:
    - .1 Grade 1: A8111 - heavy weight, steel, 4 ball bearing.
    - .2 Grade 2: A8112 - standard weight, steel, 2 ball bearing.
    - .3 Grade 3: A8133 - standard weight, steel, plain bearing.
  - .2 Exterior:
    - .1 Grade 1: A2111 - heavy weight, bronze, 4 ball bearing.
    - .2 Grade 2: A2112 - standard weight, bronze, 2 ball bearing.
    - .3 Grade 3: A2133 - standard weight, bronze, plain bearing.

2.2 MATERIALS  
(Cont'd)

- .2 Double acting spring hinge: to ANSI/BHMA-A156.17-2010, Type K81151, mortised in door, surface applied to jamb, double acting, adjustable tension, torsion springs.
- .3 Door closer: to ANSI/BHMA-A156.4-2008, Grade 1, C02011 hinge side mounting, C02021 parallel arm mounting, C02041 top jamb mounting, and adaptor plates, surface closer, modern type with cover, sprayed enamel finish, metallic 689 aluminum size to suit door width and mass. Closers will have been tested to 10,000,000 cycles without failure where required by hardware schedule. Disabled access doors: to operate at a minimum pressure not exceeding 38 N for exterior doors, 22 N for interior doors and close in not less than 5 seconds from an open position of 90°. All closers to be cast iron body construction reversible and fully adjustable from sizes 1-6 as necessary.
- .4 Fire/Life Safety closer/holder: to ANSI/BHMA-A156.15-2008, when current is interrupted, hold-open releases and door closes, hold open, rack and pinion door closer when hold-open not engaged or current is interrupted, with both isolated normally open and normally closed dry contacts for interface with alarm system, adjustable hydraulic backcheck, 120 V AC input option.
- .5 Overhead holder / stop: to ANSI/BHMA-A156.8-2010, slide type, 90° opening, stop and shock absorber effective at all times, hold open and release by push and pull, except when exposed control is set in inactive position. Function C01511 Type 1 concealed, C02511 Type 2 surface.
- .6 Lock and latch set (mortised): to ANSI/BHMA-A156.13-2005, Operational Grade 1, Security Grade 1, lock trim lever and rose with cylinder on exterior and interior, lock trim lever and anti-friction latch bolt, function indicated, UL 437 listed cylinder. Only specified Best / Stanley locks permitted on this project. Heavy duty mortise sets shall be used, dead bolts to have 25mm throw.
- .7 Dead lock mortised: to ANSI/BHMA-A156.5- 2010, dead bolt by key outside and inside, UL 437 listed cylinder with guard. Provide same manufacturer as mortise locks. Heavy duty mortise sets shall be used, dead bolts to have 25mm throw.

2.2 MATERIALS  
(Cont'd)

- .8 Exit device: to ANSI/BHMA-A156.3-2008, Grade 1, flat push pad type design with removable cover plates concealing mechanism and fasteners. Mechanism case with minimum average wall thickness of 3.5 mm. All internal parts zinc dichromated to resist corrosion. Internal springs - compression type. Complete with UL 437 listed cylinder.
- .9 Exit Device Trim: to ANSI/BHMA-A156.6-2010, solid brass lever trim (satin chrome plated) with lever design to match lockset trim and functions as detailed in hardware schedule.
- .10 Electro-magnetic lock: ULC listed, single door application with door position switch, 1200 pound holding power, complying with NBC 2010, clause 3.4.6.16. Compatible with and interconnected with: controlled exit device, proximity card reader and fire alarm system.
- .11 Normal strikes: box type, lip projection not beyond jamb ASA dimensions.
- .12 Electric strikes: to ANSI/BHMA-A156.31-2001, Grade 1, fail secure, 4.8 mm horizontal adjustment capability, dual monitor switches, E59321 - Mortised: for use with locks not having dead bolts, use also with mortise exit devices. E59311 - Semi Rim Mounted: for use with rim exit devices on single doors and surface vertical rod exit devices. E59331 - Mortised: for use with locks on single doors having latch bolts and 25 mm throw dead bolts.
- .13 Power transfer: non-load bearing, concealed when door closed, UL listed for Burglary Protection and Class 1 low voltage installation, rated for and compatible with power supply and electric latch, ten 24 gauge wires, 24VDC, 1 ampere.
- .14 Door pull: to ANSI/BHMA-A156.6-2010, type J401 straight J402 offset J405 straight with 1.27 mm escutcheon plate J407 straight with 3.2 mm escutcheon plate, 225 mm centres, surface through bolt mounted.
- .15 Push plate: to ANSI/BHMA-A156.6-2010, type J301, rectangular, square 90° bevelled corners, bevelled edges. Torx screw fasteners to suit door material.

2.2 MATERIALS  
(Cont'd)

- .16 Kick plate: to ANSI/BHMA-A156.6-2010, type stainless steel, 3 bevelled edges. Torx screw fasteners to suit door material.
- .17 Mop plate (half door): to ANSI/BHMA-A156.6-2010, type J103 stainless steel, 3 bevelled edges. Torx screw fasteners to suit door material.
- .18 Wall type bumper: to ANSI/BHMA-A156.16-2008, type L42101, finish 626, convex pad, concealed fasteners.
- .19 Wall type door stop: to ANSI/BHMA-A156.16-2008, type L02011, finish 626, overall projection 89 mm, attached by surface screws.
- .20 Floor door stop: to ANSI/BHMA-A156.16-2008, dome type, cushion secured by concealed fasteners, anti-rotation stud, type L22141 finish 626 for doors without threshold and type L22161, finish 626 for doors with threshold.
- .21 Lever extension flush bolt: to ANSI/BHMA-A156.16-2008, type L14251 fire rated, cast brass, 300 mm long rod, 19 mm backset, mortised keeper, 626.
- .22 Threshold: to ANSI/BHMA-A156.21-2009, type J32190, 150 mm wide, aluminum serrated exposed surface, rigid PVC thermal break for exterior thresholds, square butt edge, Torx screw fasteners to suit.
- .23 Smoke seal gasketing to ANSI A156.22-2005: extruded aluminum, mill finish, surface screw applied to pull side of door, at head, jamb and meeting stile, solid neoprene tube, tested to ASTM E283-04. Torx Fasteners to suit.
- .24 Smoke/sound seal gasketing: to ANSI/BHMA-A156.22-2005, Function ROY154, solid neoprene or silicone tube, self adhesive, tested to ASTM E283-04, cUL 1-1/2 hours.
- .25 Sweep: to ANSI A156.22-2005, densely compressed nylon filaments encased in clear anodized aluminum retainer, for surface mounting on door face, Torx fasteners to suit.
- .26 Weatherstrip: non-rigid, extruded vinyl chloride polymer or copolymer bulb or strip in aluminum strip at head and jamb.

2.2 MATERIALS  
(Cont'd)

- .27 Padlock: high security padlock, inter-changeable core, keyed under master keying system and/or group.
- .28 Fire door grille: ULC listed and labelled, meeting requirements of Federal Fire Commissioner (FFC), CAN/ULC-S112-10 "Standard Method of Fire Test of Fire Damper Assemblies", rating as required by code for membrane being pierced, galvanized steel multi-blade type, 90° inverted V louvres, sight proof, frame with double flange 32 x 32 x 1.6 mm (16 guage) steel angle on full perimeter of frame on both sides of barrier being pierced, install in accordance with NFPA 90A-2009 and manufacturer's installation instructions, size: 459 x 306 mm. Complete with thru bolts and one way vandal proof heads.
- .29 Door contact: to Section 28 13 27.
- .30 Card reader: to Section 28 13 27.

PART 3 - EXECUTION

3.1 HARDWARE  
SCHEDULE

- .1 Refer to attached hardware schedule. Install all builders and detention hardware detailed in the hardware schedule to manufacturers recommendations, standards and in accordance with the standards of NFPA80, CSDMA, DHI and applicable building codes.
- .2 Use only manufactuers provided fasteners and as detailed.
- .3 Adjust all hardware to ensure proper operation of doors after all mechanical systems and equipment has been finalized.





Hdwr Group	Qty	Opening Number	Location 1	To/ From	Location 2	Door Type	Nominal Width	NominalDoor Height	Door Thick.	Swing	Door Mat'l	Frame Mat'l	Label
001	1	B02.1	CORRIDOR B07	FROM	ELECT RM B02	A/F1	915,915	2134	45	LHRA/RHR	HM	PS	
002	1	B06.1	CORRIDOR B03	FROM	MECH VEST B06	A/F1	915,915	2134	45	LHRA/RHR	HM	PS	
003	1	ST1.2	STAIR ST01	FROM	BASEMENT CORR B07	C/F1	915	2134	45	RHR	HM,	PS	45 MIN
004	1	ST3.1	BREAKDOWN 117	FROM	STAIR ST03	C/F1	915	2134	45	RHR	HM	PS	45 MIN
005	1	108.1	VESTIBULE 109	FROM	CHEMICAL VEST 108A	C/F1	915	2134	45	LHR	HM	EX PS	
006	1	108.2	CHEM STORAGE 108	TO	VESTIBULE 108A	C/F1	915	2134	45	LH	HM	PS	45 MIN
007	1	113.1	CORRIDOR 145	TO	ELECTRICAL 113	C/F1	915	2134	45	LH	HM	PS	
008	1	114.1	STORAGE 114	TO/FROM	STORAGE 116	E/-	1500	2134		OVERHEA	MTL	ICT	
009	1	114.2	CORRIDOR 145	FROM	DRY STORAGE 114	C/F1	915	2134	45	LHR	HM	PS	
010	1	115.1	INGREDIENT STORE 116	TO	OFFICE 115	B/F1	915	2134	45	LH	HM	PS	
010	1	121.1	DINING AREA 123	TO	OFFICE 121	B/F1	915	2134	45	RH	HM	PS	
010	1	126.1	KITCHEN AREA 144	TO	OFFICE 126	B/F1	915	2134	45	LH	HM	PS	
010	1	135.1	SGMP AREA 138	TO	OFFICE 135	B/F1	915	2134	45	LH	HM	PS	
011	1	116.1	KITCHEN AREA 144	TO	INGREDIENT STORE 116	C/F1	915,915	2134	45	LH/RHA	HM	PS	
011	1	116.2	BREAKDOWN 117	TO	INGREDIENT STORE 116	C/F1	915,915	2134	45	LH/RHA	HM	PS	
012	1	117.1	BREAKDOWN 117	TO	KITCHEN AREA 144	C/F1	762,762	2134	45	LHA/RH	HM	PS	
013	1	117.3	EXTERIOR	FROM	BREAKDOWN 117	-/-	2134	2134		OVERHEA	MTL	CI	
014	1	120.1	WARE WASHING 120	TO	CHILLED FOOD 118	C/F1	915,915	2134	45	LHA/RHA	HM	PS	
015	1	122.1	KITCHEN AREA 144	FROM	CHIEF FOOD SERVICES 122	B/F1	915	2134	45	RHR	HM	PS	
016	1	123.1	DINING AREA 123	TO	KITCHEN AREA 144	C/F1	915,915	2134	45	LH/RHA	HM	PS	45 MIN
017	1	123.2	DINING AREA 123	FROM	WARE WASHING 120	C/F1	915,915	2134	45	LHRA/RHR	HM	PS	45 MIN
018	1	124.1	DINING AREA 123	TO	KITCHEN AREA 144	C/F1	915	2134	45	RH	HM	PS	45 MIN
019	1	127.1	KITCHEN AREA 144	FROM	JANITOR 127	C/F1	864	2134	45	LHR	HM	PS	0 MIN
019	1	131.1	KITCHEN AREA 144	FROM	JANITOR 131	C/F1	864	2134	45	LHR	HM	PS	0 MIN
019	1	136.1	BREAKDOWN 117	FROM	JANITOR 136	C/F1	864	2134	45	RHR	HM	PS	0 MIN
019	1	141.1	KITCHEN AREA 144	FROM	JANITOR 141	C/F1	864	2134	45	RHR	HM	PS	0 MIN
019	1	142.1	DINING AREA 123	FROM	JANITOR 142	C/F1	864	2134	45	LHR	HM	PS	0 MIN
019	1	143.1	WARE WASHING 120	FROM	JANITOR 143	C/F1	864	2134	45	LHR	HM	PS	0 MIN
020	1	128.1	INMATE CHANGE RM 128	TO	KITCHEN AREA 144	C/F1	915	2134	45	LH	HM	PS	
021	1	129.1	CORRIDOR 132	TO	W/R VESTIBULE 129A	A/F1	915	2134	45	RH	HM	PS	
022	1	130.1	CORRIDOR 132	TO	W/R VESTIBULE 130A	A/F1	915	2134	45	RH	HM	PS	
023	1	129.2	W/R VESTIBULE 129A	TO	WOMEN'S W/R 129	A/F1	915	2134	45	RH	HM	PS	
023	1	130.2	W/R VESTIBULE 130A	TO	MEN'S W/R 130	A/F1	915	2134	45	LH	HM	PS	
024	1	133.1	CORRIDOR 133	TO	KITCHEN AREA 144	C/F1	915	2134	45	RH	HM	PS	
024	1	139.2	CORRIDOR 139	TO	KITCHEN AREA 144	C/F1	915	2134	45	RH	HM	PS	
025	1	134.2	CORRIDOR 133	FROM	GARBAGE 134	C/F1	915,915	2135	45	LHR/RHRA	HM	PS	45 MIN
026	1	137.1	CORRIDOR 139	TO	CORRIDOR 137	D/F1	1067	2134	45	LH	HM	PS	
027	1	137.2	CORRIDOR 137	FROM	SGMPAREA 138	C/F1	915,915	2134	45	LHRA/RHR	HM	PS	
028	1	138.1	CORRIDOR 139	TO	SGMP AREA 138	C/F1	915,915	2134	45	LH/RHA	HM	PS	
029	1	139.1	EXTERIOR	FROM	CORRIDOR 139	C/F1	1067	2134	45	LHR	IHM	PS	

**Heading #1 (001)**

1 Pair of doors B02.1, CORRIDOR B07 FROM ELECT RM B02 LHR/RHR  
 915, 915 x 2134 x 45 - HM DR x PS FR  
 "BASEMENT LEVEL"

6	Standard Hinge	NRP-TORX-FBB179 114 x 101 US26D	C26D
1	Lockset	45H7D 3 J 630 LHR SH	630
2	Flush Bolt	FB458 US26D x 305mm	C26D
1	Dust Proof Strike	DP2 C26D	C26D
1	Surface Closer	4040XP EDA AL DEL - LHR	AL
2	Kick Plate	GSH 80A C32D (203 x 889) TORX	C32D
2	Wall Door Stop	GSH 250B C32D	C32D
2	Door Silencer	SR64 GRY	GRY
1	Astragal	W-8S x 2134mm PS TORX	ps

NOTES:  
 MOUNT CLOSER ON ACTIVE DOOR ONLY.  
 MOUNT ASTRAGAL ON PULL SIDE OF ACTIVE DOOR .

**Heading #2 (002)**

1 Pair of doors B06.1, CORRIDOR B03 FROM MECH VEST B06 LHR/RHR  
 915, 915 x 2134 x 45 - HM DR x PS FR

6	Standard Hinge	NRP-TORX-FBB179 114 x 101 US26D	C26D
1	Lockset	45H7D 3 J 630 LHR SH	630
2	Flush Bolt	FB458 US26D x 305mm	C26D
1	Dust Proof Strike	DP2 C26D	C26D
1	Surface Closer	4040XP S CUSH AL	AL
1	Overhead Door Stop	904S SOC US32D (Surface - Set for 90 Deg)	C32D
2	Kick Plate	GSH 80A C32D (203 x 889) TORX	C32D
1	Astragal	W-8S x 2134mm PS TORX	ps
2	Door Silencer	SR64 GRY	GRY

NOTES:  
 MOUNT CLOSER ON ACTIVE DOOR ONLY.  
 MOUNT ASTRAGAL ON PULL SIDE OF ACTIVE DOOR.

**Heading #3 (003)**

1 Single door ST1.2, STAIR ST01 FROM BASEMENT CORR B07 RHR  
 915 x 2134 x 45 - HM, DR x PS FR - 45 MIN

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3	Standard Hinge	NRP-TORX-FBB179 114 x 101 US26D	C26D
1	Lockset	45H7D 3 J 630 RHR SH	630
1	Surface Closer	4040XP REG AL DEL	AL
1	Kick Plate	GSH 80A C32D (203 x 876) TORX	C32D
1	Wall Door Stop	GSH 250B C32D	C32D
3	Door Silencer	SR64 GRY	GRY

**Heading #4 (004)**

1 Single door ST3.1, BREAKDOWN 117 FROM STAIR ST03 RHR  
 915 x 2134 x 45 - HM DR x PS FR - 45 MIN

"GROUND FLOOR"

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3	Standard Hinge	NRP-TORX-FBB179 114 x 101 US26D	C26D
1	Lockset	45H7R 3 J 630 RHR SH	630
1	Surface Closer	4040XP EDA AL DEL - RHR	AL
1	Kick Plate	GSH 80A C32D (203 x 876) TORX	C32D
1	Mop Plate	GSH 80A C32D (101 x 889) TORX	C32D
1	Wall Door Stop	GSH 250B C32D	C32D
17	Ft. of Weatherstripping	W-22-BL	BL

**Heading #5 (005)**

1 Single door 108.1, VESTIBULE 109 FROM CHEMICAL VEST 108A LHR  
 915 x 2134 x 45 - HM DR x PS FR

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3	Standard Hinge	NRP-TORX-FBB179 114 x 101 US26D	C26D
1	Lockset	45H7D 3 J 630 LHR SH	630
1	Surface Closer	4040XP S CUSH AL	AL
1	Kick Plate	GSH 80A C32D (203 x 876) TORX	C32D
17	Ft. of Weatherstripping	W-22-BL	BL
1	Auto Door Bottom	CT-52S-CA x 915mm	CA

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**Heading #6 (006)**

1 Single door 108.2, CHEM STORAGE 108 TO VESTIBULE 108A LH  
 915 x 2134 x 45 - HM DR x PS FR - 45 MIN

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3	Standard Hinge	TORX-FBB179 114 x 101 US26D	C26D
1	Latchset	45H0N (L/C) 3 J 630 LH SH	630
1	Surface Closer	4040XP S CUSH AL	AL
1	Kick Plate	GSH 80A C32D (203 x 876) TORX	C32D
3	Door Silencer	SR64 GRY	GRY

**Heading #7 (007)**

1 Single door 113.1, CORRIDOR 145 TO ELECTRICAL 113 LH  
 915 x 2134 x 45 - HM DR x PS FR

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3	Standard Hinge	TORX-FBB179 114 x 101 US26D	C26D
1	Lockset	45H7D 3 J 630 LH SH	630
1	Surface Closer	4040XP REG AL DEL	AL
1	Kick Plate	GSH 80A C32D (203 x 876) TORX	C32D
1	Floor Door Stop	GSH 209 C26D	C26D
3	Door Silencer	SR64 GRY	GRY

**Heading #8 (008)**

1 Single door 114.1, STORAGE 114 TO/FROM STORAGE 116 OVERHEAD  
 1500 x 2134 x \_\_\_ - MTL DR x ICT FR

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1	Padlock	11B-782-L-M5 S2 630	630
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BALANCE OF HARDWARE BY GATE SUPPLIER

**Heading #9 (009)**

1 Single door 114.2, CORRIDOR 145 FROM DRY STORAGE 114 LHR  
 915 x 2134 x 45 - HM DR x PS FR

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1	Continuous Hinge	CH-953 X 2108	
1	Lockset	45H7R 3 J 630 LHR SH	630
1	Surface Closer	4040XP EDA AL DEL - LHR	AL
1	Overhead Door Stop	104S SOC US32D (Concealed - Set for 90 Deg)	C32D
1	Armor Plate	GSH 80A C32D (800 x 876) TORX	C32D
1	Mop Plate	GSH 80A C32D (101 x 889) TORX	C32D
3	Door Silencer	SR64 GRY	GRY

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**Heading #10 (010)**

1 Single door 115.1, INGREDIENT STORE 116 TO OFFICE 115 LH  
 1 Single door 121.1, DINING AREA 123 TO OFFICE 121 RH  
 1 Single door 126.1, KITCHEN AREA 144 TO OFFICE 126 LH  
 1 Single door 135.1, SGMP AREA 138 TO OFFICE 135 LH  
 915 x 2134 x 45 - HM DR x PS FR

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12	Standard Hinge	TORX-FBB179 114 x 101 US26D	C26D
3	Lockset	45H7AB 3 J 630 LH SH	630
1	Lockset	45H7AB 3 J 630 RH SH	630
4	Kick Plate	GSH 80A C32D (203 x 876) TORX	C32D
4	Floor Door Stop	GSH 209 C26D	C26D
68	Ft. of	W-22-BL	BL
4	Auto Door Bottom	CT-52S-CA x 915mm	CA

**Heading #11 (011)**

1 Pair of doors 116.1, KITCHEN AREA 144 TO INGREDIENT STORE 116 LH/RHA  
 1 Pair of doors 116.2, BREAKDOWN 117 TO INGREDIENT STORE 116 LH/RHA  
 915, 915 x 2134 x 45 - HM DR x PS FR

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4	Continuous Hinge	CH-953 X 2108	
2	Lockset	45H7R 3 J 630 RH SH	630
2	Flush Bolt	FB51P x 305mm MD US32D	C32D
2	Dust Proof Strike	DP2 C26D	C26D
2	Coordinator	3092 BLK	Special
4	Surface Closer	4040XP REG AL DEL	AL
4	Overhead Door Stop	904S SOC US32D (Surface - Set for 90 Deg)	C32D
4	Armor Plate	GSH 80A C32D (800 x 876) TORX	C32D

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**Heading #12 (012)**

1 Pair of doors 117.1, BREAKDOWN 117 TO KITCHEN AREA 144 LHA/RH  
 762, 762 x 2134 x 45 - HM DR x PS FR

2	Continuous Hinge	CH-953 X 2108	
1	Lockset	45H7R 3 J 630 LH SH	630
1	Flush Bolt	FB51P x 305mm MD US32D	C32D
1	Dust Proof Strike	DP2 C26D	C26D
1	Coordinator	3092 BLK	Special
2	Surface Closer	4040XP REG AL DEL	AL
2	Mop Plate	GSH 80A C32D (101 x 737) TORX	C32D
2	Wall Door Stop	GSH 250B C32D	C32D
1	Weatherstripping	W-20S 1 @ 1830 + 2 @ 2134 AL TORX	AL
2	Door Sweep	W-24s x 915mm AL TORX	AL
1	Astragal	W-8S x 2134mm PS TORX	ps

NOTES:  
 INSTALL W/STRIPPING PRIOR TO DOOR CLOSERS.  
 MOUNT ASTRAGAL ON PULL SIDE OF ACTIVE DOOR.

**Heading #13 (013)**

1 Single door 117.3, EXTERIOR FROM BREAKDOWN 117 OVERHEAD  
 2134 x 2134 x \_\_\_\_ - MTL DR x CI FR

1	Padlock	11B-782-L-M5 S2 630	630
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BALANCE OF HARDWARE BY DOOR SUPPLIER

**Heading #14 (014)**

1 Pair of doors 120.1, WARE WASHING 120 TO CHILLED FOOD 118 LHA/RHA  
 915, 915 x 2134 x 45 - HM DR x PS FR

2	Continuous Hinge	CH-953 X 2108	
2	Door Pull	4012-2 C32D TB	C32D
2	Push Plate	GSH 81A C32D (127 x 610) TORX	C32D
1	Surface Closer	4040XP EDA AL DEL - LH	AL
1	Surface Closer	4040XP EDA AL DEL - RH	AL
2	Armor Plate	GSH 80A C32D (800 x 876) TORX	C32D
2	Mop Plate	GSH 80A C32D (101 x 889) TORX	C32D
2	Door Silencer	SR64 GRY	GRY

NOTES:  
 MOUNT CLOSERS FOR MAXIMUM DEGREE OF SWING.

**Heading #15 (015)**

1 Single door 122.1, KITCHEN AREA 144 FROM CHIEF FOOD SERVICES 122 RHR  
 915 x 2134 x 45 - HM DR x PS FR

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3	Standard Hinge	NRP-TORX-FBB179 114 x 101 US26D	C26D
1	Lockset	45H7AB 3 J 630 RHR SH	630
1	Surface Closer	4040XP EDA AL DEL - RHR	AL
1	Kick Plate	GSH 80A C32D (203 x 876) TORX	C32D
1	H/D Door Stop	GSH 2100 60mm C32D	32D
17	Ft. of Weatherstripping	W-22-BL	BL
1	Auto Door Bottom	CT-52S-CA x 915mm	CA

**Heading #16 (016)**

1 Pair of doors 123.1, DINING AREA 123 TO KITCHEN AREA 144 LH/RHA  
 915,915 x 2134 x 45 - HM DR x PS FR - 45 MIN

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2	Continuous	CH-953 X 2108	
1	Lockset	45H7R 3 J 630 RH SH	630
1	Flush Bolt	FB51P x 305mm MD US32D	C32D
1	Dust Proof	DP2 C26D	C26D
1	Coordinator	3092 BLK	Special
1	Surface Closer	4511 EDA AL LH AVB	AL
1	Surface Closer	4511 EDA AL RH AVB	AL
2	Magnetic	SEM 7850 AL 24V (Confirm Voltage)	AL
2	Armor Plate	GSH 90F C32D (800 x 876) TORX	C32D
2	Mop Plate	GSH 80A C32D (101 x 889) TORX	C32D
2	Door Silencer	SR64 GRY	GRY
1	Astragal	W-8S x 2134mm PS TORX	ps

**NOTES:**

DIVISION 26 TO TIE MAGNETIC HOLDR INTO F/A SYSTEM.  
 MOUNT ASTRAGAL ON PUSH SIDE OF INACTIVE DOOR.

**Heading #17 (017)**

1 Pair of doors 123.2, DINING AREA 123 FROM WARE WASHING 120 LHR/RHR  
 915, 915 x 2134 x 45 - HM DR x PS FR - 45 MIN

2	Continuous Hinge	CH-953 X 2108	
1	Lockset	45H7R 3 J 630 LHR SH	630
1	Flush Bolt	FB51P x 305mm MD US32D	C32D
1	Dust Proof Strike	DP2 C26D	C26D
1	Coordinator	3092 BLK	Special
1	Surface Closer	4211 EDA AL LHR AVB	AL
1	Surface Closer	4211 EDA AL RHR AVB	AL
2	Overhead Door Stop	104S SOC US32D (Concealed - Set for 90 Deg)	C32D
2	Armor Plate	GSH 90F C32D (800 x 876) TORX	C32D
2	Mop Plate	GSH 80A C32D (101 x 889) TORX	C32D
1	Astragal	W-8S x 2134mm PS TORX	

NOTES:

MOUNT ASTRAGAL ON PULL SIDE OF ACTIVE DOOR.

**Heading #18 (018)**

1 Single door 124.1, DINING AREA 123 TO KITCHEN AREA 144 RH  
 915 x 2134 x 45 - HM DR x PS FR - 45 MIN

3	Standard Hinge	TORX-FBB168 114 x 101 US26D	C26D
1	Lockset	45H7R 3 J 630 RH SH	630
1	Surface Closer	4511 EDA AL RH AVB	AL
1	Kick Plate	GSH 80A C32D (203 x 876) TORX	C32D
1	Wall Door Stop	GSH 250B C32D	C32D



**Heading #19 (019)**

1 Single door 127.1, KITCHEN AREA 144 FROM JANITOR 127 LHR  
 1 Single door 131.1, KITCHEN AREA 144 FROM JANITOR 131 LHR  
 1 Single door 136.1, BREAKDOWN 117 FROM JANITOR 136 RHR  
 1 Single door 141.1, KITCHEN AREA 144 FROM JANITOR 141 RHR  
 1 Single door 142.1, DINING AREA 123 FROM JANITOR 142 LHR  
 1 Single door 143.1, WARE WASHING 120 FROM JANITOR 143 LHR  
 864 x 213 x 45 - HM DR x PS FR - 0 MIN

18	Standard Hinge	NRP-TORX-FBB179 114 x 101 US26D	C26D
4	Lockset	45H7D 3 J 630 LHR SH	630
2	Lockset	45H7D 3 J 630 RHR SH	630
4	Surface Closer	4211 CUSH AL LHR	AL
2	Surface Closer	4211 CUSH AL RHR	AL
6	Kick Plate	GSH 80A C32D (203 x 826) TORX	C32D
6	Mop Plate	GSH 80A C32D (101 x 839) TORX	C32D
18	Door Silencer	SR64 GRY	GRY

**Heading #20 (020)**

1 Single door 128.1, INMATE CHANGE RM 128 TO KITCHEN AREA 144 LH  
 915 x 2134 x 45 - HM DR x PS FR

3	Standard Hinge	TORX-FBB168 114 x 101 US26D	C26D
1	Dead Lock	48H7R 626 LH S2 SH	626
1	Door Pull	4012-2 C32D TB	C32D
1	Push Plate	GSH 81A C32D (127 x 610) TORX	C32D
1	Surface Closer	4211 EDA AL LH AVB	AL
1	Kick Plate	GSH 80A C32D (203 x 876) TORX	C32D
1	Engraved Push Plate	GSH 81A C32D (127 x 610) Picto Female TORX	C32D
1	Wall Door Stop	GSH 250B C32D	C32D

**Heading #21 (021)**

1 Single door 129.1, CORRIDOR 132 TO W/R VESTIBULE 129A RH  
 915 x 2134 x 45 - HM DR x PS FR

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3	Standard Hinge	TORX-FBB168 114 x 101 US26D	C26D
1	Dead Lock	48H7R 626 RH S2 SH	626
1	Door Pull	4012-2 C32D TB	C32D
1	Engraved Push Plate	GSH 81A C32D (127 x 610) Picto Female TORX	C32D
1	Surface Closer	4511 EDA AL RH AVB	AL
1	Kick Plate	GSH 80A C32D (203 x 876) TORX	C32D
1	Mop Plate	GSH 80A C32D (101 x 889) TORX	C32D
1	Wall Door Stop	GSH 250B C32D	C32D
3	Door Silencer	SR64 GRY	GRY

**Heading #22 (022)**

1 Single door 130.1, CORRIDOR 132 TO W/R VESTIBULE 130A RH  
 915 x 2134 x 45 - HM DR x PS FR

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3	Standard Hinge	TORX-FBB168 114 x 101 US26D	C26D
1	Dead Lock	48H7R 626 RH S2 SH	626
1	Door Pull	4012-2 C32D TB	C32D
1	Engraved Push Plate	GSH 81A C32D (127 x 610) Picto Male TORX	C32D
1	Surface Closer	4511 EDA AL RH AVB	AL
1	Kick Plate	GSH 80A C32D (203 x 876) TORX	C32D
1	Mop Plate	GSH 80A C32D (101 x 889) TORX	C32D
1	Wall Door Stop	GSH 250B C32D	C32D
3	Door Silencer	SR64 GRY	GRY

**Heading #23 (023)**

1 Single door 129.2, W/R VESTIBULE 129A TO WOMEN'S W/R 129 RH  
 1 Single door 130.2, W/R VESTIBULE 130A TO MEN'S W/R 130 LH  
 915 x 2134 x 45 - HM DR x PS FR

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6	Standard Hinge	TORX-FBB168 114 x 101 US26D	C26D
2	Door Pull	4012-2 C32D TB	C32D
2	Push Plate	GSH 81A C32D (127 x 610) TORX	C32D
1	Surface Closer	4211 EDA AL LH AVB	AL
1	Surface Closer	4211 EDA AL RH AVB	AL
2	Kick Plate	GSH 80A C32D (203 x 876) TORX	C32D
2	Mop Plate	GSH 80A C32D (101 x 889) TORX	C32D
2	Wall Door Stop	GSH 250B C32D	C32D
6	Door Silencer	SR64 GRY	GRY

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**Heading #24 (024)**

1 Single door 133.1, CORRIDOR 133 TO KITCHEN AREA 144 RH  
 1 Single door 139.2, CORRIDOR 139 TO KITCHEN AREA 144 RH  
 915 x 2134 x 45 - HM DR x PS FR

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6	Standard Hinge	TORX-FBB168 114 x 101 US26D	C26D
2	Lockset	45H7R 3 J 630 RH SH	630
2	Surface Closer	4211 EDA AL RH AVB	AL
2	Kick Plate	GSH 80A C32D (203 x 876) TORX	C32D
2	Mop Plate	GSH 80A C32D (101 x 889) TORX	C32D
2	Wall Door Stop	GSH 250B C32D	C32D
6	Door Silencer	SR64 GRY	GRY

**Heading #25 (025)**

1 Pair of doors 134.2, CORRIDOR 133 FROM GARBAGE 134 LHR/RHRA  
 915, 915 x 2135 x 45 - HM DR x PS FR - 45 MIN

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2	Continuous Hinge	CH-953 X 2108	
1	Lockset	45H7R 3 J 630 RHR SH	630
1	Flush Bolt	FB51P x 305mm MD US32D	C32D
1	Dust Proof Strike	DP2 C26D	C26D
1	Coordinator	3092 BLK	Special
1	Surface Closer	4211 EDA AL LHR AVB	AL
1	Surface Closer	4211 EDA AL RHR AVB	AL
2	Overhead Door Stop	104S SOC US32D (Concealed - Set for 90 Deg)	C32D
2	Armor Plate	GSH 90F C32D (800 x 876) TORX	C32D
2	Mop Plate	GSH 80A C32D (101 x 889) TORX	C32D
20	Ft. of	W-22-BL	BL
2	Auto Door Bottom	CT-52S-CA x 915mm	CA
1	Astragal	W-8S x 2134mm PS TORX	ps

NOTES:  
 MOUNT ASTRAGAL ON PULL SIDE OF ACTIVE DOOR.

**Heading #26 (026)**

1 Single door 137.1, CORRIDOR 139 TO CORRIDOR 137 LH  
 1067 x 2134 x 45 - HM DR x PS FR

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1	Continuous Hinge	CH-953 X 2108	
1	Lockset	45H7R 3 J 630 LH SH	630
1	Surface Closer	4211 EDA AL LH AVB	AL
1	Armor Plate	GSH 80A C32D (800 x 1029) TORX	C32D
1	Mop Plate	GSH 80A C32D (101 x 1042) TORX	C32D
1	Wall Door Stop	GSH 250B C32D	C32D
3	Door Silencer	SR64 GRY	GRY

**Heading #27 (027)**

1 Pair of doors 137.2, CORRIDOR 137 FROM SGMPAREA 138 LHRA/RHR  
 915, 915 x 2134 x 45 - HM DR x PS FR

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2	Continuous Hinge	CH-953 X 2108	
1	Lockset	45H7R 3 J 630 LHR SH	630
2	Flush Bolt	FB458 US26D x 305mm	C26D
1	Dust Proof Strike	DP2 C26D	C26D
1	Surface Closer	4211 EDA AL LHR AVB	AL
1	Surface Closer	4211 EDA AL RHR AVB	AL
2	Armor Plate	GSH 80A C32D (800 x 876) TORX	C32D
2	Mop Plate	GSH 80A C32D (101 x 889) TORX	C32D
2	Wall Door Stop	GSH 250B C32D	C32D
1	Astragal	W-8S x 2134mm PS TORX	ps

NOTES:  
 MOUNT ASTRAGAL ON PULL SIDE OF ACTIVE DOOR.

**Heading #28 (028)**

1 Pair of doors 138.1, CORRIDOR 139 TO SGMP AREA 138 LH/RHA  
 915, 915 x 2134 x 45 - HM DR x PS FR

6	Standard Hinge	TORX-FBB179 114 x 101 US26D	C26D
1	Lockset	45H7R 3 J 630 RH SH	630
2	Flush Bolt	FB458 US26D x 305mm	C26D
1	Dust Proof Strike	DP2 C26D	C26D
2	Kick Plate	GSH 80A C32D (203 x 876) TORX	C32D
2	Floor Door Stop	GSH 209 C26D	C26D
1	Astragal	W-8S x 2134mm PS TORX	ps
2	Door Silencer	SR64 GRY	GRY

NOTES:  
 MOUNT ASTRAGAL ON PUSH SIDE OF ACTIVE DOOR.

**Heading #29 (029)**

1 Single door 139.1, EXTERIOR FROM CORRIDOR 139 LHR  
 1067 x 2134 x 45 - IHM DR x PS FR

1	Continuous Hinge	CH-953 X 2108	
1	Cylinder	1E72 626	626
1	Exit Device	CD -98-NL US32D 990NL-R C26D LHR 4' Bar 1067	C26D
1	Surface Closer	4211 EDA AL LHR AVB	AL
1	Overhead Door Holder	105H SOC US32D (Concealed - Set for 90 Deg)	C32D
1	Armor Plate	GSH 80A C32D (800 x 1029) TORX	C32D
1	Wall Door Stop	GSH 250B C32D	C32D
1	Threshold	CT-46 x 1219mm AL TORX	AL
1	Weatherstripping	W-20S 1 @ 1830 + 2 @ 2134 AL TORX	AL
1	Door Sweep	W-35-1 x 1219mm AL TORX	AL
3	Door Silencer	SR64 GRY	GRY

NOTES:  
 INSTALL W/STRIPPING PRIOR TO CLOSER & EXIT DEVICE

END OF SECTION



PART 1 - GENERAL

- 1.1 REFERENCES
- .1 American Society for Testing and Materials (ASTM):
    - .1 ASTM E330-02(2010), Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
  - .2 Canadian General Standards Board (CGSB)
    - .1 CAN/CGSB-12.1-M90, Tempered or Laminated Safety Glass.
    - .2 CAN/CGSB-12.8-97, Insulating Glass Units.
  - .3 Glass Association of North American (GANA)
    - .1 GANA Glazing Manual - 2008.
    - .2 GANA Laminated Glazing Reference Manual - 2009.
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Submit in accordance with Section 01 33 00.
  - .2 Product Data:
    - .1 Submit manufacturer's instructions, printed product literature and data sheets for glass, sealants, and glazing accessories and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Samples:
    - .1 Submit duplicate minimum 300 mm x 300 mm samples of each type of glass and glazing unit.
    - .2 Submit duplicate samples of gaskets and sealant materials.
  - .4 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
  - .5 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
    - .1 Submit results of testing and analysis of glass under provisions of Section 01 45 00.
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- 1.3 CLOSEOUT SUBMITTALS .1 Operation and Maintenance Data: submit operation and maintenance data for glazing for incorporation into the manual specified in Section 01 78 00.
- 1.4 QUALITY ASSURANCE .1 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- 1.5 DELIVERY, STORAGE AND HANDLING .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
- .1 Store materials off ground, indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect glazing and frames from nicks, scratches, and blemishes.
  - .3 Protect finished stainless steel surfaces with wrapping or strippable coating.
  - .4 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 74 20.
- .5 Packaging Waste Management: remove for return and reuse by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 20.
- 1.6 AMBIENT CONDITIONS .1 Ambient Requirements:
- .1 Install glazing when ambient temperature is 10 deg.C minimum. Maintain ventilated environment for 24 hours after application.
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1.6 AMBIENT  
CONDITIONS  
(Cont'd)

- .1 (Cont'd)
- .2 Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Design Criteria:
  - .1 Ensure continuity of building enclosure air barrier using glass and glazing materials as follow:
    - .1 Utilize inner light of multiple light sealed units for continuity of air and vapour seal.
    - .2 Size glass to withstand wind loads, dead loads and positive and negative live loads acting normal to plane of glass to design pressure of 1.2 kPa to ASTM E330.
    - .3 Limit glass deflection to 1/200 with full recovery of glazing materials.
  - .2 Fire rated interior single glazing (GL-1): Clear wired glass to CAN/CGSB-12.11-M90 type 1 transparent, Style 3, square mesh. Thickness to suite in-service loading conditions but no less than 6mm each light.
  - .3 Security Glazing (GL-2): Glazing assembly consisting of:
    - .1 Security Glazing: Plastic safety glazing sheets: to to HP White rating of Level I Forced Entry and to CAN/CGSB-12-12-M90, Category 2, 12.7mm thick, clear; polycarbonate to ANSK thick, clear; polycarbonate to ANSK Z97.1-2004. ploycarbonate glazing.
    - .2 Transparent (one way) mirror: to CAN/CBSB-12.6-M91, type 2, class C (tempered), form 1, 6mm thick, separated from the security glazing by and airspace.
  - .4 Laminated safety glass (GL-3): to CAN/CGSB-12.1-M90, Type 1-laminated , Class B of thickness to suite in-service loading conditions but no less than 6mm each light.
  - .5 Tempered safety glass (GL-4): to CAN/CGSB-12.1-M90, Type 2-tempered, Class B of thickness to suite in-service loading conditions but no less than 6mm each light.
  - .6 Sealant: in accordance with Section 07 92 00.

- 2.2 ACCESSORIES .1 Setting blocks, spacer shims, glazing tape, gaskets and sealants to door, curtain wall and skylight manufacturers' standards. Refer to Sections 08 11 13, and 08 34 63.13.

PART 3 - EXECUTION

- 3.1 EXAMINATION .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections are acceptable for glazing installation in accordance with system manufacturer's written instructions.
- .1 Verify that openings for glazing are correctly sized and within tolerance.
  - .2 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.
  - .3 Visually inspect substrate in presence of Departmental Representative.
  - .4 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .5 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.
- 3.2 PREPARATION .1 Clean contact surfaces with solvent and wipe dry.
- .2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.
  - .3 Prime surfaces scheduled to receive sealant.
- 3.3 INSTALLATION:  
EXTERIOR - DRY  
METHOD (PREFORMED  
GLAZING) .1 Manufacturer's Instructions: comply with system manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 Perform work in accordance with GANA Glazing Manual and GANA Laminated Glazing Reference Manual for glazing installation methods.
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- 3.3 INSTALLATION: .3 Cut glazing spline to length; install on  
EXTERIOR - DRY glazing light. Seal corners by butting spline  
METHOD (PREFORMED and sealing junctions with sealant.  
GLAZING)  
(Cont'd) .4 Place setting blocks at 1/4 points, with edge  
block maximum 150 mm from corners.
- .5 Rest glazing on setting blocks and push  
against fixed stop with sufficient pressure to  
attain full contact.
- .6 Install removable stops without displacing  
glazing spline. Exert pressure for full  
continuous contact.
- .7 Trim protruding tape edge.
- 3.4 INSTALLATION: .1 Perform work in accordance with GANA Glazing  
INTERIOR - DRY Manual for glazing installation methods.  
METHOD (TAPE .2 Cut glazing tape to length and set against  
AND TAPE) permanent stops, projecting 1.6 mm above sight  
line.
- .3 Place setting blocks at 1/3 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.
- 3.5 CLEANING .1 Progress Cleaning: clean in accordance with  
Section 01 74 11.
- .1 Leave Work area clean at end of each  
day.
- .1 Remove traces of primer, caulking.
- .2 Remove glazing materials from  
finish surfaces.
- .2 Remove labels.
- .1 Clean glass using approved  
non-abrasive cleaner in accordance with  
manufacturer's instructions.
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- 3.5 CLEANING  
(Cont'd)
- .1 (Cont'd)
  - .3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
  - .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
    - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
- 3.6 PROTECTION
- .1 Protect installed products and components from damage during construction.
  - .2 After installation, mark each light with an "X" by using removable plastic tape or paste.
    - .1 Do not mark heat absorbing or reflective glass units.
  - .3 Repair damage to adjacent materials caused by glazing installation.

PART 1 - GENERAL

- 1.1 RELATED SECTIONS .1 Section 08 80 00 - Glazing.
- 1.2 REFERENCES .1 American Society for Testing and Materials (ASTM)
- .1 ASTM C1115-06(2011), Standard Specification for Dense Elastomeric Silicone Rubber Gaskets and Accessories.
  - .2 ASTM D882-10, Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
  - .3 ASTM D1044-08, Standard Test Method for Resistance of Transparent Plastics to Surface Abrasion.
  - .4 ASTM E84-11b, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .2 Underwriters laboratories (UL)
- .1 UL-972-06, Standard for Burglary Resisting Material.
- 1.3 DEFINITIONS .1 For the purposes of this specification applying definitions follow:
- .1 Safety: Reduction of risk of injury, loss or death due to accidental, natural or unintentional causes.
  - .2 Security: Reduction of risk of injury, loss or death due to intention actions of others.
- 1.4 SAMPLES .1 Submit samples in accordance with Section 01 33 00.
- .2 Submit one representative sample each pattern and type of glazing film in accordance with Section 01 33 00. Submit one 100 x 100 mm sample of film installed on 7 mm thick clear plate glass. Submit 300 mm long sample of glazing film frame.
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- 1.5 SHOP DRAWINGS .1 Submit shop drawings in accordance with Section 01 33 00.
- 1.6 QUALITY ASSURANCE .1 Qualifications of glazing film and frame applicator: trained, approved and certified by glazing film manufacturer. Submit proof of certification in writing to Departmental Representative in accordance with Sections 01 33 00 and 01 78 00.
- .2 Glazing film inspection: manufacturers' representative shall view the film at a distance of 3 m (10 feet) at angles up to 45 degrees from either side of the glass during regular daylight conditions (not in direct sunlight). To be accepted the film itself shall not appear distorted. Submit manufacturer's written inspection report to Departmental Representative in accordance with Sections 01 33 00 and 01 78 00.
- 1.7 TEST REPORTS .1 Submit test reports from approved independent testing laboratories, certifying compliance with specifications, for film applied to glass.
- 1.8 DELIVERY, STORAGE AND HANDLING .1 Deliver, store and handle materials in accordance with Section 01 61 00.
- .2 Provide and maintain dry, off-ground weatherproof storage.
- .3 Store rolls of security film flat on cross supports. Do not stand rolls of film on end.
- .4 Remove only in quantities required for same day use.
- .5 Store materials in accordance with manufacturers written instructions.
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- 1.9 WASTE MANAGEMENT AND DISPOSAL
- .1 Separate and recycle waste materials in accordance with Section 01 74 20 and with Waste Reduction Workplace.
  - .2 Place materials defined as hazardous or toxic waste in designated containers.
  - .3 Ensure emptied containers are sealed and stored safely for disposal away from children.
- 1.10 ENVIRONMENTAL AND SAFETY 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 acceptable to Canada Labour Code.
- 1.11 WARRANTY
- .1 Work of this Section 08 87 54, the warranty period is extended to 5 years.
  - .2 Ensure warranty includes items as follows:
    - .1 Maintain adhesion properties without blistering, bubbling or delaminating from glass.
    - .2 Maintain appearance without discolouration.
    - .3 Remove, replace and reapply defective materials.
    - .4 In event of product failure under warranty terms, remove and re-apply film without glass replacement at no cost to Departmental Representative.
- 1.12 MAINTENANCE DATA
- .1 Provide operation and maintenance data for window film for incorporation into manual specified in Section 01 78 00.
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PART 2 - PRODUCTS

- 2.1 MANUFACTURER .1 Use manufacturers who are members of International Window Film Association (IWFA).
- 2.2 MATERIALS .1 Security Film - General: Multi-ply optically clear polyester film with factory applied adhesive between each layer, abrasion resistant coating and release liner.
- .1 Number of laminations: 3.
  - .2 Total thickness of installed film: 0.31 mm.
  - .3 Elongation: to ASTM D882.
  - .4 Break strength: to ASTM D882.
  - .5 Young's Modulus: to ASTM D882.
  - .6 Tear resistance: to ASTM D1004-08.
  - .7 Abrasion resistance: ASTM D1044.
  - .8 Flammability: surface burn characteristics to ASTM E84.
  - .9 Adhesive: high mass pressure sensitive, acrylic base.
    - .1 Acceptable material: 'Security Laminate', manufactured by Hanita Coatings, distributed by Glass Protection Solutions, 416-548-4734, [www.protectmyglass.com](http://www.protectmyglass.com).
- .2 Mechanical anchoring: 2 sided system, aluminum alloy 6063T5 or 6060T5, with elastomeric silicone rubber gaskets to ASTM C1115. Finish to match adjacent window frame.
  - .1 Acceptable material: 'NoBar', manufactured by Al-Sorag, distributed by Glass Protection Solutions, 416-548-4734, [www.protectmyglass.com](http://www.protectmyglass.com).
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PART 3 - EXECUTION

- 3.1 INSTALLERS .1 Use only manufacturer authorized applicators who are also members of the International Window Film Association (IWFA) and have achieved accredited status as "Safety & Security Film Specialists"
- 3.2 PREPARATION .1 Clean glass before beginning installation using neutral cleaning solution.
- .2 Ensure no deleterious material adheres to glass by balding surface of glass using industrial razors.
- .3 Ensure dust, grease, and chemical residue are removed from surface of glass before installation of film.
- .4 Examine glass under natural daylight and identify cracks, blisters, bubbles, discoloration, edge defects or other anomalies that may cause, film to delaminate, or vision transparency or distortion problems. Report findings to Departmental Representative.
- .5 Proceed with Work only after receipt of written approval from Departmental Representative.
- .6 Before beginning Work, place absorbent material on window sill or at sash frame to absorb moisture accumulation generated by film application.
- 3.3 INSTALLATION .1 Cut film edges straight and square.
- .2 Apply and attach film to glass in accordance with manufacturer's written instructions.
- .3 Mechanically anchor film to window frame, where specified, in accordance with manufacturers written instructions.
- .4 Splicing:  
.1 Splice film only when glass is greater in width than film.  
.2 Splice film only after receipt of written approval from Departmental Representative.  
.3 Use butt factory edges only.
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- 3.3 INSTALLATION (Cont'd)
- .5 Use clean, clear water to remove protective water soluble coating on adhesive side of film.
  - .6 Use only water and film slip solution on glass to facilitate positioning of film.
  - .7 Ensure removal of excess water from between film and glass.
  - .8 Remove left over material from work area and return work area to original condition.
- 3.4 INSPECTION
- .1 Return to work place after 30 days but no longer than 40 days for final cleaning and inspection of installed film.
  - .2 Ensure finished surface of film is vision free of blisters, bubbles, tears, scratches, edge defects, delaminating or vision distortion when viewed under natural daylight from 2.0 m minimum.
  - .3 Remove and replace film that continues to show blisters, bubbles, tears, scratches, edge defects or vision distortion in film when viewed under natural daylight from 2.0 m minimum after 30 day period.
- 3.5 FINAL CLEANING
- .1 Wash interior and exterior of each window and film using cleaning solution recommended by film manufacturer.
- 3.6 MAINTENANCE
- .1 Follow manufacturers written instructions for care and maintenance of security film.
  - .2 Use only cleaning solution recommended by manufacturer for regularly scheduled cleaning of security film.

PART 1 - GENERAL

- 1.1 REFERENCES .1 American Society for Testing and Materials (ASTM):
- .1 ASTM A641/A641M-09a, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
  - .2 ASTM A653/A653M-09a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
  - .3 ASTM C475-02(2007), Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
  - .4 ASTM C645-09a, Standard Specification for Nonstructural Steel Framing Members.
  - .5 ASTM C754-09 Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
  - .6 ASTM C840-08, Standard Specification for Application and Finishing of Gypsum Board.
  - .7 ASTM C1002-07, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
  - .8 ASTM C1047-09, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
  - .9 ASTM C1280-99, Standard Specification for Application of Gypsum Sheathing.
  - .10 ASTM C1177/C1177M-08, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
  - .11 ASTM C1396/C1396M-09a, Standard Specification for Gypsum Wallboard.
- .2 Association of the Wall and Ceilings Industries International (AWCI)
- .1 AWCI Levels of Gypsum Board Finish-97.
- 1.2 DESIGN CRITERIA .1 Design the suspended ceiling and bulkhead framing to be attached to and supported by the joists or concrete slab above. Attachment to the steel deck will not be permitted.
- .2 The suspension system to be capable of safely supporting the weight of all items which are

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- 1.2 DESIGN CRITERIA .2 (Cont'd)  
(Cont'd)
- .1 Light fixtures.  
.2 Diffusers.  
.3 Other items supported by the ceiling system.
- .3 Be advised that light fixtures will not be provided with separate support.
- .4 Design the suspension system to withstand normal and seismic loads.
- .5 Maximum deflection: 1/360 of span to ASTM C635 deflection test.
- 1.3 ACTION AND .1 Submit in accordance with Section 01 33 00.  
INFORMATIONAL  
SUBMITTALS .2 Product Data:  
.1 Submit manufacturer's instructions, printed product literature and data sheets for gypsum board assemblies and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:  
.1 Show complete details of the suspension system.  
.2 The suspension system, including all related connections and fastenings, shall be designed by a structural engineer permanently licensed to practice in the Province of Ontario. Each shop drawing submitted shall bear the stamp and signature of the aforesaid structural engineer.
- 1.4 DELIVERY, .1 Deliver, store and handle materials in  
STORAGE AND  
HANDLING .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:  
.1 Store gypsum board assemblies materials in accordance with manufacturer's
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- 1.4 DELIVERY,  
STORAGE AND  
HANDLING  
(Cont'd)
- .3 Storage and Handling Requirements:(Cont'd)
- .1 (Cont'd)  
recommendations in clean, dry,  
well-ventilated area.
- .2 Store and protect gypsum board  
assemblies from nicks, scratches, and  
blemishes.
- .3 Protect from weather, elements and  
damage from construction operations.
- .4 Handle gypsum boards to prevent damage  
to edges, ends or surfaces.
- .5 Replace defective or damaged materials  
with new.
- .4 Develop Construction Waste Management Plan  
related to Work of this Section and in  
accordance with Section 01 74 20.
- .5 Packaging Waste Management: remove for return  
and reuse by manufacturer of pallets, crates,  
padding, and packaging materials as specified  
in Construction Waste Management Plan in  
accordance with Section 01 74 20.
- 1.5 AMBIENT  
CONDITIONS
- .1 Maintain temperature 10oC minimum, 21oC  
maximum for 48 hours prior to and during  
application of gypsum boards and joint  
treatment, and for 48 hours minimum after  
completion of joint treatment.
- .2 Apply board and joint treatment to dry,  
frost-free surfaces.
- .3 Ventilation: ventilate building spaces as  
required to remove excess moisture that would  
prevent drying of joint treatment material  
immediately after its application.

PART 2 - PRODUCTS

- 2.1 GYPSUM BOARD  
PRODUCTS
- .1 Standard board: to ASTM C1396/C1396M regular,  
13 mm thick, 1219 mm wide x maximum practical  
length, ends square cut, edges bevelled.
- .2 Glass mat gypsum substrate sheathing: to ASTM  
C1177/C1177M, 13 mm thick, 1219 mm wide x  
maximum practical length.
- .2 Water Resistant Board: to ASTM C1396/1396M  
with silicone in core, regular and fire rated
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- 2.1 GYPSUM BOARD PRODUCTS  
(Cont'd)
- .2 Water Resistant Board:(Cont'd)  
12.7 mm and 15.9 mm thick as indicated,  
bevelled edges.  
.1 For all kitchen environments.
- 2.2 STEEL FRAMING AND FURRING COMPONENTS
- .1 General: Provide components complying with ASTM C754 for conditions indicated. Fabricate sheet steel products from Galvanized steel sheet to ASTM A653M with Z 180 hot-dipped galvanized finish.
- .2 Anchors and Fasteners: Anchors and fastener of types suitable for the applications indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers, and with the capability to sustain, without failure and with a safety factor acceptable to the authorities having jurisdiction, the load imposed by ceiling construction and items supported by the ceiling.
- .3 Wire Ties: ASTM A641/A641M, Class 1 zinc coating, soft temper, 1.6 mm thick.
- .4 Hangers: As required by loading conditions and fire resistant design requirements to the satisfaction of the authorities having jurisdiction, one or more of the following:  
.1 Wire hangers: ASTM A641M, Class 1 zinc coating, soft temper, 4.1 mm diameter.  
.2 Hanger Rods: Mild steel and zinc coated.  
.3 Flat Hangers: Mild steel and zinc coated.
- .5 Channels: Cold-rolled steel, 1.5 mm minimum base metal (uncoated) thickness and 11 mm wide flanges. Sizes as required by loading conditions and fire resistant design requirements.
- .6 Steel Studs for Furring Channels: ASTM C645, 0.45 mm base metal thickness, unless otherwise indicated or required by loading conditions. Depth as indicated and as required by loading conditions.
- .7 Steel Furring Channels: ASTM C645, hat shaped, depth of 22 mm, and minimum thickness of base (uncoated) metal of 0.45 mm (26 ga), unless otherwise indicated or required by loading conditions.
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- 2.2 STEEL FRAMING .8 Steel drill screws: to ASTM C1002.  
AND FURRING  
COMPONENTS .9 Laminating compound: as recommended by  
(Cont'd) manufacturer, asbestos-free.
- .10 Casing beads, corner beads, control joints  
and edge trim: to ASTM C1047, metal  
zinc-coated, 0.5 mm base thickness, perforated  
flanges, one piece length per location.
- .11 Sealants: in accordance with Section  
07 92 00.
- .12 Joint compound: to ASTM C475, asbestos-free.

PART 3 - EXECUTION

- 3.1 EXAMINATION .1 Verification of Conditions: verify conditions  
of substrates previously installed under other  
Sections or Contracts are acceptable for  
gypsum board assemblies installation in  
accordance with manufacturer's written  
instructions.
- .1 Visually inspect substrate in presence  
of Departmental Representative.
- .2 Inform Departmental Representative of  
unacceptable conditions immediately upon  
discovery.
- .3 Proceed with installation only after  
unacceptable conditions have been  
remedied and after receipt of written  
approval to proceed from Departmental  
Representative.
- 3.2 ERECTION .1 Do application and finishing of gypsum board  
to ASTM C840 except where specified otherwise.
- .2 Do application of gypsum sheathing to ASTM  
C1280, supplemented by the following:
- .1 Install glass mat gypsum sheathing in  
accordance with the manufacturer's  
recommendations.
- .2 Install yellow side facing out.
- .3 Lay out boards so that joints are  
centred on framing or furring members.  
Stagger end joints.
- .4 Cut boards to fit irregular shapes and  
to fit snugly around door and window  
openings.
-

3.2 ERECTION  
(Cont'd)

- .2 (Cont'd)
  - .5 Ensure that all edges are supported continuously. Provide additional furring if necessary.
  - .6 Butt boards together in an easy fit.
  - .7 Fasten in accordance with the manufacturer's recommendations for the specific application. Maximum fastener spacing: 200 mm o.c.
  - .8 Locate fasteners no closer than 10 mm from the edges of the boards and drive firmly against and flush with the surface of the sheathing. Do not countersink.
- .3 Erect hangers and runner channels for suspended gypsum board ceilings to ASTM C840 except where specified otherwise.
- .4 Support light fixtures by providing additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.
- .5 Install work level to tolerance of 1:1200.
- .6 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, and grilles.
- .7 Furr for gypsum board faced vertical bulkheads within and at termination of ceilings.
- .8 Install wall furring for gypsum board wall finishes to ASTM C840, except where specified otherwise.
- .9 Furr openings and around built-in equipment, cabinets, and 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 joists, 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.



3.3 APPLICATION OF  
GYP SUM BOARD

- .1 Apply gypsum board after bucks, anchors, blocking, sound attenuation, electrical and mechanical work have been approved.
- .2 Apply single layer gypsum board to metal furring or framing using screw fasteners. Maximum spacing of screws 300 mm o.c.
  - .1 Apply gypsum board on ceilings prior to application of walls to ASTM C840.
  - .2 Apply gypsum board vertically or horizontally, providing sheet lengths that will minimize end joints.
- .3 Install ceiling boards in direction that will minimize number of end-butt joints. Stagger end joints at least 400 mm.
- .4 Install gypsum board on walls vertically to avoid end-butt joints.
- .5 Install gypsum board with face side out.
- .6 Do not install damaged or damp boards.
- .7 Locate edge or end joints over supports.

3.4 INSTALLATION OF  
ACCESSORIES

- .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 o.c.
- .2 Install casing beads around perimeter of suspended ceilings.
- .3 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.
- .4 Install access doors to electrical and mechanical fixtures specified in respective Sections.
  - .1 Rigidly secure frames to furring or framing systems.
- .5 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.

3.4 INSTALLATION OF .6  
ACCESSORIES  
(Cont'd)

Gypsum Board Finish: finish gypsum board walls and ceilings to following levels in accordance with AWCI Level 4 Gypsum Board Finish:

.1 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.

.7 Finish corner beads and trim as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.

.8 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.

.9 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.

.10 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.

3.5 CLEANING

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

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

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

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by gypsum board assemblies installation.





PART 1 - GENERAL

- 1.1 REFERENCES
- .1 American Society for Testing and Materials International, (ASTM).
    - .1 ASTM C645-11a, Standard Specification for Nonstructural Steel Framing Members.
    - .2 ASTM C754-11, Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
    - .3 ASTM C920-11, Standard Specification for Elastomeric Joint Sealants.
    - .4 ASTM E90-09, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
    - .5 ASTM E2638-10, Standard Test Method for Objective Measurement of the Speech Privacy Provided by a Closed Room.
    - .6 ASTM F1267-07, Standard Specification for Metal, Expanded, Steel.
  - .2 The Master Painters Institute (MPI) / Architectural Painting Specification Manual - February 2004.
    - .1 MPI# 79 - Primer, Alkyd, Anti-Corrosive for Metal.
  - .3 Underwriters' Laboratories of Canada (ULC)
    - .1 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
    - .2 CAN/ULC-S702-09, Standard for Thermal Insulation Mineral Fibre for Buildings.
- 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.
  - .3 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation
-

1.2 QUALITY  
ASSURANCE  
(Cont'd)

- .3 Pre-Installation Meetings:(Cont'd)  
instructions and manufacturer's warranty  
requirements. Comply with Section 01 31 19.
- .4 Partition assembly to be non-combustible  
construction and fire resistance rated where  
indicated.
- .5 Minimum sound transmission rating of  
installed panel partition to be STC 30, tested  
to ASTM E90.

1.3 WASTE  
MANAGEMENT AND  
DISPOSAL

- .1 Separate and recycle waste materials in  
accordance with Section 01 74 20.
- .2 Remove from site and dispose of packaging  
materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper,  
plastic, polystyrene, corrugated cardboard,  
packaging material for recycling in accordance  
with Waste Management Plan.
- .4 Divert unused metal materials from landfill  
to metal recycling facility approved by  
Departmental Representative.
- .5 Divert unused gypsum materials from landfill  
to recycling facility approved by Departmental  
Representative.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Non-load bearing channel stud framing: to  
ASTM C645, stud size as indicated or as  
required by site conditions, roll formed from  
0.53 mm thickness, or to suite application,  
hot dipped galvanized steel sheet, for screw  
attachment of gypsum board. Knock-out service  
holes at 460 mm centres. Steel: minimum 25%  
recycled content.
- .2 Floor and ceiling tracks: to ASTM C645, in  
widths to suit stud sizes, 32 mm flange  
height. Steel: minimum 25% recycled content.
  - .1 Bottom channel: 32 mm.
  - .2 Deflection channel (fixed to u/s  
structure): 65mm.
  - .3 Top channel: 50 mm.

- 2.1 MATERIALS  
(Cont'd)
- .3 Bridging: Fabricated from same material and finish as steel studs, 38 mm x 13mm.
  - .4 Angle clips: Fabricated from same material and finish as steel studs, 38 mm x 38 mm x depth of steel stud.
  - .5 Heavier gauge framing: Provide heavier gauge framing members and/or additional reinforcing where stud length and loading conditions require. Provide additional reinforcing for members carrying a concentrated load such as door jambs.

PART 3 - EXECUTION

- 3.1 ERECTION
- .1 Install steel framing members to receive screw-attached gypsum board in accordance with ASTM C754 except where specified otherwise.
  - .2 Align partition tracks at floor and ceiling and secure at 600 mm on centre maximum.
  - .3 Install damp proof course under stud shoe tracks of partitions on slabs on grade.
  - .4 Place studs vertically at 400 mm on centre and not more than 50 mm from abutting walls, and at each side of openings and corners. Position studs in tracks at floor and ceiling. Cross brace steel studs as required to provide rigid installation to manufacturer's instructions.
  - .5 Erect metal studding to tolerance of 1:1000.
  - .6 Attach studs to bottom track using screws.
  - .7 Co-ordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.
  - .8 Co-ordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other Sections.
  - .9 Provide two studs extending from floor to ceiling at each side of openings wider than stud centres specified. Secure studs together, 50 mm apart using column clips or other

3.1 ERECTION  
(Cont'd)

- .9 (Cont'd)  
approved means of fastening placed alongside  
frame anchor clips.
- .10 Install heavy gauge single jamb studs at  
openings.
- .11 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.
- .12 Frame openings and around built-in equipment,  
cabinets, access panels, on four sides. Extend  
framing into reveals. Check clearances with  
equipment suppliers.
- .13 Provide 40 mm stud or furring channel secured  
between studs for attachment of fixtures  
behind lavatory basins, toilet and bathroom  
accessories, and other fixtures including grab  
bars and towel rails, attached to steel stud  
partitions.
- .14 Install steel studs or furring channel  
between studs for attaching electrical and  
other boxes.
- .15 Extend partitions to ceiling height except  
where noted otherwise on drawings.
- .16 Maintain clearance under beams and structural  
slabs to avoid transmission of structural  
loads to studs...
- .17 Install continuous insulating strips to  
isolate studs from uninsulated surfaces.

3.2 CLEANING

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



PART 1 - GENERAL

- 1.1 REFERENCES
- .1 Green Seal Environmental Standards (GS)
    - .1 GS-11-2008, 2nd Edition, Paints and Coatings.
  - .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
    - .1 Material Safety Data Sheets (MSDS).
  - .3 The Master Painters Institute (MPI)
    - .1 Architectural Painting Specification Manual - current edition.
    - .2 Maintenance Repainting Manual - current edition.
  - .4 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
    - .1 SCAQMD Rule 1113-A2007, Architectural Coatings.
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Submit in accordance with Section 01 33 00.
  - .2 Product Data:
    - .1 Submit manufacturer's instructions, printed product literature and data sheets for paint and coating products and include product characteristics, performance criteria, physical size, finish and limitations.
    - .2 Submit 2 copies of WHMIS MSDS.
  - .3 Samples:
    - .1 Submit for review and acceptance of each unit.
    - .2 Samples will be returned for inclusion into work.
    - .3 Submit duplicate 200 x 300 mm sample panels of each paint with specified paint or coating in colours, gloss/sheen and textures required to MPI Painting Specification Manual standards.
  - .4 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
-

1.2 ACTION AND  
INFORMATIONAL  
SUBMITTALS  
(Cont'd)

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- .5 Sustainable Design Submittals:
  - .1 Construction Waste Management:
    - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
  - .2 Regional Materials: submit evidence that project incorporates required percentage 20% of regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.
  - .3 Low-Emitting Materials:
    - .1 Submit listing of paints and coatings used in building, comply with VOC and chemical component limits or restriction requirements.

1.3 DELIVERY,  
STORAGE AND  
HANDLING

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- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
  - .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
  - .3 Storage and Handling Requirements:
    - .1 Provide and maintain dry, temperature controlled, secure storage.
    - .2 Store painting materials and supplies away from heat generating devices.
    - .3 Store materials and equipment in well ventilated area within temperature as recommended by manufacturer.
  - .4 Fire Safety Requirements:
    - .1 Supply 1 9 kg Type ABC dry chemical fire extinguisher adjacent to storage area.
    - .2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
    - .3 Handle, store, use and dispose of flammable and combustible materials in accordance with National Fire Code of Canada requirements.
  - .5 Develop Construction Waste Management Plan related to Work of this Section.
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- 1.3 DELIVERY, STORAGE AND HANDLING  
(Cont'd)
- .6 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 20.
- 1.4 SITE CONDITIONS
- .1 Heating, Ventilation and Lighting:
- .1 Ventilate enclosed spaces in accordance with Section 01 51 00.
  - .2 Co-ordinate use of existing ventilation system with Departmental Representative and ensure its operation during and after application of paint as required.
  - .3 Provide minimum lighting level of 323 Lux on surfaces to be painted.
- .2 Temperature, Humidity and Substrate Moisture Content Levels:
- .1 Apply paint finishes when ambient air and substrate temperatures at location of installation can be satisfactorily maintained during application and drying process, within MPI and paint manufacturer's prescribed limits.
  - .2 Test concrete, masonry and plaster surfaces for alkalinity as required.
  - .3 Apply paint to adequately prepared surfaces, when moisture content is below paint manufacturer's prescribed limits.
- .3 Additional application requirements:
- .1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
  - .2 Apply paint in occupied facilities during silent hours only. Schedule operations to approval of Departmental Representative such that painted surfaces will have dried and cured sufficiently before occupants are affected.
-

PART 2 - PRODUCTS

- 2.1 MATERIALS
- .1 Supply paint materials for paint systems from single manufacturer.
  - .2 Only products listed on the Canadian Food Inspection Agency, Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products are acceptable for this project. Refer to <http://active.inspection.gc.ca/scripts/fssa/reference/reference.asp?e> for floors, walls and ceilings.
  - .3 Conform to latest MPI requirements for painting work including preparation and priming.
  - .4 Materials in accordance with MPI - Architectural Painting Specification Manual and MPI - Maintenance Repainting Manual "Approved Product" listing.
    - .1 Use MPI listed materials having E2 E3 rating where indoor air quality requirements exist.
    - .2 Primer: VOC limit 100 g/L maximum to GS-11 or SCAQMD Rule 1113.
    - .3 Paint: VOC limit 100 g/L maximum to GS-11 or SCAQMD Rule 1113.
  - .5 Colours:
    - .1 Submit proposed Colour Schedule to Departmental Representative for review.
    - .2 Base colour schedule on selection of 2 base colours and 3 accent colours.
  - .6 Mixing and tinting:
    - .1 Perform colour tinting operations prior to delivery of paint to site, in accordance with manufacturer's written recommendations. Obtain written approval from Departmental Representative for tinting of painting materials.
    - .2 Use and add thinner in accordance with paint manufacturer's recommendations.
      - .1 Do not use kerosene or similar organic solvents to thin water-based paints.
    - .3 Thin paint for spraying in accordance with paint manufacturer's written recommendations.
    - .4 Re-mix paint in containers prior to and during application to ensure break-up of
-

2.1 MATERIALS  
(Cont'd)

- .6 Mixing and tinting:(Cont'd)
- .4 (Cont'd)  
lumps, complete dispersion of settled pigment, and colour and gloss uniformity.
- .7 Gloss/sheen ratings:
- .1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:
- | Gloss Level-Categor             | Gloss @ 60 degrees | Sheen @ 85 degrees |
|---------------------------------|--------------------|--------------------|
| Gloss Level 1<br>- Matte Finish | Max. 5             | Max. 10            |
| Gloss Level 2<br>- Velvet       | Max.10             | 10 to 35           |
| Gloss Level 3<br>- Eggshell     | 10 to 25           | 10 to 35           |
| Gloss Level 4<br>- Satin        | 20 to 35           | min. 35            |
| Gloss Level 5<br>- Semi-Gloss   | 35 to 70           |                    |
| Gloss Level 6<br>- Gloss        | 70 to 85           |                    |
| Gloss Level 7<br>- High Gloss   | More than 85       |                    |
- .2 Gloss level ratings of painted surfaces as indicated and as noted on Finish Schedule.
- .8 Exterior painting: Paint exterior surfaces in accordance with MPI Architectural Painting Specifications Manual, premium grade requirements, as follows:
- .1 Galvanized Metal: high contact/high traffic areas (doors, frames, railings and handrails, etc.).
- .1 EXT 5.3B - Alkyd G5 finish.
- .9 Interior painting: Paint interior surfaces in accordance with MPI Architectural Painting Specifications Manual, premium grade requirements, as follows:
- .1 Structural Steel and Metal Fabrications: columns, beams, joists and miscellaneous metal.
- .1 INT 5.1E Alkyd - G5 finish.

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- 2.1 MATERIALS (Cont'd)
- .9 Interior painting:(Cont'd)
  - .2 Galvanized Metal: high contact/high traffic areas (doors, frames, railings and handrails, etc.).
    - .1 INT 5.3C - Alkyd G5 finish (over cementitious primer).
  - .3 Plaster and gypsum board: gypsum wallboard, drywall, "sheet rock" type material, etc.
    - .1 INT 9.2B - High Performance Architectural Latex, gloss level as follows:
      - .1 Walls: Gloss level 4.
      - .2 Ceilings: Gloss level 1.

PART 3 - EXECUTION

- 3.1 GENERAL
- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheets.
  - .2 Perform preparation and operations for interior painting in accordance with MPI - Architectural Painting Specifications Manual and MPI - Maintenance Repainting Manual except where specified otherwise.
- 3.2 EXAMINATION
- .1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Departmental Representative damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.
  - .2 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test". Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.
- 3.3 PREPARATION
- .1 Protection of in-place conditions:
    - .1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable
-

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

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- 3.3 PREPARATION (Cont'd)
- .2 Surface Preparation:(Cont'd)
    - .7 (Cont'd)  
coat and to remove defects visible from a distance up to 1000 mm.
    - .8 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements.
    - .9 Touch up of shop primers with primer as specified.
- 3.4 APPLICATION
- .1 Paint only after prepared surfaces have been accepted by Departmental Representative.
  - .2 Use method of application approved by Departmental Representative.
    - .1 Conform to manufacturer's application recommendations.
  - .3 Apply coats of paint in continuous film of uniform thickness.
    - .1 Repaint thin spots or bare areas before next coat of paint is applied.
  - .4 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
  - .5 Sand and dust between coats to remove visible defects.
  - .6 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as tops of interior cupboards and cabinets and projecting ledges.
  - .7 Finish closets and alcoves as specified for adjoining rooms.
  - .8 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.
  - .9 Mechanical/Electrical Equipment:
    - .1 Paint conduits, piping, hangers, ductwork and other mechanical and electrical equipment exposed in finished areas, to match adjacent surfaces, except as indicated.
    - .2 Do not paint over nameplates.
    - .3 Keep sprinkler heads free of paint.
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- 3.4 APPLICATION (Cont'd) .9 Mechanical/Electrical Equipment:(Cont'd)
- .4 Paint fire protection piping red.
  - .5 Paint disconnect switches for fire alarm system and exit light systems in red enamel.
  - .6 Paint natural gas piping yellow.
  - .7 Paint both sides and edges of backboards for telephone and electrical equipment before installation.
    - .1 Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.
- 3.5 CLEANING .1 Progress Cleaning: clean in accordance with Section 01 74 11.
- .1 Leave Work area clean at end of each day.
  - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
  - .3 Waste Management: separate waste materials
  - .4 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
    - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
  - .5 Place paint stains primer defined as hazardous or toxic waste, including tubes and containers, in containers or areas designated for hazardous waste.



PART 1 - GENERAL

- 1.1 PRODUCT DATA SHEETS .1 Submit product data sheets in accordance with Section s 01 33 00 and 01 78 00.
- 1.2 WHMIS .1 Submit two copies of MSDS - Material Safety Data Sheets to Departmental Representative.
- .2 Indicate VOC's during application and curing.
- .3 Enforce use of personal protective equipment required by MSDS.
- 1.3 SUBMITTALS .1 Submit samples in accordance with Section s 01 33 00 and 01 78 00.
- .2 Product Data: Submit manufacturer's technical data, installation instructions, and general recommendations for each epoxy flooring material required.
- .3 Samples: Submit duplicate 400 x 200 mm samples of each colour and finish coating applied to a rigid backing.
- 1.4 QUALITY ASSURANCE .1 Single Source Responsibility: Obtain primary epoxy flooring and materials including primers, resins, hardening agents, finishes or sealing coats from a single manufacturer with not less than ten years of successful experience in manufacturing and installing principal materials described in this section. Contractor must have completed at least five projects of similar size and complexity. Provide secondary materials only of type and from source recommended by manufacturer of primary materials.
- .2 Arrange a meeting not less than thirty (30) days prior to starting work.
- 1.5 QUALIFICATIONS .1 Applied by applicator trained and licensed by
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- 1.6 MOCK-UP
- .1 Apply materials of each finish to approximately 10 m<sup>2</sup> area of surface to be treated.
  - .2 Allow 24 h for inspection of mock-up by Departmental Representative before proceeding with coating work.
  - .3 Do not proceed until mock-up has been inspected and accepted by Departmental Representative.
  - .4 Reviewed and accepted mock-up shall become part of installed work.

- 1.7 DELIVERY STORAGE AND HANDLING
- .1 Deliver material to job site. Check materials for shipping damage and completeness prior to job start.
  - .2 All materials must be factory pre-weighed and pre-packaged in single, easy to manage batches to eliminate on site mixing errors. No on site weighing or volumetric measurements allowed.
  - .3 Store material in a dry, enclosed area protected from exposure to moisture. Temperature of storage are shall be maintained between 16 degrees and 20 degrees celsius.

- 1.8 ENVIRONMENTAL REQUIREMENTS
- .1 Do not apply epoxy systems unless uniform minimum 16°C air temperature at installation area for 24 hours prior to and after application.
  - .2 Provide adequate ventilation or isolation measures to protect against toxic fumes.
    - .1 Ventilate area 24 hours per day, during installation and for 7 days after installation is completed with minimum 30% outside air.
    - .2 Ventilate at a rate sufficient to produce a negative pressure in the work area and exhaust direct to the outside of the building. Do not recirculate contaminants within the building.
  - .3 Moisture: Ensure substrate is within moisture limits prescribed by flooring manufacturer.
  - .4 Safety: Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding the use, handling, storage and disposal of hazardous materials.
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1.8 ENVIRONMENTAL REQUIREMENTS  
(Cont'd)

- .5 Job area to be free of other trades during, and for a period of 24 hours, after wall installation.
- .6 Protection of finished wall from damage by subsequent trades is the responsibility of the General Contractor.
- .7 Manufacturer's representative must be on job site at start of installation.

1.9 MAINTENANCE DATA

- .1 Provide maintenance data for coatings for incorporation into manual specified in Section 01 33 00 and 01 78 00.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Ensure compatibility for all epoxy materials including primers, resins, hardening agents, finish coats and sealer coats.
  - .2 All epoxy materials from same manufacturer.
  - .3 Only products listed on the Canadian Food Inspection Agency, Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products are acceptable for this project. Refer to <http://active.inspection.gc.ca/scripts/fssa/reference/reference.asp?e> for floors, walls and ceilings.
  - .4 Aggregate: silica sand to coating manufacturer's requirements.
  - .5 Block filler: one component, high build, copolymer emulsion with inorganic pigments, stabilizers, extenders and fillers.
  - .6 Waterproof membrane, where indicated on drawings: two component urethane liquid applied, 100% solids.
    - .1 Tensile strength: to ASTM D-412, 8.27 MPa.
    - .2 Elongation: to ASTM D-412, 100%.
    - .3 Hardness: to ASTM D2240-05, Shore A Durometer 80.
    - .4 Bond Strength: to ASTM D4541, greater than 2.75 MPa.
-

- 2.2 COLOURS .1 As selected by Departmental Representative from manufacturer's standard colours.
- 2.3 CRACK ISOLATION MEMBRANE .1 Crack isolation membrane: 2 part epoxy, 100% solids, 283 g/0.836 m<sup>2</sup> fibreglass fabric reinforcing.  
.1 Elongation at break of flexible epoxy binder: to ASTM D638-10, 90%.  
.2 Tensile strength of fibreglass fabric: 68.947 MPa.
- 2.4 EXPANSION AND CONTROL JOINT FILLER .1 Use either joint filler A, B, C, D, E or F.  
.2 Joint filler A: self leveling, two-component sealant based on a flexible epoxy resin and a blended polyamide curing agent.  
.1 Hardness: to ASTM D2240-05(2010), Shore A Durometer 50.  
.2 Tensile Strength: to ASTM C-307, 1.7 MPa.  
.3 Elongation: to ASTM D638-10, 450%.  
.4 Joint Movement Capability: to TT-S-00227E, +/- 25%.
- 2.5 EPOXY MORTAR/ GROUT .1 Use either epoxy mortar/grout A, B, C, D, E or F.  
.2 Mortar/Grout A: 3 part epoxy grout, 100% solids, solvent free, trowelable.  
.1 Compressive strength: to ASTM C579-01(2006), 52.40 MPa after 7 days.  
.2 Tensile strength: to ASTM C307-03(2008), 12.41 MPa.  
.3 Flexural strength: to ASTM C580-02(2008), 22.75 MPa.  
.4 Hardness: to ASTM D2240-05(2010), shore D durometer 86-88.  
.5 Density: 2200 kg/m<sup>3</sup>.
- 2.6 FLOOR SYSTEM STANDARD EPOXY (EP1) .1 Floor system, in regular areas: three-component, trowelled, epoxy mortar system.  
.1 Primer: as recommended by manufacturer.  
.2 Body coat: 3 part epoxy, 100% solids, minimum 6 mm thick, grey colour and texture selected by Departmental Representative.  
.1 Compressive strength: to ASTM C579-01(2006), 68.94 MPa after 7 days.
-

- 2.6 FLOOR SYSTEM .1 (Cont'd)  
STANDARD EPOXY (EP1) .2 Body coat:(Cont'd)  
(Cont'd) .2 Tensile strength: to ASTM  
C307-03(2008), 12.06 MPa.  
.3 Flexural strength: to ASTM C580-02  
(2008), 27.57 MPa.  
.4 Hardness: to ASTM D2240-05(2010),  
shore D durometer 85-90.  
.5 Abrasion resistance: to ASTM  
D4060-10, CS-17 wheel, 0.1 g maximum weight  
loss.  
.6 Coefficient of friction: to ASTM  
D2047-04, 0.6.  
.7 Flammability: to ASTM D635-10, self  
extinguishing, extent of burning maximum  
6 mm.  
.8 Water absorption: to ASTM  
C413-01(2006), 0.2%.
- .3 Top coat: 2 part epoxy, 100% solids,  
colour selected by Departmental  
Representative aggregate to match floor  
body coat.  
.1 Coating to be formulated to provide  
outstanding protection from a wide range of  
chemicals while increasing abrasion  
resistance and cleanability.  
.2 Flammability: to ASTM D635-10, self  
extinguishing.
- .2 Floor system under heat generating equipment:  
four-component, notch trowel applied  
polyurethane mortar system.  
.1 Primer: as recommended by manufacturer.  
.2 Body coat: polyurethane mortar system,  
colour and texture selected by Departmental  
Representative.  
.1 Compressive strength: to ASTM  
C579-01(2006), 53.08 MPa after 7 days.  
.2 Tensile strength: to ASTM  
C307-03(2008), 6.89 MPa.  
.3 Flexural strength: to ASTM C580-02  
(2008), 16.54 MPa.  
.4 Hardness: to ASTM D2240-05(2010),  
shore D durometer 80-84.  
.5 Abrasion resistance: to ASTM  
D4060-10, CS-17 wheel, 0.05 g maximum  
weight loss.  
.6 Coefficient of friction: to ASTM  
DF-1679 F-2508,1.  
.7 Flammability: to ASTM E-648,Class 1.  
.8 Water absorption: to ASTM  
C413-01(2006), less than 1%.
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- 2.6 FLOOR SYSTEM .2 (Cont'd)  
STANDARD EPOXY (EP1) .2 Body coat:(Cont'd)  
(Cont'd) .9 Heat Resistance Limitations: 93  
degrees Celsius.  
.3 Top coat: 2 part epoxy, 100% solids,  
colour selected by Departmental  
Representative aggregate to match floor  
body coat.  
.1 Coating to be formulated to provide  
outstanding protection from a wide range of  
chemicals while increasing abrasion  
resistance and cleanable.  
.2 Flammability: to ASTM D635-10, self  
extinguishing.
- 2.7 COVE BASE (EP2) .1 Install cove integral with the floor 100mm in  
height.
- 2.8 WALL SYSTEM .1 Wall coating to 1200a.f.f: 3 component, trowel  
STANDARD EPOXY (EP3) applied, 100% solids, colour, selected by  
Departmental Representative.  
.1 Bond Strength: to ACK committee  
#503/pp1139-41, 2.8 MPa.  
.2 Compressive strength: to ASTM  
C579-01(2006), 53.08 MPa after 7 days.  
.3 Tensile strength: to ASTM C307-03(2008),  
25.5 MPa.  
.4 Flexural strength: to ASTM C580-02 (2008),  
25.5 MPa.  
.5 Hardness: to ASTM D2240-05(2010), shore D  
durometer 86-90.  
.6 Abrasion resistance: to ASTM D4060-10,  
CS-17 wheel, 0.75 gm maximum weight loss.  
.7 Coefficient of friction: to ASTM DF-1679  
F-2508,1.  
.8 Flammability: to ASTM D635-10, self  
extinguishing  
.9 Water absorption: to ASTM C413-01(2006),  
less .2than %.  
.10 Heat Resistance Limitations: 93 degrees  
Celsius.  
.11 Impact Resistance: to ASTM D-2794, exceeds  
1100 kPa.
- 2.9 WALL SYSTEM .1 Use either wall system A, B, C, D, E or F;  
STANDARD EPOXY (EP4) pinhole free finish.
-



- 2.9 WALL SYSTEM .2 Wall and ceiling coating A: 2 part epoxy, 92%  
STANDARD EPOXY (EP4) solids, clear colour, selected by Departmental  
(Cont'd) Representative.
- .1 Minimum dry film thickness: 0.381 mm.
  - .2 Abrasion resistance: to ASTM D4060-10, CS-17 wheel, 1,000 g load, 1,000 cycles: 0.1 gm maximum weight loss.
  - .3 Impact resistance: to ASTM D2794-93(2010) (no cracking crazing or loss of adhesion): exceeds 24 in.-lbs.
  - .4 Hardness: to ASTM D2240-05(2010), 80-85 Shore D.
  - .5 Temperature limitations:
    - .1 Continuous exposure: 60°C.
    - .2 Intermittent exposure: 93°C.
- 2.10 EXTERIOR FLOOR .1 Floor system, for exterior work:  
SYSTEM EPOXY (EP5) three-component, trowelled epoxy system.
- .1 Primer: as recommended by manufacturer.
  - .2 Body coat: 3 part epoxy, 100% solids, minimum 6 mm thick, grey colour and texture selected by Departmental Representative.
    - .1 Compressive strength: to ASTM C579-01(2006), 68.94 MPa after 7 days.
    - .2 Tensile strength: to ASTM C307-03(2008), 12.06 MPa.
    - .3 Flexural strength: to ASTM C580-02 (2008), 27.57 MPa.
    - .4 Hardness: to ASTM D2240-05(2010), shore D durometer 85-90.
    - .5 Abrasion resistance: to ASTM D4060-10, CS-17 wheel, 0.1 g maximum weight loss.
    - .6 Coefficient of friction: to ASTM D2047-04, 0.6.
    - .7 Flammability: to ASTM D635-10, self extinguishing, extent of burning maximum 6 mm.
    - .8 Water absorption: to ASTM C413-01(2006), 0.2%.
  - .3 Top coat: 2 component, high performance, waterborne, polyurethane coating. Colour selected by Departmental Representative.
    - .1 Coating to be formulated to provide outstanding protection from a wide range of chemicals while increasing abrasion resistance and cleanability.
    - .2 Flammability: to ASTM D635-10, self extinguishing.
-

2.11 MIXES .1 Mix crack isolation membrane, expansion joint filler, grout, floor base coat mortar and top coat sealer in accordance with manufacturer's written instructions.

PART 3 - EXECUTION

3.1 PREPARATION OF SURFACES .1 Prepare surfaces in accordance with manufacturer's instructions.

.2 Remove oil, dirt and grease with industrial detergent, as recommended by epoxy manufacturers representative.

.3 Mask surrounding surfaces to provide neat, clean juncture lines.

.4 Protect adjacent surfaces and equipment from damage by overspray.

.5 Complete work penetrating substrate before installing coating.

3.2 PREPARATION OF FLOORS .1 Prepare floor accordance with epoxy flooring manufacturer's instructions.

.2 Shot blast existing and new concrete floor surfaces.

3.3 PREPARATION OF WALLS .1 Apply 2 coats of block filler to walls to provide smooth surface for finish coating.

3.4 CRACK ISOLATION MEMBRANE APPLICATION .1 Apply crack isolation membrane minimum mm 0.762 mm (30 mils) thick, lay reinforcing and saturate surface in accordance with manufacturer's written instructions.

.2 Apply crack isolation membrane where indicated.

3.5 EPOXY MORTAR/ GROUT APPLICATION .1 Apply epoxy mortar/grout in accordance with manufacturer's written instructions to provide 3 6 mm in 300 mm slope to floor drains and integral cove base. Form curbs ramps to door thresholds at slope indicated on drawings.

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- 3.5 EPOXY MORTAR/  
GROUT APPLICATION  
(Cont'd) .2 Co-ordinate with room finish schedule.
- 3.6 FLOOR SYSTEM  
APPLICATION .1 Mix in accordance with material manufacturer's instructions.
- .2 Apply primer to porous surfaces and epoxy mortar in accordance with manufacturer's written instructions.
- .3 Trowel apply body coat in accordance with manufacturer's written instructions. Minimum total dry thickness 6 mm (1/4").
- .4 Apply top coat in accordance with manufacturer's written instructions. Minimum total dry film thickness 0.102 mm (4 mils) 0.204 mm (8 mils).
- .5 Co-ordinate with room finish schedule.
- 3.7 WALL SYSTEM  
APPLICATION .1 Mix in accordance with material manufacturer's written instructions.
- .2 Apply wall coating by roller. Minimum dry film thickness 0.102 mm (4 mils) 0.204 mm (8 mils).
- .3 Co-ordinate with room finish schedule.
- 3.8 CEILING SYSTEM  
APPLICATION .1 Mix in accordance with material manufacturer's written instructions.
- .2 Apply ceiling coating by roller. Minimum dry film thickness 0.102 mm (4 mils) 0.204 mm (8 mils).
- .3 Co-ordinate with room finish schedule.
- 3.9 TESTING .1 Perform two pull-off strength adhesion tests per floor area and wall area.
- .2 Do pull-off strength adhesion tests in accordance with ASTM D4541-09e1.
-

3.9 TESTING .3 Patch floors and walls where pull-off strength  
(Cont'd) \_\_\_\_\_ adhesion tests are performed. Patch shall not be  
visible when viewed 600 mm above finished floor.

PART 1 - GENERAL

- 1.1 SUBMITTALS
- .1 Submit in accordance with Section 01 33 00.
  - .2 Shop Drawings: Indicate fabrication details, plans, elevations, hardware, and installation details.
  - .3 Samples:
    - .1 Submit duplicate 300 mm x 300 mm samples of panel showing finishes, edge and corner construction and core construction.
    - .2 Submit duplicate representative samples of each hardware item, including brackets, fastenings and trim.

PART 2 - PRODUCTS

- 2.1 TOILET PARTITIONS
- .1 Solid phenolic floor mounted, headrail braced, to the following configuration:
    - .1 Compartment Depth and Width: As indicated on drawings.
    - .2 Door Width: As indicated on drawings.
    - .3 Height Above Floor: 305 mm
    - .4 Door Height: 1473 mm Door Width: As indicated on drawings. Height Above Floor: 305 mm. Door Height: 1473 mm.
    - .5 Pilaster Height: 2165 mm.
  - .2 Panels, pilasters and doors: 25 mm thick solid polymer resin core with self-lubricating polypropylene surface, straight cut with fine radius edges; homogeneous colour.
  - .3 Pilaster levelling device: Steel levelling bar with sleeve anchors requiring minimum 50 mm penetration into floor slab.
  - .4 Pilaster shoe: Minimum 100 mm high, 0.8 mm thick stainless steel.
  - .5 Headrail: 25 mm x 40 mm x 0.9 mm thick, tubular or channel-shaped stainless steel or clear anodized aluminum of anti grip design, with formed steel or aluminum end brackets.
-

2.1 TOILET  
PARTITIONS  
(Cont'd)

- .6 Urinal screens: Same material and construction as partitions, wall-mounted.
- .7 Door stops: Provide stainless steel wall-mounted door stop where barrier-free toilet compartment door swings against a wall.
- .8 Colour: To be selected by the Departmental Representative from the manufacturer's complete colour range.

2.2 HARDWARE

- .1 Hinges:
    - .1 Heavy duty, self lubricating, steel pins, nylon cams.
    - .2 Material/finish: chrome plated non ferrous casting
    - .3 Swing: as indicated on the drawings.
    - .4 Return movement, adjustable to hold door open at any angle up to 90 deg.
  - .2 Latch set: surface mounted, slide bolt and keeper, chrome plated non ferrous extrusion or casting, emergency access feature.
  - .3 Wall and connecting brackets: chrome plated non ferrous extrusion or casting, or stainless steel
  - .4 Coat hook: combination hook and rubber door bumper, chrome plated non ferrous casting.
  - .5 Door pull: type suited for outswinging doors, stainless steel.
  - .6 Attachment: stainless steel tamperproof type screws and bolts.
-

PART 3 - EXECUTION

- 3.1 INSTALLATION .1 Do work in accordance with CAN/CSA B651 and the manufacturer's written instructions.
- 3.2 ERECTION .1 Install partitions secure, level, plumb and square.
- .2 Leave 12 mm space between wall and panel or end pilaster.
- .3 Anchor mounting brackets to masonry concrete surfaces using screws and shields, to hollow walls using bolts and toggle type anchors.
- Attach panel and pilaster to mounting brackets with through-type sleeve bolt and nut.
- Provide for adjustment of floor level variations with screw jack through-steel saddles made integral with pilaster. Conceal junction between pilaster and floor with pilaster shoe.
- .4 Equip each door with hinges, latch set, and each stall with coat hooks mounted on the partition wall. Adjust and align hardware for easy, proper function. Set door open position at 30o to front. Install door bumper, door mounted.
- .5 Install hardware





PART 1 - GENERAL

1.1 REFERENCES

- .1 ASTM A 167-99(2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- .2 ASTM B 456-03, Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
- .3 ASTM A 653/A 653M-09, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .4 ASTM A 924/A 924M-09, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- .5 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.81-M90, Air Drying and Baking Alkyd Primer for Vehicles and Equipment.
  - .2 CAN/CGSB-1.88-92, Gloss Alkyd Enamel, Air Drying and Baking.
  - .3 CGSB 31-GP-107MA-90, Non-inhibited Phosphoric Acid Base Metal Conditioner and Rust Remover.
- .6 CSA International
  - .1 CAN/CSA-B651-04, Accessible Design for the Built Environment.
  - .2 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Product Data:
    - .1 Provide manufacturer's printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Shop Drawings:
    - .1 Indicate size and description of components, base material, surface finish inside and out, hardware and locks, attachment devices, description of
-

- 1.2 ACTION AND INFORMATIONAL SUBMITTALS (Cont'd)
- .3 Shop Drawings:(Cont'd)
- .1 (Cont'd)  
rough-in-frame, building-in details of anchors for grab bars.
- 1.3 CLOSEOUT SUBMITTALS
- .1 Provide maintenance data for toilet and bath accessories for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- 1.4 MAINTENANCE MATERIAL SUBMITTALS
- .1 Tools:
- .1 Provide special tools required for assembly, disassembly or removal for toilet and bath accessories in accordance with requirements specified in Section 01 78 00 - Closeout Submittals.
- .2 Deliver special tools to Departmental Representative.
- 1.5 DELIVERY, STORAGE AND HANDLING
- .1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name
- .2 Storage and Handling Requirements:
- .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect toilet and bathroom accessories from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 20 - Construction/Demolition Waste Management and Disposal.
-

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Sheet steel: to ASTM A 653/A 653M with ZF001 designation zinc coating.
- .2 Stainless steel sheet metal: to ASTM A 167, Type 304, with Polished finish.
- .3 Stainless steel tubing: Type 304, commercial grade, seamless welded, 1.2 mm wall thickness.
- .4 Fasteners: concealed screws and bolts hot dip galvanized, exposed fasteners to match face of unit. Expansion shields fibre, lead or rubber as recommended by accessory manufacturer for component and its intended use.

2.2 COMPONENTS

- .1 Toilet tissue dispenser: single roll type, surface mounted, chrome plated steel frame, capacity of 500 double ply roll, roll under spring tension for controlled delivery.
  - .2 Paper towel dispenser: for single fold paper towels, stainless steel cabinet, hinged front panel, lock and key, surface mounted.
  - .3 Feminine napkin disposal bin: stainless steel, surface unit, continuous hinged door, self closing, embossed with "napkin disposal" "receptacle de serviette-sanitaire" & universally accepted symbol, removable stainless steel receptacles fitted with spring clip for deodorizer block.
  - .4 Hand dryer: listed under re-examination service of ULC and CSA approved.
    - .1 Electrical Input voltage: 120 V AC, single phase 60Hz Rated power: 1400 W Motor type: Dyson digital motor, switched reluctance brush less Motor speed: 81,000 rpm, Heater type: None, Standby power consumption: 1 W, Energy consumption per dry: 0.00467 kWh.
    - .2 Construction: Die-cast aluminum casing with anti-microbial resistant lacquer coating on exterior surfaces, Colour finish: Metallic silver, glass lacquer, Light reflective value: 39.9, Anti-microbially impregnated external plastics and seals, Galvanized steel
-

2.1 MATERIALS  
(Cont'd)

- .4 Hand dryer:(Cont'd)
  - .2 Construction:(Cont'd)  
backplate / mounting bracket,  
tamper-proof T30 type exterior screws,  
water ingress protection to IPX5.
  - .3 Filtration Anti-microbial HEPA filter  
Particulate removal tested to 99.95% at  
0.3  $\mu$  according to ASTM 1977 Bacteria  
removal > 99.9%, Operation Touch-free  
infra-red activation.
  - .4 Hand dry time: 12 seconds (measured to  
method defined within National Sanitation  
Foundation protocol P335) Operation  
lock-out period: 30 seconds, Airspeed at  
nozzle: 640 km/h. Operating airflow:  
31.15l/s / 66.1 CFM, Rated operating  
noise power: 85 dB(A)
- .5 Grab bars: 32 mm diameter x 1.6 mm wall 38 mm  
diameter x 1.6 mm wall tubing of stainless  
steel, 76 mm diameter wall flanges,concealed  
screw attachment, flanges welded to tubular  
bar, provided with steel back plates and all  
accessories. Knurl bar at area of hand grips.  
Grab bar material and anchorage to withstand  
downward pull of 2.2 kN.
- .6 Mirror: wall mounted unit, fixed framed  
mirror 6 mm, stainless steel frame.

2.3 FABRICATION

- .1 Weld and grind joints of fabricated  
components flush and smooth. Use mechanical  
fasteners only where approved.
- .2 Wherever possible form exposed surfaces from  
one sheet of stock, free of joints.
- .3 Brake form sheet metal work with 1.5 mm  
radius bends.
- .4 Form surfaces flat without distortion.  
Maintain flat surfaces without scratches or  
dents.
- .5 Back paint components where contact is made  
with building finishes to prevent  
electrolysis.
- .6 Hot dip galvanize concealed ferrous metal  
anchors and fastening devices to CAN/CSA-G164.
- .7 Shop assemble components and package complete  
with anchors and fittings.

- 
- 2.3 FABRICATION (Cont'd)
- .8 Deliver inserts and rough-in frames to job site at appropriate time for building-in. Provide templates, details and instructions for building in anchors and inserts.
  - .9 Provide steel anchor plates and components for installation on studding and building framing.
- 2.4 FINISHES
- .1 Chrome and nickel plating: to ASTM B 456, polished finish.
  - .2 Baked enamel: condition metal by applying one coat of metal conditioner to CGSB 31-GP-107Ma, apply one coat Type 2 primer to CAN/CGSB-1.81 and bake, apply two coats Type 2 enamel to CAN/CGSB-1.88 and bake to hard, durable finish. Sand between final coats. Colour selected from standard range by Departmental Representative.
  - .3 Manufacturer's or brand names on face of units not acceptable.
- PART 3 - EXECUTION
- 3.1 EXAMINATION
- .1 Verification of Conditions: verify that conditions of substrates and surfaces to receive toilet and bathroom accessories previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's instructions prior to toilet and bathroom accessories installation.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied.
- 3.2 INSTALLATION
- .1 Install and secure accessories rigidly in place as follows:
    - .1 Stud walls: install steel back-plate to stud prior to plaster or drywall finish. Provide plate with threaded studs or plugs.
-

- 3.2 INSTALLATION .1 (Cont'd)
- (Cont'd)
- .2 Hollow masonry units, existing plaster or drywall: use toggle bolts drilled into cell or wall cavity.
  - .3 Solid masonry, marble, stone or concrete: use bolt with lead expansion sleeve set into drilled hole.
  - .4 Toilet and shower compartments: use male to female through bolts.
- .2 Install grab bars on built-in anchors provided by bar manufacturer.
- .3 Use tamper proof screws/bolts for fasteners.
- .4 Fill units with necessary supplies shortly before final acceptance of building.
- 3.3 ADJUSTING .1 Adjust toilet and bathroom accessories components and systems for correct function and operation in accordance with manufacturer's written instructions.
- .2 Lubricate moving parts to operate smoothly and fit accurately.
- 3.4 CLEANING .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- 3.5 PROTECTION .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by toilet and bathroom accessories installation.
- 3.6 SCHEDULE .1 Locate accessories where indicated Exact locations determined by Departmental Representative.
-

3.5 PROTECTION  
(Cont'd)

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- .2 Toilet tissue dispenser: one in each toilet compartment.
- .3 Paper towel dispenser: one at each washroom . Maximum height of dispenser and operable part from floor 1200 mm.
- .4 Feminine napkin disposal bin: one in each female toilet compartment.
- .5 Hand dryer: one for each washroom placed as indicated on drawings. Maximum height of dispenser and operable part from floor 1200 mm.
- .6 Grab bar: two in each handicapped toilet compartment. Height of grab bar from floor 750 mm. Side grab bar: maximum distance from rear wall 300 mm, minimum distance passed front edge of toilet 450 mm.
- .7 Mirror: one at each wash basin and bathroom compartment, height of bottom edge of mirror from floor 1000 mm. floor 1000 mm.





PART 1 - GENERAL

- 1.1 REFERENCES .1 ASTM International
- .1 ASTM D624-00(2007), Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
  - .2 ASTM D1171-99(2007), Standard Test Method for Rubber Deterioration-Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens).
  - .3 ASTM D2632-01(2008), Standard Test Method for Rubber Property-Resilience by Vertical Rebound.
- .2 Green Seal Environmental Standards (GS)
- .1 GS-11-2008, 2nd Edition, Paints and Coatings.
  - .2 GS-36-00, Commercial Adhesives.
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
- .1 Submit manufacturer's printed product literature and data sheets for loading dock bumpers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
  - .2 Indicate on drawings:
    - .1 Dimensions and required clearances.
    - .2 Fastening methods for dock bumpers.
- .4 Samples:
- .1 Submit duplicate samples of 300 mm long sections of dock bumpers.
- .5 Sustainable Design Submittals:
- .1 Construction Waste Management:
    - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
  - .2 Recycled Content: submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of
-

- 1.2 ACTION AND INFORMATIONAL SUBMITTALS (Cont'd)
- .5 Sustainable Design Submittals:(Cont'd)
- .2 Recycled Content:(Cont'd)  
post-consumer and post-industrial content,  
and total cost of materials for project.
- .3 Low-Emitting Materials:  
.1 Submit listing of adhesives and sealants and paints and coatings used in building, comply with VOC and chemical component limits or restrictions requirements.
- 1.3 DELIVERY, STORAGE AND HANDLING
- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:  
.1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.  
.2 Store and protect loading dock bumpers from nicks, scratches, and blemishes.  
.3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 20.

PART 2 - PRODUCTS

- 2.1 MATERIALS
- .1 Description:  
.1 Sustainability Characteristics:  
.1 Primers Paints: in accordance with manufacturer's recommendations for surface conditions.
-

- 2.2 MANUFACTURED UNITS .1 Laminated Dock Bumper:
- .1 Nylon impregnated heavy duty industrial rubber 254 x 305 mm, with 230 mm overall projection.
    - .1 Pads punched to receive 19 mm steel supporting rods.
  - .2 Rubber pads laminated between structural steel angles and compressed under approximately 680 kg pressure.
    - .1 Angles welded to 19 mm steel rods at one end and closed with threaded rod and nut at other end.
  - .3 Anchor leg of angle extends 76 mm beyond rubber surface at each end and contains two or three 21 mm anchor bolt holes as required.
  - .4 Hot-dipped galvanized finish for exposed metal parts.

PART 3 - EXECUTION

- 3.1 EXAMINATION .1 Verification of Conditions: verify conditions of substrates and surfaces previously installed under other Sections or Contracts are acceptable for loading dock bumper installation in accordance with manufacturer's instructions prior to loading dock bumper installation.
- .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval from Departmental Representative.
- 3.2 INSTALLATION .1 No assembly required for pre-manufactured unit.
- .1 Install loading dock bumper as indicated.
  - .2 Laminated Dock Bumper: weld structural mounting angles as per manufacturers instructions.
- 3.3 CLEANING .1 Progress Cleaning: clean in accordance with Section 01 74 11.
- .1 Leave Work area clean at end of each day.

- 
- 3.3 CLEANING  
(Cont'd)
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
  - .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
    - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
- 3.4 PROTECTION
- .1 Protect installed products and components from damage during construction.
  - .2 Repair damage to adjacent materials caused by loading dock bumper installation.

PART 1 - GENERAL

- .1 Division 26: Disconnect switch at power unit, conduit and wiring between disconnect switch, power unit, dock ramp and control station
  
  - 1.1 SHOP DRAWINGS
    - .1 Submit shop drawings in accordance with Section [s 01 33 00 and 01 78 00].
    - .2 Indicate manufacturer's name, model number, size, material and finish; motor horsepower and rpm; storage tank working pressure; cylinder factory tested pressure, pipe and hose type and size.
    - .3 Indicate pit layout, location of storage tank, power unit, pump, jack linkage, valves and piping.
    - .4 Indicate details of cylinder, plunger, pump, motor, valves and operating station.
  
  - 1.2 CERTIFICATES
    - .1 Submit written manufacturer's certificate certifying compliance with specification requirements for operation.
  
  - 1.3 MAINTENANCE DATA
    - .1 Submit maintenance data for maintenance manuals specified in Section [01 78 00].
    - .2 Include sequence of operation; wiring diagram; electrical characteristics; parts list with cuts, numbers and supplier's name and address.
    - .3 Indicate hydraulic and electrical component manufacturer's names and numbers for each part used in assembly, number to match that on part.
    - .4 Indicate location, frequency and description of method of adjustment, lubrication and parts replacement.
  
  - 1.4 WARRANTY
    - .1 Commence repair of breakdowns or deficiencies in operation within 24 hours of notification.
    - .2 Inspect hydraulic dock ramp 30 days before expiry of warranty period and correct defects within 15 days of inspection.
-

- 1.5 CHARACTERISTICS
- .1 Capacity: [9000] kg axle load.
  - .2 Travel: [350] mm above platform. [300] mm below platform.
  - .3 Lip extension: [400] mm.
  - .4 Power supply: [115] volt; [1] phase; 60 hertz; AC.

PART 2 - PRODUCTS

- 2.1 MATERIALS
- .1 Steel: to CSA-G40.20-04(R2009)/G40.21-04(R2009), Grade 300W, minimum 25% recycled content.
  - .2 Steel floor plate: hot rolled steel top surface non-slip, minimum lug height 1.0 mm, minimum 25% recycled content. Finish: factory applied one coat of protective grey paint.
  - .3 Welding material: to CSA W59-03(R2008).
  - .4 Bearings and bushings: sealed, self-lubricating.
  - .5 Neoprene: moulded, black, 30 to 40 durometer hardness.
  - .6 Wiring: TWH insulation, copper conductors.
  - .7 Rigid piping: required to suit oil pressure.
  - .8 Flexible hose: required to suit oil pressure and maintain flexibility.
  - .9 Primer: to Master Painters Institute MPI# 79 - Primer, Alkyd, Anti-Corrosive for Metal. Ecologo certified.
  - .10 Undercoat: lead primer to CAN/CGSB-1.140-M89, Ecologo certified.
  - .11 Paint: exterior enamel to CAN/CGSB-1.59-97, Ecologo certified, in safety yellow colour to CGSB 1-GP-12c+Amdt-Feb-85, number 505-101.
-

2.2 FABRICATION

- .1 To Ontario Ministry of Labour, Occupational Health and Safety Division, Industrial Health and Safety Branch, Engineering Data Sheet No. 8-03, June 1980, unless otherwise specified.
  - .2 Mounting; Integral steel box structure or concrete pit.
  - .3 Cylinder: Bore turned, polished, seamless steel pipe with oil connections, positive stop ring, top and bottom bearing mounting, size to suit efficiency and safety, piston type with stuffing box, packing, plunger wipe and packing gland or displacement type with positive stop ring and limit switch preventing platform travel beyond stated limits.
  - .4 Power unit: remote, minimum 372 W motor with overload protection, directly connected pump with pressure relief valve bypassing oil back to reservoir, oil piping, wiring, conduit, check valve, and flexible hose, metal enclosure and wall support frame.
  - .5 Oil reservoir: integral with torque tube or separate non-ferrous metal tank or steel tank with strainer assembly, overflow, drain connection and protected vent opening.
  - .6 Platform: steel floor plate welded to steel members of size, type and spacing required to accommodate capacity load in out-of-level condition without deformation or affect on operation. Out-of-level compensation, minimum 100 mm, when floating on truck bed.
  - .7 Toe guard: steel plate side skirts both sides of dock ramp for full width and height of ramp, with ramp at highest position.
  - .8 Safety lock: velocity fuse at cylinder inlet to limit downward travel of ramp top maximum 75 mm if trailer or truck moves away while carrying capacity load.
  - .9 Control station: pushbutton, continuous pressure operation, wall mounted, to complement operation.
  - .10 Shop apply 1 coat of primer, 1 coat of undercoat and 2 coats of paint to metal surfaces.
-

2.2 FABRICATION  
(Cont'd)

- .11 Weatherseals: neoprene, mounted on curb angles, continuous both sides and across back of platform in cross traffic position.
- .12 Maintenance strut: steel, size and type to support ramp in up position while being serviced.
- .13 Override switch: prevent dock ramp rising when overhead door is closed.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 In accordance with manufacturer's instructions.
- .2 By mechanics experienced in this work.
- .3 Turn components built into concrete and templates over to Concrete Section for building in.
- .4 Centre and shim plumb, level and square to a tolerance of 1:500, flush with adjoining surfaces.
- .5 Securely fix components in place.
- .6 Mount power unit on interior wall 2000 mm above floor.
- .7 Mount control unit on interior wall 1200 mm above floor.
- .8 Extend and connect hydraulic piping between power unit and dock ramp.
- .9 Fill hydraulic system with oil.
- .10 Adjust and align components to achieve smooth dock ramp operation.
- .11 Touch up scratched and chipped paint.
- .12 Lubricate components.

3.2 OPERATION

- .1 Activate control station button, ramp rises.
- .2 Dock ramp to travel to highest position.



3.2 OPERATION  
(Cont'd)

- .3 Lip to automatically extend and lock in position.
- .4 Release control station button, ramp descends.
- .5 Dock ramp to float down to and rest freely on truck bed.
- .6 When truck pulls away from above dock level position, dock ramp to automatically return to cross traffic position and lip automatically return behind bumpers.
- .7 To lower dock ramp below cross traffic position, activate control station button to raise dock ramp above cross traffic position. Manually operate lever to pull front plate beyond stop hooks to cut out automatic return, dock ramp descends to bottom of travel without lip extension and stops.
- .8 When truck pulls away from below dock level position, activate control station button to raise dock ramp above cross traffic, release control button, ramp descends to cross traffic position.

3.3 TEST

- .1 Conduct factory tests in presence of Engineer under load capacity and submit test results in writing to Engineer before shipping ramp to site.
- .2 Operate dock to limits of travel.
- .3 Demonstrate out-of-level compensation on bed of variety of trucks and trailers.
- .4 Demonstrate mechanical or hydraulic safety fuse.



PART 1 - GENERAL

1.1 RELATED  
SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29 - Health and Safety Requirements.
- .3 Section 01 45 00 - Quality Control.
- .4 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.
- .5 Section 01 78 00 - Closeout Submittals.
- .6 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

1.2 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00.
  - .2 Shop drawings; submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
  - .3 Submit for approval within 10 days after Award of Contract.
  - .4 Shop drawings to show:
    - .1 Mounting arrangements.
    - .2 Operating and maintenance clearances.
  - .5 Shop drawings and product data accompanied by:
    - .1 Detailed drawings of bases, supports, and anchor bolts.
    - .2 Acoustical sound power data, where applicable.
    - .3 Points of operation on performance curves.
    - .4 Manufacturer to certify current model production.
    - .5 Certification of compliance to applicable codes.
  - .6 In addition to transmittal letter referred to in Section 01 33 00: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
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- 1.2 SUBMITTALS (Cont'd)
- .7 Closeout Submittals:
- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00.
  - .2 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
  - .3 Operation data to include:
    - .1 Control schematics for systems including environmental controls.
    - .2 Description of systems and their controls.
    - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
    - .4 Operation instruction for systems and component.
    - .5 Description of actions to be taken in event of equipment failure.
    - .6 Valves schedule and flow diagram.
    - .7 Colour coding chart.
  - .4 Maintenance data to include:
    - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
    - .2 Data to include schedules of tasks, frequency, tools required and task time.
  - .5 Performance data to include:
    - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
    - .2 Equipment performance verification test results.
    - .3 Special performance data as specified.
    - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93.
  - .6 Approvals:
    - .1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
    - .2 Make changes as required and re-submit as directed by Departmental Representative.
  - .7 Additional data:
    - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
-

- 1.2 SUBMITTALS (Cont'd) .7 Closeout Submittals:(Cont'd)
- .8 As-built drawings and specifications:
    - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
    - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (date).
    - .3 Submit to Departmental Representative for approval and make corrections as directed.
    - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings and specifications.
    - .5 Submit completed reproducible as-built drawings and specifications with Operating and Maintenance Manuals.
  - .9 Submit copies of as-built drawings and specifications for inclusion in final TAB report.
- 1.3 HALOCARBONS .1 Comply with Federal Halocarbon Regulations 2003 under the Canadian Environmental Protection Act 1999, EPAM and PWGSC Ontario Region Halocarbon Information Sheet dated March 2010.
- 1.4 QUALITY ASSURANCE .1 Quality Assurance: in accordance with Section 01 45 00.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.
- 1.5 MAINTENANCE .1 Furnish spare parts in accordance with Section 01 78 00 as follows:
- .1 One set of packing for each pump.
  - .2 One casing joint gasket for each size pump.
  - .3 One head gasket set for each heat exchanger.
  - .4 One glass for each gauge glass.
  - .5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
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- 1.5 MAINTENANCE (Cont'd)
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00.
  - .3 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- .1 Waste Management and Disposal:
    - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

PART 2 - PRODUCTS

- 2.1 MATERIALS
- .1 Complete list of equipment and materials to be used on this project by adding manufacturer's name, model number and details of materials, and submit for approval.

PART 3 - EXECUTION

- 3.1 CLEANING
- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.
- 3.2 FIELD QUALITY CONTROL
- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 and submit report as described in PART 1 - SUBMITTALS.
  - .2 Manufacturer's Field Services:
    - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
    - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
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- 3.2 FIELD QUALITY CONTROL (Cont'd) .2 Manufacturer's Field Services:(Cont'd)  
.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
- 3.3 DEMONSTRATION .1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Trial usage to apply to following equipment and systems:  
.1 HVAC and plumbing equipment.
- .3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .4 Where specified elsewhere in Division 22 or 23 manufacturers to provide demonstrations and instructions.
- .5 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .6 Instruction duration time requirements as specified in appropriate sections.
- .7 Departmental Representative will record these demonstrations on video tape for future reference.
- 3.4 PROTECTION .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.





PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 61 00 - Common Product Requirements.
  - .3 Section 01 74 11 - Cleaning.
  - .4 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.
  - .5 Section 01 78 00 - Closeout Submittals.
  - .6 Section 01 91 00 - General Commissioning (CX) Requirements.
  - .7 Section 23 05 05 - Installation of Pipework.
  - .8 Section 23 05 19.01 - Thermometers and Pressure Gauges - Piping Systems.
- 1.2 REFERENCES
- .1 National Fire Protection Association (NFPA)
    - .1 NFPA (Fire) 13-2010, Standard for the Installation of Sprinkler Systems, 2010 Edition.
    - .2 NFPA (Fire) 14, Standard for the Installation of Standpipe and Hose Systems, 2010 Edition.
    - .3 NFPA (Fire) 20, Standard for the Installation of Stationary Pumps for Fire Protection, 2010 Edition.
- 1.3 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Provide submittals in accordance with Section 01 33 00.
  - .2 Product Data:
    - .1 Provide manufacturer's printed product literature and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Shop Drawings:
    - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
    - .2 Submit complete plans to Authority of Jurisdiction for review and approval before commencement of work.
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- 1.3 ACTION AND INFORMATIONAL SUBMITTALS (Cont'd)
- .3 Shop Drawings:(Cont'd)  
.3 Indicate grooved joint couplings and fittings on drawings.
- .4 Samples:  
.1 Submit the following samples:  
.1 Firehose nozzles.  
.2 Section of hose.
- .5 Test reports:  
.1 Submit certified test reports for standpipe and hose assembly from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
- .6 Manufacturers' Instructions:  
.1 Provide manufacturer's installation instructions.
- .7 Field Quality Control Submittals:  
.1 Manufacturer's Field Reports: manufacturer's field reports specified.
- 1.4 CLOSEOUT SUBMITTALS
- .1 Provide maintenance data for standpipe and hose system for incorporation into manual specified in Section 01 78 00.
- 1.5 QUALITY ASSURANCE
- .1 Qualifications:  
.1 Installer: company or person specializing in standpipe and hose assembly approved by manufacturer.
- .2 Supply grooved joint couplings, fittings, valves, grooving tools and specialties from a single manufacturer. Use date stamped castings for coupling housings, fittings, valve bodies, for quality assurance and traceability.
- 1.6 DELIVERY, STORAGE AND HANDLING
- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:  
.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
-

- 1.6 DELIVERY,  
STORAGE AND  
HANDLING  
(Cont'd)
- .3 Storage and Protection:  
.1 Store materials indoors or in dry location.  
.2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.
- .4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding and packaging materials in accordance with Section 01 74 20.

PART 2 - PRODUCTS

- 2.1 SYSTEM  
DESCRIPTION
- .1 Design system to NFPA (Fire) 14 and following parameters:  
.1 Combined with sprinkler systems: hydraulic.
- 2.2 SUSTAINABLE  
REQUIREMENTS
- .1 Grooved couplings and fittings made from minimum 90% recycled metal.
- 2.3 PIPE, FITTINGS  
AND VALVES
- .1 Pipe:  
.1 Ferrous: to NFPA (Fire) 14.  
.2 Copper tube: to NFPA (Fire) 14.
- .2 Fittings and joints to NFPA (Fire) 14:  
.1 Ferrous: screwed, welded, flanged or roll grooved.  
.1 Grooved joints designed with two ductile iron housing segments, pressure responsive gasket, and zinc-electroplated steel bolts and nuts. Cast with offsetting angle-pattern bolt pads for rigidity and visual pad-to-pad offset contact.  
.2 Copper tube: screwed, soldered, brazed.
- .3 Valves:  
.1 ULC listed for fire protection service.  
.2 Up to NPS 2: bronze, screwed ends, grooved, OS&Y gate.  
.3 NPS 2-1/2 and over: cast or ductile iron, flanged or roll grooved ends, indicating butterfly valve.  
.4 Check valves: spring actuated swing type, composition disc or seal.
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- 2.3 PIPE, FITTINGS AND VALVES  
(Cont'd)
- .4 Pipe hangers:  
.1 ULC listed for fire protection services.
- .5 Drain valve: NPS 1, complete with hose end, cap and chain.
- .6 Inspector's test connections: NPS 1 gate valve.
- 2.4 CABINETS
- .1 To NFPA (Fire) 14 and ULC listed: surface type as indicated, constructed of 1.6 mm thick steel, 180 degrees opening door of 2.5 mm thick steel with hinge same side as water supply and latching device. Provide locking cabinet with 2 sets of keys to be turned over to Owner.
- .2 Cabinets to maintain fire resistive rating of construction in which they occur.
- .3 Cabinet door: with 5 mm full tempered glass panel c/w security mesh.
- .4 Large enough to accommodate angle valve, hose rack, fire hose nozzle and spanner, fire extinguisher.
- .5 ULC listed for fire service. NPS 1-1/2 cast or forged brass complete with hand wheel, open or drip connections, or hydrolator valve. Where water pressure exceeds 690 kPa, provide ULC listed pressure reducing device c/w 30.5 mm hose.
- .6 ULC listed, NPS 2-1/2 forged or cast brass angle valve: with thread compatible with local fire department, complete with handwheel, cap and chain. Cap to be part of ULC listing for valve.
- .7 Fire extinguisher shall be 4.5 kg ABC.
- 2.5 PUMPER CONNECTION
- .1 To NFPA (Fire) 14, ULC listed, Siamese type, location as indicated. Threads to be compatible with local fire department complete with threaded metal caps and chains.
-

2.6 PRESSURE GAUGES .1 90 mm diameter, to Section 23 05 19.01.

2.7 FINISHES .1 In finished areas, chrome plate valves, nozzles, fittings and hose rack.

.2 Cabinets.  
.1 Tub: prime coated.  
.2 Door and frame: No. 4 satin finish stainless steel.

PART 3 - EXECUTION

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

3.2 INSTALLATION .1 Install and test to acceptance in accordance with NFPA (Fire) 14.

.2 Install pipework in accordance with Section 23 05 05, supplemented as specified.

.3 Run inspectors test connections to sight glass.

.4 Install drain pipes and valves to drain parts of systems and so arranged that any one standpipe riser can be drained without shutting down any other parts of systems.

.5 Install 90 mm diameter pressure gauge in accordance with Section 23 05 19.01 at top of risers and in accordance with NFPA (Fire) 14.

.6 The source of the water supply shall be reliable and capable of providing the required supply for not less than 30 minutes.

.7 Water supply for standpipe system:  
.1 Class I Systems:  
.1 Receive water supply sufficient to provide 1892.50 lpm for each additional standpipe.  
.2 Total supply not to exceed 9462.5 lpm.

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- 3.2 INSTALLATION (Cont'd) .7 Water supply for standpipe system:(Cont'd)
- .1 Class I Systems:(Cont'd)
    - .3 Supply system: capable of maintaining residual pressure of 690 kPa at each topmost outlet with 1892.50 standpipe and 946.25 lpm flowing from each additional standpipe up to maximum of 9462.5 lpm.
  - .2 Class III Systems:
    - .1 Receive water supply from source sufficient to provide 1892.50 lpm for single standpipe and 946.25 lpm for each additional standpipe.
    - .2 Total supply not to exceed 9462.5 lpm.
    - .3 System: capable of maintaining residual pressure of 690 kPa at each top most outlet with 1892.50 lpm flowing from most remote standpipe and 946.25 lpm flowing from each additional standpipe up to maximum of 9462.5 lpm flowing.
  - .3 Standpipe systems: hydraulically designed.
- 3.3 FIELD QUALITY CONTROL .1 Manufacturer's Field Services:
- .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
- 3.4 SITE TEST .1 General:
- .1 In accordance with NFPA (Fire) 14, supplemented as specified.
  - .2 In accordance with Section 01 91 00: General Requirements, supplemented as specified.
- .2 Testing witnessed by Fire Commissioner of Canada and authority having jurisdiction.
-

- 3.4 SITE TEST  
(Cont'd)
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- .3 Disposal of water used in flushing and testing:  
.1 Discuss appropriate measures with Departmental Representative.
- .4 Timing:  
.1 Connect fire hoses when flushing out and pressure tests have been completed.  
.2 Charge system with water when there is no possibility of freeze-up.  
.3 Perform tests after pressure booster pumps have been tested.
- .5 Co-ordination:  
.1 Co-ordinate tests with performance verification of:  
.1 Standpipe and hose systems specified in Section 21 12 01.  
.2 Fire alarm systems specified Section 28 31 00 01. Co-ordinate tests with performance verification of fire pumps.  
.3 Wet pipe sprinkler systems specified Section 21 13 13.
- .6 Procedures:  
.1 Verify that system is complete prior to start-up and testing procedures.  
.2 Verify that ULC labels are visible.  
.3 Fill system with water for pressure. Record water supply pressure.  
.4 Pressure test piping system as required by authority having jurisdiction.  
.5 Start up fire pumps and jockey pumps.  
.6 Verify flow switches are operational.  
.7 Verify valves in system are visible and monitored.  
.8 Flushing: fill with water, let stand at operating pressure for 1 week. Drain risers separately, then drain main.  
.9 Flush buried mains and lead-in connections before making connection to indoor sprinkler system.  
.10 Perform flow tests, including tests of pre-action systems, as required by:  
.1 Authority having jurisdiction.  
.2 Applicable NFPA standards such as 13, 14 & 20.  
.3 Local building codes.  
.11 Record incoming pressure to building for 10 days prior to activating system.  
.12 Adjust PRV on pump discharge to maximum pressure of 620 kPa at top fire hose station.  
.13 Adjust PRV's at lower fire hose stations to 550 kPa maximum.
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- 3.4 SITE TEST  
(Cont'd)
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- .6 Procedures:(Cont'd)
    - .14 Fill glycol legs, confirming proper operation of backflow preventers.
    - .15 Adjust pressure switches.
  - .7 Sundry checks:
    - .1 Verify that properly sized pressure restricting discs are installed where required.
  - .8 Identification:
    - .1 Verify devices are properly labelled, identifying area served, etc.
  - .9 Report:
    - .1 Refer to Section 01 91 00, reports supplemented as specified.
    - .2 In addition to reports required by NFPA (Fire) 14, include the following:
      - .1 Copy of schematic and valve schedule.
  - .10 Posted Instructions:
    - .1 Prepare schematic, mount behind glare-free glass and install where directed.
    - .2 Prepare valve schedule, mount behind glare-free glass and install where directed.
  - .11 Training:
    - .1 Refer to Section 01 91 00: Training of O&M Personnel.
  - .12 Documentation:
    - .1 Provide written certification to Departmental Representative that system was installed, flushed and tested in accordance with appropriate codes, approved plans and calculations.
    - .2 Certificate to include:
      - .1 Contractors name.
      - .2 Contractors address.
      - .3 Contractors license number.
      - .4 List of approved materials and devices installed.
      - .5 Description of system test conducted.
      - .6 Dates of flushing and testing.
      - .7 Certification that connections welding conform to acceptable standards.
      - .8 Certification that system is complete and in service.
      - .9 Approved signage has been provided and attached as appropriate.
-



3.4 SITE TEST .12 Documentation:(Cont'd)  
(Cont'd) .2 Certificate to include:(Cont'd)  
.10 Hose threads of system and test  
connections match those of responding  
fire department.

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



PART 1 - GENERAL

1.1 RELATED  
SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 61 00 - Common Product Requirements.
- .3 Section 01 74 11 - Cleaning.
- .4 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.
- .5 Section 01 78 00 - Closeout Submittals.
- .6 Section 23 05 19.01 - Thermometers and Pressure Gauges - Piping Systems.
- .7 Section 26 05 00 - Common Work Results - For Electrical.
- .8 Section 28 31 00.01 - Multiplex Fire Alarm System.

1.2 REFERENCES

- .1 National Fire Prevention Association (NFPA)
    - .1 NFPA (Fire) 13, Standard for the Installation of Sprinkler Systems, 2010 Edition.
    - .2 NFPA (Fire) 20, Standard for the of Stationary Pumps for Fire Protection, 2010 Edition.
    - .3 NFPA (Fire) 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances, 2010 Edition.
    - .4 NFPA (Fire) 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems, 2008 Edition.
  - .2 Underwriter's Laboratories of Canada (ULC)
    - .1 CAN/ULC-S543-09, Standard for Internal Lug Quick Connect Coupling for Fire Hose.
    - .2 CAN/ULC-S543-09-AM1, Amendment 1 to Standard for Internal Lug Quick Connect Coupling for Fire Hose.
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1.3 ACTION AND  
INFORMATIONAL  
SUBMITTALS

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- .1 Provide submittals in accordance with Section 01 33 00.
  - .2 Product Data:
    - .1 Provide manufacturer's printed product literature and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Shop Drawings:
    - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
    - .2 Indicate:
      - .1 Materials.
      - .2 Finishes.
      - .3 Method of anchorage
      - .4 Number of anchors.
      - .5 Supports.
      - .6 Reinforcement.
      - .7 Assembly details.
      - .8 Accessories.
  - .4 Samples:
    - .1 Submit samples of following:
      - .1 Each type of sprinkler head.
      - .2 Signs.
  - .5 Test reports:
    - .1 Submit certified test reports for wet pipe fire protection sprinkler systems from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
  - .6 Certificates:
    - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .7 Manufacturers' Instructions:
    - .1 Provide manufacturer's installation instructions.
  - .8 Field Quality Control Submittals:
    - .1 Manufacturer's Field Reports: manufacturer's field reports specified.
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1.4 CLOSEOUT  
SUBMITTALS

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- .1 Provide operation, maintenance and engineering data for incorporation into manual specified in Section 01 78 00 in accordance with NFPA (Fire) 20.
  - .2 Manufacturer's Catalog Data, including specific model, type, and size for:
    - .1 Pipe and fittings.
    - .2 Alarm valves.
    - .3 Valves, including gate, check, and globe.
    - .4 Water motor alarms.
    - .5 Sprinkler heads.
    - .6 Pipe hangers and supports.
    - .7 Pressure or flow switch.
    - .8 Fire department connections.
    - .9 Excess pressure pump.
    - .10 Mechanical couplings.
  - .3 Drawings:
    - .1 Sprinkler heads and piping system layout.
      - .1 Prepare 760 mm by 1050 mm detail working drawings of system layout in accordance with NFPA (Fire) 13, "Working Drawings (Plans)".
      - .2 Show data essential for proper installation of each system.
      - .3 Show details, plan view, elevations, and sections of systems supply and piping.
      - .4 Show piping schematic of systems supply, devices, valves, pipe, and fittings. Show point to point electrical wiring diagrams.
    - .2 Electrical wiring diagrams.
  - .4 Design Data:
    - .1 Calculations of sprinkler system design.
    - .2 Indicate type and design of each system and certify that each system has performed satisfactorily in the manner intended for not less than 18 months.
  - .5 Field Test Reports:
    - .1 Preliminary tests on piping system.
  - .6 Records:
    - .1 As-built drawings of each system.
      - .1 After completion, but before final acceptance, submit complete set of as-built drawings of each system for record purposes.
      - .2 Submit 760 mm by 1050 mm drawings on reproducible Mylar film with title
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|---|----|---|
| <u>1.4 CLOSEOUT<br/>SUBMITTALS<br/>(Cont'd)</u>   | .6 | Records:(Cont'd)<br>.1 (Cont'd)<br>.2 (Cont'd)<br>block similar to full size contract drawings.   |
|   | .7 | Operation and Maintenance Manuals:<br>.1 Provide detailed hydraulic calculations including summary sheet, and Material and Test Certificate for aboveground and underground piping and other documentation for incorporation into manual in accordance with NFPA (Fire) 13. |
| <u>1.5 QUALITY<br/>ASSURANCE</u>                  | .1 | Qualifications:<br>.1 Installer: company or person specializing in wet sprinkler systems with documented experience approved by manufacturer.   |
|   | .2 | Supply grooved joint couplings, fittings, valves, grooving tools and specialties from a single manufacturer. Use date stamped castings for coupling housings, fittings, valve bodies, for quality assurance and traceability.   |
| <u>1.6 MAINTENANCE<br/>MATERIAL SUBMITTALS</u>    | .1 | Extra Materials:<br>.1 Provide maintenance materials in accordance with Section 01 78 00.<br>.2 Provide spare sprinklers and tools in accordance with NFPA (Fire) 13.   |
| <u>1.7 DELIVERY,<br/>STORAGE AND<br/>HANDLING</u> | .1 | Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.   |
|   | .2 | Delivery and Acceptance Requirements:<br>.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.  |
|   | .3 | Storage and Protection:<br>.1 Store materials indoors or in dry location.<br>.2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.   |
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1.7 DELIVERY,  
STORAGE AND  
HANDLING  
(Cont'd)  
PART 2 - PRODUCTS

- .4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials in accordance with Section 01 74 20.

2.1 DESIGN  
REQUIREMENTS

- .1 Design automatic wet pipe fire suppression sprinkler systems in accordance with required and advisory provisions of NFPA (Fire) 13, by hydraulic calculations for uniform distribution of water over design area.
- .2 Include with each system materials, accessories, and equipment inside and outside building to provide each system complete and ready for use.
- .3 Design and provide each system to give full consideration to blind spaces, piping, electrical equipment, ducts, and other construction and equipment in accordance with detailed shop drawings.
- .4 Locate sprinkler heads in consistent pattern with ceiling grid, lights, and air supply diffusers.
- .5 Devices and equipment for fire protection service: ULC approved for use in wet pipe sprinkler systems.
- .6 Design systems for earthquake protection for buildings in seismic zones 3 and 4, and only essential and high risk buildings in seismic zone 2.
- .7 Location of Sprinkler Heads:  
.1 Locate heads in relation to ceiling and spacing of sprinkler heads not to exceed that permitted by NFPA (Fire) 13 for ordinary or extra hazard occupancy as indicated on drawings  
.2 Uniformly space sprinklers on branch.
- .8 Water Distribution:  
.1 Make distribution uniform throughout the area in which sprinkler heads will open.  
.2 Discharge from individual heads in hydraulically most remote area to be 100% of specified density.

2.1 DESIGN  
REQUIREMENTS  
(Cont'd)

- .9 Density of Application of Water:
  - .1 Size pipe to provide specified density when system is discharging specified total maximum required flow.
  - .2 Application to horizontal surfaces below sprinklers shall be as noted on drawings.
- .10 Sprinkler Discharge Area:
  - .1 Area: hydraulically most remote area as defined in NFPA (Fire) 13.
- .11 Outside Hose Allowances:
  - .1 Include allowance in hydraulic calculations of outside hose streams in accordance with NFPA 13.
- .12 Friction Losses:
  - .1 Calculate losses in piping in accordance with Hazen-Williams formula with 'C' value of 120 for steel piping, 150 for copper tubing, and 140 for cement-lined ductile-iron piping.
- .13 Water Supply:
  - .1 Base hydraulic calculations on static pressure of 375 kPa with 4061 lpm available at residual pressure of 345 kPa at junction with water distribution piping system.

2.2 SUSTAINABLE  
REQUIREMENTS

- .1 Grooved couplings and fittings made from minimum 90% recycled metal.

2.3 ABOVE GROUND  
PIPING SYSTEMS

- .1 Provide fittings for changes in direction of piping and for connections.
  - .1 Make changes in piping sizes through tapered reducing pipe fittings, bushings will not be permitted.
- .2 Perform welding in shop; field welding will be permitted.
- .3 Conceal piping in areas with.

2.4 PIPE, FITTINGS  
AND VALVES

- .1 Pipe:
    - .1 Ferrous: to NFPA (Fire) 13.
    - .2 Copper tube: to NFPA (Fire) 13.
  - .2 Fittings and joints to NFPA (Fire) 13:
-



2.4 PIPE, FITTINGS .2  
AND VALVES  
(Cont'd)

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(Cont'd)

.1 Ferrous: screwed, welded, flanged or roll grooved.

.1 Grooved joints designed with two ductile iron housing segments, pressure responsive gasket, and zinc-electroplated steel bolts and nuts. Cast with offsetting angle-pattern bolt pads for rigidity and visual pad-to-pad offset contact.

.2 Copper tube: screwed, soldered, brazed, grooved.

.3 Provide welded, threaded, grooved-end type fittings into which sprinkler heads, sprinkler head riser nipples, or drop nipples are threaded.

.4 Plain-end fittings with mechanical couplings and fittings which use steel gripping devices to bite into pipe when pressure is applied will not be permitted.

.5 Rubber gasketed grooved-end pipe and fittings with mechanical couplings are permitted in pipe sizes 32 mm and larger.

.6 Fittings: ULC approved for use in wet pipe sprinkler systems.

.7 Ensure fittings, mechanical couplings, and rubber gaskets are supplied by same manufacturer.

.8 Side outlet tees using rubber gasketed fittings are not permitted.

.9 Sprinkler pipe and fittings: metal.

.3 Valves:

.1 ULC listed for fire protection service.

.2 Gate valves: open by counterclockwise rotation.

.3 Provide rising stem OS & Y wall indicator valve beneath each alarm valve in each riser when more than one alarm valve is supplied from same water supply pipe.

.4 Check valves: flanged clear opening swing or spring actuated check type with flanged inspection and access cover plate for sizes 10 cm and larger.

.5 Provide gate valve in piping protecting elevator hoistways, machine rooms, and machinery spaces.

.4 Pipe hangers:

.1 ULC listed for fire protection services in accordance with NFPA.

- 2.5 SPRINKLER HEADS .1 General: to NFPA (Fire) 13 and ULC listed for fire services.
- .2 Sprinkler Head Type:
- .1 Type A: upright bronze.
  - .2 Type B: pendant chrome link and lever type.
  - .3 Type C: pendant chrome glass bulb type.
  - .4 Type D: recessed chrome type with ring and cup.
  - .5 Type E: flush chrome link and lever type.
  - .6 Type F: side wall chrome link and lever type.
- .3 Provide nominal 1.2 cm orifice sprinkler heads.
- .1 Release element of each head to be of intermediate temperature rating or higher as suitable for specific application.
  - .2 Provide polished stainless steel ceiling plates sprinklers below suspended ceilings.
  - .3 Provide corrosion-resistant sprinkler heads and sprinkler head guards in accordance with NFPA (Fire) 13.
  - .4 Deflector: not more than 75 mm below suspended ceilings.
  - .5 Ceiling plates: not more than 25 mm deep.
  - .6 Ceiling cups: not permitted.
- 2.6 ALARM CHECK VALVE .1 Alarm check valve to NFPA (Fire) 13 and ULC listed for fire service.
- .2 Provide variable pressure type alarm valve complete with alarm test valve, alarm shutoff valve, drain valve, pressure gages, accessories, and appurtenances for proper operation of system.
- .3 Provide valve complete with internal components that are replaceable without removing the valve from the installed position.
- 2.7 WATER MOTOR ALARMS .1 Provide alarms approved weatherproof and guarded type, to sound locally on flow of water in each corresponding sprinkler system.
- .2 Mount alarms on outside of outer walls of each building at location as directed.
-

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- 2.7 WATER MOTOR ALARMS  
(Cont'd)
- .3 Provide separate drain piping directly to exterior of building.
- 
- 2.8 SUPERVISORY SWITCHES
- .1 General: to NFPA (Fire) 13 and ULC listed for fire service.
- .2 Valves:  
.1 Mechanically attached to valve body, with normally open and normally closed contacts and supervisory capability.
- .3 Pressure or flow switch type:  
.1 With normally open and normally closed contacts and supervisory capability.  
.2 Provide switch with circuit opener or closer for automatic transmittal of alarm over facility fire alarm system.  
.3 Connect into building fire alarm system.  
.4 Connection of switch: Section 28 31 00.01.  
.5 Alarm actuating device: mechanical diaphragm controlled retard device adjustable from 10 to 60 seconds and instantly recycle.
- .4 Pressure alarm switch:  
.1 With normally open and normally closed contacts and supervisory capability.
- 
- 2.9 WATER GONG
- .1 To NFPA (Fire) 13 and ULC listed for fire service. Location as indicated.
- 
- 2.10 FIRE DEPARTMENT CONNECTION
- .1 Provide connections approximately 1.5 m above finish grade, location as indicated.
- .2 To NFPA (Fire) 13 and CAN/ULC-S543 listed, Siamese type.
- .3 Polished bronze chrome plated recessed exposed of approved two-way type with 2.5 inch National Standard female hose threads with plug, chain, and identifying fire department connection escutcheon plate.
- .4 Thread specifications: compatible with local fire department.
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- 2.10 FIRE DEPARTMENT CONNECTION  
(Cont'd)
- .5 Install a 90-degree elbow with drain connection at the low-point near each fire department connection to allow for system drainage to prevent freezing.
- 
- 2.11 EXCESS PRESSURE PUMP
- .1 Provide pumps on each sprinkler piping riser.
- .2 Pumps:
- .1 Pumps: positive displacement, gear type rated at 1 lpm, integrally mounted with motor.
- .2 Double acting displacement type, open cylinder design, direct drive, ULC listed, complete with relief valve.
- .3 Pump and motor unit:
- .1 Approved for automatic wet pipe fire extinguishing sprinkler systems; complete with pilot light panel, differential motor control switch, high pressure switch, and low pressure switch.
- .2 EEMAC Class B squirrel cage induction 1725 rpm, continuous duty, drip proof, ball bearing, maximum temperature rise 50 degrees C, 0.25 kW, 120/1/60.
- .3 Capacity: 7.6 L/min.
- .4 Provide electrical power supply connections for pump and pilot light panel at supply side of building service panel.
- .5 Provide separate fused safety-type switch with locked lever for each connection.
- .6 Provide pressure pump sensing piping in supply piping upstream of fire pump.
- .7 Pump operation switch: to operate excess pressure pump with pressure differential of 103 kPa.
- .8 Shut-off valve and strainer on pump inlet. Relief valve, check valve and shut-off valve on discharge connections.
- 
- 2.12 PRESSURE GAUGES
- .1 ULC listed and to Section 23 05 19.01.
- .2 Maximum limit of not less than twice normal working pressure at point where installed.
-

2.13 BURIED WATER  
PIPING SYSTEM

- .1 Pipe and Fittings:
  - .1 Provide outside-coated, cement-mortar lined, ductile-iron pipe, and fittings, in accordance with NFPA (Fire) 24, for piping under building and outside of building walls.
  - .2 Anchor joints in accordance with NFPA (Fire)
  
- 24.
  - .3 Provide concrete thrust block at elbow where pipe turns up toward the floor, and restrain pipe riser with steel rods from elbow to flange above floor.
  - .4 Minimum pipe size: 150 mm.
  - .5 Minimum depth of cover: 1.0 metre at finish grade.
  - .6 Piping beyond 1.5 metre outside of building walls: Refer to civil drawing and specifications.
  
- .2 Valves:
  - .1 In accordance with NFPA (Fire) 24.
  - .2 Gate valves: ULC listed and opened by counterclockwise rotation.
  
- .3 Post Indicator Valves:
  - .1 Provide with operating nut located about 1.5 m above finish grade.
  - .2 Gate valves for use with indicator post, ULC listed.
  - .3 Indicator posts: ULC listed.
  - .4 Provide each indicator post with 1 coat of primer and two coats of red enamel paint.
  
- .4 Valve Boxes:
  - .1 Except where indicator posts are provided, for each buried valve, provide cast-iron, ductile-iron, plastic valve box of suitable size.
  - .2 Plastic boxes: constructed of acrylonitrile butadiene styrene (ABS) inorganic fiber-reinforced black polyolefin.
  - .3 Provide cast-iron, ductile-iron, plastic cover for valve box with word English French Bilingual wording for "WATER" cast on cover.
  - .4 Minimum box shaft diameter: 13.3 cm.
  - .5 Coat cast-iron ductile-iron boxes with bituminous paint applied to minimum dry-film thickness of 10 ml.
  
- .5 Buried Utility Warning and Identification Tape:
  - .1 Provide detectable aluminum foil plastic backed tape detectable magnetic plastic tape manufactured specifically for warning and

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- 2.13 BURIED WATER PIPING SYSTEM (Cont'd) .5 (Cont'd)
- .1 (Cont'd)  
identification of buried piping detectable by electronic detection instrument.
  - .2 Provide tape in rolls, 7.6 cm minimum width, colour coded in accordance with local utility, with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length.
  - .3 Warning and identification: to read "CAUTION BURIED WATER PIPING BELOW".
  - .4 Use permanent code and letter colouring unaffected by moisture and other substances contained in trench backfill material.
- 2.14 PIPE SLEEVES .1 Provide pipe sleeves where piping passes through walls, floors, and roofs.
- .2 Secure sleeves in position and location during construction.
  - .3 Provide sleeves of sufficient length to pass through entire thickness of walls, floors, and roofs.
  - .4 Provide 2.5 cm minimum clearance between exterior of piping and interior of sleeve or core-drilled hole.
    - .1 Firmly pack space with mineral wool insulation.
    - .2 Seal space at both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to firm but pliable mass, provide mechanically adjustable segmented elastomeric seal.
    - .3 In fire walls and fire floors, seal both ends of pipe sleeves or core-drilled holes with ULC listed fill, void, or cavity material.
  - .5 Sleeves in Masonry and Concrete Walls, Floors, and Roofs:
    - .1 Provide hot-dip galvanized steel, ductile-iron, cast-iron sleeves.
    - .2 Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in core-drilled hole are completely grouted smooth.
  - .6 Sleeves in Other Than Masonry and Concrete Walls, Floors, and Roofs:
    - .1 Provide 0.61 mm thick galvanized steel sheet.
-

- 2.15 ESCUTCHEON PLATES
- .1 Provide one piece split hinge type metal plates for piping passing through walls, floors, and ceilings in exposed spaces.
  - .2 Provide polished stainless steel plates chromium-plated finish on copper alloy plates in finished spaces.
  - .3 Provide paint finish on metal plates in unfinished spaces.
- 2.16 INSPECTOR'S TEST CONNECTION
- .1 Locate inspector's test connection at hydraulically most remote part of each system, provide test connections approximately 3 m above floor for each sprinkler system or portion of each sprinkler system equipped with alarm device.
  - .2 Provide test connection piping to location where discharge will be readily visible and where water may be discharged without property damage.
  - .3 Provide discharge orifice of same size as corresponding sprinkler orifice.
- 2.17 SIGNS
- .1 Attach properly lettered Bilingual and approved metal signs to each valve and alarm device to NFPA (Fire) 13.
  - .2 Permanently fix hydraulic design data nameplates to riser of each system.
- 2.18 ANTIFREEZE
- .1 Antifreeze loops to NFPA (Fire) 13, locations as indicated.
- 2.19 SPARE PARTS CABINET
- .1 Provide metal cabinet with extra sprinkler heads and sprinkler head wrench adjacent to each alarm valve. Number and types of extra sprinkler heads as specified in NFPA (Fire) 13.
-

PART 3 - EXECUTION

- 3.1 MANUFACTURER'S INSTRUCTIONS .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- 3.2 INSTALLATION .1 Install, inspect and test to acceptance in accordance with NFPA (Fire) 13 and NFPA (Fire) 25.
- 3.3 PIPE INSTALLATION .1 Install piping straight and true to bear evenly on hangers and supports. Do not hang piping from plaster ceilings.
- .2 Keep interior and ends of new piping and existing piping thoroughly cleaned of water and foreign matter.
- .3 Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter.
- .4 Inspect piping before placing into position.
- 3.4 ELECTRICAL CONNECTIONS .1 Provide electrical work associated with this section under Section 26 05 00.
- .2 Provide fire alarm system under Section 28 31 00.01.
- .3 Provide control and fire alarm wiring, including connections to fire alarm systems, in accordance with National Electrical Code.
- .4 Provide wiring in rigid metal conduit or intermediate metal conduit.
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- 3.5 CONNECTIONS TO EXISTING WATER SUPPLY SYSTEMS
- .1 Notify Contracting Officer in writing at least 15 days prior to connection date.
  - .2 Use tapping or drilling machine valve and mechanical joint type sleeves for connections to be made under pressure.
  - .3 Bolt sleeves around main piping.
  - .4 Bolt valve to branch connection. Open valve, attach drilling machine, make tap, close valve, and remove drilling machine, without interruption of service.
  - .5 Furnish materials required to make connections into existing water supply systems, and perform excavating, backfilling, and other incidental labour as required.
- 3.6 BURIED PIPING SYSTEM
- .1 Bury tape with printed side up at depth of 30 cm below the top surface of earth or top surface of subgrade under pavements.
- 3.7 FIELD PAINTING
- .1 Clean, pretreat, prime, and paint new systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories.
  - .2 Apply coatings to clean, dry surfaces, using clean brushes.
  - .3 Clean surfaces to remove dust, dirt, rust, and loose mill scale.
  - .4 Immediately after cleaning, provide metal surfaces with 1 coat of pretreatment primer applied to minimum dry film thickness of 0.3 ml, and one coat of zinc chromate primer applied to minimum dry film thickness of 1.0 ml.
  - .5 Shield sprinkler heads with protective covering while painting is in progress.
  - .6 Upon completion of painting, remove protective covering from sprinkler heads.
  - .7 Remove sprinkler heads which have been painted and replace with new sprinkler heads.
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- 3.7 FIELD PAINTING .8 Provide primed surfaces with following:  
(Cont'd)
- .1 Piping in Finished Areas:
    - .1 Provide primed surfaces with 2 coats of paint to match adjacent surfaces.
    - .2 Provide valves and operating accessories with 1 coat of red alkyd gloss enamel applied to minimum dry film thickness of 1.0 mil.
    - .3 Provide piping with 50 mm wide red enamel bands self-adhering red plastic bands spaced at maximum of 6 m intervals throughout piping systems.
  - .2 Piping in Unfinished Areas:
    - .1 Provide primed surfaces with one coat of red alkyd gloss enamel applied to minimum dry film thickness of 1.0 mil in attic spaces, spaces above suspended ceilings, crawl spaces, pipe chases, mechanical equipment room, and spaces where walls or ceiling are not painted or not constructed of a prefinished material.
    - .2 Provide piping with 50 mm wide red enamel bands self-adhering red plastic bands spaced at maximum of 6 m intervals.
- 3.8 FIELD QUALITY .1 Site Test, Inspection:  
CONTROL
- .1 Perform test to determine compliance with specified requirements in presence of Departmental Representative.
  - .2 Test, inspect, and approve piping before covering or concealing.
  - .3 Preliminary Tests:
    - .1 Hydrostatically test each system at 200 psig for a 2 hour period with no leakage or reduction in pressure.
    - .2 Flush piping with potable water in accordance with NFPA (Fire) 13.
    - .3 Piping above suspended ceilings: tested, inspected, and approved before installation of ceilings.
    - .4 Test alarms and other devices.
    - .5 Test water flow alarms by flowing water through inspector's test connection. When tests have been completed and corrections made, submit signed and dated certificate in accordance with NFPA (Fire) 13.
  - .4 Formal Tests and Inspections:
    - .1 Do not submit request for formal test and inspection until preliminary
-

- 3.8 FIELD QUALITY CONTROL  
(Cont'd)
- .1 (Cont'd)
- .4 Formal Tests and Inspections:(Cont'd)
- .1 (Cont'd)  
test and corrections are completed and approved.
- .2 Submit written request for formal inspection at least 15 days prior to inspection date.
- .3 Repeat required tests as directed.
- .4 Correct defects and make additional tests until systems comply with contract requirements.
- .5 Furnish appliances, equipment, instruments, connecting devices, and personnel for tests.
- .6 Authority of Jurisdiction, will witness formal tests and approve systems before they are accepted.
- .2 Manufacturer's Field Services:
- .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
- .3 Site Tests:
- .1 Field test each fire pump, driver and controllers in accordance with NFPA (Fire) 20. Testing shall include:
- .1 Verification of proper installation system initiation adjustment and fine tuning.
- .2 Verification of the sequence of operations and alarm systems.
- .2 Testing to be witnessed by Fire Commissioner of Canada Canadian Forces Fire Marshal authority having jurisdiction.
- .3 Develop, with Departmental Representative assistance, detailed instructions for O & M of this installation.
-

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

PART 1 - GENERAL

1.1 RELATED  
SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 00 - Closeout Submittals.
- .3 Section 01 91 00 - General Commissioning (CX) Requirements.
- .4 Section 21 05 01 - Common Work Results - Mechanical.
- .5 Section 23 05 05 - Installation of Pipework.
- .6 Section 23 05 23.01 - Valves - Bronze.
- .7 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .8 Section 33 11 16 - Incoming Site Water Utility Distribution Piping.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME)
    - .1 ANSI/ASME B16.15-2011, Cast Copper Alloy Threaded Fittings: Classes 125 and 250.
    - .2 ANSI/ASME B16.18-2012, Cast Copper Alloy Solder Joint Pressure Fittings.
    - .3 ANSI/ASME B16.22-2001(R2010), Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
    - .4 ANSI/ASME B16.24-2011, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500.
  - .2 ASTM International Inc. (ASTM)
    - .1 ASTM A307-10, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
    - .2 ASTM B88M-05(2011), Standard Specification for Seamless Copper Water Tube (Metric).
  - .3 American Water Works Association (AWWA)
    - .1 ANSI/AWWA C111/A21.11-07-07, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
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1.2 REFERENCES  
(Cont'd)

- .4 Canada Green Building Council (CaGBC)
  - .1 LEED Canada For New Construction and Major Renovations 2009.
  - .2 LEED Canada For Core and Shell 2009.
  - .3 LEED Canada-CI Version 1.0-2007, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
- .5 Canadian Standards Association (CSA International)
  - .1 CSA B242-05, Groove and Shoulder Type Mechanical Pipe Couplings.
- .6 Department of Justice Canada (Jus)
  - .1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).
- .7 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .8 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
  - .1 MSS-SP-67-2011, Butterfly Valves.
  - .2 MSS-SP-70-2011, Gray Iron Gate Valves, Flanged and Threaded Ends.
  - .3 MSS-SP-71-2011, Gray Iron Swing Check Valves, Flanged and Threaded Ends.
  - .4 MSS-SP-80-2008, Bronze Gate, Globe, Angle and Check Valves.
- .9 National Research Council (NRC)/Institute for Research in Construction
  - .1 NRCC 47668, National Plumbing Code of Canada (NPC) - 2010.
- .10 Transport Canada (TC)
  - .1 Transportation of Dangerous Goods Act, 1992, c. 34 (TDGA).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

- 1.3 ACTION AND INFORMATIONAL SUBMITTALS  
(Cont'd)  
PART 2 - PRODUCTS
- .3 Closeout Submittals:  
.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.
- 2.1 PIPING
- .1 Domestic hot, cold and recirculation systems, within building.  
.1 Above ground: copper tube, hard drawn, type L: to ASTM B88M.  
.2 Buried or embedded: copper tube, soft annealed, type K: to ASTM B88M, in long lengths and with no buried joints.
- 2.2 FITTINGS
- .1 Bronze pipe flanges and flanged fittings, Class 150: to ANSI/ASME B16.24.  
.2 Cast bronze threaded fittings, Class 125: 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.  
.4 Teflon tape: for threaded joints.  
.5 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM flush seal gasket.  
.6 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.
-

- 2.4 GLOBE VALVES .1 NPS2 and under, soldered:  
.1 To MSS-SP-80, Class 125, 860 kPa, bronze body, renewable composition disc, screwed over bonnet as specified Section 23 05 23.01.
- .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 23.01.
- 2.5 SWING CHECK VALVES .1 NPS 2 and under, soldered:  
.1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 23.01.
- .2 NPS 2 and under, screwed:  
.1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 23.01.
- .3 NPS 2-1/2 and over, flanged:  
.1 To MSS-SP-71, Class 125, 860 kPa, cast iron body, flat flange faces, renewable seat, bronze disc, bolted cap specified Section 23 05 23.01.
- 2.6 BALL VALVES .1 NPS 2 and under, screwed:  
.1 Class 150.  
.2 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and Bunan seat, steel lever handle as specified Section 23 05 23.01.
- .2 NPS 2 and under, soldered:  
.1 To ANSI/ASME B16.18, Class 150.  
.2 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and Bunan seat, steel lever handle, with NPT to copper adaptors as specified Section 23 05 23.01.
-



PART 3 - EXECUTION

- 3.1 APPLICATION .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.
- 3.2 INSTALLATION .1 Install in accordance with NPC, Provincial Plumbing Code and local authority having jurisdiction.
- .2 Install pipe work in accordance with Section 23 05 05, supplemented as specified herein.
- .3 Assemble piping using fittings manufactured to ANSI standards.
- .4 Install CWS piping below and away from HWS and HWC and other hot piping so as to maintain temperature of cold water as low as possible.
- .5 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.
- .6 Buried tubing:  
.1 Lay in well compacted washed sand in accordance with AWWA Class B bedding.  
.2 Bend tubing without crimping or constriction. Minimize use of fittings.
- 3.3 VALVES .1 Isolate equipment, fixtures and branches with ball valves.
- .2 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.
- 3.4 PRESSURE TESTS .1 Conform to requirements of Section 21 05 01.
- .2 Test pressure: greater of 1 times maximum system operating pressure or 860 kPa.
-

- 3.5 FLUSHING AND CLEANING .1 Flush entire system for 8 h. Ensure outlets flushed for 2 h. Let stand for 24 h, then draw one sample off longest run. Submit to testing laboratory to verify that system is clean to Provincial and Federal potable water guidelines. Let system flush for additional 2 h, then draw off another sample for testing.
- 3.6 PRE-START-UP INSPECTIONS .1 Systems to be complete, prior to flushing, testing and start-up.
- .2 Verify that system can be completely drained.
- .3 Ensure that pressure booster systems are operating properly.
- .4 Ensure that air chambers, expansion compensators are installed properly.
- 3.7 DISINFECTION .1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction and approval of Departmental Representative.
- .2 Coordinate with Section 33 11 16.
- .3 Upon completion, provide laboratory test reports on water quality for Departmental Representative approval.
- 3.8 START-UP .1 Timing: Start up after:
- .1 Pressure tests have been completed.
- .2 Disinfection procedures have been completed.
- .3 Certificate of static completion has been issued.
- .4 Water treatment systems operational.
- .2 Provide continuous supervision during start-up.
- .3 Start-up procedures:
- .1 Establish circulation and ensure that air is eliminated.
- .2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.
- .3 Commission water conditioning specified Section 22 31 13.
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- 3.8 START-UP  
(Cont'd)
- .3 Start-up procedures:(Cont'd)
    - .4 Bring HWS storage tank up to design temperature slowly.
    - .5 Monitor piping HWS and HWC piping systems for freedom of movement, pipe expansion as designed.
    - .6 Check control, limit, safety devices for normal and safe operation.
  - .4 Rectify start-up deficiencies.
- 3.9 PERFORMANCE  
VERIFICATION
- .1 Scheduling:
    - .1 Verify system performance after pressure and leakage tests and disinfection are completed, and Certificate of Completion has been issued by authority having jurisdiction.
  - .2 Procedures:
    - .1 Verify that flow rate and pressure meet Design Criteria.
    - .2 TAB HWC in accordance with Section 23 05 93.
    - .3 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.
    - .4 Sterilize HWS and HWC systems for Legionella control.
    - .5 Verify performance of temperature controls.
    - .6 Verify compliance with safety and health requirements.
    - .7 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.
    - .8 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.
  - .3 Reports:
    - .1 In accordance with Section 01 91 00: Reports, using report forms as specified in Section 01 91 00: Report Forms and Schematics.
    - .2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.
-

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

PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 61 00 - Common Product Requirements.
  - .3 Section 23 05 05 - Installation of Pipework.
- 1.2 REFERENCES
- .1 ASTM International Inc.
    - .1 ASTM B32-08, Standard Specification for Solder Metal.
    - .2 ASTM B306-09, Standard Specification for Copper Drainage Tube (DWV).
  - .2 Canada Green Building Council (CaGBC)
    - .1 LEED Canada For New Construction and Major Renovations 2009.
    - .2 LEED Canada For Core and Shell 2009.
    - .3 LEED Canada-CI Version 1.0-2007, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
  - .3 Canadian Standards Association (CSA International).
    - .1 CSA B67-1972(R1996), Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.
    - .2 CSA-B70-12, Cast Iron Soil Pipe, Fittings and Means of Joining.
    - .3 CAN/CSA-B125.3-11, Plumbing Fittings.
  - .4 Green Seal Environmental Standards (GSES)
    - .1 Standard GS-36-00, Commercial Adhesives.
  - .5 South Coast Air Quality Management District (SCAQMD), California State
    - .1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.
- 1.3 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Provide submittals in accordance with Section 01 33 00.
  - .2 Product Data:
    - .1 Provide manufacturer's printed product literature and datasheets for adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.
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- 1.4 DELIVERY, STORAGE AND HANDLING
- .1 Deliver, store and handle in accordance with Section 01 61 00.
  - .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

PART 2 - PRODUCTS

- 2.1 COPPER TUBE AND FITTINGS
- .1 Above ground vent DCW, DHW, DHWR Type DWV to: ASTM B306.
    - .1 Fittings.
      - .1 Cast brass: to CAN/CSA-B125.3.
      - .2 Wrought copper: to CAN/CSA-B125.3.
    - .2 Solder: lead free, to ASTM B32.

- 2.2 CAST IRON PIPING AND FITTINGS
- .1 Above ground sanitary, storm and vent: to CAN/CSA-B70.
    - .1 Joints:
      - .1 Hub and spigot:
        - .1 Caulking lead: to CSA B67.
      - .2 Mechanical joints:
        - .1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

PART 3 - EXECUTION

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

- 3.2 INSTALLATION
- .1 In accordance with Section 23 05 05.
  - .2 Install in accordance with National Plumbing Code, Provincial Plumbing Code and local authority having jurisdiction.
-

- 3.3 TESTING
- .1 Pressure test buried systems before backfilling.
  - .2 Hydraulically test to verify grades and freedom from obstructions.
- 3.4 PERFORMANCE VERIFICATION
- .1 Cleanouts:
    - .1 Ensure accessible and that access doors are correctly located.
    - .2 Open, cover with linseed oil and re-seal.
    - .3 Verify that cleanout rods can probe as far as the next cleanout, at least.
  - .2 Test to ensure traps are fully and permanently primed.
  - .3 Storm water drainage:
    - .1 Verify domes are secure.
    - .2 Ensure weirs are correctly sized and installed correctly.
    - .3 Verify provisions for movement of roof system.
  - .4 Ensure that fixtures are properly anchored, connected to system and effectively vented.
  - .5 Affix applicable label (storm, sanitary, vent, pump discharge etc.) c/w directional arrows every floor or 4.5 m (whichever is less).





PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 61 00 - Common Product Requirements.
  - .3 Section 23 05 05 - Installation of Pipework.
- 1.2 REFERENCES
- .1 ASTM International Inc.
    - .1 ASTM D2564-04(2009)e1, Standard Specification for Solvent Cements for Poly(Vinyl-Chloride) (PVC) Plastic Piping Systems.
  - .2 Canadian Standards Association (CSA International)
    - .1 CSA B1800-11, Thermoplastic Nonpressure Pipe Compendium - B1800 Series.
  - .3 Green Seal Environmental Standards (GSES)
    - .1 Standard GS-36-00, Commercial Adhesives.
  - .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
    - .1 Material Safety Data Sheets (MSDS).
  - .5 South Coast Air Quality Management District (SCAQMD), California State
    - .1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.
- 1.3 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Provide submittals in accordance with Section 01 33 00.
  - .2 Product Data:
    - .1 Provide manufacturer's printed product literature and datasheets for piping and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.
    - .2 Provide two copies WHMIS MSDS - Material Safety Data Sheets.
-

- 1.4 DELIVERY,  
STORAGE AND  
HANDLING
- .1 Deliver, store and handle in accordance with Section 01 61 00.
  - .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
  - .3 Store at temperatures and conditions recommended by manufacturer.

PART 2 - PRODUCTS

- 2.1 PIPING AND  
FITTINGS
- .1 For buried DWV piping to:
    - .1 CAN/CSA-B1800.

- 2.2 JOINTS
- .1 Solvent weld for PVC: to ASTM D2564.

PART 3 - EXECUTION

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

- 3.2 INSTALLATION
- .1 In accordance with Section 23 05 05.
  - .2 Install in accordance with National Plumbing Code, Provincial Plumbing Code and local authority having jurisdiction.

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

3.4 PERFORMANCE  
VERIFICATION

- .1 Cleanouts:
  - .1 Ensure accessible and that access doors are correctly located.
  - .2 Open, cover with linseed oil and re-seal.
  - .3 Verify cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Storm water drainage:
  - .1 Verify domes are secure.
  - .2 Ensure weirs are correctly sized and installed correctly.
  - .3 Verify provisions for movement of roof system.
- .4 Ensure fixtures are properly anchored, connected to system and effectively vented.
- .5 Affix applicable label (storm, sanitary, vent, pump discharge) c/w directional arrows every floor or 4.5 m (whichever is less).

3.5 CLEANING

- .1 Remove surplus materials, excess materials, rubbish, tools and equipment.



PART 1 - GENERAL

- 1.1 SUMMARY
- .1 Section Includes:
    - .1 The supply and installation of Plumbing Fixtures and Trim.
    - .2 Sustainable requirements for construction and verification.
    - .3 Products Installed but not Supplied Under this Section:
      - .1 Install rough-in for equipment supplied by others, complete with valves on hot and cold water supplies, waste and vent.
      - .2 Equipment installed by others.
        - .1 Connect with unions.
      - .3 Equipment not installed.
        - .1 Capped for future connection by others.
    - .4 Related Sections:
      - .1 Section 01 33 00 - Submittal Procedures.
      - .2 Section 01 35 29 - Health and Safety Requirements.
      - .3 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.
      - .4 Section 01 78 00 - Closeout Submittals.
- 1.2 REFERENCES
- .1 Canadian Standards Association (CSA International).
    - .1 CAN/CSA-B45 Series-02(R2008), Plumbing Fixtures.
    - .2 CSA-B125.3-11, Plumbing Fittings.
    - .3 CAN/CSA-B651-04(R2010), Accessible Design for the Built Environment.
- 1.3 SUBMITTALS
- .1 Submittals in accordance with Section 01 33 00.
  - .2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets.
    - .1 Submit shop drawings and product data in accordance with Section 01 33 00.
      - .1 Indicate, for all fixtures and trim:
        - .1 Dimensions, construction details, roughing-in dimensions.
-

- 
- 1.3 SUBMITTALS  
(Cont'd)
- .3 Closeout Submittals:  
.1 Submit maintenance data in accordance with Section 01 78 00.  
.2 Include:  
.1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.  
.2 Details of operation, servicing, maintenance.  
.3 List of recommended spare parts.
- 1.4 QUALITY ASSURANCE
- .1 Health and Safety:  
.1 Do construction occupational health and safety in accordance with Section 01 35 29.
- 1.5 DELIVERY STORAGE AND DISPOSAL
- .1 Waste Management and Disposal:  
.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.  
.2 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.  
.3 Fold up metal and plastic banding, flatten and place in designated area for recycling.
- PART 2 - PRODUCTS
- 2.1 MANUFACTURED UNITS
- .1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.
- .2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.
- .3 Exposed plumbing brass to be chrome plated.
- .4 Number, locations: architectural drawings to govern.
- .5 Fixtures in any one location to be product of one manufacturer and of same type.
- .6 Trim in any one location to be product of one manufacturer and of same type.
-

- 2.1 MANUFACTURED UNITS  
(Cont'd)
- .7 Mop sinks:
    - .1 Sink: 316 stainless steel 300 mm high undrilled integral back. Size: 610 x 610 x 254 mm.
    - .2 Supply fitting: with built-in elevated vacuum breaker, indexed cross handles, 1400 mm long rubber hose, escutcheons, union inlets, heavy cast brass spout with pail hook, aerator, brace to wall, integral stop valves. Provide accessories to limit maximum flow rate to 8.35 l/minute at 413 kPa.
  - .8 Fixture piping:
    - .1 Hot and cold water supplies to each fixture:
      - .1 Chrome plated rigid supply pipes each with screwdriver stop, reducers, escutcheon.
      - .2 Waste:
        - .1 Brass P trap with clean out on each fixture not having integral trap.
        - .2 Chrome plated in all exposed places.
  - .9 Chair carriers:
    - .1 Factory manufactured floor-mounted carrier systems for all wall-mounted fixtures.

PART 3 - EXECUTION

- 3.1 INSTALLATION
- .1 Mounting heights:
    - .1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified.
    - .2 Wall-hung fixtures: coordinate on site, measured from finished floor.
    - .3 Physically handicapped: to comply with most stringent of either NBCC and CAN/CSA-B651.
- 3.2 ADJUSTING
- .1 Conform to water conservation requirements specified this section.
  - .2 Adjustments:
    - .1 Adjust water flow rate to design flow rates.
    - .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.

3.2 ADJUSTING  
(Cont'd)

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- .3 Checks:
  - .1 Aerators: operation, cleanliness.
  - .2 Vacuum breakers, backflow preventers:  
operation under all conditions.
  - .3 Wash fountains: operation of  
flow-actuating devices.
  
- .4 Thermostatic controls:
  - .1 Verify temperature settings, operation  
of control, limit and safety controls.



PART 1 - GENERAL

- 1.1 SUMMARY
- .1 Section Includes:
    - .1 Materials and installation for plumbing specialties and accessories.
  - .2 Related Sections:
    - .1 Section 01 33 00 - Submittal Procedures.
    - .2 Section 01 78 00 - Closeout Submittals.
    - .3 Section 01 91 00 - Commissioning - General Requirements.
- 1.2 REFERENCES
- .1 American Society for Testing and Materials International (ASTM).
    - .1 ASTM A126-04(2009), Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
    - .2 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
  - .2 Canadian Standards Association (CSA International).
    - .1 CSA B64 Series-11, Backflow Preventers and Vacuum Breakers.
    - .2 CSA B79-08, Floor, Area and Shower Drains, and Cleanouts for Residential Construction.
    - .3 CSA B356-10, Water Pressure Reducing Valves for Domestic Water Supply Systems.
  - .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
    - .1 Material Safety Data Sheets (MSDS).
  - .4 Plumbing and Drainage Institute (PDI).
    - .1 PDI-G101-96, Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data.
    - .2 PDI-WH201-92, Water Hammer Arresters Standard.
- 1.3 SUBMITTALS
- .1 Submittals in accordance with Section 01 33 00.
  - .2 Product Data:
    - .1 Submit manufacturer's printed product literature, specifications and datasheet for fixtures and equipment.
-

- 1.3 SUBMITTALS  
(Cont'd)
- .2 Product Data:(Cont'd)
    - .2 Indicate dimensions, construction details and materials for specified items.
    - .3 Submit WHMIS MSDS. Indicate VOC's for adhesive and solvents during application and curing.
  - .3 Shop Drawings:
    - .1 Submit shop drawings to indicate materials, finishes, method of anchorage, number of anchors, dimensions construction and assembly details.
  - .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .5 Instructions: submit manufacturer's installation instructions.
  - .6 Manufacturers' Field Reports: manufacturers' field reports specified.
  - .7 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00, 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.

PART 2 - PRODUCTS

- 2.1 FLOOR DRAINS
- .1 Floor Drains and Trench Drains: to CSA B79.
  - .2 Type FD-1: general duty; cast iron body round, adjustable head, heavy duty stainless steel strainer, integral seepage pan, and clamping collar c/w tamper resistant screws.
  - .3 Type FFD-1: combination funnel floor drain; cast iron body with integral seepage pan, clamping collar, nickel-bronze adjustable head strainer with integral funnel c/w tamper resistant screws.
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<u>2.1 FLOOR DRAINS</u> (Cont'd)	.4	Type FD2: 100 $\phi$ mm epoxy coated trench drain with stainless steel grate, anchor flanges, membrane clamps.
<u>2.2 CLEANOUTS</u>	.1	Cleanout Plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.
	.2	Access Covers: <ul style="list-style-type: none"><li>.1 Wall Access: face or wall type, polished nickel bronze stainless steel roundcover with flush head securing screws, bevelled edge frame complete with anchoring lugs.</li><li>.2 Floor Access: round cast iron body and frame with adjustable secured nickel bronze top and:<ul style="list-style-type: none"><li>.1 Plugs: bolted bronze with neoprene gasket.</li><li>.2 Cover for Unfinished Concrete Floors: nickel bronze round, gasket, vandal-proof screws.</li><li>.3 Cover for Terrazzo Finish: polished nickel bronze with recessed cover for filling with terrazzo, vandal-proof locking screws.</li></ul></li></ul>
<u>2.3 NON-FREEZE WALL HYDRANTS</u>	.1	Recessed with integral vacuum breaker, NPS 3/4 hose outlet, removable operating key. Chrome plated finish.
<u>2.4 WATER HAMMER ARRESTORS</u>	.1	Stainless steel or copper construction: to PDI-WH201.
<u>2.5 BACK FLOW PREVENTERS</u>	.1	Preventers: to CSA B64 Series, application as indicated, reduced pressure principle type eck valve assembly as indicated on drawings.
<u>2.6 VACUUM BREAKERS</u>	.1	Breakers: to CSA B64 Series, vacuum breaker atmospheric.

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- 2.7 PRESSURE REGULATORS
- .1 Capacity: as indicated.
    - .1 Inlet pressure: 413 kPa.
    - .2 Outlet pressure: 276 kPa.
    - .3 Capacity: 2 L/s.
  - .2 Up to NPS 1-1/2 bronze bodies, screwed: to ASTM B62.
  - .3 NPS 2 and over, semi-steel bodies, Class 125, flanged: to ASTM A126.
  - .4 Semi-steel spring chambers with bronze trim.
- 2.8 WATER MAKE-UP ASSEMBLY
- .1 Complete with backflow preventer pressure gauge on inlet and outlet, pressure reducing valve to CSA B356, pressure relief valve on low pressure side and gate valves on inlet and outlet.
- 2.9 WATER METERS
- .1 By others.
- 2.10 TRAP SEAL PRIMERS
- .1 Brass, with integral vacuum breaker, NPS 1/2 solder ends, NPS 1/2 drip line connection.
- 2.11 STRAINERS
- .1 860 kPa, Y type with 20 mesh, monel, bronze or stainless steel removable screen.
  - .2 NPS 2 and under, bronze body, screwed ends, with brass cap.
  - .3 NPS 2-1/2 and over, cast iron body, flanged ends, with bolted cap.
- 2.12 GREASE INTERCEPTORS
- .1 Tested and rated in accordance with PDI G101, complete with acid resistant interior enamel finish for mounting flush with floor with non-skid covers complete with flow control fitting suitably vented.
  - .2 Capacity: as per drawings.
-

- 2.13 SOAP DISPENSING SYSTEMS
- .1 By others. Provide piping only.
  - .2 Piping: NPS 1/2 black steel with standard malleable iron fitting for concealed installations. NPS 1/2 chrome plated brass pipe and fittings for exposed installations. Fit exposed piping with chrome plated solid red brass wall flanges. Make joints with litharge and glycerine.

PART 3 - EXECUTION

- 3.1 MANUFACTURER'S INSTRUCTIONS
- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.
- 3.2 INSTALLATION
- .1 Install in accordance with National Plumbing Code of Canada, provincial codes and local authority having jurisdiction.
  - .2 Install in accordance with manufacturer's instructions and as specified.
- 3.3 CLEANOUTS
- .1 Install cleanouts at base of soil and waste stacks, and rainwater leaders, at locations required code, and as indicated.
  - .2 Bring cleanouts to wall or finished floor unless serviceable from below floor.
  - .3 Building drain cleanout and stack base cleanouts: line size to maximum NPS4.
- 3.4 BACK FLOW PREVENTORS
- .1 Install in accordance with CSA B64 Series, where indicated and elsewhere as required by code.
  - .2 Pipe discharge to terminate over nearest drain and/or service sink.
-

- 3.5 HOSE BIBBS AND  
SEDIMENT FAUCETS .1 Install at bottom of risers, at low points to  
drain systems, and as indicated.
- 3.6 TRAP SEAL  
PRIMERS .1 Install for floor drains and elsewhere, as  
indicated.
- .2 Install on cold water supply to nearest  
frequently used plumbing fixture, in concealed  
space, to approval of Engineer.
- .3 Install soft copper or plastic tubing to  
floor drain.
- 3.7 STRAINERS .1 Install with sufficient room to remove  
basket.
- 3.8 GREASE  
INTERCEPTORS .1 Install with sufficient space, as indicated,  
for ease of maintenance.
- 3.9 WATER METERS .1 Install water meter provided by local water  
authority.
- .2 Install water meter as indicated.
- 3.10 WATER MAKE-UP  
ASSEMBLY .1 Install on valved bypass.
- .2 Pipe discharge from relief valve to nearest  
floor drain.
- 3.11 START-UP .1 General:  
.1 In accordance with Section 01 91 00:  
General Requirements, supplemented as  
specified herein.
- .2 Timing: start-up only after:  
.1 Pressure tests have been completed.  
.2 Disinfection procedures have been  
completed.  
.3 Certificate of static completion has  
been issued.  
.4 Water treatment systems operational.
-

- 3.11 START-UP  
(Cont'd) .3 Provide continuous supervision during start-up.
- 3.12 TESTING AND ADJUSTING .1 General:  
.1 In accordance with Section 01 91 00: General Requirements, supplemented as specified.
- .2 Timing:  
.1 After start-up deficiencies rectified.  
.2 After certificate of completion has been issued by authority having jurisdiction.
- .3 Application tolerances:  
.1 Pressure at fixtures: +/- 70 kPa.  
.2 Flow rate at fixtures: +/- 20%.
- .4 Adjustments:  
.1 Verify that flow rate and pressure meet design criteria.  
.2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.
- .5 Floor drains:  
.1 Verify operation of trap seal primer.  
.2 Prime, using trap primer. Adjust flow rate to suit site conditions.  
.3 Check operations of flushing features.  
.4 Check security, accessibility, removeability of strainer.  
.5 Clean out baskets.
- .6 Vacuum breakers, backflow preventers, backwater valves:  
.1 Test tightness, accessibility for O&M of cover and of valve.  
.2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.  
.3 Verify visibility of discharge from open ports.
- .7 Roof drains:  
.1 Check location at low points in roof.  
.2 Check security, removeability of dome.  
.3 Adjust weirs to suit actual roof slopes, meet requirements of design.  
.4 Clean out sumps.  
.5 Verify provisions for movement of roof systems.
-

3.12 TESTING AND  
ADJUSTING  
(Cont'd)

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- .8 Access doors:
  - .1 Verify size and location relative to items to be accessed.
- .9 Cleanouts:
  - .1 Verify covers are gas-tight, secure, yet readily removable.
- .10 Water hammer arrestors:
  - .1 Verify proper installation of correct type of water hammer arrester.
- .11 Wall, Ground hydrants:
  - .1 Verify complete drainage, freeze protection.
  - .2 Verify operation of vacuum breakers.
- .12 Pressure regulators, PRV assemblies:
  - .1 Adjust settings to suit locations, flow rates, pressure conditions.
- .13 Strainers:
  - .1 Clean out repeatedly until clear.
  - .2 Verify accessibility of cleanout plug and basket.
  - .3 Verify that cleanout plug does not leak.
- .14 Grease interceptors:
  - .1 Activate, using manufacturer's recommended procedures and materials.



PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 61 00 - Common Product Requirements.
  - .3 Section 01 74 11 - Cleaning.
  - .4 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.
  - .5 Section 01 78 00 - Closeout Submittals.
- 1.2 REFERENCES
- .1 Canadian Standards Association (CSA International)
    - .1 CAN/CSA-B45 Series-02(R2008), Plumbing Fixtures.
    - .2 CSA-B125.3-11, Plumbing Fittings.
- 1.3 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Provide submittals in accordance with Section 01 33 00.
  - .2 Product Data:
    - .1 Provide manufacturer's printed product literature and datasheets for washroom fixtures, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Indicate fixtures and trim:
    - .1 Dimensions, construction details, roughing-in dimensions.
    - .2 Factory-set water consumption per flush at recommended pressure.
    - .3 (For water closets, urinals): minimum pressure required for flushing.
    - .4 172 kPA.
  - .4 Shop Drawings:
    - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
-

- 1.4 CLOSEOUT  
SUBMITTALS
- .1 Provide operation and maintenance data for washroom fixtures, for incorporation into manual specified in Section 01 78 00.
  - .2 Include:
    - .1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.
    - .2 Details of operation, servicing, maintenance.
    - .3 List of recommended spare parts.
- 1.5 DELIVERY,  
STORAGE AND  
HANDLING
- .1 Deliver, store and handle in accordance with Section 01 61 00.
  - .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

PART 2 - PRODUCTS

- 2.1 MANUFACTURED  
UNITS
- .1 Fixtures: manufacture in accordance with CAN/CSA B45 series.
  - .2 Trim, fittings: manufacture in accordance with CSA B125.3.
  - .3 Exposed plumbing brass to be chrome plated.
  - .4 Number, locations: as indicated.
  - .5 Fixtures in any one location to be product of one manufacturer and of same type.
  - .6 Trim in any one location to be product of one manufacturer and of same type.
  - .7 Water closets:
    - .1 White vitreous china bowl, floor mounted elongated top spud siphon jet, dual flush 4.2/6.0 Litres per flush. Provide corresponding dual flush valve c/w seat bumper. Open front seat less cover with stainless steel hinges.
  - .8 Lavatories:
    - .1 Provide wall hung barrier-free lavatory 540 x 559 x 127-191 mm. Vitreous china rear overflow for concealed arm carrier. Provide chrome plated 100 mm centre faucet deck mount

- 2.1 MANUFACTURED UNITS (Cont'd)
- .8 Lavatories:(Cont'd)
    - .1 (Cont'd)  
with ceramic disk lever handles & accessories to limit flow to 1.9 LPM.
  - .9 Chair carriers:
    - .1 Factory manufactured floor-mounted carrier systems for wall-mounted fixtures.
  - .10 Emergency eyewash & shower:
    - .1 Provide free standing stainless steel showerhead with 1.26 L/s flow control c/w eye/face wash stainless steel bowl, emergency mixing valve & stainless steel lockable cabinet & security screws. All screws shall be vandal resistant penitentiary grade.

PART 3 - EXECUTION

- 3.1 APPLICATION
- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.
- 3.2 INSTALLATION
- .1 Mounting heights:
    - .1 Standard: to manufacturer's recommendations, measured from finished floor.
    - .2 Wall-hung fixtures: as per manufacturer's instructions.
- 3.3 ADJUSTING
- .1 Conform to water conservation requirements specified this section.
  - .2 Adjustments:
    - .1 Adjust water flow rate to design flow rates.
    - .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
    - .3 Adjust flush valves to suit actual site conditions.
    - .4 Adjust urinal flush timing mechanisms.
    - .5 Set controls of automatic flush valves for WCs and urinals to prevent unnecessary flush cycles.
-

- 3.3 ADJUSTING      .3    Checks:  
(Cont'd)
- .1    Water closets, urinals: flushing action.
  - .2    Aerators: operation, cleanliness.
  - .3    Vacuum breakers, backflow preventers:  
operation under all conditions.
- .4    Thermostatic controls:
- .1    Verify temperature settings, operation  
of control, limit and safety controls.
- 
- 3.4 CLEANING      .1    Clean in accordance with Section 01 74 11.
- .1    Remove surplus materials, excess  
materials, rubbish, tools and equipment.
- .2    Waste Management: separate waste materials  
for reuse and recycling in accordance with  
Section 01 74 20.

PART 1 - GENERAL

- 1.1 USE OF SYSTEMS .1 Use of new permanent heating and ventilating systems for supplying temporary heat or ventilation is permitted only under the following conditions:
- .1 Entire system is complete, pressure tested, cleaned, flushed out.
  - .2 Specified water treatment system has been commissioned, water treatment is being continuously monitored.
  - .3 Building has been closed in, areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.
  - .4 There is no possibility of damage from any cause.
  - .5 Supply ventilation systems are protected by 60% filters, which shall be inspected daily, changed every week or more frequently as required.
  - .6 Return systems have approved filters over all openings, inlets, outlets.
  - .7 All systems will be:
    - .1 operated as per manufacturer's recommendations or instructions.
    - .2 operated by Contractor.
    - .3 monitored continuously by Contractor.
  - .8 Warranties and guarantees are not thereby relaxed.
  - .9 Regular preventive and all other manufacturers recommended maintenance routines are performed by Contractor at his own expense and under supervision of Departmental Representative.
  - .10 Before static completion, entire system to be refurbished, cleaned internally and externally, restored to "as- new" condition, filters in air systems replaced.
- .2 Filters referred to herein are over and above those specified elsewhere in this specification.
- .3 Exhaust systems are not included in any approvals for temporary heating ventilation.
-

PART 2 - PRODUCTS

2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not Used.

PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.
  - .3 Section 01 78 00 - Closeout Submittals.
  - .4 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- 1.2 TRIAL USAGE
- .1 Departmental Representative may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
  - .2 Trial usage to apply to following equipment and systems:
    - .1 HVAC & Plumbing.
- 1.3 PROTECTION OF OPENINGS
- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.
- 1.4 SPARE PARTS
- .1 Furnish spare parts in accordance with Section 01 78 00 as follows:
    - .1 One set of packing for each pump.
    - .2 One casing joint gasket for each size pump.
    - .3 One head gasket set for each heat exchanger.
    - .4 One glass for each gauge glass.
    - .5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- 1.5 SPECIAL TOOLS
- .1 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00.
  - .2 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.
-

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 Where specified elsewhere in Mechanical Divisions, manufacturers to provide demonstrations and instructions.
- .3 Use operation and maintenance manual, as-built drawings, audio visual aids, etc. as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.
- .5 Where deemed necessary, Departmental Representative may record these demonstrations on video tape for future reference.

1.7 CLOSEOUT  
SUBMITTALS

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00.
  - .2 Operation and maintenance manual to be approved by, and final copies deposited with, Departmental Representative 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.
-



- 
- 1.7 CLOSEOUT SUBMITTALS  
(Cont'd)
- .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 as specified in Section 23 05 93.
- .6 Approvals:
- .1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless so directed by Departmental Representative.
  - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .7 Additional data:
- .1 Prepare and insert into operation and maintenance manual 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.
- .2 Shop drawings and product data shall show:
- .1 Mounting arrangements.
  - .2 Operating and maintenance clearances. eg. access door swing spaces.
- .3 Shop drawings and product data shall be accompanied by:
- .1 Detailed drawings of bases, supports, and anchor bolts.
  - .2 Acoustical sound power data, where applicable.
  - .3 Points of operation on performance curves.
  - .4 Manufacturer to certify as to current model production.
  - .5 Certification of compliance to applicable codes.
- .4 In addition to transmittal letter referred to in Section 01 33 00: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
-

- 1.9 CLEANING .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.
- 1.10 AS-BUILT DRAWINGS .1 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 Departmental Representative for approval and make corrections as directed.  
.4 TAB to be performed using as-built drawings.  
.5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .2 Submit copies of as-built drawings for inclusion in final TAB report.
- 1.11 WASTE MANAGEMENT AND DISPOSAL .1 Separate and recycle waste materials in accordance with Section 01 74 20.  
.2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.  
.3 Dispose of unused paint material at official hazardous material collections site approved by Departmental Representative.  
.4 Do not dispose of unused paint material into sewer system, into streams, lakes, onto ground or in other locations where it will pose health or environmental hazard.  
.5 Remove from site and dispose of packaging materials at appropriate recycling facilities.  
.6 Dispose of corrugated cardboard, polystyrene, plastic packaging material in appropriate on-site bin for recycling in accordance with site waste management program.
-

1.12 HALOCARBONS .1 Comply with Federal Halocarbon Regulations 2003 under the Canadian Environmental Protection Act 1999, EPAM and PWGSC Ontario Region Halocarbon Information Sheet dated March 2010.

PART 2 - PRODUCTS

2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not Used.



PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 74 11 - Cleaning.
  - .3 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.
  - .4 Section 01 78 00 - Closeout Submittals.
  - .5 Section 07 84 00 - Fire Stopping.
  - .6 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
- 1.2 REFERENCES
- .1 Canadian General Standards Board (CGSB)
    - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
  - .2 Canada Green Building Council (CaGBC)
    - .1 LEED Canada-NC Version 1.0-2004, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations.
    - .2 Rating System Addenda for New Construction and Major Renovations LEED Canada-NC Version 1.0-Addendum 2007.
    - .3 LEED Canada-CI Version 1.0-2007, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
- 1.3 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Provide submittals in accordance with Section 01 33 00.
- 1.4 DELIVERY, STORAGE AND HANDLING
- .1 Deliver, store and handle in accordance with Section 01 61 00.
  - .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
-

PART 2 - PRODUCTS

2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

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

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

3.3 CLEARANCES .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.  
.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, components.

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

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- 3.4 DRAINS  
(Cont'd)
- .4 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.
- 3.5 AIR VENTS
- .1 Install automatic air vents at high points in piping systems.
- .2 Install isolating valve at each automatic air valve.
- .3 Install drain piping to approved location and terminate where discharge is visible.
- 3.6 DIELECTRIC  
COUPLINGS
- .1 General: compatible with system, to suit pressure rating of system.
- .2 Locations: where dissimilar metals are joined.
- .3 NPS 2 and under: isolating unions or bronze valves.
- .4 Over NPS 2: isolating flanges.
- 3.7 PIPEWORK  
INSTALLATION
- .1 Screwed fittings jointed with Teflon tape.
- .2 Protect openings against entry of foreign material.
- .3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .4 Assemble piping using fittings manufactured to ANSI standards.
- .5 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.
- .1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.
- .6 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
-

3.7 PIPEWORK  
INSTALLATION  
(Cont'd)

- .7 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .9 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .10 Group piping wherever possible.
- .11 Ream pipes, remove scale and other foreign material before assembly.
- .12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .13 Provide for thermal expansion as indicated.
- .14 Valves:
  - .1 Install in accessible locations.
  - .2 Remove interior parts before soldering.
  - .3 Install with stems above horizontal position unless otherwise indicated.
  - .4 Valves accessible for maintenance without removing adjacent piping.
  - .5 Install globe valves in bypass around control valves.
  - .6 Use ball valves at branch take-offs for isolating purposes except where otherwise specified.
  - .7 Install butterfly valves between weld neck flanges to ensure full compression of liner.
  - .8 Install ball valves for glycol service.
- .15 Check Valves:
  - .1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and elsewhere as indicated.
  - .2 Install swing check valves in horizontal lines on discharge of pumps and elsewhere as indicated.

3.8 SLEEVES

- .1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.
- .2 Material: schedule 40 black steel pipe.



- 
- 3.8 SLEEVES  
(Cont'd)
- .3 Construction: foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.
  - .4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.
  - .5 Installation:
    - .1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.
    - .2 Other floors: terminate 25 mm above finished floor.
    - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.
  - .6 Sealing:
    - .1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.
    - .2 Elsewhere: Provide space for firestopping. Maintain fire rating integrity.
    - .3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.
    - .4 Ensure no contact between copper pipe or tube and sleeve.
- 3.9 ESCUTCHEONS
- .1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.
  - .2 Construction: one piece type with set screws. Chrome or nickel plated brass or type 302 stainless steel.
  - .3 Sizes: outside diameter to cover opening or sleeve. Inside diameter to fit around pipe or outside of insulation if so provided.
- 3.10 PREPARATION FOR FIRE STOPPING
- .1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to Section 07 84 00.
  - .2 Uninsulated unheated pipes not subject to movement: No special preparation.
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- 3.10 PREPARATION FOR FIRE STOPPING  
(Cont'd)
- .3 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe movement without damaging fires topping material or installation.
- .4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.
- 3.11 FLUSHING OUT OF PIPING SYSTEMS
- .1 Flush system in accordance with Section 23 08 02.
- .2 Before start-up, clean interior of piping systems in accordance with requirements of relevant mechanical sections.
- .3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.
- 3.12 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK
- .1 Advise Departmental Representative 48 hours minimum prior to performance of pressure tests.
- .2 Pipework: test as specified in relevant sections of heating, ventilating and air conditioning work.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .5 Conduct tests in presence of Departmental Representative.
- .6 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests by Departmental Representative.
-

3.13 EXISTING  
SYSTEMS

- .1 Connect into existing piping systems at times approved by Departmental Representative.
- .2 Request written approval 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.

3.14 CLEANING

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



PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.
- 1.2 REFERENCES
- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
    - .1 ANSI/ASHRAE 90.1-2007, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
  - .2 Electrical Equipment Manufacturers' Advisory Council (EEMAC)
- 1.3 SECTIONS INCLUDES
- .1 Electrical work to conform to Electrical Divisions including the following:
    - .1 Supplier and installer responsibility is indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
    - .2 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 23. Refer to Division 26 for quality of materials and workmanship.
- 1.4 SHOP DRAWINGS
- .1 Submit shop drawings in accordance with Section 01 33 00.
- 1.5 CLOSEOUT SUBMITTALS
- .1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 33 00.
-

1.6 WASTE  
MANAGEMENT AND  
DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
- .2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.
- .3 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .4 Dispose of corrugated cardboard, polystyrene, plastic packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Motors to be high efficiency, in accordance with local Hydro company standards and the requirements of ASHRAE 90.1.

2.2 MOTORS

- .1 Provide motors for mechanical equipment as specified.
- .2 If delivery of specified motor will delay delivery or installation of equipment, install motor approved by Departmental Representative for temporary use. Final acceptance of equipment will not occur until specified motor is installed.
- .3 Motors under 373 W 1/2 HP: speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.
- .4 Motors 373 W 1/2 HP and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40°C, 3 phase, 575 V, unless otherwise specified or indicated.

2.3 TEMPORARY  
MOTORS

- .1 If delivery of specified motor will delay completion or commissioning work, install motor approved by Departmental Representative for temporary use. Work will only be accepted when specified motor is installed.

2.4 BELT DRIVES

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise specified.
- .3 For motors under 7.5 kW 10 HP: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- .4 For motors 7.5 kW 10 HP and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
- .5 Correct size of sheave to be determined during commissioning.
- .6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .7 Motor slide rail adjustment plates to allow for centre line adjustment.
- .8 Supply one set of spare belts for each set installed.

2.5 DRIVE GUARDS

- .1 Provide guards for unprotected drives.
  - .2 Guards for belt drives;
    - .1 Expanded metal screen welded to steel frame.
    - .2 Minimum 1.2 mm thick sheet metal tops and bottoms.
    - .3 38 mm dia holes on both shaft centres for insertion of tachometer.
    - .4 Removable for servicing.
  - .3 Provide means to permit lubrication and use of test instruments with guards in place.
  - .4 Install belt guards to allow movement of motors for adjusting belt tension.
  - .5 Guard for flexible coupling:
    - .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
    - .2 Securely fasten in place.
-

- 2.5 DRIVE GUARDS      .5    Guard for flexible coupling:(Cont'd)  
    (Cont'd)                      .3    Removable for servicing.
- .6    Unprotected fan inlets or outlets:  
                                 .1    Wire or expanded metal screen,  
                                        galvanized, 19 mm mesh.  
                                 .2    Net free area of guard: not less than  
                                        80% of fan openings.  
                                 .3    Securely fasten in place.  
                                 .4    Removable for servicing.

PART 3 - EXECUTION

- 3.1 INSTALLATION      .1    Fasten securely in place.
- .2    Make removable for servicing, easily returned  
                                        into, and positively in position.



PART 1 - GENERAL

- 1.1 REFERENCES
- .1 NEMA MG 1-2009, Part 30.
  - .2 NEMA MG 1-2009, Part 31.
  - .3 IEEE 519-1992, IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
  - .4 CSA 22.2-1998.
  - .5 ANSI/UL 508C Revision 7/03, Standard for Power Conversion Equipment.
- 1.2 SCOPE
- .1 Provide Variable Frequency Drives (VFD's) for the equipment listed on Drawing Schedules.
  - .2 Provide on-site commissioning (start-up) of the Variable Frequency Drives by factory trained service personnel. Adequate time must be allowed to thoroughly and safely start, program, and test run the VFD with the building management system. A separate site visit to be provided for training of operation and maintenance personnel.
  - .3 The contractor is responsible for ensuring that the existing equipment is in top operating condition before the commissioning of the VFD's occur. Any additional work required to bring the equipment into top operating condition should be brought to the Engineers attention.
- 1.3 SUBMITTALS
- .1 All submittals must include the following:
    - .1 A detailed description of all components in the VFD package, including line and load reactor impedance ratings and or filter design type, VFD current, HP, and voltage rating.
    - .2 A list of any exceptions to this specification.
    - .3 Harmonic specification compliance calculations.
-

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- 1.3 SUBMITTALS (Cont'd)
- .2 All approval submittals shall include the following and approvals must be received prior to delivery of any goods:
- .1 Schematic wiring diagram showing all VFD package component connections and all serial, digital and analog inputs and outputs to be connected to the control system.
  - .2 Mechanical dimensional drawings with mounting details.
- .3 On completion of the installation, the supplier shall provide the following:
- .1 Full commissioning report documenting all programmable settings, AC input voltage, DC Bus voltage, current draw at maximum speed, amp vs speed curve and a description of ambient conditions.
  - .2 One operators manual for each VFD installed.
  - .3 One 216 mm x 279 mm wiring diagram for each VFD installed.
- 1.4 GENERAL DESIGN CHARACTERISTIC
- .1 The VFD shall be of the Pulse Width Modulated (PWM) voltage source type, utilizing fixed diode bridge input rectification and Insulated Gate Bipolar Transistor (IGBT) / Intelligent Power Module (IPM) technology.
- .2 The VFD's digital electronic control board(s) shall be manufactured using Surface Mount Technology (SMT).
- .3 The VFD shall be dual rated for variable torque applications, with the continuous duty output current on the nameplate. The overload rating shall be 110% for 60 seconds. The VFD shall be selected such that the continuous duty current rating shall be equal to or greater than the connected motor full load current rating.
- .4 All VFD's shall be factory CSA/CUL certified.
- .5 All packaged drive systems shall be CSA certified.
- .6 The VFD shall have the capability of operating multiple motors. The minimum VFD continuous current rating shall be the sum of the full load current ratings of the connected motors.
-

- 1.4 GENERAL DESIGN CHARACTERISTIC (Cont'd)
- .7 The VFD shall be capable of operating in an open circuit mode i.e. with the motor(s) disconnected, for start-up and test purposes.
  - .8 The VFD shall have a minimum displacement power factor of 0.96 or higher at all output frequencies.
  - .9 The VFD and all options (e.g. line and load reactors, filters, bypass, etc.) must be manufacturer wired & warrantied as an assembly in NEMA 1 enclosures. The enclosures may be of a Wall or Floor mount design, depending on the rating, and be supplied with forced ventilation complete with cleanable air filters in enclosures where components produce excessive heat.
  - .10 The VFD manufacturer shall have a minimum of five years experience in the Canadian Market.
  - .11 Warranty of the VFD System shall be for 24 months from the date of start-up or thirty months from date of delivery, whichever is sooner. The warranty shall include all parts and repair labour. The VFD manufacturer shall have the ability to repair the system within 24 hours of notification.

## PART 2 - PRODUCTS

- 2.1 STANDARD VFD DESIGN FEATURE
- .1 Microprocessor Logic: The VFD shall include a 32 bit microprocessor and DSP (Digital Signal Processor). A digital display keypad shall be provided for input of parameter setting and operating commands. The digital display shall indicate output frequency, motor RPM, output current, as well as fault history information.
  - .2 Digital Inputs: The VFD shall include a minimum of five (5) digital inputs programmable for function. Each input shall also be programmable to operate as a normally open (n/o) or normally closed (n/c) contact.
  - .3 Analog Inputs: The VFD shall accept an analog speed reference input signal of 0-5 V DC, 0-10 V DC, and/or 4-20 ma). If both inputs are active, the 0-10V DC (or 0-5 V DC) or 4-20 mA signals shall be selectable by a digital input.

2.1 STANDARD VFD  
DESIGN FEATURE  
(Cont'd)

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- .4 Digital Outputs: The VFD shall include two(2) digital outputs each programmable for drive run, frequency arrival (at set speed) or over torque. Each output shall also be programmable to operate as a normally open (n/o) or normally closed (n/c) contact.
  - .5 Analog Output: The VFD shall provide an analog pwm output signal (0-10 V DC, @ 1 ma) proportional to the output frequency or output current.
  - .6 Alarm Relay Outputs: The VFD shall provide an alarm relay which activates during a fault condition. The relay contacts shall include a set of normally open/normally closed (form c) contacts.
  - .7 Auto Restart: The VFD shall have the capability to automatically restart the motor after an interruption in input power.
  - .8 Critical Frequency Rejection: The VFD shall provide a minimum of three(3) selectable jump frequency points used to avoid critical resonance of the mechanical system. Frequency bandwidth for each jump frequency shall be programmable from 0 to +/- 9.9 Hz.
  - .9 DC Injection Braking: The VFD DC braking control shall be capable of automatic initiation prior to all start commands to stop a "wind-milling" fan motor before issuing a run command. The duration and amplitude of this setting is to be programmable through the operator interface.
  - .10 Acceleration/Deceleration Control: The VFD shall provide independent programmable settings for accel/dec l time (0-999 seconds). The VFD shall also include a setting to allow the motor to coast to a stop.  
  
Acceleration and deceleration shall be programmable for linear, S-Curve, U-Curve or Reverse-U-Curve output.
  - .11 Carrier Frequency: The carrier frequency shall be programmable from 3 kHz up to a maximum of 16 kHz in 0.1 increments.
  - .12 Energy Savings:
    - .1 The VFD shall be programmable for variable torque V/F curves to optimize energy consumption.
-

2.1 STANDARD VFD  
DESIGN FEATURE  
(Cont'd)

- .12 Energy Savings:(Cont'd)  
.2 The VFD shall include an Automatic Energy Savings feature to further reduce energy consumption by minimizing the current demand of the motor for a given load, automatically.
- .13 Automatic Voltage Regulation: The VFD shall maintain the rated starting torque independent of the input voltage tolerance of +/-10%.
- .14 Power Loss Ride-through: The VFD shall have a ride-through capability during an intermittent loss of power for up to 15 mSec.
- .15 Min/Max Speed: Minimum and maximum speed settings shall be adjustable from 0 - 100%.
- .16 Fault Log: A fault log will record the total number of faults and display details of the last three faults, including reason for fault, frequency at time of fault, current at time of fault, and DC Bus Voltage at time of fault.
- .17 Pre-set Speeds: Using the digital inputs a minimum of 7 programmable pre-set speeds shall be selectable.
- .18 Safety Interlocks: Terminals to be provide for connection of safety interlocks such as motor thermistors Fire-stat and Freeze-stat. These interlocks shall shutdown operation in either the Drive or Bypass operating modes.
- .19 Door Mounted Operator Controls/Indicators: The basic operator controls shall consist of the following:  
- Hand - Off - Auto Selector Switch  
- Potentiometer for setting speed in "Hand"  
- Indicating Lights for:  
- Power On  
- Run  
- Fault  
- Drive Keypad for setting parameters, control and viewing of Speed, Current, and Alarms.  
- Bypass

2.2 OUTPUT RATINGS

- .1 The VFD shall operate within the following rated values.  
.1 Output Frequency Range: 0.1 to 400 Hz.  
.2 Frequency Accuracy: +/- 0.01% with respect to digital input setting.

- 
- 2.2 OUTPUT RATINGS (Cont'd) .1 (Cont'd)  
.3 Overload Rating: VT - 125% for 60 seconds.
- 2.3 INPUT POWER .1 Voltage: 3 phase (3 wire) 575 V +/- 10%  
.2 Frequency: 60 Hz +/- 5%
- 2.4 ENVIRONMENTAL RATINGS .1 The VFD shall operate within the following parameters without the need for derating:  
.1 Temperature: -10 to 40°C.  
.2 Humidity: 20 - 90% RH non-condensing.  
.3 Altitude: up to 1,000 meters.  
.4 Vibration of 0.2 G or less.
- 2.5 PROTECTIVE FEATURES .1 The VFD shall be designed to include the following protective functions and displays for maintainability:  
.1 All control circuits (5, 12, & 24 V DC) shall be physically and electrically isolated from the power circuit voltages to ensure safety to maintenance personnel.  
.2 Instantaneous Over Current Protection: The output of the VFD shall automatically be turned off if the operating current exceeds the specified level.  
.3 Motor Overload Protection: The VFD shall include electronic thermal overload protection for automatic reduction of the overload limit at reduced operating speed. The output of the VFD shall be disabled if the motor's thermal rating is exceeded.  
.4 External Trip: The VFD shall have the capability to accept an external trip input and the input shall be programmable for either N/O or N/C operation.  
.5 Phase Loss Protection: Phase loss detection shall be provided to prevent single phasing of the VFD input.  
.6 Unattended Start Protection: The VFD shall include a user selectable function to prevent an automatic restart after an interruption in input power.  
.7 Over Voltage Protection: The output of the VFD shall be automatically cut off if the DC Bus voltage exceeds the specified
-

2.5 PROTECTIVE  
FEATURES  
(Cont'd)

- .1 (Cont'd)
- .7 Over Voltage Protection:(Cont'd)  
level due to regenerative energy from the motor.
- .8 Ground Fault Protection: The VFD shall have the capability to sense current imbalance during motor start-up for protection of the power circuit in the event of a ground fault.
- .9 Software Lock The VFD shall include a software function which prevents changes to the user defined settings.
- .10 Power Module Protection: The IPM shall incorporate thermal and short circuit protection circuits.
- .11 CPU or EEPROM Error: VFD shall automatically be turned off in the event of an error in the CPU or EEPROM.
- .12 Option board communication error: VFD will automatically be turned off in the event of an option board error.

2.6 RELIABILITY

- .1 A complete description of the manufacturer's quality assurance and testing program shall be provided.
- .2 Printed Circuit Boards / Pre-assembly: All blank circuit boards shall be checked for appearance, dimensions and continuity as per specification. All electronic components shall be subjected to a visual and functional test. Circuit board components shall be stored at 15-30°C @ 5 % humidity.
- .3 Printed Circuit Board Inspection: All surface-mount devices shall be subjected to microscopic inspection for component alignment and solder joint integrity. All completed circuit boards shall undergo a thermal stress test with temperatures cycled between -5 to 65°C.
- .4 All VFD's of a series shall use one common logic printed circuit board for all units supplied.

2.7 INPUT  
FILTERING

- .1 All VFD's shall be furnished with the following protective devices as a minimum: All 575 volt systems require 5% impedance harmonically compensated Line reactors rated to carry 150% total RMS current continuously

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- 2.7 INPUT FILTERING (Cont'd) .1 (Cont'd)  
for the reduction of line harmonics and to  
limit line voltage transients.
- 2.8 INTEGRAL BYPASS .1 Provide Bypass package in a NEMA 1 enclosure.  
Bypass shall include three (3) contactors for  
manual switching from the VFD to line and from  
Line to VFD. Control Transformer, Class J  
fuses relay and:
- .1 Provide an Operator station consisting  
of:
    - Hand-Off-Auto Selector Switch
    - VFD-Off-Bypass Selector Switch
    - Auto Bypass Enable Switch
    - Test Mode Switch
    - Manual Speed Potentiometer
    - Power On Light
    - External Trip On Light
    - Hand Operation Light
    - Auto Operation Light
    - VFD On Light
    - VFD Run Light
    - VFD Fault Light
    - Frequency Arrival (at set speed) Light
    - Bypass On Light
    - Bypass Fault Light
    - Auto Bypass Enable Light
    - Test Mode Light
  - .2 When in Bypass Mode the VFD shall be  
isolated from the line and motor to  
enable servicing by qualified personnel.  
The Drive output contactor and the bypass  
contactor must be mechanically  
interlocked to prevent simultaneous  
closure.
  - .3 Provide dry contacts for Fault, Run  
Status, and Frequency arrival to the  
building automation system.
  - .4 Provide a 24 VDC power supply.
  - .5 The Drive output contactor and the  
bypass contactor must be mechanically  
interlocked to prevent simultaneous  
closure.
- 2.9 DISCONNECT SWITCH .1 Provide fusible Input Disconnect complete  
with Class J 200 kA interrupt fuses (sized per  
CEC tables), for all VFD installations. The  
Fusible disconnect shall be integrally mounted  
and wired within the VFD NEMA 1 enclosure and  
be provided with a door interlock mechanism to  
prevent unauthorized entry with the power on.
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- 2.9 DISCONNECT SWITCH (Cont'd) .1 (Cont'd)  
In addition the disconnect must have provision for padlocking in the off position. Service personnel shall be able to open the door when the system is operating.
- 2.10 DIGITAL KEYPAD .1 Provide a multi-line display (minimum 4 lines) (68 characters) digital backlit keypad that employs words and numbers for easy operator interface. Keypad shall be capable of monitoring, programming, and operating the VFD.
- 2.11 OVERLOAD RELAY .1 Provide a separately mounted Class 20 overload relay for each motor. Provide door mounted overload reset buttons.
- 2.12 VFD OPERATION .1 Each VFD package shall include a Dual Pump controller to enable one VFD to control either of the two pumps. A three position door mounted selector switch shall allow selection of either pump or in the BMS-Auto position allow the BMS to select either pump with a single N/O contact input. The pumps shall either operate in VFD or Bypass as determined by the bypass control module and shall include the following:
- .1 Provision to switch between pumps "on the fly" i.e. with the VFD ON.
  - .2 Provide O/L relays for each pump c/w door mounted reset buttons.
  - .3 If operating in "BMS-AUTO" and an O/L should trip the controller shall automatically transfer control to the alternate pump, whether in VFD or Bypass operation.
  - .4 Provide automatic bypass operation should the VFD trip and be in fault lockout.
  - .5 If operating in "BMS-AUTO" and the VFD should trip the controller shall, after a time delay, automatically shut down the operating pump and transfer to the alternate pump in full speed bypass operation.
  - .6 Provide pilot light indication for the dual pump controller as follows:
    - Pump 1 selected
    - Pump 2 selected
-

- 2.12 VFD OPERATION .1 (Cont'd)  
(Cont'd) .6 (Cont'd)
- Pump 1 O/L tripped
  - Pump 2 O/L tripped
  - Auto transfer of pumps
- .7 Provide dry contact status indication to the BMS as follows:
- Pump 1 contactor closed
  - Pump 2 contactor closed
  - Auto Transfer

PART 3 - EXECUTION

- 3.1 START-UP AND COMMISSIONING SERVICES .1
- The manufacturer shall provide start-up and commissioning of the variable frequency drive and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. The commissioning personnel shall be the same personnel that will provide the factory service and warranty repairs at the customer site. Sales personnel and other agents who are not factory certified technicians for drive repair shall not be acceptable as commissioning agents. The manufacturer shall have the ability to repair his products within 24 hours of notification of failure.
- .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. Included in this service shall be as a minimum:
- .1 Verification of contractor wire terminations and conduit runs to and from the VFD.
  - .2 One hour of customer operator training on the operation and service diagnostics at the time of commissioning.
  - .3 Measurement for verification of proper operation of the following:
    - .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 for the following set-points:
      - .1 minimum speed
      - .2 maximum speed

- 3.1 START-UP AND COMMISSIONING SERVICES  
(Cont'd)
- .2 (Cont'd)
- .3 (Cont'd)
- .3 (Cont'd)
- .3 acceleration and deceleration rates.
- .3 Commissioning agent to verify the programming of the VFD and to provide a written copy of the settings to the engineer.
- .4 Commissioning agent to lock out critical frequencies throughout the operating curve of the equipment as identified and required by the engineer. The agent shall record amperages at six (minimum) different frequencies from minimum to maximum speed.
- 3.2 EXAMINATION
- .1 The contractor is to verify that the job site conditions for installation meet the factory recommended and code required conditions for the VFD installation prior to start-up. These shall include as a minimum:
- .1 Clearance spacing.
- .2 Compliance with environmental ratings of the VFD system.
- .3 Separate conduit installation of the input wiring, the motor wiring, and control wiring. At no time does any of this wiring run in parallel with each other.
- .4 All power and control wiring is complete.
- .2 The VFD is to be covered and protected from installation dust and contamination until the environment is cleaned and ready for operation. The VFD system shall not be operated while the unit is covered.
- .3 Power shall not be applied until the manufacturer has started up his equipment.



PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 61 00 - Common Product Requirements.
  - .3 Section 01 74 11 - Cleaning.
  - .4 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.
- 1.2 REFERENCES
- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
    - .1 ASME B31.1-2010, Power Piping.
    - .2 ANSI/ASME B31.3-2006, Process Piping.
    - .3 ASME Boiler and Pressure Vessel Code BPVC-2010:
      - .1 BPVC 2010 Section I: Power Boilers.
      - .2 BPVC 2010 Section V: Nondestructive Examination.
      - .3 BPVC 2010 Section IX: Welding and Brazing Qualifications.
  - .2 American National Standards Institute/American Water Works Association (ANSI/AWWA)
    - .1 ANSI/AWWA C206-03, Field Welding of Steel Water Pipe.
  - .3 American Welding Society (AWS)
    - .1 AWS C1.1M/C1.1-2000(R2006), Recommended Practices for Resistance Welding.
    - .2 AWS Z49.1-2005, Safety in Welding, Cutting and Allied Process.
    - .3 AWS W1-2000, Welding Inspection Handbook.
  - .4 Canada Green Building Council (CaGBC)
    - .1 LEED Canada-NC Version 1.0-2004, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations.
    - .2 Rating System Addenda for New Construction and Major Renovations LEED Canada-NC Version 1.0-Addendum 2007.
    - .3 LEED Canada-CI Version 1.0-2007, LEED (Leadership in Energy and Environmental
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- 1.2 REFERENCES .4 (Cont'd)  
(Cont'd) .3 (Cont'd)  
Design): Green Building Rating System  
Reference Guide For Commercial Interiors.
- .5 Canadian Standards Association (CSA  
International)  
.1 CSA W47.2-M1987(R2008), Certification of  
Companies for Fusion Welding of Aluminum.  
.2 CSA W48-06, Filler Metals and Allied  
Materials for Metal Arc Welding.  
.3 CSA B51-03(R2007), Boiler, Pressure  
Vessel and Pressure Piping Code.  
.4 CSA-W117.2-2006, Safety in Welding,  
Cutting and Allied Processes.  
.5 CSA W178.1-2008, Certification of  
Welding Inspection Organizations.  
.6 CSA W178.2-2008, Certification of  
Welding Inspectors.
- 1.3 ACTION AND .1 Provide submittals in accordance with Section  
INFORMATIONAL 01 33 00.  
SUBMITTALS
- 
- 1.4 QUALITY .1 Qualifications:  
ASSURANCE .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 Submit welder's qualifications to  
Departmental Representative.  
.4 Each welder to possess  
identification symbol issued by authority  
having jurisdiction.  
.5 Certification of companies for  
fusion welding of aluminum in accordance  
with CSA W47.2.
- .2 Inspectors:  
.1 Inspectors qualified to CSA W178.2.
- .3 Certifications:  
.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.
-

- 1.5 DELIVERY,  
STORAGE AND  
HANDLING
- .1 Deliver, store and handle in accordance with Section 01 61 00.
  - .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

PART 2 - PRODUCTS

- 2.1 ELECTRODES
- .1 Electrodes: in accordance with CSA W48 Series.

PART 3 - EXECUTION

- 3.1 APPLICATION
- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.
- 3.2 QUALITY OF WORK
- .1 Welding: in accordance with ANSI/ASME B31.1 & 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, applicable requirements of provincial authority having jurisdiction.
- 3.3 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.
-

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- 3.4 INSPECTION AND TESTS - GENERAL REQUIREMENTS
- .1 Review weld quality requirements and defect limits of applicable codes and standards with Departmental Representative before work is started.
  - .2 Formulate "Inspection and Test Plan" in co-operation with Departmental Representative.
  - .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.
- 3.5 SPECIALIST EXAMINATIONS AND TESTS
- .1 General:
    - .1 Perform examinations and tests by specialist qualified to CSA W178.1 and CSA W178.2 and approved by Departmental Representative.
    - .2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.
    - .3 Inspect and test 25% of welds in accordance with "Inspection and Test Plan" by non-destructive visual examination.
  - .2 Hydrostatically test welds to 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 Departmental Representative of total of up to 10% of welds.
  - .5 Magnetic particle tests for natural gas piping systems.
- 3.6 DEFECTS CAUSING REJECTION
- .1 As described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code.
    - .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.
-



- 3.6 DEFECTS CAUSING REJECTION  
(Cont'd) .1 (Cont'd)
- .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 tests.
- 3.7 REPAIR OF WELDS WHICH FAILED TESTS .1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.
- 3.8 CLEANING .1 Clean in accordance with Section 01 74 11.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.



PART 1 - GENERAL

- 1.1 SECTION INCLUDES .1 Materials and installation for thermometers and pressure gauges in piping systems.
- 1.2 RELATED SECTIONS .1 Section 01 33 00 - Submittal Procedures.  
.2 Section 01 35 29 - Health and Safety Requirements.  
.3 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.  
.4 Section 23 05 53.01 - Mechanical Identification.
- 1.3 REFERENCES .1 American Society of Mechanical Engineers (ASME).  
.1 ASME B40.100-05, Pressure Gauges and Gauge Attachments.  
.2 ASME B40.200-2008, Thermometers, Direct Reading and Remote Reading.  
.2 Canadian General Standards Board (CGSB).  
.1 CAN/CGSB-14.4-M88, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.  
.2 CAN/CGSB-14.5-M88, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.
- 1.4 SUBMITTALS .1 Submittals in accordance with Section 01 33 00.  
.2 Submit shop drawings and product data.  
.3 Submit manufacturer's product data for following items:  
.1 Thermometers.  
.2 Pressure gauges.  
.3 Stop cocks.  
.4 Syphons.  
.5 Wells.
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- 1.5 HEALTH AND SAFETY .1 Do construction occupational health and safety in accordance with Section 01 35 29.
- 1.6 WASTE MANAGEMENT AND DISPOSAL .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.
- .2 Collect, separate and place in designated containers for reuse and recycling paper, plastic, polystyrene, corrugated cardboard, packaging Steel, Metal, Plastic in accordance with Waste Management Plan.
- .3 Fold up metal banding, flatten and place in designated area for recycling.
- .4 Place materials defined as hazardous or toxic waste in designated containers.
- .5 Ensure emptied containers are sealed, labelled and stored safely for disposal away from children.

PART 2 - PRODUCTS

- 2.1 GENERAL .1 Design point to be at mid point of scale or range.
- .2 Ranges: as required.
- 2.2 DIRECT READING THERMOMETERS .1 Industrial, variable angle type, liquid filled, 125 mm scale length: to CAN/CGSB14.4 & ASME B40.200.
- 2.3 THERMOMETER WELLS .1 Copper pipe: copper or bronze.
- .2 Steel pipe: brass or stainless steel.
- 2.4 PRESSURE GAUGES .1 112 mm, dial type: to ASME B40.100, Grade 2A, stainless steel phosphor bronze bourdon tube having 0.5% accuracy full scale unless otherwise specified.
-

- 2.4 PRESSURE GAUGES .2 Provide:  
(Cont'd)
- .1 Siphon for steam service.
  - .2 Snubber for pulsating operation.
  - .3 Diaphragm assembly for corrosive service.
  - .4 Gasketed pressure relief back with solid front.
  - .5 Bronze stop cock.

PART 3 - EXECUTION

- 3.1 GENERAL .1 Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units.
- .2 Install between equipment and first fitting or valve.

- 3.2 THERMOMETERS .1 Install in wells on piping. Provide heat conductive material inside well.
- .2 Install in locations as indicated and on inlet and outlet of:
- .1 Heat exchangers.
  - .2 Water heating and cooling coils.
  - .3 Water boilers.
  - .4 Chillers.
  - .5 Cooling towers.
  - .6 DHW tanks.
- .3 Install wells as indicated only for balancing purposes.
- .4 Use extensions where thermometers are installed through insulation.

- 3.3 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 Inlet and outlet of coils.
  - .5 Inlet and outlet of liquid side of heat exchangers.
  - .6 Outlet of boilers.
  - .7 In other locations as indicated.

- 3.3 PRESSURE GAUGES .2 Install gauge cocks for balancing purposes,  
(Cont'd) elsewhere as indicated.
- .3 Use extensions where pressure gauges are  
installed through insulation.
- 3.4 NAMEPLATES .1 Install engraved lamicaid nameplates as  
specified in Section 23 05 53.01, identifying  
medium.

PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 74 20 - Construction/Demolition Waste Management And Disposal.
  - .3 Section 01 78 00 - Closeout Submittals.
- 1.2 REFERENCES
- .1 American Society of Mechanical Engineers (ASME).
  - .2 ASME Fluid Meter's Handbook: Their Theory and Application, Sixth Edition.
- 1.3 PRODUCT DATA
- .1 Submit product data in accordance with Section 01 33 00.
  - .2 Submittals to include:
    - .1 Service conditions.
    - .2 Full details of primary element - standard of design and construction, materials, type serial number, flow rate, differential pressure, irrecoverable head loss (IHL), calculation sheets.
    - .3 Accuracy statements for each component at specified flow rates and other conditions.
    - .4 Flow and temperature ranges.
    - .5 Signal processor calibration data.
    - .6 Minimum turndown ratio.
- 1.4 SHOP DRAWINGS
- .1 Submit shop drawings in accordance with Section 01 33 00.
  - .2 Submittals to include:
    - .1 Piping configuration and sizing - straight pipe upstream and downstream, distances to first weld, protrusion, thermowell, pressure tap.
-

- 1.5 SAMPLES .1 Submit sample in accordance with Section 01 33 00.
- .2 Samples to include:  
.1 Full size samples of recorder charts, integrator readings.
- 1.6 CLOSEOUT SUBMITTALS .1 Submit maintenance data including monitoring requirements for incorporation into manuals specified in Section 01 78 00.
- 1.7 WASTE MANAGEMENT AND DISPOSAL .1 Separate and recycle waste materials in accordance with Section 01 74 20.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 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 ACCURACY .1 Calculate overall accuracy of each installation using following expression:  
Overall accuracy =  $(E (\text{accuracy of all individual components of system})^2)^{1/2}$ .
- .2 Components to include:  
.1 Primary flow measuring elements.  
.2 Transmitters: flow, differential pressure, pressure, temperature, temperature difference.  
.3 RTD's.  
.4 Signal processors, recorders.  
.5 Calibration of signal processors: Assume 0.20% per processor.  
.6 Installation tolerances: Assume 1% for concentricity of pipe, difference in height of transmitter piping.
- .3 Show in proposal overall accuracy at 100%, 70%, 10%, minimum specified design flow rate.
- .4 Indicate minimum measurable flow rate.



PART 3 - EXECUTION

- 3.1 PREPARATION .1 Before final calculations for orifice diameter, and before purchase of orifice plate, nozzle, venturi, measure:  
.1 Internal diameter of main at the primary element to +/-0.01 mm accuracy.  
.2 For concentricity of pipe.
- 3.2 INSTALLATION OF PRIMARY ELEMENT .1 Follow manufacturer's instructions.
- 3.3 INSTALLATION OF DIFFERENTIAL PRESSURE TAPS AND PIPING .1 Differential pressure taps to be truly horizontal and level with each other to within ±1.5 mm.  
.2 Tubing to be straight, supported throughout its length, sloped 5%-10% upward to main for drainage and venting, without air pockets, with blowdown valves at bottom.
- 3.4 START-UP .1 Follow manufacturer's recommendations.



PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 61 00 - Common Product Requirements.
  - .3 Section 01 74 11 - Cleaning.
  - .4 Section 01 74 20 - Construction/Demolition Waste Management And Disposal.
  - .5 Section 01 78 00 - Closeout Submittals.
- 1.2 REFERENCES
- .1 American Society of Mechanical Engineers (ASME)
    - .1 ASME B1.20.1-1983(R2006), Pipe Threads, General Purpose (Inch).
    - .2 ASME B16.18-2001, Cast Copper Alloy Solder Joint Pressure Fittings.
  - .2 ASTM International
    - .1 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
  - .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
    - .1 MSS SP-80-2008, Bronze Gate Globe, Angle and Check Valves.
- 1.3 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Provide submittals in accordance with Section 01 33 00.
  - .2 Product Data:
    - .1 Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.
    - .2 Submit WHMIS MSDS - Material Safety Data Sheets.
  - .3 Shop Drawings:
    - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
    - .2 Submit data for valves specified in this Section.
-

- 1.4 CLOSEOUT SUBMITTALS .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.
- 1.5 MAINTENANCE MATERIAL SUBMITTALS .1 Extra Materials/Spare Parts:  
.1 Furnish following spare parts:  
.1 Valve seats: one for every 10 valves each size, minimum 1.  
.2 Discs: one for every 10 valves, each size. Minimum 1.  
.3 Stem packing: one for every 10 valves, each size. Minimum 1.  
.4 Valve handles: 2 of each size.  
.5 Gaskets for flanges: one for every 10 flanged joints.  
.2 Tools:  
.1 Furnish special tools for maintenance of systems and equipment.  
.2 Include following:  
.1 Lubricant gun for expansion joints.
- 1.6 DELIVERY, STORAGE AND HANDLING .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.  
.2 Delivery and Acceptance Requirements:  
.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.  
.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 20.

PART 2 - PRODUCTS

- 2.1 MATERIALS .1 Valves:  
.1 Except for specialty valves, to be single manufacturer.  
.2 Products to have CRN registration numbers.  
.2 End Connections:  
.1 Connection into adjacent piping/tubing:  
.1 Steel pipe systems: screwed ends to ANSI/ASME B1.20.1.
-

- 2.1 MATERIALS  
(Cont'd)
- 
- .2 End Connections:(Cont'd)
- .1 (Cont'd)
    - .2 Copper tube systems: solder ends to ASME B16.18.
  - .3 Lockshield Keys:
    - .1 Where lockshield valves are specified, provide 10 keys of each size: malleable iron cadmium plated.
  - .4 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, vertical lift type, bronze disc, Class 125:
      - .1 Disc: rotating disc having guides top and bottom, disc guides, retaining rings.
  - .5 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/ASME B1.20.1 and with hex. shoulders.
      - .4 Disc and seat: renewable rotating disc.
      - .5 Stainless steel spring, heavy duty.
      - .6 Seat: regrindable.
  - .6 Ball Valves:
    - .1 NPS 3 and under:
      - .1 Body and cap: cast high tensile bronze to ASTM B62.
-

- 2.1 MATERIALS  
(Cont'd)
- .6 Ball Valves:(Cont'd)
    - .1 NPS 3 and under:(Cont'd)
      - .2 Pressure rating: Class 125 2760-kPa CWP.
  - .7 Butterfly Valves:
    - .1 NPS 2 1/2 through NPS 6, 2068 kPa with grooved ends.
      - .1 Body: cast bronze, with copper-tube dimensioned grooved ends.
      - .2 Disc: elastomer coated ductile iron with integrally cast stem.
      - .3 Operator: lever.

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.
- 3.2 CLEANING
- .1 Clean in accordance with Section 01 74 11.
    - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

PART 1 - GENERAL

1.1 RELATED  
SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 61 00 - Common Product Requirements.
- .3 Section 01 74 11 - Cleaning.
- .4 Section 01 74 20 - Construction/Demolition Waste Management And Disposal.
- .5 Section 01 78 00 - Closeout Submittals.
- .6 Section 03 30 00 - Cast-in-Place Concrete.
- .7 Section 05 12 23 - Structural Steel for Bridges.
- .8 Section 05 50 00 - Metal Fabrications.

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
    - .1 ASME B31.1-2010, Power Piping.
  - .2 ASTM International
    - .1 ASTM A125-96(2007), Standard Specification for Steel Springs, Helical, Heat-Treated.
    - .2 ASTM A307-10, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
    - .3 ASTM A563-07a, Standard Specification for Carbon and Alloy Steel Nuts.
  - .3 Canada Green Building Council (CaGBC)
    - .1 LEED Canada For New Construction and Major Renovations 2009.
    - .2 LEED Canada For Core and Shell 2009.
    - .3 LEED Canada-CI Version 1.0-2007, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
  - .4 Factory Mutual (FM)
  - .5 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
    - .1 MSS SP 58-2009, Pipe Hangers and Supports - Materials, Design and Manufacture.
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- 1.3 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Provide submittals in accordance with Section 01 33 00.
  - .2 Product Data:
    - .1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.
    - .3 Shop Drawings:
      - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
      - .2 Submit shop drawings for:
        - .1 Bases, hangers and supports.
        - .2 Connections to equipment and structure.
        - .3 Structural assemblies.
    - .4 Certificates:
      - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
    - .5 Manufacturers' Instructions:
      - .1 Provide manufacturer's installation instructions.
        - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.
- 1.4 CLOSEOUT SUBMITTALS
- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.
- 1.5 DELIVERY, STORAGE AND HANDLING
- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
  - .2 Delivery and Acceptance Requirements:
    - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
  - .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 20.
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PART 2 - PRODUCTS

- 2.1 SYSTEM DESCRIPTION
- .1 Design Requirements:
    - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
    - .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP 58.
    - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
    - .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
    - .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP 58.
  - .2 Performance Requirements:
    - .1 Design supports, platforms, catwalks, hangers to withstand seismic events in the design area.
- 2.2 GENERAL
- .1 Fabricate hangers, supports and sway braces in accordance with MSS SP 58 and ASME B31.1.
  - .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.
- 2.3 PIPE HANGERS
- .1 Finishes:
    - .1 Pipe hangers and supports: galvanized after manufacture.
    - .2 Use electro-plating galvanizing process or hot dipped galvanizing process.
    - .3 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.
  - .2 Upper attachment structural: suspension from lower flange of I-Beam:
-

- 
- 2.3 PIPE HANGERS  
(Cont'd)
- .2 Upper attachment structural:(Cont'd)
    - .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut.
      - .1 Rod: 9 mm UL listed.
    - .2 Cold piping NPS 2-1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed & FM approved.
  - .3 Upper attachment structural: suspension from upper flange of I-Beam:
    - .1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed & FM approved to MSS SP 58.
    - .2 Cold piping NPS 2-1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed & FM approved.
  - .4 Upper attachment to concrete:
    - .1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
    - .2 Concrete inserts: wedge shaped body with knockout protector plate UL listed & FM approved to MSS SP 58.
  - .5 Shop and field-fabricated assemblies:
    - .1 Trapeze hanger assemblies.
    - .2 Steel brackets.
    - .3 Sway braces for seismic restraint systems.
  - .6 Hanger rods: threaded rod material to MSS SP 58:
    - .1 Ensure that hanger rods are subject to tensile loading only.
    - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
    - .3 Do not use 22 mm or 28 mm rod.
  - .7 Pipe attachments: material to MSS SP 58:
    - .1 Attachments for steel piping: carbon steel galvanized.
    - .2 Attachments for copper piping: copper plated black steel.
    - .3 Use insulation shields for hot pipework.
    - .4 Oversize pipe hangers and supports.
-

- 
- 2.3 PIPE HANGERS  
(Cont'd)
- .8 Adjustable clevis: material to MSS SP 58 UL listed & FM approved, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
    - .1 Ensure "U" has hole in bottom for rivetting to insulation shields.
  - .9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP 58.
  - .10 U-bolts: carbon steel to MSS SP 58 with 2 nuts at each end to ASTM A563.
    - .1 Finishes for steel pipework: galvanized.
    - .2 Finishes for copper, glass, brass or aluminum pipework: galvanized, with formed portion plastic coated.
  - .11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP 58.
- 2.4 RISER CLAMPS
- .1 Steel or cast iron pipe: galvanized carbon steel to MSS SP 58, type 42, UL listed & FM approved.
  - .2 Copper pipe: carbon steel copper plated to MSS SP 58, type 42.
  - .3 Bolts: to ASTM A307.
  - .4 Nuts: to ASTM A563.
- 2.5 INSULATION  
PROTECTION SHIELDS
- .1 Insulated cold piping:
    - .1 64 kg/m<sup>3</sup> density insulation plus insulation protection shield to: MSS SP 58, galvanized sheet carbon steel. Length designed for maximum 3 m span.
  - .2 Insulated hot piping:
    - .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP 58.
- 2.6 CONSTANT  
SUPPORT SPRING  
HANGERS
- .1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR).
-

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- 2.6 CONSTANT SUPPORT SPRING HANGERS  
(Cont'd)
- .2 Load adjustability: 10% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.
  - .3 Provide upper and lower factory set travel stops.
  - .4 Provide load adjustment scale for field adjustments.
  - .5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.
  - .6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.
- 2.7 VARIABLE SUPPORT SPRING HANGERS
- 
- .1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.
  - .2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.
  - .3 Variable spring hanger complete with factory calibrated travel stops.
  - .4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.
- 2.8 EQUIPMENT SUPPORTS
- 
- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 12 23. Submit calculations with shop drawings.
- 2.9 EQUIPMENT ANCHOR BOLTS AND TEMPLATES
- 
- .1 Provide templates to ensure accurate location of anchor bolts.
-

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- 2.10 PLATFORMS AND CATWALKS .1 To Section 05 50 00.
- 2.11 HOUSE-KEEPING PADS .1 Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 50 mm larger than equipment; chamfer pad edges.
- .2 Concrete: to Section 03 30 00.
- 2.12 OTHER EQUIPMENT SUPPORTS .1 Fabricate equipment supports from structural grade steel meeting requirements of Section 05 12 23.
- .2 Submit structural calculations with shop drawings.
- PART 3 - EXECUTION
- 3.1 MANUFACTURER'S INSTRUCTIONS .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- 3.2 INSTALLATION .1 Install in accordance with:
- .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
- .1 Install on piping systems at pumps, boilers, chillers, cooling towers, and as indicated.
- .3 Clamps on riser piping:
- .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
- .2 Bolt-tightening torques to industry standards.
- .3 Steel pipes: install below coupling or shear lugs welded to pipe.
- .4 Cast iron pipes: install below joint.
- .4 Clevis plates:
- .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
-

- 3.2 INSTALLATION (Cont'd)
- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
  - .6 Use approved constant support type hangers where:
    - .1 Vertical movement of pipework is 13 mm or more,
    - .2 Transfer of load to adjacent hangers or connected equipment is not permitted.
  - .7 Use variable support spring hangers where:
    - .1 Transfer of load to adjacent piping or to connected equipment is not critical.
    - .2 Variation in supporting effect does not exceed 25 % of total load.

- 3.3 HANGER SPACING
- .1 Plumbing piping: to Canadian Plumbing Code, Provincial Code and authority having jurisdiction.
  - .2 Fire protection: to applicable fire code.
  - .3 Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.
  - .4 Copper piping: up to NPS 1/2: every 1.5 m.
  - .5 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.
  - .6 Within 300 mm of each elbow.

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.4 m	1.8 m
1-1/2	3.0 m	2.4 m
2	3.0 m	2.4 m
2-1/2	3.7 m	3.0 m
3	3.7 m	3.0 m
3-1/2	3.7 m	3.3 m
4	3.7 m	3.6 m
5	4.3 m	
6	4.3 m	

- .7 Pipework greater than NPS 12: to MSS SP 58.

- 
- 3.4 HANGER  
INSTALLATION
- .1 Install hanger so that rod is vertical under operating conditions.
  - .2 Adjust hangers to equalize load.
  - .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.
- 3.5 HORIZONTAL  
MOVEMENT
- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
  - .2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.
- 3.6 FINAL  
ADJUSTMENT
- .1 Adjust hangers and supports:
    - .1 Ensure that rod is vertical under operating conditions.
    - .2 Equalize loads.
  - .2 Adjustable clevis:
    - .1 Tighten hanger load nut securely to ensure proper hanger performance.
    - .2 Tighten upper nut after adjustment.
  - .3 C-clamps:
    - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
  - .4 Beam clamps:
    - .1 Hammer jaw firmly against underside of beam.
- 3.7 FIELD QUALITY  
CONTROL
- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
  - .2 Manufacturer's Field Services:
    - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and
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- 3.7 FIELD QUALITY CONTROL      .2      Manufacturer's Field Services:(Cont'd)  
    (Cont'd)
- .1      (Cont'd)  
        submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
  - .2      Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3      Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
- 
- 3.8 CLEANING                      .1      Clean in accordance with Section 01 74 11.
- .1      Remove surplus materials, excess materials, rubbish, tools and equipment.



PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 74 20 - Construction/Demolition Waste Management And Disposal.
  - .3 Section 23 09 33 - Electric and Electronic Control System for HVAC.
  - .4 Section 26 05 01 - Common Work Results - Electrical.
- 1.2 PRODUCT DATA
- .1 Submit product data in accordance with Section 01 33 00.
- 1.3 WASTE MANAGEMENT AND DISPOSAL
- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
  - .2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.
  - .3 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .4 Dispose of corrugated cardboard, polystyrene, plastic packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

PART 2 - PRODUCTS

- 2.1 PIPE/TANK TRACING HEATING CABLES
- .1 Self-limiting heating cable with copper ground wire, thermoplastic rubber or polyolefin or fluoropolymer primary and overall jackets. Heating capacity: 10 W/m. For use with 120 V power supply.
- 2.2 CONTROLS
- .1 Thermostat: remote bulb type, to Section 23 09 33. Rating as indicated.
-

PART 3 - EXECUTION

- 3.1 INSTALLATION
- .1 Install Type A heating cables in accordance with manufacturer's instructions. Coordinate installation with pipe insulation application.
  - .2 Install heating cables in accordance with manufacturer's instructions. Distribute and fasten cable evenly on pipe using pipe strap or tape at maximum spacing 0.5 m. Ensure that heating cables do not touch or cross each other at any point. Run only cold leads in conduit and ensure sensing bulb does not touch cable. Ground shield to building ground. Coordinate cable installation with insulation application. Loop additional cable at fittings, valves, and flanges.
  - .3 Make power and control connections.
- 3.2 FIELD QUALITY CONTROL
- .1 Perform tests in accordance with Section 26 05 01.
  - .2 Use 500 V megger to test cables for continuity and insulation value and record readings before, during and after installation.
  - .3 Where resistance of 50 megohms or less is measured, stop work and advise Departmental Representative.

PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 74 20 - Construction/Demolition Waste Management And Disposal.
  - .3 Section 03 30 00 - Cast-in-Place Concrete.
  - .4 Section 23 05 93 - Testing, Adjusting and Balancing of HVAC.
- 1.2 REFERENCES
- .1 National Fire Protection Association (NFPA)
    - .1 NFPA 13-2009, Installation of Sprinkler Systems.
  - .2 National Building Code of Canada (NBC) 2010.
- 1.3 SHOP DRAWINGS
- .1 Submit shop drawings in accordance with Section 01 33 00.
  - .2 Provide system shop drawings complete with performance and product data.
  - .3 Provide detailed drawings of all seismic control measures for equipment and piping.
- 1.4 WASTE MANAGEMENT AND DISPOSAL
- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
  - .2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.
  - .3 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .4 Dispose of corrugated cardboard, polystyrene, plastic packaging material in appropriate on-site bin for recycling in accordance with site waste management program.
-

## PART 2 - PRODUCTS

- 2.1 GENERAL .1 Size and shape of bases type and performance of vibration isolation to be as indicated.
- 2.2 ELASTOMERIC PADS .1 Type 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.
- 2.5 SPRING MOUNT .1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.
- .2 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.
- .3 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.
-

- 2.6 HANGERS
- .1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30° arc without metal to metal contact.
  - .2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.
  - .3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.
  - .4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.
  - .5 Type H4 - stable spring, elastomeric element with precompression washer and nut with deflection indicator.
- 2.7 ACOUSTIC BARRIERS FOR ANCHORS AND GUIDES
- .1 Acoustic barriers: between pipe and support, consisting of 25 mm minimum thick heavy duty duck and neoprene isolation material.
- 2.8 SEISMIC CONTROL MEASURES
- .1 General:
    - .1 Following systems and/or equipment to remain operational during and after earthquakes:
      - .1 All.
      - .2 Seismic control systems to work in all directions.
      - .3 Fasteners and attachment points to resist same maximum load as seismic restraint.
      - .4 Drilled or power driven anchors and fasteners not permitted.
      - .5 No equipment, equipment supports or mounts to fail before failure of structure.
      - .6 Supports of cast iron or threaded pipe not permitted.
      - .7 Seismic control measures not to interfere with integrity of firestopping.
  - .2 Static equipment:
    - .1 Anchor equipment to equipment supports. Anchor equipment supports to structure.
    - .2 Suspended equipment:
      - .1 Use one or more of following methods depending upon site conditions:
        - .1 Install tight to structure.
        - .2 Cross brace in all directions.
-

2.8 SEISMIC  
CONTROL MEASURES  
(Cont'd)

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- .2 Static equipment:(Cont'd)
  - .2 Suspended equipment:(Cont'd)
    - .1 (Cont'd)
      - .3 Brace back to structure.
      - .4 Cable restraint system.
    - .3 Seismic restraints:
      - .1 Cushioning action to be gentle and steady.
      - .2 Shall never reach metal-like stiffness.
  - .3 Vibration isolated equipment:
    - .1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9 mm clearance during normal operation of equipment and systems between seismic restraint and equipment.
    - .2 Incorporate seismic restraints into vibration isolation system to resist complete isolator unloading.
    - .3 As indicated.
  - .4 Piping systems:
    - .1 Fire protection systems: to NFPA 13.
    - .2 All piping systems: hangers longer than 300 mm; brace at each hanger.
    - .3 To be compatible with requirements for anchoring and guiding of piping systems.
  - .5 Bracing methods:
    - .1 Approved by Departmental Representative.
    - .2 Structural angles or channels.
    - .3 Cable restraint system incorporating grommets, shackles and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points. Incorporate neoprene into cable connections to reduce shock loads.
  - .6 Service and utilities entrance into building.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Seismic control measures to meet requirements of NBC.
- .2 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.
- .3 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.
- .4 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.
- .5 Where isolation is bolted to floor use vibration isolation rubber washers.
- .6 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 SITE VISIT

- .1 Manufacturer to visit site and provide written certification that installation is in accordance with manufacturer's instructions and submit report to Departmental Representative.
  - .2 Provide Departmental Representative with notice 24 h in advance of visit.
  - .3 Make adjustments and corrections in accordance with written report.
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- 3.3 TESTING
- .1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC systems after start up and TAB of systems to Section 23 05 93.
  - .2 Provide Departmental Representative with notice 24 h in advance of commencement of tests.
  - .3 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations (including sound curves).
  - .4 Submit complete report of test results including sound curves.



PART 1 - GENERAL

- 1.1 SUMMARY .1 Section Includes:
- .1 Seismic restraint systems for statically supported and vibration isolated equipment and systems; equipment and systems, both vibration isolated and statically supported.
- .2 Related Sections:
- .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 35 29 - Health and Safety Requirements.
  - .3 Section 01 61 00 - Common Product Requirements.
  - .4 Section 01 74 11 - Cleaning.
  - .5 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.
  - .6 Section 01 78 00 - Closeout Submittals.
  - .7 Section 21 13 13 - Wet Pipe Sprinkler Systems.
  - .8 Section 21 13 16 - Dry Pipe Sprinkler Systems.
- 1.2 REFERENCES .1 Canadian Standards Association (CSA International)
- .1 CAN/CSA-G40.20/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).
- .3 National Building Code of Canada (NBC) - 2010
- 1.3 DEFINITIONS .1 Priority Two (P2) Buildings: buildings in which life safety is of paramount concern. It is not necessary that P2 buildings remain operative during or after earthquake activity.
- .2 SRS: acronym for Seismic Restraint System.
-

1.4 SYSTEM  
DESCRIPTION

- .1 SRS fully integrated into, and compatible with:
  - .1 Noise and vibration controls specified elsewhere.
  - .2 Structural, mechanical, electrical design of project.
- .2 Systems, equipment not required to be operational during and after seismic event.
- .3 During seismic event, SRS to prevent systems and equipment from causing personal injury and from moving from normal position.
- .4 Designed by Professional Engineer specializing in design of SRS and registered in Province of Ontario.

1.5 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00.
- .2 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .3 Submit design data including:
  - .1 Full details of design criteria.
  - .2 Working drawings (prepared to same standard of quality and size as documents forming these documents), materials lists, schematics, full specifications for components of each SRS to be provided.
  - .3 Design calculations (including restraint loads resulting from seismic forces in accordance with National Building Code, detailed work sheets, tables).
  - .4 Separate shop drawings for each SRS and devices for each system, equipment.
  - .5 Identification of location of devices.
  - .6 Schedules of types of SRS equipment and devices.
  - .7 Details of fasteners and attachments to structure, anchorage loadings, attachment methods.
  - .8 Installation procedures and instructions.
  - .9 Design calculations including restraint loads to NBC and Supplement.
  - .10 Detailed work sheets, tables.
  - .11 Detailed design of SRS including complete working drawings prepared to same standard of quality and size as Contract

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- 1.5 SUBMITTALS (Cont'd)
- .3 Submit design data including:(Cont'd)
    - .11 (Cont'd)  
Documents, materials lists, design calculations, schematics, specifications.
  - .4 Submit additional copy of shop drawings and product data to Structural Engineer for review of connection points to building structure.
  - .5 Quality assurance submittals: submit following in accordance with Section 01 33 00.
    - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
    - .2 Instructions: submit manufacturer's installation instructions.
      - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.
  - .6 Closeout Submittals:
    - .1 Provide maintenance data including monitoring requirements for incorporation into manuals specified in Section 01 78 00.
- 1.6 QUALITY ASSURANCE
- .1 Health and Safety:
    - .1 Do construction occupational health and safety in accordance with Section 01 35 29.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- .1 Packing, shipping, handling and unloading:
    - .1 Deliver, store and handle in accordance with Section 01 61 00.
    - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
  - .2 Waste Management and Disposal:
    - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
-

PART 2 - PRODUCTS

- 2.1 SRS MANUFACTURER .1 SRS from one manufacturer regularly engaged in SRS production.
- 2.2 GENERAL .1 SRS to provide gentle and steady cushioning action and avoid high impact loads.
- .2 SRS to restrain seismic forces in every direction.
- .3 Fasteners and attachment points to resist same load as seismic restraints.
- .4 SRS of Piping systems compatible with:  
.1 Expansion, anchoring and guiding requirements.  
.2 Equipment vibration isolation and equipment SRS.
- .5 SRS utilizing cast iron, threaded pipe, other brittle materials not permitted.
- .6 Attachments to RC structure:  
.1 Use high strength mechanical expansion anchors.  
.2 Drilled or power driven anchors not permitted.
- .7 Wet pipe sprinkler systems: refer to Section 21 13 13.
- .8 Dry pipe sprinkler systems: refer to Section 21 13 16.
- .9 Seismic control measures not to interfere with integrity of firestopping.
- 2.3 SRS FOR STATIC EQUIPMENT, SYSTEMS .1 Floor-mounted equipment, systems:  
.1 Anchor equipment to equipment supports.  
.2 Anchor equipment supports to structure.  
.3 Use size of bolts scheduled in approved shop drawings.
- .2 Suspended equipment, systems:  
.1 Use one or combination of following methods:  
.1 Install tight to structure.  
.2 Cross-brace in every direction.
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- 2.3 SRS FOR STATIC .2 Suspended equipment, systems:(Cont'd)  
EQUIPMENT, SYSTEMS .1 (Cont'd)  
(Cont'd) .3 Brace back to structure.  
.4 Slack cable restraint system.  
.2 SCS to prevent sway in horizontal plane,  
"rocking" in vertical plane, sliding and  
buckling in axial direction.  
.3 Hanger rods to withstand compressive  
loading and buckling.
- 2.4 SRS FOR .1 Floor mounted equipment, systems:  
VIBRATION ISOLATED .1 Use one or combination of following  
EQUIPMENT methods:  
.1 Vibration isolators with built-in  
snubbers.  
.2 Vibration isolators and separate  
snubbers.  
.3 Built-up snubber system approved by  
Departmental Representative, consisting  
of structural elements and elastomeric  
layer.  
.2 SRS to resist complete isolator  
unloading.  
.3 SRS not to jeopardize noise and  
vibration isolation systems. Provide 4-8 mm  
clearance between seismic restraint snubbers  
and equipment during normal operation of  
equipment and systems.  
.4 Cushioning action: gentle and steady by  
utilizing elastomeric material or other means  
in order to avoid high impact loads.
- .2 Suspended equipment, systems:  
.1 Use one or combination of following  
methods:  
.1 Slack cable restraint system.  
.2 Brace back to structure via  
vibration isolators and snubbers.
- 2.5 SLACK CABLE .1 Use elastomer materials or similar to avoid  
RESTRAINT SYSTEM high impact loads and provide gentle and  
(SCS) steady cushioning action.
- .2 SCS to prevent sway in horizontal plane,  
"rocking" in vertical plane, sliding and  
buckling in axial direction.
- .3 Hanger rods to withstand compressive loading  
and buckling.
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- 2.6 SERVICE UTILITIES ENTRANCE INTO BUILDING .1 Provide flexibility to prevent breakage in the event of earthquake activity.

PART 3 - EXECUTION

- 3.1 MANUFACTURER'S INSTRUCTIONS .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- 3.2 INSTALLATION .1 Attachment points and fasteners:  
.1 To withstand same maximum load that seismic restraint is to resist and in every direction.
- .2 Slack Cable Systems (SCS):  
.1 Connect to suspended equipment so that axial projection of wire passes through centre of gravity of equipment.  
.2 Use appropriate grommets, shackles, other hardware to ensure alignment of restraints and to avoid bending of cables at connection points.  
.3 Piping systems: provide transverse SCS at 10 m spacing maximum, longitudinal SCS at 20 m maximum or as limited by anchor/slack cable performance.  
.4 Small pipes may be rigidly secured to larger pipes for restraint purposes, but not reverse.  
.5 Orient restraint wires on ceiling hung equipment at approximately 90 degrees to each other (in plan), tie back to structure at maximum of 45 degrees to structure.  
.6 Adjust restraint cables so that they are not visibly slack but permit vibration isolation system to function normally.  
.7 Tighten cable to reduce slack to 40 mm under thumb pressure. Cable not to support weight during normal operation.
- .3 Install SRS at least 25 mm from equipment, systems, services.
- .4 Miscellaneous equipment not vibration-isolated:  
.1 Bolt through house-keeping pad to structure.
-

- 3.2 INSTALLATION (Cont'd) .5 Co-ordinate connections with other disciplines.
- .6 Vertical tanks:  
.1 Anchor through house-keeping pad to structure.  
.2 Provide steel bands above centre of gravity.
- .7 Horizontal tanks:  
.1 Provide at least two straps with anchor bolts fastened to structure.
- 3.3 FIELD QUALITY CONTROL .1 Manufacturer's Field Services:  
.1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.  
.2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:  
.1 After delivery and storage of Products.  
.2 After preparatory work is complete but before installation commences.  
.3 Twice during the installation, at 25% and 60% completion stages.  
.4 Upon completion of installation.  
.3 Submit manufacturer's reports to Departmental Representative within 3 days of manufacturer representative's review.
- .2 Inspection and Certification:  
.1 SRS: inspected and certified by Seismic Engineer upon completion of installation.  
.2 Provide written report to Departmental Representative with certificate of compliance.
- .3 Commissioning Documentation:  
.1 Upon completion and acceptance of certification, hand over to Departmental Representative complete set of construction documents, revised to show "as-built" conditions.
- 3.4 CLEANING .1 Proceed in accordance with Section 01 74 11.
- .2 Upon completion and verification of performance of installation, remove surplus
-

3.4 CLEANING .2 (Cont'd)  
(Cont'd) materials, excess materials, rubbish, tools  
and equipment.



PART 1 - GENERAL

1.1 RELATED  
SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29 - Health and Safety Requirements.
- .3 Section 01 61 00 - Common Product Requirements.
- .4 Section 01 74 11 - Cleaning.
- .5 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.
- .6 Section 09 91 23 - Interior Painting.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
  - .1 CSA-B149.1-10, Natural Gas and Propane Installation Code.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
  - .2 CAN/CGSB-24.3-92, Identification of Piping Systems.
- .3 Master Painters Insitute (MPI)
- .4 National Fire Protection Association (NFPA)
  - .1 NFPA (Fire) 13, Standard for the Installation of Sprinkler Systems, 2010 Edition.
  - .2 NFPA (Fire) 14, Standard for the Installation of Standpipe and Hose Systems, 2010 Edition.

1.3 SUBMITTALS

- .1 Product Data: submit product data for each item specified.
  - .2 Submittals: in accordance with Section 01 33 00.
  - .3 Product data to include paint colour chips, other products specified in this section.
  - .4 Samples:
    - .1 Submit samples in accordance with Section 01 33 00.
-

- 1.3 SUBMITTALS (Cont'd) .4 Samples:(Cont'd)  
.2 Samples to include nameplates, labels, tags, lists of proposed legends.
- 1.4 QUALITY ASSURANCE .1 Quality assurance submittals: submit following in accordance with Section 01 33 00.  
.2 Health and Safety:  
.1 Do construction occupational health and safety in accordance with Section 01 35 29.
- 1.5 DELIVERY, STORAGE, AND HANDLING .1 Packing, shipping, handling and unloading:  
.1 Deliver, store and handle in accordance with Section 01 61 00.  
.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.  
.2 Waste Management and Disposal:  
.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 20.  
.2 Dispose of unused material at official hazardous material collections site approved by Departmental Representative.  
.3 Do not dispose of unused material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

PART 2 - PRODUCTS

- 2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.  
.2 Lettering and numbers raised or recessed.  
.3 Information to include, as appropriate:  
.1 Equipment: manufacturer's name, model, size, serial number, capacity.  
.2 Motor: voltage, Hz, phase, power factor, duty, frame size.
-

2.2 SYSTEM  
NAMEPLATES

- .1 Colours:
  - .1 Hazardous: red letters, white background.
  - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
  - .1 3 mm thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
  - .1 Conform to following table:

Size #	mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1		10 x 50	1	3
2		13 x 75	1	5
3		13 x 75	2	3
4		20 x 100	1	8
5		20 x 100	2	5
6		20 x 200	1	8
7		25 x 125	1	12
8		25 x 125	2	8
9		35 x 200	1	20
  - .2 Use maximum of 25 letters/numbers per line.
- .4 Locations:
  - .1 Terminal cabinets, control panels: use size #5.
  - .2 Equipment in Mechanical Rooms: use size #9.
- .5 Identification for PWGSC Preventive Maintenance Support System (PMSS):
  - .1 Use arrangement of Main identifier, Source identifier, Destination identifier.
  - .2 Equipment in Mechanical Room:
    - .1 Main identifier: size #9.
    - .2 Source and Destination identifiers: size #6.
    - .3 Terminal cabinets, control panels: size #5.
  - .3 Equipment elsewhere: sizes as appropriate.

2.3 EXISTING  
IDENTIFICATION  
SYSTEMS

- .1 Apply existing identification system to new work.
- .2 Where existing identification system does not cover for new work, use identification system specified this section.
- .3 Before starting work, obtain written approval of identification system from Departmental Representative.

2.4 PIPING SYSTEMS  
GOVERNED BY CODES

- .1 Identification:
  - .1 Natural gas: to CAN/CSA-B149.1 and authority having jurisdiction.
  - .2 Sprinklers: to NPFA (Fire) 13.
  - .3 Standpipe and hose systems: to NPFA (Fire) 14.

2.5 IDENTIFICATION  
OF PIPING SYSTEMS

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB-24.3 except where specified otherwise.
  - .2 Pictograms:
    - .1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.
  - .3 Legend:
    - .1 Block capitals to sizes and colours listed in CAN/CGSB-24.3.
  - .4 Arrows showing direction of flow:
    - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
    - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
    - .3 Use double-headed arrows where flow is reversible.
  - .5 Extent of background colour marking:
    - .1 To full circumference of pipe or insulation.
    - .2 Length to accommodate pictogram, full length of legend and arrows.
-

2.5 IDENTIFICATION OF PIPING SYSTEMS (Cont'd)

- .6 Materials for background colour marking, legend, arrows:
  - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
  - .2 Other pipes: pressure sensitive plastic-coated cloth or vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.
  - .7 Colours and Legends:
    - .1 Where not listed, obtain direction from Departmental Representative.
    - .2 Colours for legends, arrows: to following table:

Background colour:	Legend, arrows:
Yellow	BLACK
Green	WHITE
Red	WHITE

- .3 Background colour marking and legends for piping systems:

Contents	Background colour marking	Legend
Hot glycol heating supply	Yellow	HEATING GLYCOL SUPPLY
Hot glycol heating return	Yellow	HEATING GLYCOL RETURN
Make-up water	Yellow	MAKE-UP WTR
Boiler feed water	Yellow	BLR. FEED WTR
Domestic hot water supply	Green	DOM. HW SUPPLY
Dom. HWS recirculation	Green	DOM. HW CIRC
Domestic cold water supply	Green	DOM. CWS
Storm water	Green	STORM
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Refrigeration suction	Yellow	REF. SUCTION
Refrigeration liquid	Yellow	REF. LIQUID
Refrigeration hot gas	Yellow	REF. HOT GAS
Natural gas	to Codes	
Gas regulator vents	to Codes	
Demineralized water	Green	DEMIN. WATER
Fire protection water	Red	FIRE PROT. WTR
Sprinklers	Red	SPRINKLERS

2.6 IDENTIFICATION OF DUCTWORK SYSTEMS

- .1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.
- .2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

- 2.7 VALVES,  
CONTROLLERS .1 Brass tags with 12 mm stamped identification data filled with black paint.
- .2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.
- 2.8 CONTROLS  
COMPONENTS  
IDENTIFICATION .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.
- .2 Inscriptions to include function and (where appropriate) fail-safe position.
- 2.9 LANGUAGE .1 Identification in English.
- .2 Use one nameplate and label.

PART 3 - EXECUTION

- 3.1 MANUFACTURER'S  
INSTRUCTIONS .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- 3.2 TIMING .1 Provide identification only after painting specified Section 09 91 23 has been completed.
- 3.3 INSTALLATION .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC and/or CSA registration plates as required by respective agency.
- .3 Identify systems, equipment to conform to PWGSC PMSS.
-

- 3.4 NAMEPLATES .1 Locations:  
.1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs:  
.1 Provide for nameplates on hot and/or insulated surfaces.
- .3 Protection:  
.1 Do not paint, insulate or cover.
- 3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification easily and accurately readable from usual operating areas and from access points.  
.1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.
-

3.6 VALVES,  
CONTROLLERS

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Departmental Representative. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively.

3.7 CLEANING

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



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 Departmental Representative within 90 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 and confirm in writing to Departmental Representative adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to Departmental Representative in writing all proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.
- 1.7 START-UP .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified elsewhere in Division 15.
- 1.8 OPERATION OF SYSTEMS DURING TAB .1 Operate systems for length of time required for TAB and as required by Departmental Representative for verification of TAB reports.
- 1.9 START OF TAB .1 Notify Departmental Representative 7 days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:
- .3 Installation of ceilings, doors, windows, other construction affecting TAB.
- .4 Application of weatherstripping, sealing, caulking.
- .5 All pressure, leakage, other tests specified elsewhere in Division 23.
- .6 All provisions for TAB installed and operational.
- .7 Start-up, verification for proper, normal and safe operation of mechanical and associated
-

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- 1.9 START OF TAB .7 (Cont'd)  
(Cont'd)
- electrical and control systems affecting TAB including but not limited to:
- .1 Proper thermal overload protection in place for electrical equipment.
  - .2 Air systems:
    - .1 Filters in place, clean.
    - .2 Duct systems clean.
    - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
    - .4 Correct fan rotation.
    - .5 Fire, smoke, volume control dampers installed and open.
    - .6 Coil fins combed, clean.
    - .7 Access doors, installed, closed.
    - .8 Outlets installed, volume control dampers open.
  - .3 Liquid systems:
    - .1 Flushed, filled, vented.
    - .2 Correct pump rotation.
    - .3 Strainers in place, baskets clean.
    - .4 Isolating and balancing valves installed, open.
    - .5 Calibrated balancing valves installed, at factory settings.
    - .6 Chemical treatment systems complete, operational.
- 1.10 APPLICATION .1 Do TAB to following tolerances of design  
TOLERANCES values:  
.1 HVAC systems: plus 10%, minus 0%.
- 1.11 ACCURACY .1 Measured values to be accurate to within plus  
TOLERANCES or minus 2% of actual values.
- 1.12 INSTRUMENTS .1 Prior to TAB, submit to Departmental  
Representative list of instruments to be used  
together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
  - .3 Calibrate within 3 months of TAB. Provide certificate of calibration to Departmental Representative.
-

- 1.13 SUBMITTALS .1 Submit, prior to commencement of TAB:
- .2 Proposed methodology and procedures for performing TAB if different from referenced standard.
- 1.14 PRELIMINARY TAB REPORT .1 Submit for checking and approval of Departmental Representative, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
- .1 Details of instruments used.
- .2 Details of TAB procedures employed.
- .3 Calculations procedures.
- .4 Summaries.
- 1.15 TAB REPORT .1 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 Departmental Representative for verification and approval, in English in D-ring binders, complete with index tabs.
- 1.16 VERIFICATION .1 Reported results subject to verification by Departmental Representative.
- .2 Provide manpower and instrumentation to verify up to 30% of reported results.
- .3 Number and location of verified results to be at discretion of Departmental Representative.
- .4 Bear costs to repeat TAB as required to satisfaction of Departmental Representative.
- 1.17 SETTINGS .1 After TAB is completed to satisfaction of Departmental Representative, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life of facility. Markings not to be eradicated or covered in any way.
-

- 1.18 COMPLETION OF TAB .1 TAB to be considered complete when final TAB Report received and approved by Departmental Representative.
- 1.19 AIR SYSTEMS .1 Standard: TAB to be to most stringent of this section or TAB standards of ASHRAE.
- .2 Do TAB of systems, equipment, components, controls:
- .1 AHU.
- .2 Return fan.
- .3 Exhaust fans.
- .4 Associated controls.
- .3 Qualifications: personnel performing TAB to be current member in good standing of AABC or NEBB.
- .4 Quality assurance: Perform TAB under direction of supervisor qualified to standards of AABC or NEBB.
- .5 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
- .6 Locations of equipment measurements: To include, but not be limited to, following as appropriate:
- .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
- .2 At controllers, controlled device.
- .7 Locations of systems measurements to include, but not be limited to, following as appropriate: Main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).
- 1.20 HYDRONIC SYSTEMS .1 Definitions: for purposes of this section, to include low pressure hot water heating, chilled water, condenser water, glycol systems.
- .2 Standard: TAB to be to most stringent of TAB standards of AABC, NEBB, SMACNA or ASHRAE.
-

1.20 HYDRONIC  
SYSTEMS  
(Cont'd)

- .3 Do TAB of systems, equipment, components, controls specified Divisions 21, 22 & 23 including the following systems, equipment, components, controls:
  - .1 Domestic water pumps.
  - .2 Hydronic pumps.
- .4 Qualifications: personnel performing TAB to be qualified to standards of AABC or NEBB.
- .5 Quality assurance: perform TAB to standards of AABC or NEBB.
- .6 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.
- .7 Locations of equipment measurement: To include, but not be limited to, following as appropriate:
  - .1 Inlet and outlet of heat exchangers (primary and secondary sides), boiler, chiller, coil, humidifier, cooling tower, condenser, pump, PRV, control valve, other equipment causing changes in conditions.
  - .2 At controllers, controlled device.
- .8 Locations of systems measurements to include, but not be limited to, following as appropriate: Supply and return of primary and secondary loops (main, main branch, branch, sub-branch of all hydronic systems, inlet connection of make-up water.

1.21 DOMESTIC HWC  
SYSTEMS

- .1 Meet requirements as specified for hydronic systems.
- .2 Locations of equipment measurements: To include, but not be limited to, following as appropriate: Inlet and outlet of heaters, tank, pump, circulator, at controllers, controlled device.
- .3 Locations of systems measurements to include, but not be limited to, following as appropriate: main, main branch, branch, sub-branch.

- 1.22 OTHER SYSTEMS .1 Plumbing systems:  
.1 TAB procedures:  
.1 Flush valves: adjust to suit project pressure conditions.  
.2 Pressure booster systems: test for capacity and pressures under all conditions and at all times.  
.3 Controlled flow roof drain systems: adjust weirs to suit actual roof conditions, slopes, areas drained.
- 1.23 OTHER TAB REQUIREMENTS .1 General requirements applicable to work specified this paragraph:  
.1 Qualifications of TAB personnel: as for air systems specified this section.  
.2 Quality assurance: as for air systems specified this section.
- .2 Laboratory fume hoods:  
.1 TAB procedures: as described in standard.
- .3 Building pressure conditions:  
.1 Adjust HVAC systems, equipment, controls to ensure specified pressure conditions at all times.
- .4 Zone pressure differences:  
.1 Adjust HVAC systems, equipment, controls to establish specified air pressure differentials, with all systems in all possible combinations of normal operating modes.  
.2 TAB procedures:  
.1 Kitchen area shall be at all times at lever pressure with respect to surrounding elevated walk ways.
- .5 Smoke management systems:  
.1 Test for proper operation of all smoke and fire dampers, sensors, detectors, installed as component parts of air systems specified Division 15.  
.2 Emergency evacuation: See post-occupancy TAB activities specified below.
- 1.24 POST-OCCUPANCY TAB .1 Measure DBT, air velocity, NC levels, in occupied zone of following areas: kitchen.
- .2 Emergency evacuation: Participate in full scale emergency evacuation exercises..
-

1.24 POST- .3 Participate in systems checks twice during  
OCCUPANCY TAB Warranty Period - #1 approximately 3 months  
(Cont'd) after acceptance and #2 within 1 month of  
termination of Warranty Period.

PART 2 - PRODUCTS

2.1 NOT USED .1 Not used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not used.



PART 1 - GENERAL

- 1.1 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 Departmental Representative to witness tests and to verify reported results.
  - .2 To be certified by the same TAB agency approved by Departmental Representative 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 Departmental Representative at least three months before anticipated start date.
  - .5 Test instruments to be calibrated and certificate of calibration deposited with Departmental Representative no more than 28 days before start of tests.
  - .6 Instruments to be re-calibrated every six months thereafter.
- 1.9 SYSTEM LEAKAGE TOLERANCES
- .1 System leakage tolerances specified herein are stated as a percentage of total flow rate handled by the system. Therefore, when testing sections of ductwork this acceptable leakage shall be pro-rated to entire system. Leakage for sections of duct systems shall not exceed the total allowable leakage.
  - .2 Leakage tests on following systems not to exceed specified leakage rates.
    - .1 Small duct systems up to 250 Pa: Leakage 2%.
-

- 1.9 SYSTEM LEAKAGE .2 (Cont'd)  
TOLERANCES .2 Large low pressure duct systems up to  
(Cont'd) 500 Pa: Leakage 2%.
- .3 Evaluation of test results to use surface  
area of duct and pressure in duct as basic  
parameters.
- 1.10 REPORT FORMS .1 Submit proposed report form and test report  
format to Departmental Representative for  
approval at least three months before proposed  
date of first series of tests. Do not start  
tests until approval received in writing from  
Departmental Representative.
- 1.11 PRESSURE TEST .1 Prepare report of results and submit to  
REPORTS Departmental Representative within 24 hours of  
completion of tests. Include:  
.1 Schematic of entire system.  
.2 Schematic of section under test showing  
test site.  
.3 Required and achieved static pressures.  
.4 Orifice differential pressure at test  
sites.  
.5 Permissible and actual leakage flow rate  
(L/s) for test sites.  
.6 Witnessed certification of results.
- .2 Include test reports in final TAB report.
- PART 2 - PRODUCTS
- 2.1 NOT USED .1 Not Used.
-

PART 3 - EXECUTION

3.1 NOT USED .1 Not Used.

PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 61 00 - Common Product Requirements.
  - .3 Section 01 74 11 - Cleaning.
  - .4 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.
  - .5 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- 1.2 REFERENCES
- .1 Definitions:
    - .1 For purposes of this section:
      - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
      - .2 "EXPOSED" - means "not concealed" as previously defined.
      - .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.
    - .2 TIAC Codes:
      - .1 CRD: Code Round Ductwork,
      - .2 CRF: Code Rectangular Finish.
  - .2 Reference Standards:
    - .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
      - .1 ANSI/ASHRAE/IES 90.1-2010, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
    - .2 ASTM International Inc.
      - .1 ASTM B209M-10, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
      - .2 ASTM C335-10e1, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
      - .3 ASTM C411-11, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
      - .4 ASTM C449-07, Standard Specification for Mineral Fiber-Hydraulic- Setting Thermal Insulating and Finishing Cement.
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- 1.2 REFERENCES (Cont'd)
- .2 Reference Standards:(Cont'd)
- .2 (Cont'd)
- .5 ASTM C547-11, Standard Specification for Mineral Fiber Pipe Insulation.
- .6 ASTM C553-11, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- .7 ASTM C612-10, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
- .8 ASTM C795-08, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- .9 ASTM C921-10, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
- .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .4 Canada Green Building Council (CaGBC)
- .1 LEED Canada-NC-2004, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations.
- .2 Rating System Addenda for New Construction and Major Renovations LEED Canada-NC.
- .3 LEED Canada-CI Version 1.0-2007, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
- .5 Green Seal Environmental Standards (GSES)
- .1 Standard GS-36-00, Commercial Adhesives.
- .6 South Coast Air Quality Management District (SCAQMD), California State
- .1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.
- .7 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).
- .8 Underwriters Laboratories of Canada (ULC)
- .1 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
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- 1.2 REFERENCES (Cont'd) .2 Reference Standards:(Cont'd)  
.8 (Cont'd)  
.2 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- 1.3 ACTION AND INFORMATIONAL SUBMITTALS .1 Provide submittals in accordance with Section 01 33 00.  
.2 Product Data:  
.1 Provide manufacturer's printed product literature and datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations.  
.1 Description of equipment giving manufacturer's name, type, model, year and capacity.  
.2 Details of operation, servicing and maintenance.  
.3 Recommended spare parts list.  
.3 Shop Drawings:  
.1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.  
.4 Samples:  
.1 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed.  
.2 Mount sample on 12 mm plywood board.  
.3 Affix typewritten label beneath sample indicating service.  
.5 Manufacturers' Instructions:  
.1 Provide manufacture's written duct insulation jointing recommendations. and special handling criteria, installation sequence, cleaning procedures.
- 1.4 QUALITY ASSURANCE .1 Qualifications:  
.1 Installer: specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards.
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- 1.5 DELIVERY,  
STORAGE AND  
HANDLING
- .1 Deliver, store and handle in accordance with Section 01 61 00.
  - .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
  - .3 Packaging Waste Management: remove for reuse and return of pallets, crates, padding and packaging materials in accordance with Section 01 74 20.

PART 2 - PRODUCTS

- 2.1 FIRE AND SMOKE  
RATING
- .1 To CAN/ULC-S102:
    - .1 Maximum flame spread rating: 25.
    - .2 Maximum smoke developed rating: 50.
- 2.2 INSULATION
- .1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.
  - .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.
  - .3 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).
  - .4 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).
    - .1 Mineral fibre: to ASTM C553.
    - .2 Jacket: to CGSB 51-GP-52Ma.
    - .3 Maximum "k" factor: to ASTM C553.
- 2.3 JACKETS
- .1 Canvas:
    - .1 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
  - .2 Lagging adhesive: compatible with insulation.
-



2.3 JACKETS  
(Cont'd)

- .3 Aluminum:
  - .1 To ASTM B209M with moisture barrier as scheduled in PART 3 of this section.
  - .2 Thickness: 0.50 mm sheet.
  - .3 Finish: Smooth.
  - .4 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel.
    - .1 Stainless steel:
  - .5 Type: 304.
  - .6 Thickness: 0.25 mm sheet.
  - .7 Finish: Smooth.
  - .8 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel.

2.4 ACCESSORIES

- .1 Vapour retarder lap adhesive:
  - .1 Water based, fire retardant type, compatible with insulation.
- .2 Indoor Vapour Retarder Finish:
  - .1 Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating Cement: setting on mineral wool, to ASTM C449.
- .4 ULC Listed Canvas Jacket:
  - .1 220 gm/m<sup>2</sup> 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<sup>2</sup>.
- .6 Tape: self-adhesive, aluminum, plain reinforced, 75 mm wide minimum.
- .7 Tie wire: 1.5 mm stainless steel.
- .8 Banding: 19 mm wide, 0.5 mm thick stainless steel.
- .9 Facing: 25 mm galvanized steel hexagonal wire mesh stitched on one face of insulation one face of insulation with expanded metal lath on other face.
- .10 Fasteners: 4 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

PART 3 - EXECUTION

- 3.1 APPLICATION .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.
- 3.2 PRE-INSTALLATION REQUIREMENTS .1 Pressure test ductwork systems complete, witness and certify.  
.2 Ensure surfaces are clean, dry, free from foreign material.
- 3.3 INSTALLATION .1 Install in accordance with TIAC National Standards.  
.2 Apply materials in accordance with manufacturers instructions and as indicated.  
.3 Use 2 layers with staggered joints when required nominal thickness exceeds 75 mm.  
.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.  
.1 Ensure hangers, and supports are outside vapour retarder jacket.  
.5 Hangers and supports in accordance with Section 23 05 29.  
.1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.  
.6 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum 2 rows each side.
- 3.4 DUCTWORK INSULATION SCHEDULE .1 Insulation types and thicknesses: conform to following table:

	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular cold and dual temperature supply air ducts	C-1	yes	50

3.4 DUCTWORK .1 (Cont'd)  
 INSULATION SCHEDULE  
 (Cont'd)

Round cold and dual temperature supply air ducts	C-2	yes	50
Rectangular warm air ducts	C-1	no	25
Round warm air ducts	C-1	no	25
Supply, return and exhaust ducts exposed in space being served			none
Outside air ducts to mixing plenum	C-1	yes	25
Mixing plenums	C-1	yes	25
Exhaust duct between dampers and louvres	C-1	no	25
Rectangular ducts outside	C-1	special	50
Round ducts outside	C-1	special	50
Acoustically lined ducts	none		

- .2 Exposed round ducts 600 mm and larger, smaller sizes where subject to abuse:  
 .1 Use TIAC code C-1 insulation, scored to suit diameter of duct.  
 .1 Finishes: conform to following table:

	TIAC Code	
Indoor, concealed	Rectangular none	Round none
Indoor, exposed within mechanical room	CRF/1	CRD/2

3.4 DUCTWORK .2 (Cont'd)  
INSULATION SCHEDULE .1 (Cont'd)  
(Cont'd) .1 Finishes:(Cont'd)

	TIAC Code	
Indoor, exposed elsewhere	CRF/2	CRD/3
Outdoor, exposed to precipitation	CRF/3	CRD/4
Outdoor, elsewhere	CRF/4	CRD/5

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

PART 1 - GENERAL

1.1 RELATED  
SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29 - Health and Safety Requirements.
- .3 Section 01 61 00 - Common Product Requirements.
- .4 Section 01 74 11 - Cleaning.
- .5 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
    - .1 ANSI/ASHRAE 90.1-04-SI Edition, Energy Standard for Buildings Except Low-Rise Residential Buildings.
  - .2 ASTM International Inc.
    - .1 ASTM B209M-10, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
    - .2 ASTM C335-05ae1, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
    - .3 ASTM C449/C449M-07, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
    - .4 ASTM C533-09, Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
    - .5 ASTM C547-07e1, Standard Specification for Mineral Fiber Pipe Insulation.
    - .6 ASTM C553-08, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
    - .7 ASTM C612-09, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
    - .8 ASTM C795-08, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
    - .9 ASTM C921-09, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
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1.2 REFERENCES  
(Cont'd)

- .3 Canadian General Standards Board (CGSB)
  - .1 CGSB 51-GP-52MA-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
  - .2 CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.
- .4 Canada Green Building Council (CaGBC)
  - .1 LEED Canada-NC Version 1.0-2004, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations.
  - .2 Rating System Addenda for New Construction and Major Renovations LEED Canada-NC Version 1.0-Addendum 2007.
  - .3 LEED Canada-CI Version 1.0-2007, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .6 South Coast Air Quality Management District (SCAQMD), California State
  - .1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.
- .7 Thermal Insulation Association of Canada (TIAC)
  - .1 National Insulation Standards 2005.
- .8 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.3 ACTION AND  
INFORMATIONAL  
SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and datasheets for insulation and adhesives, include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Provide two copies WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 29.

1.3 ACTION AND  
INFORMATIONAL  
SUBMITTALS  
(Cont'd)

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- .3 Samples:
  - .1 Provide for review: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed.
    - .1 Mount sample on 12 mm plywood board.
    - .2 Affix typewritten label beneath sample indicating service.
- .4 Manufacturer's Instructions:
  - .1 Include procedures to be used and installation standards to be achieved.
- .5 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

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

PART 2 - PRODUCTS

2.1 FIRE AND SMOKE  
RATING

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- .1 Fire and smoke ratings to CAN/ULC-S102:
  - .1 Maximum flame spread rating: 25.
  - .2 Maximum smoke developed rating: 50.

2.2 INSULATION

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- .1 Mineral fibre: includes glass fibre, rock wool, slag wool.
  - .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.
-

- 
- 2.2 INSULATION  
(Cont'd)
- .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 51-GP-52MA.
    - .3 Maximum "k" factor: ASTM C547.
  - .5 TIAC Code C-1: rigid mineral fibre board, unfaced.
    - .1 Mineral fibre: ASTM C612.
    - .2 Maximum "k" factor: ASTM C612.
  - .6 TIAC Code C-4: rigid mineral fibre board faced with factory applied vapour retarder jacket.
    - .1 Mineral fibre: ASTM C612.
    - .2 Jacket: to CGSB 51-GP-52MA.
    - .3 Maximum "k" factor: ASTM C612.
  - .7 TIAC Code C-2: mineral fibre blanket unfaced or faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
    - .1 Mineral fibre: ASTM C553.
    - .2 Jacket: to CGSB 51-GP-52MA.
    - .3 Maximum "k" factor: ASTM C553.
  - .8 TIAC Code A.6: flexible unicellular tubular elastomer.
    - .1 Insulation: with vapour retarder jacket.
    - .2 Jacket: to CGSB 51-GP-52MA.
    - .3 Maximum "k" factor.
    - .4 Certified by manufacturer free of potential stress corrosion cracking corrodents.
  - .9 TIAC Code A-2: rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.
    - .1 Insulation: ASTM C533.
    - .2 Maximum "k" factor: ASTM C533.
    - .3 Design to permit periodic removal and re-installation.
- 2.3 CEMENT
- .1 Thermal insulating and finish
    - .1 To: ASTM C449/C449M.
    - .2 Hydraulic setting or Air drying on mineral wool, to ASTM C449/C449M.
-



2.4 JACKETS

- .1 Polyvinyl Chloride (PVC):
  - .1 One-piece moulded type to CAN/CGSB-51.53 with pre-formed shapes as required.
  - .2 Minimum service temperatures: -20 degrees C.
  - .3 Maximum service temperature: 65 degrees C.
  - .4 Moisture vapour transmission: 0.02 perm.
  - .5 Thickness: 25 mm.
  - .6 Fastenings:
    - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
    - .2 Tacks.
    - .3 Pressure sensitive vinyl tape of matching colour.
- .2 Canvas:
  - .1 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
  - .2 Lagging adhesive: compatible with insulation.
- .3 Aluminum:
  - .1 To ASTM B209M.
  - .2 Thickness: 0.50 mm sheet.
  - .3 Finish: smooth.
  - .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, aluminum, reinforced, 50 mm wide minimum.
  - .2 Tie wire: 1.5 mm diameter stainless steel.
  - .3 Bands: Stainless steel, 19 mm wide, 0.5 mm thick.
  - .4 Facing: 25 mm galvanized steel hexagonal wire mesh on one face of insulation on one face of insulation with expanded metal lath on other face.
  - .5 Fasteners: 2 mm diameter pins with 35 mm diameter clips. Length of pin to suit thickness of insulation.
-

2.6 VAPOUR RETARDER .1 Water based, fire retardant type, compatible  
LAP ADHESIVE with insulation.

2.7 INDOOR VAPOUR .1 Vinyl emulsion type acrylic, compatible with  
RETARDER FINISH insulation.

2.8 OUTDOOR VAPOUR .1 Vinyl emulsion type acrylic, compatible with  
RETARDER MASTIC insulation.

.2 Reinforcing fabric: Fibrous glass, untreated  
305 g/m<sup>2</sup>.

PART 3 - EXECUTION

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

3.2 PRE- .1 Pressure testing of equipment and adjacent  
INSTALLATION piping systems complete, witnessed and  
REQUIREMENTS certified.

.2 Surfaces clean, dry, free from foreign  
material.

3.3 INSTALLATION .1 Install in accordance with TIAC National  
Standards  
.1 Hot equipment: To TIAC code 1503-H.  
.2 Cold equipment: to TIAC code 1503-C.  
.2 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.

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- 3.3 INSTALLATION  
(Cont'd)
- .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.
- 3.4 CLEANING
- .1 Clean in accordance with Section 01 74 11.
    - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
  - .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.



PART 1 - GENERAL

1.1 SUMMARY

- .1 Section Includes:
  - .1 Thermal insulation for piping and piping accessories in commercial type applications.
  - .2 Insulation and pipe coverings shall be compatible with Canadian Food Inspection Agency's recommendations. Refer to Agency's web page for approved materials and manufacturers.
  - .3 Sustainable requirements for construction and verification.
  - .4 Related Sections:
    - .1 Section 01 33 00 - Submittal Procedures.
    - .2 Section 01 35 29 - Health and Safety Requirements.
    - .3 Section 01 61 00 - Common Product Requirements.
    - .4 Section 01 74 11 - Cleaning.
    - .5 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.
    - .6 Section 07 92 00 - Joint Sealants.

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
    - .1 ASHRAE Standard 90.1-2007, Energy Standard for Buildings Except Low-Rise Residential Buildings (ANSI approved; IESNA co-sponsored).
  - .2 American Society for Testing and Materials International (ASTM)
    - .1 ASTM B209M-10, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
    - .2 ASTM C335/C335M-10e1, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
    - .3 ASTM C411-11, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
    - .4 ASTM C449-07, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
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1.2 REFERENCES  
(Cont'd)

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- .2 (Cont'd)
    - .5 ASTM C533-07, Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
    - .6 ASTM C547-07e1, Standard Specification for Mineral Fiber Pipe Insulation.
    - .7 ASTM C795-08, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
    - .8 ASTM C921-10, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
  - .3 Canadian General Standards Board (CGSB)
    - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
    - .2 CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.
  - .4 Department of Justice Canada (Jus)
    - .1 Canadian Environmental Assessment Act (CEAA), 1992, c. 37.
    - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
    - .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
  - .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
    - .1 Material Safety Data Sheets (MSDS).
  - .6 Manufacturer's Trade Associations
    - .1 Thermal Insulation Association of Canada (TIAC): Mechanical Insulation Best Practice Guide(Revised 2005).
  - .7 Underwriters' Laboratories of Canada (ULC)
    - .1 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies.
    - .2 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
    - .3 CAN/ULC-S702-09, Thermal Insulation, Mineral Fibre, for Buildings
    - .4 ULC-S702.2-10, Standard for Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.
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- 1.3 DEFINITIONS .1 For purposes of this section:
- .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
  - .2 "EXPOSED" - will mean "not concealed" as specified.
- .2 TIAC ss:
- .1 CRF: Code Rectangular Finish.
  - .2 CPF: Code Piping Finish.
- 1.4 SUBMITTALS .1 Submittals: in accordance with Section 01 33 00.
- .2 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00. Include product characteristics, performance criteria, and limitations.
    - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).
- .3 Shop Drawings:
- .1 Submit shop drawings in accordance with Section 01 33 00.
    - .1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .4 Samples:
- .1 Submit samples in accordance with Section 01 33 00.
  - .2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix label beneath sample indicating service.
- .5 Quality assurance submittals: submit following in accordance with Section 01 33 00.
- .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
-

- 1.4 SUBMITTALS (Cont'd) .5 Quality assurance submittals:(Cont'd)
- .2 Instructions: submit manufacturer's installation instructions.
    - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.
- 1.5 QUALITY ASSURANCE .1 Qualifications:
- .1 Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.
  - .2 Health and Safety:
    - .1 Do construction occupational health and safety in accordance with Section 01 35 29.
- 1.6 DELIVERY, STORAGE AND HANDLING .1 Packing, shipping, handling and unloading:
- .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
  - .3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Storage and Protection:
- .1 Protect from weather, construction traffic.
  - .2 Protect against damage.
  - .3 Store at temperatures and conditions required by manufacturer.
- .3 Waste Management and Disposal:
- .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
  - .2 Place excess or unused insulation and insulation accessory materials in designated containers.
  - .3 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.
  - .4 Dispose of unused adhesive material at official hazardous material collections
-



1.6 DELIVERY,  
STORAGE AND  
HANDLING  
(Cont'd)  
PART 2 - PRODUCTS

- .3 Waste Management and Disposal:(Cont'd)  
.4 (Cont'd)  
site approved by Departmental  
Representative.

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°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 & ASTM  
C547.  
.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 & ASTM  
C547.  
.2 Jacket: to CGSB 51-GP-52Ma.  
.3 Maximum "k" factor: to CAN/ULC-S702 &  
ASTM C547.
- .5 TIAC Code C-2: mineral fibre blanket faced  
with factory applied vapour retarder jacket  
(as scheduled in PART 3 of this section).  
.1 Mineral fibre: to CAN/ULC-S702 & ASTM  
C547.  
.2 Jacket: to CGSB 51-GP-52Ma.  
.3 Maximum "k" factor: to CAN/ULC-S702 &  
ASTM C547.
- .6 TIAC Code A-6: flexible unicellular tubular  
elastomer.  
.1 Insulation: with vapour retarder jacket.  
.2 Jacket: to CGSB 51-GP-52Ma.  
.3 Certified by manufacturer: free of  
potential stress corrosion cracking  
corrodants.
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<u>2.2 INSULATION (Cont'd)</u>	.7	TIAC Code A-2: rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements. .1 Insulation: to ASTM C533. .2 Design to permit periodic removal and re-installation.
<u>2.3 INSULATION SECUREMENT</u>	.1	Tape: self-adhesive, aluminum, 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.
<u>2.4 CEMENT</u>	.1	Thermal insulating and finishing cement: .1 Hydraulic setting or Air drying on mineral wool, to ASTM C449.
<u>2.5 VAPOUR RETARDER LAP ADHESIVE</u>	.1	Water based, fire retardant type, compatible with insulation.
<u>2.6 INDOOR VAPOUR RETARDER FINISH</u>	.1	Vinyl emulsion type acrylic, compatible with insulation.
<u>2.7 OUTDOOR VAPOUR RETARDER FINISH</u>	.1	Vinyl emulsion type acrylic, compatible with insulation.
	.2	Reinforcing fabric: fibrous glass, untreated 305 g/m <sup>2</sup> .
<u>2.8 JACKETS</u>	.1	Polyvinyl Chloride (PVC): .1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required. .2 Colours: to match adjacent finish paint or by Departmental Representative. .3 Minimum service temperatures: -20 degrees C.

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2.8 JACKETS  
(Cont'd)

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- .1 (Cont'd)
    - .4 Maximum service temperature: 65 degrees C.
    - .5 Moisture vapour transmission: 0.02 perm.
    - .6 Thickness: as required.
    - .7 Fastenings:
      - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
      - .2 Tacks.
      - .3 Pressure sensitive vinyl tape of matching colour.
  - .2 Canvas:
    - .1 220 and 120 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
    - .2 Lagging adhesive: compatible with insulation.
  - .3 Aluminum:
    - .1 To ASTM B209M.
    - .2 Thickness: 0.50 mm sheet.
    - .3 Finish: smooth.
    - .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.
  - .4 Stainless steel:
    - .1 Type: 304.
    - .2 Thickness: 0.25 mm.
    - .3 Finish: smooth.
    - .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.
-

2.9 WEATHERPROOF .1 Caulking to: Section 07 92 00.  
CAULKING FOR  
JACKETS INSTALLED  
OUTDOORS

---

PART 3 - EXECUTION

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

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

3.3 INSTALLATION .1 Install in accordance with TIAC National  
Standards.  
.2 Apply materials in accordance with  
manufacturers instructions and this  
specification.  
.3 Use two layers with staggered joints when  
required nominal wall thickness exceeds 75 mm.  
.4 Maintain uninterrupted continuity and  
integrity of vapour retarder jacket and  
finishes.  
.1 Install hangers, supports outside vapour  
retarder jacket.  
.5 Supports, Hangers:  
.1 Apply high compressive strength  
insulation, suitable for service, at  
oversized saddles and shoes where  
insulation saddles have not been  
provided.

---

3.4 INSTALLATION OF ELASTOMERIC INSULATION

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

3.5 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 at 300 mm on centre.
  - .2 Seals: lap seal adhesive, lagging adhesive.
  - .3 Installation: TIAC Code 1501-H.
- .3 TIAC Code: A-3.
  - .1 Securements: SS wire bands at 300 mm on centre.
  - .2 Seals: VR lap seal adhesive, VR lagging adhesive.
  - .3 Installation: TIAC Code: 1501-C].
- .4 TIAC Code: A-6.
  - .1 Insulation securements.
  - .2 Seals: lap seal adhesive, lagging adhesive.
  - .3 Installation: TIAC Code.
- .5 TIAC Code: C-2 without vapour retarder jacket.
  - .1 Insulation securements.
  - .2 Seals: lap seal adhesive, lagging adhesive.
  - .3 Installation: TIAC Code: 1501-C.
- .6 TIAC Code: A-2.
  - .1 Insulation securements.
  - .2 Seals: lap seal adhesive, lagging adhesive.
  - .3 Installation: TIAC Code: 1501-H.
- .7 Thickness of insulation as listed in following table.
  - .1 Run-outs to individual units and equipment not exceeding 4000 mm long.
  - .2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Applic ation	Temp degrees	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)
-----------------	-----------------	--------------	--

3.5 PIPING .7 (Cont'd)  
 INSULATION .2 (Cont'd)  
 SCHEDULES  
 (Cont'd)

		Run out	to 1	1-1/4 to 2	2-1/2 to 4	5 to 6	8 & over
Glycol 60 - Heating 94	A-1	25	38	38	38	38	38
Domest ic HWS	A-1	25	25	25	38	38	38
Domest ic CWS with vapour retard er	C-2	25	25	25	25	25	25
Refrig 4 - 13 erant hot gas liquid suction	A-6	25	25	25	25	25	25
Refrig below erant 4 hot gas liquid suction on	A-6	25	25	38	38	38	38
RWL and RWP	C-2	25	25	25	25	25	25
Cooling Coil cond. drain	C-2	25	25	25	25	25	25

- .8 Finishes:
- .1 Exposed indoors: aluminum or PVC jacket.
  - .2 Exposed in mechanical rooms: canvas, aluminum or PVC jacket.
  - .3 Concealed, indoors: canvas on valves, fittings. No further finish.
  - .4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.

- 3.5 PIPING  
INSULATION  
SCHEDULES  
(Cont'd)
- .8 Finishes:(Cont'd)
- .5 Finish attachments: SS bands, at 150 mm  
on centre. Seals: closed.
- .6 Installation: to appropriate TIAC code  
CRF/1 through CPF/5.
- 3.6 CLEANING
- .1 Proceed in accordance with Section 01 74 11 -  
Cleaning .
- .2 Upon completion and verification of  
performance of installation, remove surplus  
materials, excess materials, rubbish, tools  
and equipment.





PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 01 91 00 - Commissioning: General Requirements, supplemented as specified herein.
  - .2 Section 22 42 01 - Plumbing Specialities and Accessories.
  - .3 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
  - .4 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
  - .5 Section 23 57 00 - Heat Exchangers for HVAC.
  - .6 Section 33 65 36 - Telethermics - Cathodic Protection.
- 1.2 REFERENCES
- .1 ASTM E202-09, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.
- 1.3 CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS
- .1 In accordance with Section 23 08 02.
- 1.4 HYDRONIC SYSTEMS - PERFORMANCE VERIFICATION (PV)
- .1 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
-

- 1.4 HYDRONIC SYSTEMS - PERFORMANCE VERIFICATION (PV)  
(Cont'd)
- .2 (Cont'd)
- .2 (Cont'd)  
simulating maximum design conditions and varying.
- .1 Pump operation.
  - .2 Boiler and/or chiller operation.
  - .3 Pressure bypass open/closed.
  - .4 Control pressure failure.
  - .5 Maximum heating demand.
  - .6 Maximum cooling demand.
  - .7 Boiler and/or chiller failure.
  - .8 Cooling tower (and/or industrial fluid cooler) fan failure.
  - .9 Outdoor reset. Re-check heat exchanger output supply temperature at 100% and 50% reset, maximum water temperature.
- 1.5 HYDRONIC SYSTEM CAPACITY TEST
- .1 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 Heating system capacity test:
- .1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:
    - .1 Increasing OA flow rates through heating coils (in this case, monitor heating coil discharge temperatures at all times to ensure that coils are not subjected to freezing conditions) or
-

- 1.5 HYDRONIC SYSTEM CAPACITY TEST (Cont'd) .6 Heating system capacity test:(Cont'd)
- .1 (Cont'd)
  - .2 Reducing space temperature by turning of heating system for sufficient period of time before starting testing.
  - .2 Test procedures:
    - .1 Open fully heat exchanger, heating coil and radiation control valves.
    - .2 With boilers on full firing and hot water heating supply temperature stabilized, record flow rates and supply and return temperatures simultaneously.
    - .3 Conduct flue gas analysis test on boilers at full load and at low fire conditions.
- 1.6 GLYCOL SYSTEMS .1 Test to prove concentration will prevent freezing to minus 40°C Test inhibitor strength and include in procedural report. Refer to ASTM E202.
- 1.7 POTABLE WATER SYSTEMS .1 When cleaning is completed and system filled:
  - .1 Verify performance of equipment and systems as specified elsewhere in Division 15.
  - .2 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or recharge air chambers. Repeat for each outlet and flush valve.
  - .3 Confirm water quality consistent with supply standards, verifying that no residuals remain as a result of flushing and/or cleaning.
- 1.8 WET AND DRY PIPE SPRINKLER SYSTEM, STANDPIPE AND HOSE SYSTEMS .1 Cleaning, testing, start-up, performance verification of equipment, systems, components, and devices is specified elsewhere in Division 15.
- .2 Verification of controls, detection devices, alarm devices is specified Electrical Divisions.
  - .3 Demonstrate that fire hose will reach to most remote location regardless of partitions, obstructions, etc.
-



PART 3 - EXECUTION

3.1 NOT USED .1 Not Used.



PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.
  - .2 Section 23 25 00 - HVAC Water Treatment Systems.
  - .3 Section 23 05 93 - Testing Adjusting and Balancing for HVAC.
- 1.2 REFERENCES
- .1 American Society for Testing and Materials
    - .1 ASTM E202-10, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.
- 1.3 WASTE MANAGEMENT AND DISPOSAL
- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
  - .2 Dispose of unused cleaning solutions at official hazardous material collections site approved by the Departmental Representative.
  - .3 Do not dispose of unused cleaning solutions into sewer system, into streams, lakes, onto ground or in other locations where it will pose health or environmental hazard.
  - .4 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .5 Dispose of 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 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 AND STEAM 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.
-



3.1 CLEANING  
HYDRONIC AND STEAM  
SYSTEMS  
(Cont'd)

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- .5 (Cont'd)
    - .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 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° 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. Circulate for 12 h, ensuring flow in all circuits. Remove heat, continue to circulate until temperature is below 38° 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).
  
  - .8 Glycol Systems:
    - .1 In addition to procedures specified above perform procedures specified herein.
-

3.1 CLEANING  
HYDRONIC AND STEAM  
SYSTEMS  
(Cont'd)

- .8 Glycol Systems:(Cont'd)  
.2 Test to prove concentration will prevent freezing to minus 40° C Test inhibitor strength and include in procedural report. Refer to ASTM E202.

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.  
.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.  
.12 Adjust pipe supports, hangers, springs as necessary.  
.13 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.  
.14 If sliding type expansion joints bind or 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.

3.2 START-UP OF HYDRONIC SYSTEMS  
(Cont'd)

.1 (Cont'd)  
.20 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.



PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.
- 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 20, 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 THERMOSTAT (LINE VOLTAGE, HEATING)
- .1 Line voltage wall mounted electric heating thermostat with:
    - .1 Full load rating: 22 A at 120 V.
    - .2 Temperature setting range: 5°C to 30°C.
    - .3 Single pole.
    - .4 Thermometer range: 5°C to 30°C.
    - .5 Scale markings: Off-5-10-15-20-25°C.
- 2.2 THERMOSTAT (LOW VOLTAGE)
- .1 Low voltage wall thermostat:
    - .1 For use on 24 V circuit at 1.5 A capacity.
    - .2 With heat anticipator adjustable 0.1 to 1.2 A.
    - .3 Temperature setting range: 10°C to 25°C.
    - .4 Without sub-base.
-

- 2.3 THERMOSTAT (REMOTE BULB) .1 Line voltage remote bulb type thermostat with:  
.1 8 A rating on 120 V.  
.2 3 m copper capillary tube nylon coated.  
.3 Moisture and dust-resistant enclosure cast weathertight box.
- 2.4 THERMOSTAT GUARDS .1 Thermostat guards: lockable, cast metal. Slots for air circulation to thermostat.
- 2.5 LOW LIMIT TEMPERATURE ALARM .1 Low limit temperature alarm with:  
.1 Rating: 10.2 A at 120 V.  
.2 Sensing bulb and 6 m long capillary tube.  
.3 Switching action: manual.  
.4 Temperature setting range: 0°C to 15 °C.
- 2.6 HIGH LIMIT TEMPERATURE ALARM .1 High limit temperature alarm with:  
.1 Rating 10 A at 120 V.  
.2 Positive lock-out.  
.3 Manual reset only after 14°C drop-in temperature.  
.4 Cutout setting: 50°C.

PART 3 - EXECUTION

- 3.1 INSTALLATION .1 Install control devices.  
.2 On outside wall, mount thermostats on bracket or insulated pad 25 mm from exterior wall.  
.3 Install remote sensing device and capillary tube in metallic conduit. Conduit enclosing capillary tube must not touch heater or heating cable.

PART 1 - GENERAL

1.1 RELATED  
SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.
- .3 Section 01 78 00 - Closeout Submittals.
- .4 Section 23 08 01 - Performance Verification Mechanical Piping Systems.
- .5 Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems.
- .6 Section 23 05 01 - Installation of Pipework.
- .7 Section 23 08 01 - Performance Verification of Mechanical Piping Systems.

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
    - .1 ANSI/ASME B16.5-2009, Pipe Flanges and Flanged Fittings.
    - .2 ANSI/ASME B16.18-2012, Cast Copper Alloy Solder Joint Pressure Fittings.
    - .3 ANSI/ASME B16.22-2001(R2010), Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
    - .4 ANSI/ASME B18.2.1-2010, Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws.
  - .2 ASTM International
    - .1 ASTM A47/A47M-99(R2009), Specification for Ferritic Malleable Iron Castings.
    - .2 ASTM A53/A53M-10, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
    - .3 ASTM B32-08, Specification for Solder Metal.
    - .4 ASTM B75M-99(R2011), Specification for Seamless Copper Tube Metric.
  - .3 Canadian Standards Association (CSA)
    - .1 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel Structures.
    - .2 CSA-B149.1-10, Natural Gas Installation Code.
    - .3 CSA-B149.2-10, Propane Installation Code.
-

- 1.3 PRODUCT DATA .1 Submit product data in accordance with Section 01 33 00.
- .2 Indicate on manufacturers catalogue literature following: valves.
- 1.4 CLOSEOUT SUBMITTALS .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.
- 1.5 WASTE MANAGEMENT AND DISPOSAL .1 Separate and recycle waste materials in accordance with Section 01 74 20.
- .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 PIPE .1 Steel pipe: to ASTM A53/A53M, Schedule 40, seamless as follows:
- .1 NPS 1/2 to 2, screwed.
- .2 NPS 2-1/2 and over, plain end.
- .2 Copper tube: to ASTM B75M.
- 2.2 JOINTING MATERIAL .1 Screwed fittings: pulverized lead paste.
- .2 Welded fittings: to CSA W47.1.
- .3 Flange gaskets: nonmetallic flat.
- 2.3 FITTINGS .1 Steel pipe fittings, screwed, flanged or welded:
- .1 Malleable iron: screwed, banded, Class 150.
- .2 Steel pipe flanges and flanged fittings: to ANSI/ASME B16.5.
- .3 Welding: butt-welding fittings.
- .4 Unions: malleable iron, brass to iron, ground seat, to ASTM A47/A47M.
- .5 Bolts and nuts: to ANSI/ASME B18.2.1.
-



- 2.3 FITTINGS  
(Cont'd)
- .1 (Cont'd)
  - .6 Nipples: schedule 40, to ASTM A53/A53M.
  - .2 Copper pipe fittings, screwed, flanged or soldered:
    - .1 Cast copper fittings: to ANSI/ASME B16.18.
    - .2 Wrought copper fittings: to ANSI/ASME B16.22.

- 2.4 VALVES
- .1 Provincial Code approved, lubricated plug or ball type.

PART 3 - EXECUTION

- 3.1 PIPING
- .1 Install in accordance with Section 23 05 01, supplemented as specified herein.
  - .2 Install in accordance with applicable Provincial/Territorial Codes.
  - .3 Install in accordance with CSA B149.1 & CSA B149.2.
  - .4 Install drip points:
    - .1 At low points in piping system.
    - .2 At connections to equipment.

- 3.2 VALVES
- .1 Install valves with stems upright or horizontal unless otherwise approved by Departmental Representative.
  - .2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.

- 3.3 FIELD QUALITY CONTROL
- .1 Test system in accordance with CSA B149.1 & CSA B149.2 and requirements of authorities having jurisdiction.

- 3.4 PURGING
- .1 Purge after pressure test in accordance with CSA B149.1 & CSA B149.2.
-

- 3.5 PRE-START-UP INSPECTIONS
- .1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.
  - .2 Check gas trains, entire installation is approved by authority having jurisdiction.
- 3.6 CLEANING AND START-UP
- .1 In accordance with Section 23 08 02, supplemented as specified herein.
  - .2 In accordance with requirements of CSA B149.1 & CSA B149.2, supplemented as specified herein.
- 3.7 PERFORMANCE VERIFICATION (P.V.)
- .1 Refer to Section 23 08 01.
  - .2 Application tolerances:
  - .3 PV procedures:
    - .1 Test performance of components.

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section Includes:
  - .1 Copper piping valves and fittings for hydronic systems.
- .2 Sustainable requirements for construction and verification.
- .3 Related Sections:
  - .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 35 29 - Health and Safety Requirements.
  - .3 Section 01 61 00 - Common Product Requirements.
  - .4 Section 01 74 11 - Cleaning.
  - .5 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.
  - .6 Section 01 78 00 - Closeout Submittals.
  - .7 Section 21 05 01 - Common Work Results - Mechanical.
  - .8 Section 23 05 17 - Pipe Welding.
  - .9 Section 23 05 23.01 - Valves - Bronze.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/American Welding Society (AWS)
    - .1 ANSI/AWS A5.8/A5.8M-04, Specification Filler Metals for Brazing and Bronze Welding.
  - .2 American Society of Mechanical Engineers (ASME)
    - .1 ANSI/ASME B16.4-2006, Gray Iron Threaded Fittings.
    - .2 ANSI/ASME B16.15-2006, Cast Bronze Threaded Fittings.
    - .3 ANSI B16.18-2001(R2005), Cast Copper Alloy, Solder Joint Pressure Fittings.
    - .4 ANSI/ASME B16.22-2001(R2005), Wrought Copper and Copper-Alloy Solder Joint Pressure Fittings.
  - .3 American Society for Testing and Materials International (ASTM)
    - .1 ASTM B32-08, Standard Specification for Solder Metal.
    - .2 ASTM B61-08, Standard Specification for Steam or Valve Bronze Castings.
    - .3 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
-

- 1.2 REFERENCES (Cont'd)
- .3 (Cont'd)
    - .4 ASTM B88M-05, Standard Specification for Seamless Copper Water Tube Metric.
    - .5 ASTM E202-09, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.
  - .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
    - .1 Material Safety Data Sheets (MSDS).
  - .5 Manufacturers Standardization Society (MSS)
    - .1 MSS SP-67-2002a, Butterfly Valves.
    - .2 MSS SP-70-2006, Gray Iron Gate Valves, Flanged and Threaded Ends.
    - .3 MSS SP-71-2005, Gray Iron Swing Check Valves, Flanged and Threaded Ends.
    - .4 MSS SP-80-2008, Bronze Gate, Globe, Angle and Check Valves.
    - .5 MSS SP-85-2002, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.
- 1.3 SUBMITTALS
- .1 Product Data:
    - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00. Include product characteristics, performance criteria, and limitations.
      - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00.
  - .2 Shop Drawings:
    - .1 Submit shop drawings in accordance with Section 01 33 00.
      - .1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
      - .2 Indicate on manufacturers catalogue literature the following: Valves.
  - .3 Quality assurance submittals: submit following in accordance with Section 01 33 00.
    - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
-

- 1.3 SUBMITTALS  
(Cont'd)
- .3 Quality assurance submittals:(Cont'd)
    - .2 Instructions: submit manufacturer's installation instructions.
      - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.
    - .4 Closeout Submittals:
      - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.
- 1.4 QUALITY ASSURANCE
- .1 Regulatory Requirements: ensure Work is performed in compliance with CEPA, CEAA, TDGA, and applicable Provincial /Territorial regulations.
  - .2 Health and Safety:
    - .1 Do construction occupational health and safety in accordance with Section 01 35 29.
- 1.5 MAINTENANCE
- .1 Extra Materials:
- 1.6 DELIVERY, STORAGE, AND HANDLING
- .1 Packing, shipping, handling and unloading:
    - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00.

PART 2 - PRODUCTS

- 2.1 SUSTAINABLE REQUIREMENTS
- .1 Minimum recycled content:
    - .1 Copper sheet: 44%
    - .2 Copper supply pipe: 64%.
    - .3 Copper drainage pipe: 64%.
    - .4 Cast iron: 25%.
  - .2 Copper pipe solder: 100% lead free.
- 2.2 TUBING
- .1 Hard drawn copper tubing: to ASTM B88M, minimum 64% recycled content.
-

- 2.3 FITTINGS
- .1 Cast bronze threaded fittings: to ANSI/ASME B16.15.
  - .2 Wrought copper and copper alloy solder joint pressure fittings: to ANSI/ASME B16.22, minimum 64% recycled content.
  - .3 Cast iron threaded fittings: to ANSI/ASME B16.4, minimum 25% recycled content.
  - .4 Cast copper alloy solder joint pressure fittings: to ANSI B16.18, minimum 64% recycled content.
- 2.4 FLANGES
- .1 Brass or bronze: threaded.
  - .2 Cast iron: threaded.
  - .3 Orifice flanges: slip-on, raised face, 2100 kPa.
- 2.5 JOINTS
- .1 Solder, tin-antimony, 95:5: to ASTM B32, lead free.
  - .2 Silver solder BCUP: to ANSI/AWS A5.8.
  - .3 Brazing: as indicated.
- 2.6 VALVES
- .1 Connections:
    - .1 NPS 2 and smaller: ends for soldering.
    - .2 NPS 2-1/2 and larger: flanged ends.
  - .2 Butterfly valves: application: isolating each cell or section of multiple component equipment (eg. multi-section coils:
    - .1 NPS 2-1/2 and over: lug type: as specified Section 23 05 17.
  - .3 Globe valves: application: throttling, flow control, emergency bypass:
    - .1 NPS 2 and under:
      - .1 Mechanical Rooms: with PFTE disc, as specified Section 23 05 23.01.
      - .2 Elsewhere: globe, with composition disc, as specified Section 23 05 23.01.
    - .2 NPS 2-1/2 and over:
      - .1 With composition disc, trim, as specified Section 23 05 23.01.
-

- 2.6 VALVES  
(Cont'd)
- .4 Balancing, for TAB:
    - .1 Sizes: calibrated balancing valves, as specified.
    - .2 NPS 2 and under:
      - .1 Mechanical Rooms: globe, with disc as specified Section 23 05 23.01.
      - .2 Elsewhere: globe, with disc as specified Section 23 05 23.01.
  - .5 Drain valves: gate, Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23.01.
  - .6 Swing check valves:
    - .1 NPS 2 and under:
      - .1 Class 125, swing, with brass disc, as specified Section 23 05 23.01.
      - .2 NPS 2-1/2 and over:
        - .1 Flanged ends: as specified Section 23 05 23.01.
  - .7 Silent check valves:
    - .1 NPS 2 and under:
      - .1 As specified Section 23 05 23.01.
    - .2 NPS 2-1/2 and over:
      - .1 Flanged ends: as specified Section 23 05 23.01.
  - .8 Ball valves:
    - .1 NPS 2 and under: as specified Section 23 05 23.01.
  - .9 Lubricated Plug Valves:
    - .1 NPS 2 and under.
    - .2 NPS 2-1/2 and over: as specified Section 23 05 23.01.

PART 3 - EXECUTION

- 3.1 MANUFACTURER'S  
INSTRUCTIONS
- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- 3.2 PIPING  
INSTALLATION
- .1 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.

3.2 PIPING  
INSTALLATION  
(Cont'd)

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- .2 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping where ever practical.
- .3 Slope piping in direction of drainage and for positive venting.
- .4 Use eccentric reducers at pipe size change installed to provide positive drainage or positive venting.
- .5 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.
- .6 Assemble piping using fittings manufactured to ANSI standards.

3.3 VALVE  
INSTALLATION

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- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Install ball or butterfly valves at branch take-offs and to isolate each piece of equipment, and as indicated.
- .3 Install globe valves for balancing and in by-pass around control valves as indicated.
- .4 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and as indicated.
- .5 Install swing check valves in horizontal lines on discharge of pumps and as indicated.
- .6 Install chain operators on valves NPS 21/2 and over where installed more than 2400 mm above floor in Boiler Rooms and Mechanical Equipment Rooms.
- .7 Install ball valves for glycol service.

3.4 CIRCUIT  
BALANCING VALVES

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- .1 Install flow measuring stations and flow balancing valves as indicated.
  - .2 Remove handwheel after installation and TAB is complete.
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3.4 CIRCUIT  
BALANCING VALVES  
(Cont'd)

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- .3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

3.5 FLUSHING AND  
CLEANING

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- .1 Flush and clean in presence of Departmental Representative.
- .2 Flush after pressure test for a minimum of 4h.
- .3 Fill with solution of water and non-foaming, phosphate-free detergent 3% solution by weight. Circulate for minimum of 8h.
- .4 Refill system with clean water. Circulate for at least 4h. Clean out strainer screens/baskets regularly. Then drain.
- .5 Refill system with clean water. Circulate for at least 2h. Clean out strainer screens/baskets regularly. Then drain.
- .6 Drainage to include drain valves, dirt pockets, strainers, low points in system.
- .7 Re-install strainer screens/baskets only after obtaining Departmental Representative's approval.

3.6 FILLING OF  
SYSTEM

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- .1 Refill system with glycol mixture.

3.7 FIELD QUALITY  
CONTROL

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- .1 Testing:
    - .1 Test system in accordance with Section 21 05 01.
    - .2 For glycol systems, retest with propylene glycol to ASTM E202, inhibited, for use in building system after cleaning. Repair leaking joints, fittings or valves.
  - .2 Balancing:
    - .1 Balance water systems to within plus or minus 5% of design output.
  - .3 Glycol Charging:
    - .1 Provide mixing tank and positive displacement pump for glycol charging.
-

- 3.7 FIELD QUALITY CONTROL  
(Cont'd) .3 Glycol Charging:(Cont'd)
- .2 Retest for concentration to ASTM E202 after cleaning.
  - .3 Provide report to Departmental Representative.
- 
- 3.8 CLEANING .1 Proceed in accordance with Section 01 74 11.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

PART 1 - GENERAL

1.1 RELATED  
REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29 - Health and Safety Requirements.
- .3 Section 01 61 00 - Common Product Requirements.
- .4 Section 01 74 11 - Cleaning.
- .5 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.
- .6 Section 01 78 00 - Closeout Submittals.
- .7 Section 21 05 01 - Common Work Results - Mechanical.
- .8 Section 23 05 05 - Installation of Pipework.
- .9 Section 23 05 17 - Pipe Welding.
- .10 Section 23 05 23.01 - Valves - Bronze.
- .11 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .12 Section 23 08 01 - Performance Verification of Mechanical Piping Systems.
- .13 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

1.2 REFERENCES

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
    - .1 ANSI/AWWA C111/A21.11-06, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
  - .2 American Society of Mechanical Engineers (ASME)
    - .1 ASME B16.1-10, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
    - .2 ASME B16.3-06, Malleable Iron Threaded Fittings: Classes 150 and 300.
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1.2 REFERENCES  
(Cont'd)

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- .2 (Cont'd)
  - .3 ASME B16.5-09, Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard.
  - .4 ASME B16.9-07, Factory-Made Wrought Buttwelding Fittings.
  - .5 ASME B18.2.1-10, Square Hex, Heavy Hex and Askew Head Bolts and Hex, Heavy Hex, Hex Flange. Loded Head and Lag Screws (Inch Series).
  - .6 ASME B18.2.2-10, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).
  - .3 ASTM International
    - .1 ASTM A47/A47M-99(2009), Standard Specification for Ferritic Malleable Iron Castings.
    - .2 ASTM A53/A53M-10, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
    - .3 ASTM A536-84(2009), Standard Specification for Ductile Iron Castings.
    - .4 ASTM B61-08, Standard Specification for Steam or Valve Bronze Castings.
    - .5 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
    - .6 ASTM E202-10, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.
  - .4 Canada Green Building Council (CaGBC)
    - .1 LEED Canada-NC-2009, LEED (Leadership in Energy and Environmental Design): Green Building Rating System for New Construction and Major Renovations 2009.
    - .2 LEED Canada-CI Version 1.0-2007, LEED (Leadership in Energy and Environmental Design): Green Building Rating System for Commercial Interiors.
    - .3 LEED Canada-EB: O&M-2009, LEED (Leadership in Energy and Environmental Design): Green Building Rating System for Existing Buildings: Operations and Maintenance 2009.
  - .5 CSA International
    - .1 CSA B242-05(R2011), Groove and Shoulder Type Mechanical Pipe Couplings.
    - .2 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.
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- 1.2 REFERENCES (Cont'd) .6 Manufacturer's Standardization of the Valve and Fittings Industry (MSS)
- .1 MSS-SP-67-2002a, Butterfly Valves.
  - .2 MSS-SP-70-06, Gray Iron Gate Valves, Flanged and Threaded Ends.
  - .3 MSS-SP-71-05, Gray Iron Swing Check Valves Flanged and Threaded Ends.
  - .4 MSS-SP-80-08, Bronze Gate, Globe, Angle and Check Valves.
  - .5 MSS-SP-85-02, Gray Iron Globe and Angle Valves, Flanged and Threaded Ends.
- 1.3 ACTION AND INFORMATIONAL SUBMITTALS .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for hydronic systems and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
  - .2 Indicate on drawings:
    - .1 Components and accessories.
- 1.4 CLOSEOUT SUBMITTALS .1 Submit in accordance with Section 01 78 00.
- .2 Operation and Maintenance Data: submit operation and maintenance data for hydronic systems for incorporation into manual.
- .1 Include special servicing requirements.
- 1.5 EXTRA STOCK MATERIALS .1 Supply spare parts as follows:
- .1 Valve seats: 1 minimum for every ten valves, each size. Minimum one.
  - .2 Discs: 1 minimum for every ten valves, each size. Minimum one.
  - .3 Stem packing: 1 minimum for every ten valves, each size. Minimum one.
  - .4 Valve handles: 2 minimum of each size.
  - .5 Gaskets for flanges: 1 minimum for every ten flanges.
-

1.6 DELIVERY,  
STORAGE AND  
HANDLING

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

PART 2 - PRODUCTS

2.1 PIPE

- .1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:
  - .1 To NPS 6: Schedule 40.

2.2 PIPE JOINTS

- .1 NPS 2 and under: screwed fittings with PTFE tape or lead-free pipe dope.
- .2 NPS 2-1/2 and over: welding fittings and flanges to CSA W48.
- .3 Flanges: raised face, to ANSI/AWWA C111/ A21.11.
- .4 Orifice flanges: slip-on raised face, 2100 kPa.
- .5 Flange gaskets: to ANSI/AWWA C111/ A21.11.

- 2.2 PIPE JOINTS (Cont'd)
- .6 Pipe thread: taper.
  - .7 Bolts and nuts: to ASME B18.2.1 and ASME B18.2.2.
- 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 ductile iron to ASTM A536.
- 2.4 VALVES
- .1 Connections:
    - .1 NPS 2 and smaller: screwed ends.
    - .2 NPS 2-1/2 and larger: flanged ends.
  - .2 Gate valves: to MSS-SP-70 application: isolating equipment, control valves, pipelines:
    - .1 NPS 2 and under:
      - .1 Mechanical Rooms: Class 125, rising stem, wedge disc, as specified Section 23 05 23.01.
      - .2 Elsewhere: Class 125, rising stem, solid wedge disc, as specified Section 23 05 23.01.
    - .2 NPS 2-1/2 and over:
      - .1 Mechanical Rooms: rising stem, wedge disc, bronze trim, as specified Section 23 05 23.01.
        - .1 Operators: manual.
        - .2 Elsewhere: rising stem, wedge disc, bronze trim, as specified Section 23 05 23.01.
  - .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 NPS 2-1/2 and over: lug type: as specified Section 23 05 17.
-

- 2.4 VALVES  
(Cont'd)
- .4 Balancing, for TAB:
    - .1 Sizes: calibrated balancing valves, as specified this section.
    - .2 NPS 2 and under:
      - .1 Mechanical Rooms: globe, with plug disc as specified Section 23 05 23.01.
      - .2 Elsewhere: globe, with plug disc as specified Section 23 05 23.01.
  - .5 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23.01.
  - .6 Swing check valves: to MSS-SP-71.
    - .1 NPS 2 and under:
      - .1 Class 125, swing, with composition disc, as specified Section 23 05 23.01.
    - .2 NPS 2-1/2 and over:
      - .1 Flanged ends: as specified Section 23 05 23.01.
  - .7 Silent check valves:
    - .1 NPS 2 and under:
      - .1 As specified Section 23 05 23.01.
    - .2 NPS 2-1/2 and over:
      - .1 Flanged ends: as specified Section 23 05 23.01.
  - .8 Ball valves:
    - .1 NPS 2 and under: as specified Section 23 05 23.01.
  - .9 Lubricated Plug Valves
    - .1 NPS 2 and under.
    - .2 NPS 2-1/2 and over:
      - .1 As specified Section 23 05 23.01.

PART 3 - EXECUTION

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



- 3.1 EXAMINATION .1 (Cont'd)  
(Cont'd) .3 (Cont'd)  
remedied and after receipt of written approval to proceed from Departmental Representative.
- 3.2 PIPING .1 Install pipework in accordance with Section  
INSTALLATION 23 05 05.
- 3.3 CIRCUIT .1 Install flow measuring stations and flow  
BALANCING VALVES 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.
- 3.4 CLEANING, .1 In accordance with Section 23 08 02.  
FLUSHING AND  
START-UP
- 3.5 TESTING .1 Test system in accordance with Section  
21 05 01.
- .2 For glycol systems, retest with propylene glycol to ASTM E202, inhibited, for use in building system after cleaning. Repair leaking joints, fittings or valves.
- 3.6 BALANCING .1 Balance water systems to within plus or minus  
5% of design output.
- .2 In accordance with Section 23 05 93 for applicable procedures.
- 3.7 GLYCOL CHARGING .1 Include mixing tank and positive displacement  
pump for glycol charging.
- .2 Retest for concentration to ASTM E202 after cleaning.
-

3.8 PERFORMANCE  
VERIFICATION

.1 In accordance with Section 23 08 01.

3.9 CLEANING

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

.1 Leave Work area clean at end of each  
day.

.2 Final Cleaning: upon completion remove  
surplus materials, rubbish, tools and  
equipment in accordance with Section 01 74 11.

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

.1 Remove recycling containers and bins  
from site and dispose of materials at  
appropriate facility.

3.10 PROTECTION

.1 Protect installed products and components  
from damage during construction.

.2 Repair damage to adjacent materials caused by  
hydronic systems installation.

PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 61 00 - Common Product Requirements.
  - .3 Section 01 74 11 - Cleaning.
  - .4 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.
  - .5 Section 01 78 00 - Closeout Submittals.
- 1.2 REFERENCES
- .1 American Society of Mechanical Engineers (ASME)
    - .1 ASME-04(2007), Boiler and Pressure Vessel Code.
  - .2 ASTM International Inc.
    - .1 ASTM A278/A278M-01(2006), Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (350 degrees C).
    - .2 ASTM A516/A516M-06, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
    - .3 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
  - .3 Canadian Standards Association (CSA International)
    - .1 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.
    - .2 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code, Supplement #1.
- 1.3 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Provide submittals in accordance with Section 01 33 00.
  - .2 Product Data:
    - .1 Provide manufacturer's printed product literature and datasheets for expansion tanks, air vents, separators, valves, and strainers, and include product characteristics, performance criteria, physical size, finish and limitations.
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- 1.3 ACTION AND INFORMATIONAL SUBMITTALS (Cont'd)
- .3 Shop Drawings:  
.1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- 1.4 CLOSEOUT SUBMITTALS
- .1 Submit maintenance and operation data in accordance with Section 01 78 00.
- 1.5 DELIVERY, STORAGE AND HANDLING
- .1 Deliver, store and handle in accordance with Section 01 61 00.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return of pallets, crates, padding and packaging materials in accordance with Section 01 74 20.

PART 2 - PRODUCTS

- 2.1 CLOSED EXPANSION TANK
- .1 Horizontal or vertical expansion tank with threaded pipe connections.
- .2 Capacity: as per schedule.
- .3 Size: as per schedule.
- .4 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.
- .5 Accessories:  
.1 Expansion pipe connection at bottom.  
.2 NPS 1 drain connection at bottom with drain valve.  
.3 Vent connection, NPS 1, at top.  
.4 Relief valve and connection at top, to manufacturer's recommendations.  
.5 12 mm sight glass connections at 1/8 and 7/8 points of height, complete with sight
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- 2.1 CLOSED EXPANSION TANK (Cont'd)
- .5 Accessories: (Cont'd)
    - .5 (Cont'd) glass, shut-off valves with blowdown and protective guards.
    - .6 Two - 62 mm inspection tappings on centre line of sides, one near each end.
  - .6 Supports: provide supports with hold down bolts and installation templates incorporating seismic restraint systems.
- 2.2 DIAPHRAGM TYPE EXPANSION TANK
- .1 Horizontal or vertical steel pressurized diaphragm type expansion tank.
  - .2 Capacity: as per drawings.
  - .3 Size: as per drawings.
  - .4 Diaphragm sealed in elastomer or EPDM suitable for 115 degrees C operating temperature.
  - .5 Working pressure: 860 kPa with ASME stamp and certification.
  - .6 Air precharged to 84 kPa (initial fill pressure of system).
  - .7 Saddles for horizontal installation and base mount for vertical installation.
  - .8 Supports: provide supports with hold down bolts and installation templates incorporating seismic restraint systems.
- 2.3 AUTOMATIC AIR VENT
- .1 Standard float vent: brass body and NPS 1/8 connection and rated at 310 kPa working pressure.
- 2.4 AIR SEPARATOR - EXPANSION TANK FITTING
- .1 Complete with adjustable vent tube and built-in manual vent valve.
  - .2 Working pressure: 860 kPa.
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2.5 AIR SEPARATOR - IN-LINE .1 Working pressure: 860 kPa.  
.2 Size: to match inlet and outlet ppe sizes.

2.6 PIPE LINE STRAINER .1 NPS 1/2 to 2: bronze body to ASTM B62, screwed connections, Y pattern.  
.2 NPS 2-1/2 to 8: cast steel body to ASTM A278/A278M, Class 30, flanged connections.  
.3 Blowdown connection: NPS 1.  
.4 Screen: stainless steel with 1.19 mm perforations.  
.5 Working pressure: 860 kPa.

2.7 SUCTION DIFFUSER .1 Body: cast iron with flanged screwed connections.  
.2 Strainer: with built-in, disposable 1.19 mm mesh, low pressure drop screen and NPS 1 blowdown connection.  
.3 Permanent magnet particle trap.  
.4 Full length straightening vanes.  
.5 Pressure gauge tappings.  
.6 Adjustable support leg.

PART 3 - EXECUTION

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

3.2 GENERAL .1 Run drain lines and blow off connections to terminate above nearest drain.  
.2 Maintain adequate clearance to permit service and maintenance.

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- 3.2 GENERAL  
(Cont'd)
- .3 Should deviations beyond allowable clearances arise, request and follow Departmental Representative's directive.
  - .4 Check shop drawings for conformance of tappings for ancillaries and for equipment operating weights.
- 3.3 STRAINERS
- .1 Install in horizontal or down flow lines.
  - .2 Ensure clearance for removal of basket.
  - .3 Install ahead of each pump.
  - .4 Install ahead of each automatic control valve larger than NPS 1 and as indicated.
- 3.4 AIR VENTS
- .1 Install at high points of systems.
  - .2 Install gate valve on automatic air vent inlet. Run discharge to nearest drain or service sink.
- 3.5 EXPANSION TANKS
- .1 Adjust expansion tank pressure as indicated.
  - .2 Install lockshield type valve at inlet to tank.
- 3.6 PRESSURE SAFETY  
RELIEF VALVES
- .1 Run discharge pipe to terminate above nearest drain.
- 3.7 SUCTION  
DIFFUSERS
- .1 Install on inlet to pumps having suction size greater than 50 mm  $\phi$ .
- 3.8 PERFORMANCE  
VERIFICATION
- .1 Repair and maintenance materials and instructions.
- 3.9 CLEANING
- .1 Clean in accordance with Section 01 74 11.
    - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
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3.9 CLEANING .2 Waste Management: separate waste materials  
(Cont'd) for reuse and recycling in accordance with  
Section 01 74 20.



PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 61 00 - Common Product Requirements.
  - .3 Section 01 74 11 - Cleaning.
  - .4 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.
  - .5 Section 01 78 00 - Closeout Submittals.
  - .6 Section 01 91 00 - General Commissioning (CX) Requirements.
- 1.2 REFERENCES
- .1 Canadian Standards Association (CSA International)
    - .1 CSA-B214-07, Installation Code for Hydronic Heating Systems.
  - .2 National Electrical Manufacturers' Association (NEMA)
    - .1 NEMA MG 1-2006, Motors and Generators.
- 1.3 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Provide submittals in accordance with Section 01 33 00.
  - .2 Product Data:
    - .1 Provide manufacturer's printed product literature and datasheets for pump, circulator, and equipment, and include product characteristics, performance criteria, physical size, finish and limitations indicate point of operation, and final location in field assembly.
  - .3 Shop Drawings:
    - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
  - .4 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.
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1.4 CLOSEOUT  
SUBMITTALS .1 Provide maintenance and operation data for  
incorporation into manual specified in Section  
01 78 00.

1.5 MAINTENANCE .1 Provide maintenance materials in accordance  
with Section 01 78 00.

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

PART 2 - PRODUCTS

2.1 EQUIPMENT .1 Size and select components to: CSA-B214.

2.2 IN-LINE  
CIRCULATORS .1 Volute: cast iron radially split, with  
screwed or flanged design suction and  
discharge connections.  
.2 Impeller: cast bronze or stainless steel.  
.3 Shaft: stainless steel with bronze sleeve  
bearing, integral thrust collar.  
.4 Seal assembly: mechanical for service to  
135°C.  
.5 Coupling: rigid self-aligning.  
.6 Motor: to NEMA MG 1 drip proof, TEFC, sleeve  
bearing, 1,800 r/min, minimum efficiency 94%,  
as per drawings.  
.7 Capacity: as indicated.  
.8 Design pressure: 860 kPa.

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2.3 VERTICAL  
IN-LINE CIRCULATORS

- .1 Volute: cast iron radially split, with tapped openings for venting, draining and gauge connections, with screwed or flanged suction and discharge connections.
- .2 Impeller: brass, bronze or stainless steel.
- .3 Shaft: stainless steel with bronze sleeve bearing, integral thrust collar.
- .4 Seal assembly: mechanical for service to 135°C.
- .5 Coupling: rigid self-aligning.
- .6 Motor: to NEMA MG 1 resilient mounted, drip proof, sleeve bearing, 1,800 r/min, as per drawings.
- .7 Capacity: as indicated.
- .8 Design pressure: 1200 kPa.

2.4 SINGLE SUCTION  
CENTRIFUGAL PUMP

- .1 General: cast steel all bronze pump complete with motor.
- .2 Base: common cast iron 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 tapings.
- .4 Impeller: bronze or stainless steel enclosed type, keyed drive with locking nut or screw.
- .5 Shaft: stainless steel with two point support, machined shoulders for ball bearing mounting sleeve bearings hardened wear rings at packing gland.
- .6 Seal assembly: mechanical permanently lubricated.
- .7 Coupling: flexible self-aligning.
- .8 Motor: NEMA MG 1, squirrel cage induction, 1,725 r/min. kW HP, continuous duty, drip proof, ball bearing, maximum temperature rise 50°C.
- .9 Capacity: as indicated.

2.4 SINGLE SUCTION .10 Design pressure: 1200 kPa.  
CENTRIFUGAL PUMP  
(Cont'd)

PART 3 - EXECUTION

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

3.2 INSTALLATION .1 Install hydronic pumps to: CSA-B214.  
.2 In line circulators: install as indicated by  
flow arrows.  
.1 Support at inlet and outlet flanges or  
unions.  
.2 Install with bearing lubrication points  
accessible.  
.3 Base mounted type: supply templates for  
anchor bolt placement.  
.1 Include anchor bolts with sleeves. Place  
level, shim unit and grout.  
.2 Align coupling in accordance with  
manufacturer's recommended tolerance.  
.3 Check oil level and lubricate..  
.4 Ensure that pump body does not support piping  
or equipment.  
.1 Provide stanchions or hangers for this  
purpose.  
.2 Refer to manufacturer's installation  
instructions for details.  
.5 Pipe drain tapping to drain.  
.6 Install volute venting pet cock in accessible  
location.  
.7 Check rotation prior to start-up.  
.8 Install pressure gauge test cocks.

3.3 START-UP .1 General:  
.1 In accordance with Section 01 91 00:  
General Requirements; supplemented as  
specified herein.

- 
- 3.3 START-UP  
(Cont'd)
- .1 General:(Cont'd)
    - .2 In accordance with manufacturer's recommendations.
  - .2 Procedures:
    - .1 Before starting pump, check that cooling water system over-temperature and other protective devices are installed and operative.
    - .2 After starting pump, check for proper, safe operation.
    - .3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
    - .4 Check base for free-floating, no obstructions under base.
    - .5 Run-in pumps for 12 continuous hours minimum.
    - .6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.
    - .7 Eliminate air from scroll casing.
    - .8 Adjust water flow rate through water-cooled bearings.
    - .9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.
    - .10 Adjust alignment of piping and conduit to ensure true flexibility.
    - .11 Eliminate cavitation, flashing and air entrainment.
    - .12 Adjust pump shaft seals, stuffing boxes, glands.
    - .13 Measure pressure drop across strainer when clean and with flow rates as finally set.
    - .14 Replace seals if pump used to degrease system or if pump used for temporary heat.
    - .15 Verify lubricating oil levels.
- 3.4 PERFORMANCE  
VERIFICATION (PV)
- .1 General:
    - .1 Verify performance in accordance with Section 01 91 00: General Requirements, supplemented as specified herein.
  - .2 Verify that manufacturer's performance curves are accurate.
  - .3 Ensure valves on pump suction and discharge provide tight shut-off.
  - .4 Net Positive Suction Head (NPSH):
-

- 3.4 PERFORMANCE VERIFICATION (PV) (Cont'd)
- .4 Net Positive Suction Head (NPSH):(Cont'd)
    - .1 Application: measure NPSH for pumps which operate on open systems and with water at elevated temperatures.
    - .2 Measure using procedures prescribed in Section 01 91 00.
    - .3 Where procedures do not exist, discontinue PV, report to Departmental Representative and await instructions.
  - .5 Multiple Pump Installations - Series and Parallel:
    - .1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.
  - .6 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.
  - .7 Commissioning Reports: in accordance with Section 01 91 00 reports supplemented as specified herein. Reports to include:
    - .1 Record of point(s) of actual performance at maximum and minimum conditions and for single and parallel operation as finally set at completion of commissioning on pump curves.
    - .2 Use Report Forms specified in Section 01 91 00: Report Forms and Schematics.
    - .3 Pump performance curves (family of curves).
- 3.5 OPERATION REQUIREMENTS
- .1 Repair and maintenance materials and instructions.
- 3.6 CLEANING
- .1 Clean in accordance with Section 01 74 11.
    - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
  - .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

PART 1 - GENERAL

- 1.1 REFERENCES
- .1 American National Standards Institute (ANSI) / American Society of Mechanical Engineers (ASME)
    - .1 ASME B16.1-10, Gray Iron Pipe Flanges and Flanged Fittings: Class 25, 125, 250 and 800.
    - .2 ASME B16.25-07, Buttwelding Ends.
    - .3 ASME B16.3-11, Malleable Iron Threaded Fittings: Classes 150 and 300.
    - .4 ANSI/ASME B16.5-09, Pipe Flanges and Flanged Fittings: NPS ½ through 24.
    - .5 ANSI/ASME B16.9-07, Factory-Made Wrought Steel Buttwelding Fittings.
    - .6 ANSI/ASME B18.2.2-87(R2005), Square and Hex Nuts (Inch Series).
  - .2 American National Standards Institute (ANSI) / American Water Works Association (AWWA)
    - .1 ANSI/AWWA C111/A21.11-07, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
  - .3 ASTM International Inc.
    - .1 ASTM A47/A47M-99(2009), Standard Specification for Ferritic Malleable Iron Castings.
    - .2 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
  - .4 Canada Green Building Council (CaGBC)
    - .1 LEED Canada-NC -2009, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations.
    - .2 Rating System Addenda for New Construction and Major Renovations LEED Canada-NC - 2009.
    - .3 LEED Canada-CI Version 1.0-2007, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
  - .5 Canadian Standards Association (CSA International)
    - .1 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.
-

- 1.2 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Provide submittals in accordance with Section 01 33 00.
  - .2 Product Data:
    - .1 Provide manufacturer's printed product literature and datasheets for valves and pipes and include product characteristics, performance criteria, physical size, finish and limitations.
    - .3 Shop Drawings:
      - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- 1.3 CLOSEOUT SUBMITTALS
- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 and include following:
    - .1 Special servicing requirements.
- 1.4 DELIVERY, STORAGE AND HANDLING
- .1 Deliver, store and handle in accordance with Section 01 61 00.
  - .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
  - .3 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials in accordance with Section 01 74 20.
- 1.5 MAINTENANCE MATERIALS SUBMITTALS
- .1 Extra Stock Materials:
    - .1 Provide spare parts as follows:
      - .1 Valve seats: one for every ten valves, each size. Minimum one.
      - .2 Discs: one for every ten valves, each size. Minimum one.
      - .3 Stem packing: one for every ten valves, each size. Minimum one.
      - .4 Valve handles: 2 of each size.
      - .5 Gaskets for flanges: one for every ten flanges.
-



PART 2 - PRODUCTS

- 2.1 PIPE .1 Steel pipe: to ASTM A53/A53M, Grade B as follows:  
.1 Steam;  
.1 To UPS 2: threded schedule 80  
.2 To UPS 2: welded schedule 40  
.3 To NPS 6: schedule 40.  
.2 Condensate: schedule 80.
- 2.2 PIPE JOINTS .1 NPS 2 and under: screwed fittings with PTFE tape or lead-free dope.  
.2 NPS 2-1/2 and over: welding fittings and flanges to CSA W48.  
.3 Flanges: plain or raised face. Flange gaskets to ANSI/AWWA C111/A21.11.  
.4 Pipe thread: taper.  
.5 Bolts and nuts: carbon steel, to ANSI/ASME B18.2.1 and ANSI/ASME B18.2.2.  
.6 Buttwelding ends: to ANSI/ASME B16.25 as indicated.
- 2.3 FITTINGS .1 Pipe flanges: cast-iron to ASME B16.1, Class 125.  
.2 Screwed fittings: malleable iron to ASME B16.3, Class 150.  
.3 Steel pipe gaskets, flanges and flanged fittings: to ANSI/ASME B16.5.  
.4 Buttwelding fittings: steel to ANSI/ASME B16.9.  
.5 Unions: malleable iron, to ASTM A47/A47M and ASME B16.3.
- 2.4 VALVES .1 Connections:  
.1 NPS 2 and smaller: screwed ends.  
.2 NPS 2 1/2 and larger:  
.1 Equipment: Flange, or welded ends.  
.2 Elsewhere: Flangedor welded
-

2.4 VALVES  
(Cont'd)

- .2 Gate valves: Application: Steam service, for isolating equipment, control valves, pipelines.
  - .1 NPS 2 and under:
    - .1 Mechanical Rooms: Class 125, rising stem, wedge disc, as specified Section 23 05 23.01.
    - .2 Elsewhere: Class 125, rising stem, solid wedge disc, as specified Section 23 05 23.01.
  - .2 NPS 2 1/2 -8:
    - .1 Mechanical Rooms: Class 150, rising stem, splitwedge disc, cast iron, lead-free bronze trim, as specified Section 23 05 23.02.
      - .1 Operators: Class 150.
      - .2 Elsewhere: Class 150, rising stem, solidwedge disc, cast iron with lead-free bronze trim, as specified Section 23 05 23.02.
        - .1 Operators: Class 150.
- .3 Globe valves: Application: Steam service, throttling, flow control, emergency bypass.
  - .1 NPS 2 and under:
    - .1 Mechanical Rooms: Class 150 with PFTEDisc as specified Section 23 05 23.01.
    - .2 Elsewhere: Class 150 with composition disc as specified Section 23 05 23.01.
  - .2 NPS 2 1/2 and over:
    - .1 With bronze disc, cast iron with bronze trim, to Section 23 05 23.02.
      - .1 Operators: Class 150.
- .4 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23.01.
- .5 Bypass valves around large size globe valves: as specified Section 23 05 23.03.
- .6 Lift check valves:
  - .1 NPS 2 and under: Class 125, lift, with composition disc, as specified Section 23 05 23.01.
  - .2 NPS 2 1/2 and over: as specified Section 23 05 23.02.

2.5 VALVE OPERATORS .1 Handwheel with chain operators: on valves installed more than 2400 mm above floor.

PART 3 - EXECUTION

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

3.2 PIPING .1 Install pipework in accordance with Section 23 05 01.

.2 Connect branch lines into top of mains.

.3 Install piping in direction of flow with slopes as follows, unless indicated:

.1 Steam: 1:240.

.2 Condensate return: 1:70.

.4 Make provision for thermal expansion as required.

.5 Drip pocket: line size.

3.3 VALVES .1 Install globe valves around, NPS 8 and over, gate valves.

3.4 TESTING .1 Test system in accordance with Section 21 05 01.

.2 Test pressure: 1-1/2 times maximum system operating pressure or 860 kPa whichever is greater.

3.5 SYSTEM START-UP .1 In accordance with Section 23 08 02.

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- 3.6 PERFORMANCE VERIFICATION (PV) .1 General:
- .1 Verify performance in accordance with Section 23 08 01 supplemented as specified herein.
  - .2 Timing, only after:
    - .1 Pressure tests successfully completed.
    - .2 Flushing as specified has been completed.
    - .3 Water treatment system has been commissioned.
  - .3 PV Procedures:
    - .1 Verify complete drainage of condensate from steam coils.
    - .2 Verify proper operation of system components, including, but not limited to:
      - .1 Steam traps - verify no blow-by.
      - .2 Flash tanks.
      - .3 Thermostatic vents.
    - .3 Monitor operation of provisions for controlled pipe movement including expansion joints, loops, guides, anchors.
      - .1 If bellows type expansion joints flex incorrectly, shut down system, re-align, repeat start-up procedures.
- 3.7 CLEANING .1 Clean in accordance with Section 01 74 11.
- .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
  - .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

PART 1 - GENERAL

1.1 REFERENCES

- .1 American Society for Mechanical Engineers  
(ASME International)
  - .2 ASTM International Inc.
    - .1 ASTM A126-04(2009), Standard  
Specification for Gray Iron Castings for  
Valves, Flanges and Pipe Fittings.
    - .2 ASTM A167-99(2009), Standard  
Specification for Stainless and  
Heat-Resisting Chromium-Nickel Steel  
Plate, Sheet and Strip.
    - .3 ASTM A216/A216M-08, Standard  
Specification for Steel Castings, Carbon,  
Suitable for Fusion Welding for  
High-Temperature Service.
    - .4 ASTM A240/A240M-12, Standard  
Specification for Chromium and  
Chromium-Nickel Stainless Steel Plate,  
Sheet, and Strip for Pressure Vessels and  
for General Applications.
    - .5 ASTM A276-10, Standard Specification for  
Stainless Steel Bars and Shapes.
    - .6 ASTM A278/A278M-01(2011), Standard  
Specification for Gray Iron Castings for  
Pressure - Containing Parts for  
Temperatures up to 650 Degrees F (350  
degrees C).
    - .7 ASTM A351/A351M-12, Standard  
Specification for Castings, Austenitic,  
for Pressure- Containing Parts.
    - .8 ASTM A564/A564M-10, Standard  
Specification for Hot-Rolled and  
Cold-Finished Age-Hardening Stainless  
Steel Bars and Shapes.
    - .9 ASTM B62-09, Standard Specification for  
Composition Bronze or Ounce Metal  
Castings.
  - .3 Canada Green Building Council (CaGBC)
    - .1 LEED Canada-NC Version 1.0-2004, LEED  
(Leadership in Energy and Environmental  
Design): Green Building Rating System  
Reference Package For New Construction  
and Major Renovations.
    - .2 Rating System Addenda for New  
Construction and Major Renovations LEED  
Canada-NC Version 1.0-Addendum 2007.
    - .3 LEED Canada-CI Version 1.0-2007, LEED  
(Leadership in Energy and Environmental  
Design): Green Building Rating System  
Reference Guide For Commercial Interiors.
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- 1.1 REFERENCES (Cont'd)
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)  
.1 Material Safety Data Sheets (MSDS).
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:  
.1 Provide manufacturer's printed product literature Canadian Registration Number (CRN), and datasheets for steam traps, vacuum breakers, pressure reducing valves, air vents, safety relief valves, and include product characteristics, performance criteria, physical size, finish and limitations.  
.2 Provide two copies WHMIS MSDS - Material Safety Data Sheets.
- .3 Shop Drawings:  
.1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .4 Closeout Submittals:  
.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.
- 1.3 DELIVERY, STORAGE AND HANDLING
- .1 Deliver, store and handle in accordance with Section 01 61 00.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 20.
-

PART 2 - PRODUCTS

- 2.1 MATERIALS
- .1 Cast steel: to ASTM A216/A216M.
  - .2 Cast iron: to ASTM A278, Class 150.
  - .3 Bronze: to ASTM B62.
  - .4 Stainless steel: to ASTM A351/A351M.
- 2.2 FLOAT AND THERMOSTATIC STEAM TRAPS 0-110 kPa
- .1 Application: end of run condensate removal and system warm-up.
  - .2 Materials: body - cast-steel; valve - stainless steel with stainless steel seat; float and mechanisms - stainless steel; air vent - stainless steel thermostatic type.
  - .3 Capacity: as indicated.
- 2.3 FLOAT AND THERMOSTATIC STEAM TRAPS 111-1000 kPa
- .1 Application: for end of run condensate removal.
  - .2 Materials: body - cast-steel; valve - stainless steel with stainless steel seat; air vent - stainless steel.
  - .3 Capacity: as indicated.
- 2.4 PRESSURE REDUCING VALVE -EXTERNAL PILOT OPERATED
- .1 Location: as indicated.
  - .2 Self operating, external pilot, single seat, diaphragm operated, dead end shutoff, enclosed spring chamber main and pilot valve.
  - .3 Connections:
    - .1 Under NPS 2: screwed ends.
    - .2 NPS 2-1/2 and over: flanged ends.
  - .4 Main valve:
    - .1 Body: cast iron to ASTM A126, Class B
    - .2 Diaphragm: stainless steel to ASTM A167 ASTM A240/A240M.
    - .3 Seat rings: stainless steel to ASTM A276.
    - .4 Disc: stainless steel to ASTM A564/A564M, ASTM A276.

- 
- 2.4 PRESSURE  
REDUCING VALVE  
-EXTERNAL PILOT  
OPERATED  
(Cont'd)
- .4 Main valve:(Cont'd)
    - .5 Stem: stainless steel to ASTM A276.
    - .6 Spring: carbon steel.
    - .7 Bolting: carbon steel.
  - .5 Pilot valve:
    - .1 Body: cast iron to ASTM A126, Class B.
    - .2 Diaphragm: stainless steel to ASTM A167  
ASTM A240/A240M.
  - .6 Noise criteria:.
  - .7 Capacity: as indicated
- 2.5 SAFETY AND  
RELIEF VALVES
- 
- .1 Spring loaded type of cast iron with high capacity and semi-nozzle and to ASME code.
  - .2 Material: body -cast iron; valve - housing lead-free cast bronze; spring - steel, cadmium plated; bronze/brass trim.
  - .3 Capacity:as per drawings.
- 2.6 DRIP PAN  
ELBOWS
- 
- .1 Application: on discharge of steam safety relief valves as indicated.
  - .2 Cast iron or steel with screwed or flanged inlet and threaded drain connections.
- 2.7 PIPE LINE  
STRAINERS UP TO NPS
- 
- .1 Application: ahead of condensate pumps, steam traps, control valves and elsewhere as indicated.
  - .2 Working pressure: 860kPa.
  - .3 Body: cast iron.
  - .4 Connections: screwed.
  - .5 Screen: stainless steel with 0.8 mm perforations.
-



- 2.8 PIPE LINE STRAINERS NPS 2-1/2 AND OVER
- .1 Application: ahead of condensate pumps, steam traps, control valves as indicated.
  - .2 Working pressure: 860 kPa.
  - .3 Body: cast iron.
  - .4 Connections: flanged.
  - .5 Blowdown connection: NPS 1-1/4 complete with gate valve and cap.
  - .6 Screen: stainless steel with 3.2 mm perforations.

- 2.9 FLASH TANKS
- .1 Locations: as indicated.
  - .2 Tank: horizontal type with flanged drop tube connections.
  - .3 Sizes: 200 mm diameter x 600 mm long.
  - .4 Construction: to ASME code.
  - .5 Maximum working pressure: 860 kPa.
  - .6 Connections: NPS 2 and under, screwed; NPS 2-1/2 and over, flanged.
  - .7 Finish: prime coated.
  - .8 Supports: vertical legs for vertical tank; saddles for horizontal tank.

PART 3 - EXECUTION

- 3.1 APPLICATION
- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.
  - .2 Maintain proper clearance around equipment to permit maintenance.

- 3.2 STRAINERS .1 Install as indicated.  
.2 Ensure clearance for removal of basket.  
.3 Install valved blow-down as indicated.
- 3.3 SAFETY RELIEF VALVE .1 Pipe to atmosphere independent of other vents and in accordance with applicable code.  
.2 Support discharge pipe against reaction forces and to take up thermal movement.  
.3 Drain pipe from drip pan elbow to terminate over floor drain.
- 3.4 STEAM TRAPS .1 Install unions on inlet and outlet.
- 3.5 PRESSURE REDUCING VALVES .1 Install on 3-valve bypass with strainer on inlet.  
.2 Pipe as indicated. Follow manufacturer's installation instructions.
- 3.6 FLASH TANKS .1 Pipe arrangement as indicated.
- 3.7 PERFORMANCE VERIFICATION .1 In accordance with Section 23 08 01.
- 3.8 CLEANING .1 Clean in accordance with Section 01 74 11.  
.1 Remove surplus materials, excess materials, rubbish, tools and equipment.  
.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.
  - .2 Section 01 78 00 - Closeout Submittals.
  - .3 Section 23 05 01 - Installation of Pipework.
- 1.2 REFERENCES
- .1 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME)
    - .1 ANSI/ASME B16.22-2001(R2010), Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
    - .2 ANSI/ASME B16.24-2011, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
    - .3 ANSI/ASME B16.26-2011, Cast Copper Alloy Fittings for Flared Copper Tubes.
    - .4 ANSI/ASME B31.5-2010, Refrigeration Piping and Heat Transfer Components.
  - .2 ASTM International
    - .1 ASTM A307-10, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
    - .2 ASTM B280-08, Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
  - .3 Canadian Standards Association (CSA)
    - .1 CSA B52-05(R2009), Mechanical Refrigeration Code.
  - .4 Environment Canada (EC)
  - .5 EPS 1/RA/1-96, Environmental Code of Practice for the Reduction of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.
- 1.3 WASTE MANAGEMENT AND DISPOSAL
- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
  - .2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan
-

1.3 WASTE  
MANAGEMENT AND  
DISPOSAL  
(Cont'd)

- .3 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 - PRODUCTS

2.1 TUBING

- .1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.  
.1 Hard copper: to ASTM B280, type ACR.  
.2 Annealed copper: to ASTM B280, with minimum wall thickness as per CSA B52 and ASME B31.5.

2.2 FITTINGS

- .1 Service: design pressure 2070 kPa and temperature 121°C.  
.2 Brazed:  
.1 Fittings: wrought copper to ASME B16.22.  
.2 Joints: silver solder or copper-phosphorous, 95% Cu-5%P and non-corrosive flux.  
.3 Flanged:  
.1 Bronze or brass, to ASME B16.24, Class 150 and Class 300.  
.2 Gaskets: suitable for service.  
.3 Bolts, nuts and washers: to ASTM A307, heavy series.  
.4 Flared:  
.1 Bronze or brass, for refrigeration, to ASME B16.26.

2.3 PIPE SLEEVES

- .1 Hard copper or steel, sized to provide 6 mm clearance around between sleeve and uninsulated pipe or between sleeve and insulation.

2.4 VALVES

- .1 22 mm and under: Class 500, 3.5 Mpa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moistureproof seal for below freezing applications, brazed connections.  
.2 Over 22 mm: Class 375, 2.5 Mpa, globe or angle type, diaphragm, packless type,

2.4 VALVES .2 Over 22 mm:(Cont'd)  
(Cont'd) back-seating, cap seal, with cast bronze body  
and bonnet, moistureproof seal for below  
freezing applications, brazed connections.

PART 3 - EXECUTION

3.1 GENERAL .1 In accordance with Section 23 05 01,  
supplemented as specified herein  
.2 Install in accordance with CSA B52, EPS1/RA/1  
and ASME B31.5.

3.2 BRAZING .1 Bleed inert gas into pipe during brazing.  
PROCEDURES .2 Remove valve internal parts, solenoid valve  
coils, sight glass.  
.3 Do not apply heat near expansion valve and  
bulb.

3.3 PIPING .1 General:  
INSTALLATION .1 Soft annealed copper tubing: bend  
without crimping or constriction or hard drawn  
copper tubing: do not bend. Minimize use of  
fittings.  
.2 Hot gas lines:  
.1 Pitch at least 1:240 down in direction  
of flow to prevent oil return to compressor  
during operation.  
.2 Provide trap at base of risers greater  
than 2400 mm high and at each 7600 mm  
thereafter.  
.3 Provide inverted deep trap at top of  
risers.  
.4 Provide double risers for compressors  
having capacity modulation.  
.1 Large riser: install traps as  
specified above.  
.2 Small riser: size for 5.1 m/s at  
minimum load. Connect upstream of traps  
on large riser.

- 
- 3.4 PRESSURE AND LEAK TESTING
- .1 Close valves on factory charged equipment and other equipment not designed for test pressures.
  - .2 Leak test to CSA B52 before evacuation to 2MPa and 1MPa on high and low sides respectively.
  - .3 Test Procedure: Build pressure up to 35 kPa with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.
- 3.5 DEHYDRATION AND CHARGING
- .1 Close service valves on factory charged equipment.
  - .2 Ambient temperatures to be at least 13°C for at least 12 hours before and during dehydration.
  - .3 Use copper lines of largest practical size to reduce evacuation time.
  - .4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5Pa absolute and filled with dehydrated oil.
  - .5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.
  - .6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:
    - .1 Twice to 14Pa absolute and hold for 4 h.
    - .2 Break vacuum with refrigerant to 14kPa.
    - .3 Final to 5Pa absolute and hold for at least 12 h.
    - .4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
    - .5 Submit test results to Departmental Representative.
  - .7 Charging:
    - .1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.
    - .2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is
-

- 3.5 DEHYDRATION AND CHARGING  
(Cont'd)
- .7 Charging:(Cont'd)  
.2 (Cont'd)  
fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.  
.3 Re-purge charging line if refrigerant container is changed during charging process.
- .8 Checks:  
.1 Make checks and measurements as per manufacturer's operation and maintenance instructions.  
.2 Record and report measurements to Departmental Representative.
- 3.6 INSTRUCTIONS .1 Post instructions in frame with glass cover in accordance with Section 01 78 00 and CSA B52.





PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.
  - .3 Section 01 78 00 - Closeout Submittals.
- 1.2 REFERENCES
- .1 American Society of Mechanical Engineers (ASME)
    - .1 ASME Boiler and Pressure Vessel Code, Section VII-2001.
- 1.3 SHOP DRAWINGS
- .1 Submit shop drawings in accordance with Section 01 33 00.
- 1.4 CLOSEOUT SUBMITTALS
- .1 Submit operation and maintenance data for incorporation into manual specified in Section 01 78 00.
  - .2 Include following:
    - .1 Log sheets as recommended by manufacturer.
- 1.5 WASTE MANAGEMENT AND DISPOSAL
- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
  - .2 Unused metal and wiring materials are to be diverted from landfill to a metal recycling facility as approved by the Departmental Representative.
  - .3 Dispose of unused water treatment chemicals at official hazardous material collections site approved by Departmental Representative.
  - .4 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.
  - .5 Remove from site and dispose of packaging materials at appropriate recycling facilities.
-

PART 2 - PRODUCTS

- 2.1 MANUFACTURER .1 Equipment, chemicals, service by one supplier.
- 2.2 POT FEEDER .1 Welded steel, pressure rating 1,200 kPa. Temperature rating: 90° C.
- 2.3 CHEMICAL FEED PIPING .1 Resistant to chemicals employed. Pressure rating: 1,200 kPa.
- 2.4 CHEMICAL FEED PUMPS .1 Top-mounted electronic metering diaphragm type: flow range 0-100%, adjustable, plus or minus 1.0% accuracy (repetitive), on-off operation, with pressure relief valve, check valve, foot valve, injection fitting.
- .2 Piston type: flow range 0-100%, adjustable, plus or minus 1.0% accuracy (repetitive), on-off operation, with stainless steel piston, pressure relief valve, double ball and check valves.
- 2.5 SHIPPING/ FEEDING CHEMICAL CONTAINERS .1 High density moulded polyethylene, with liquid level graduations, cover.
- 2.6 CONDUCTIVITY CONTROLLER .1 Fully transistorized, suitable for wall or flush panel mounting, linear over full measuring range of 0-5000 micromhs.
- .2 Insensitive to phase angle shifts, capable of operating on 95-130 Volts without affecting accuracy, power, bleedoff status lights.
- 2.7 CONDUCTIVITY PROBES .1 Dual carbon elements in PVC holder, quick disconnect, self-locking connection.
-

- 2.8 WATER TREATMENT FOR HYDRONIC SYSTEMS
- .1 Glycol system: Pot feeder, 25 L, operating pressure 138 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.
- 2.9 WATER TREATMENT FOR STEAM SYSTEMS
- .1 Performance: To control sludge, scale, dissolved solids, provide corrosion protection.
  - .2 Chemical feed pump:
    - .1 Capacity: 0.06 L/s at 138 kPa.
    - .2 One pump per feed tank.
  - .3 Chemical container:
    - .1 Containers: See specification elsewhere this section.
  - .4 Chemical feed pump control:
    - .1 Repeat cycle percentage timer. Feed time fully adjustable for 0-100% of repeated time cycle, 30 minute repeat.
    - .2 Electric interlock with make-up water controls.
    - .3 Electric interlock with steam boiler feed pump.
    - .4 Reset timer initiated by signal from contact head metre installed on water make-up line to feed tank.

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  
Departmental Representative.
- .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 7 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 WATER SOFTENER .1 Install in accordance with manufacturer's instructions.
- .2 Install water metre in water softener inlet piping.
- 3.6 START-UP .1 Start up water treatment systems in accordance with manufacturer's instructions.
- 3.7 COMMISSIONING .1 Commissioning Agency: To be Holder of service contract.
- .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 initial 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
-

- 3.7 COMMISSIONING .4 (Cont'd)  
(Cont'd)
- .6 (Cont'd)  
required until system stabilizes at required level of performance).
- .7 Advise Departmental Representative in writing on matters regarding installed water treatment systems.
- .5 Commissioning procedures - Water Softeners:  
.1 Demonstrate compliance with specifications by chemical analyses of raw water and treated water.  
.2 Determine, demonstrate actual softening capacity between regenerations.  
.3 Establish regeneration intervals and procedures.  
.4 Train O&M personnel in all regeneration procedures.
- .6 Commissioning procedures - Water side of closed circuit coolers, Cooling Tower Systems:  
.1 Verify operation of bleed-off system.  
.2 Establish bleed-off flow rate.  
.3 Establish rate of chemical feed - continual and periodic.  
.4 Test system water for chlorides, TDS, suspended solids, algae, slime, inhibitor level, pH, alkalinity, hardness, other impurities and microbiological organisms.  
.5 Compare with readings of total dissolved and suspended solids metre.  
.6 Read make-up water metre, compare with chiller load summation (ton-hours).  
.7 Test make-up water for chlorides, hardness.  
.8 Compare test results with readings from TDS metre.  
.9 Record quantity of make-up water, compare with summation of chiller load (in ton-hours).  
.10 Record types, quantities of chemicals applied.
- .7 Commissioning procedures - Closed Circuit Hydronic Systems:  
.1 Analyse water in system.  
.2 Based upon an assumed rate of loss approved by Departmental Representative, establish rate of chemical feed.  
.3 Record types, quantities of chemicals applied.
- .8 Training:
-

- 3.7 COMMISSIONING (Cont'd)
- .8 Training:(Cont'd)
    - .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.
  - .9 Certificates:
    - .1 Upon completion, furnish certificates confirming satisfactory installation and performance.
  - .10 Commissioning Reports:
    - .1 To include system schematics, test results, test certificates, raw and treated water analyses, design criteria, other data required by Departmental Representative.
  - .11 Commissioning activities during Warranty Period:
    - .1 Check out water treatment systems on regular basis and submit written report to Departmental Representative.





PART 1 - GENERAL

1.1 SUMMARY

- .1 Section Includes:
  - .1 Materials and installation of low-pressure metallic ductwork, joints and accessories.
  - .2 Sustainable requirements for construction and verification.
- .2 Related Sections:
  - .1 Section 07 84 00 - Firestopping.
  - .2 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
  - .3 Section 23 05 94 - Pressure Testing of Ducted Air Systems.
  - .4 Section 23 41 00 - Particulate Air Filtration.

1.2 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
  - .2 ASTM International.
    - .1 ASTM A480/A480M-11b, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
    - .2 ASTM A635/A635M-09b, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
    - .3 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
  - .3 Department of Justice Canada (Jus).
    - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33 .
  - .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
    - .1 Material Safety Data Sheets (MSDS).
  - .5 National Fire Protection Association (NFPA).
    - .1 NFPA 90A-2012, Standard for the Installation of Air-Conditioning and Ventilating Systems.
    - .2 NFPA 90B-2012, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
-

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- 1.2 REFERENCES .5 (Cont'd)  
(Cont'd)
- .3 NFPA 96-2011, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .6 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).  
.1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition 2005.  
.2 SMACNA HVAC Air Duct Leakage Test Manual, 1985, 1st Edition.  
.3 SMACNA IAQ Guidelines for Occupied Buildings Under Construction 2nd edition 2007; ANSI/SMACNA 008-2008.
- .7 Transport Canada (TC).  
.1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
- 1.3 SUBMITTALS .1 Submit shop drawings and product data in accordance with Section 01 33 00.  
.2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets for the following:  
.1 Sealants.  
.2 Tape.  
.3 Proprietary Joints.
- 1.4 QUALITY .1 Certification of Ratings:  
ASSURANCE .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.  
.2 Health and Safety:  
.1 Do construction occupational health and safety in accordance with Section 01 35 29.  
.2 During construction meet or exceed the requirements of SMACNA IAQ Guidelines for Occupied Buildings under Construction.
- 1.5 DELIVERY, .1 Protect on site stored or installed  
STORAGE AND absorptive material from moisture damage.  
HANDLING .2 Waste Management and Disposal:  
.1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
-

1.5 DELIVERY,  
STORAGE AND  
HANDLING  
(Cont'd)

- .2 Waste Management and Disposal:(Cont'd)  
.2 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.  
.3 Separate for reuse and recycling and place in designated containers Steel, Metal, Plastic waste in accordance with Waste Management Plan.  
.4 Place materials defined as hazardous or toxic in designated containers.  
.5 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.  
.6 Fold up metal and plastic banding, flatten and place in designated area for recycling.

PART 2 - PRODUCTS

2.1 SEAL  
CLASSIFICATION

- .1 Classification as follows:

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°C to plus 93°C.

- 2.3 TAPE .1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.
- 2.4 DUCT LEAKAGE .1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.
- 2.5 FITTINGS .1 Fabrication: to SMACNA.
- .2 Radiused elbows.  
.1 Rectangular: standard radius or short radius with single thickness turning vanes  
Centreline radius: 1.5 times width of duct.  
.2 Round: smooth radius 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 45 degrees entry on branch.  
.2 Round main and branch: enter main duct at 45 degrees conical connection.  
.3 Provide volume control damper in branch duct near connection to main duct.  
.4 Main duct branches: with splitter damper.
- .5 Transitions:  
.1 Diverging: 20 degrees maximum included angle.  
.2 Converging: 30 degrees maximum included angle.
- .6 Offsets:  
.1 Full radiused elbows.
- .7 Obstruction deflectors: maintain full cross-sectional area.  
.1 Maximum included angles.
- 2.6 FIRE STOPPING .1 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00.
-

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- 2.6 FIRE STOPPING .2 Fire stopping material and installation must  
(Cont'd)
- 2.7 GALVANIZED .1 Lock forming quality: to ASTM A653/A653M, Z90  
STEEL coating.
- .2 Thickness, fabrication and reinforcement: to  
ASHRAE & SMACNA.
- .3 Joints: to ASHRAE & SMACNA.
- 2.8 STAINLESS STEEL .1 To ASTM A480/A480M, Type 304.
- .2 Finish: No. 4.
- .3 Thickness, fabrication and reinforcement: to.  
ASHRAE & SMACNA.
- .4 Joints: to ASHRAE and SMACNA be continuous  
inert gas welded.
- 2.9 ALUMINUM .1 To ASHRAE and SMACNA. Aluminum type:  
3003-H-14.
- .2 Thickness, fabrication and reinforcement: to  
ASHRAE & SMACNA.
- .3 Joints: to ASHRAE & SMACNA be continuous  
weld].
- 2.10 BLACK STEEL .1 To ASTM A635/A635M.
- .2 Thickness: as per NFPA 96.
- .3 Fabrication: ducts and fittings to ASHRAE &  
SMACNA.
- .4 Reinforcement: as required.
- .5 Joints: continuous weld.
-

2.11 KITCHEN  
EXHAUST SYSTEMS

- .1 Construct in accordance with NFPA 96.
- .2 Material: Type stainless steel black sheet.
- .3 Thickness: 1.63 mm (16 gauge).
- .4 Fabrication: welded.
- .5 Reinforcement: as required per manufacturer, NFPA 96 and seismic.
- .6 Drainage: 50mm to nearest FFD connection to grease intrceptor.
- .7 Grease filters: to Section 23 41 00.

2.12 HANGERS AND  
SUPPORTS

- .1 Hangers and Supports: in accordance with Section 23 05 29.
  - .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
    - .1 Maximum size duct supported by strap hanger: 500.
    - .2 Hanger configuration: to ASHRAE and SMACNA.
    - .3 Hangers: galvanized steel angle with galvanized steel rods to ASHRAE and SMACNA:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

- .4 Upper hanger attachments:
  - .1 For concrete: manufactured concrete inserts.
  - .2 For steel joist: manufactured joist clamp steel plate washer.
  - .3 For steel beams: manufactured beam clamps:

PART 3 - EXECUTION

- 3.1 GENERAL
- .1 Do work in accordance with NFPA 90A, NFPA 90B, ASHRAE and SMACNA.
  - .2 Do not break continuity of insulation vapour barrier with hangers or rods.
    - .1 Insulate strap hangers 100 mm beyond insulated duct. Ensure diffuser is fully seated.
  - .3 Support risers in accordance with ASHRAE and 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 ASHRAE and SMACNA

Duct Size	Spacing
(mm)	(mm)
to 1500	3000
1501 and over	2500

- 3.3 WATERTIGHT DUCT
- .1 Provide watertight duct for:
    - .1 Dishwasher exhaust (welded aluminum).
    - .2 Fresh air intake.
    - .3 Kitchen hood exhausts.
  - .2 Form bottom of horizontal duct without longitudinal seams.
    - .1 Weld joints of bottom and side sheets.
    - .2 Seal other joints with duct sealer.

- 3.3 WATERTIGHT DUCT (Cont'd) .3 Slope horizontal branch ductwork down towards hoods served (or as indicated).  
.1 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 KITCHEN EXHAUST SYSTEMS .1 Install to NFPA 96.
- 3.5 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.
- 3.6 LEAKAGE TESTS .1 Refer to Section 23 05 94.  
.2 In accordance with SMACNA HVAC Duct Leakage Test Manual.  
.3 Do leakage tests in sections.  
.4 Make trial leakage tests as instructed to demonstrate workmanship.  
.5 Do not install additional ductwork until trial test has been passed.  
.6 Test section minimum of 30 m long with not less than three branch takeoffs and two 90 degrees elbows.  
.7 Complete test before performance insulation or concealment Work.



PART 1 - GENERAL

1.1 RELATED  
SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.
- .3 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- .2 American Society for Testing and Materials (ASTM)
  - .1 ASTM A653/A653M-09a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .2 ASTM C423-09a, Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
  - .3 ASTM E90-09, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
  - .4 ASTM E477-06a, Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.
- .3 National Building Code (NBC)
- .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.
  - .2 Provide separate shop drawings for each piece of attenuation equipment system shop drawings complete with product data.
-

1.4 PERFORMANCE  
RATING DATA

- .1 Provide performance rating data, certified by a professional engineer or accredited test laboratory and supported by test results in accordance with referenced standards as follows:
- .1 Silencer: insertion loss, pressure drop at design conditions, generated noise level.
  - .2 Acoustic plenums: transmission loss and acoustical absorption.
  - .3 Acoustical performance measurements to be made in accordance with ASTM E477, ASTM E90 and ASTM C423, except where specified otherwise.

1.5 WASTE  
MANAGEMENT AND  
DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
- .2 Divert unused metal from landfill to metal recycling facility approved by Departmental Representative.
- .3 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .4 Dispose of corrugated cardboard, polystyrene plastic packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

PART 2 - PRODUCTS

2.1 ABSORPTION AND  
INSULATING MEDIA

- .1 Acoustic quality, glass fibre, free of shot and odour; bacteria and fungus resistant; free of corrosion causing or accelerating agents; packed to density to meet performance requirements; and meet NBC fire requirements or requirements of authority having jurisdiction for duct lining.

2.2 ACOUSTIC  
PLENUMS

- .1 Panels: tongue and groove connection type, designed for individual panel removal for equipment access without major dismantling of plenum.
- .1 Outer sheet: 1.3 mm thick galvanized steel to ASTM A653/A653M, with coating designation Z275.
  - .2 Inner sheet: 0.085 mm thick galvanized steel to ASTM A653/A653M, with coating

2.2 ACOUSTIC  
PLENUMS  
(Cont'd)

- .1 Panels:(Cont'd)
  - .2 Inner sheet:(Cont'd)  
designation Z90 with 2 mm diameter clean cut perforations on 5 mm staggered centres.
  - .3 Fully framed with 1.3 mm thick galvanized steel channels.
  - .4 Horizontal stiffeners: 0.85 mm minimum galvanized steel on 800 mm centres to control media settlement.
  - .5 Access panels: sized for equipment removal; two handles per panel; screw at 100 mm maximum centres; perimeter neoprene sponge gasket; materials same as standard panel.
  - .6 Deflection: not to exceed 1/240 of unsupported panel span at design pressure differential of 500 Pa.
- .2 Doors: access doors with minimum 510 x 1375 mm opening.
  - .1 Construction same as standard panel except interiors to be solid.
  - .2 Two butt-type nylon bushed hinges, two cam-type latches with inside and outside handles.
  - .3 Neoprene gasket seal.
  - .4 Zinc plated hardware.
  - .5 Open against air pressure.
- .3 Assembly: base sections and flashings 1.3 mm minimum galvanized steel.
  - .1 Panel and flashing joints externally sealed with 5 mm diameter bead of non sag, non hardening sealant. Floor channel to floor connection sealed with 3 x 13 mm monolastomeric tape.
  - .2 Factory cut and frame openings where greatest dimension exceeds 300 mm. Smaller panel openings, to be site located and cut 50 mm larger in diameter, sleeved with 0.75 mm minimum galvanized steel.
  - .3 Fill space between pipe or conduit and sleeve with acoustic media, covered and mastic sealed in accordance with manufacturer's instructions.
  - .4 No sensory leakage at design pressure differential of 850 Pa.
  - .5 Assembly RSI not less than 1.2 (m<sup>2</sup>.° C)/W at 10° C.
  - .6 Certified acoustical performance:
    - .1 Transmission loss to ASTM E90.
    - .2 Acoustical absorption to ASTM C423.

2.2 ACOUSTIC  
PLENUMS  
(Cont'd)

- .3 Assembly:(Cont'd)
- .6 (Cont'd)
- .2 (Cont'd)

Octave bands, (Hz)	125	250	500	1000	2000	4000
Transmis sion loss, dB	21	28	39	50	53	56
Absorpti on coeffici ent	0.7	0.9	.99	.99	0.9	0.9

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Noise flanking: where indicated, install in wall sleeve with uniform clearance around to ensure no contact of silencer with wall sleeve. Pack with flexible, non hardening caulking on both sides of sleeves.
- .3 Instrument test ports: install at inlet and outlet to permit measurement of insertion loss and pressure loss.
- .4 Suspension: to manufacturer's instructions.

3.2 SITE VISIT

- .1 Supplier of equipment to visit site to ensure installation is in accordance with manufacturer's instructions and submit report to Departmental Representative.
- .2 Make adjustments and corrections in accordance with written report.
- .3 Provide Departmental Representative with notice 24 h in advance of visit.

3.3 TESTING

- .1 Experienced and competent sound and vibration testing professional engineer to take sound measurement after start up and testing, adjusting and balancing of systems to Section 23 05 93.

3.3 TESTING  
(Cont'd)

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- .2 Sound measurements to extend over frequency range and to be taken:
  - .1 Upstream and downstream of each silencer and plenum.
  - .2 In areas adjacent to mechanical equipment rooms, duct and pipe shafts.
  - .3 At 1800 mm above floor adjacent to first air terminal.
  - .4 At following critical locations: first set of diffusers off main branches.
- .3 Provide Departmental Representative with notice 24 h in advance of commencement of tests.
- .4 Establish adequacy of equipment isolation, acceptability of noise levels in occupied areas, other conditions affecting acoustics and, where appropriate, recommendation for remedial measures and costs.
- .5 Submit complete report of test results including sound curves.



PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 74 20 - 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, 2005.
- 1.3 PRODUCT DATA
- .1 Submit product data in accordance with Section 01 33 00.
  - .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 20.
  - .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 1.63 mm thick 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°C to plus 90°C, density of 1.3 kg/m<sup>2</sup>.
- 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 or foam rubber.
- .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, 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 1000 x 1500 mm for person size entry.
- .2 1000 x 1000 mm for servicing entry.
- .3 500 x 500 mm for viewing.
- .4 As indicated.
- .2 Locations:
- .1 Fire and smoke dampers.
- .2 Control dampers.
- .3 Devices requiring maintenance.
- .4 Required by code.
- .5 Reheat coils.
-

- 
- 3.1 INSTALLATION  
(Cont'd)
- .2 Access doors and viewing panels:(Cont'd)
    - .2 Locations:(Cont'd)
      - .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 Departmental Representative.
          - .3 At inlet and outlet of coils.
          - .4 Downstream of junctions of two converging air streams of different temperatures.
          - .5 And as indicated.
    - .4 Turning vanes:
      - .1 Install in accordance with recommendations of SMACNA and as indicated.

PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.
- 1.2 REFERENCES
- .1 Sheet Metal and Air Conditioning National Association (SMACNA)
    - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-2005.
- 1.3 PRODUCT DATA
- .1 Submit product data in accordance with Section 01 33 00.
- 1.4 WASTE MANAGEMENT AND DISPOSAL
- .1 Separate and recycle waste materials in accordance with Section 01 74 20, and with the Waste Reduction Workplan.
  - .2 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 Double thickness construction.
  - .3 Control rod with locking device and position indicator.
  - .4 Rod configuration to prevent end from entering duct.
-

- 
- 2.2 SPLITTER DAMPERS (Cont'd) .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 or bronze 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 Bearings: pin in bronze bushings or self-lubricating nylon.  
.4 Linkage: shaft extension with locking quadrant.  
.5 Channel frame of same material as adjacent duct, complete with angle stop.  
.6 Maximum leakage: 5% at 500 Pa.
- 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.
-

3.1 INSTALLATION  
(Cont'd)

- .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.



PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 78 00 - Closeout Submittals.
  - .3 Section 23 33 00 - Air Duct Accessories.
  - .4 Section 23 09 43 - Pneumatic Control System for HVAC.
- 1.2 REFERENCES
- .1 ASTM International
    - .1 ASTM A653/A653M-11, 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.
  - .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.
- 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 20, 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 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.
  - .6 Performance:
    - .1 Leakage: in closed position to be less than 2% of rated air flow at 500 Pa differential across damper.
    - .2 Pressure drop: at full open position to be less than 30 Pa differential across damper at 17 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 BACK DRAFT DAMPERS
- .1 Automatic gravity operated, multi leaf, aluminum construction with nylon bearings.
- 2.3 RELIEF DAMPERS
- .1 Automatic multi-leaf aluminum dampers with ball bearing centre pivoted and counter-weights set to open at 188 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.
- .5 Ensure dampers are observable and accessible.



PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.
  - .3 Section 01 78 00 - Closeout Submittals.
  - .4 Section 23 33 00 - Air Duct Accessories.
- 1.2 REFERENCES
- .1 National Fire Protection Association (NFPA)
    - .1 NFPA 90A-2012, Installation of Air Conditioning and Ventilating Systems.
  - .2 Underwriters Laboratories of Canada (ULC)
    - .1 CAN/ULC-S112-10, Standard Method of Fire Test of Fire Damper Assemblies.
    - .2 CAN/ULC-S112.2-07, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.
    - .3 ULC-S505-1974, Fusible Links for Fire Protection Service.
- 1.3 PRODUCT DATA
- .1 Submit product data in accordance with Section 01 33 00.
  - .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.
- 1.4 CLOSEOUT SUBMITTALS
- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.
- 1.5 EXTRA MATERIALS
- .1 Provide maintenance materials in accordance with Section 01 78 00.
  - .2 Provide following:
    - .1 6 fusible links of each type.
-

1.6 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.

1.7 WASTE  
MANAGEMENT AND  
DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20, 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: bear label of ULC, meet requirements of provincial fire authority, Fire Commissioner of Canada (FCC), CFFM, NFPA 90A and authorities having jurisdiction. Fire damper assemblies to be fire tested in accordance with CAN/ULC-S112.
  - .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
  - .3 Top hinged: offset single damper, round or square; multi-blade hinged or interlocking type; roll door 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.
-

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with NFPA 90A and in accordance with conditions of ULC listing.
- .2 Maintain integrity of fire separation.
- .3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
- .4 Install access door adjacent to each damper. See Section 23 33 00.
- .5 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.



PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.
- 1.2 REFERENCES
- .1 American Society for Testing and Materials (ASTM)
    - .1 ASTM C177-10, Standard 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-2010, Standard for the Installation of Air Conditioning and Ventilating Systems.
    - .2 NFPA 90B-2010, Standard for the 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-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- 1.3 PRODUCT DATA
- .1 Submit product data in accordance with Section 01 33 00.
-

1.4 WASTE  
MANAGEMENT AND  
DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
- .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<sup>3</sup> minimum.
  - .4 Thermal resistance to be minimum 0.76 m<sup>2</sup>.°C/W for 25 mm thickness 1.15 m<sup>2</sup>.°C/W for 38 mm thickness 1.51 m<sup>2</sup>.°C/W for 50 mm thickness when tested in accordance with ASTM C177, at 24°C 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<sup>3</sup> minimum.
  - .4 Thermal resistance to be minimum 0.37 m<sup>2</sup>.°C/W for 12 mm thickness 0.74 m<sup>2</sup>.°C/W for 25 mm thickness 1.11 m<sup>2</sup>.°C/W for 38 mm thickness 1.41 m<sup>2</sup>.°C/W to 50 mm thickness when tested in accordance with ASTM C177, at 24°C 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 29°C to plus 93°C.



2.3 FASTENERS .1 Weld pins 2.0 mm diameter, length to suit thickness of insulation. Nylon 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 NFPA 90B.  
.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 68°C to plus 93°C.

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 Departmental Representative.

3.3 JOINTS  
(Cont'd)

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- .3 Protect leading and trailing edges of duct sections with sheet metal nosing having 15 mm overlap and fastened to duct.

PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 78 00 - Closeout Submittals.
  - .3 Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
  - .4 Section 23 05 14 - Variable Frequency Drives.
  - .5 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
  - .6 Section 23 33 00 - Air Duct Accessories.
- 1.2 REFERENCES
- .1 Air Movement and Control Association (AMCA)
    - .1 AMCA 99-10, Standards Handbook.
    - .2 ANSI/AMCA 210-07/ANSI/ASHRAE 51-2007, Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating.
    - .3 ANSI/AMCA 300-08, Reverberant Room Method for Sound Testing of Fans.
    - .4 ANSI/AMCA 301-06, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
  - .2 CAN/CGSB-1.181-99, 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.
  - .2 Provide:
    - .1 Fan performance curves showing point of operation, BHP, kW 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.
- 1.5 EXTRA MATERIALS .1 Provide maintenance materials in accordance with Section 01 78 00.  
.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, W, 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 ANSI/AMCA 301, tested to ANSI/AMCA 300. Unit shall bear AMCA certified sound rating seal.
- .4 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210/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 supplemented as specified herein.  
.2 For use with variable speed controllers.  
.3 Sizes as indicated.

- 
- 2.1 FANS GENERAL  
(Cont'd)
- .6 Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards, coupling guards fan inlet safety screens as indicated and as specified in Section 23 05 13. Inlet 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.
  - .11 Flexible connections: to Section 23 33 00.
- 2.2 CENTRIFUGAL  
FANS
- 
- .1 Fan wheels:
    - .1 Welded steel construction.
    - .2 Maximum operating speed of centrifugal fans not more than 50% of first critical speed.
  - .2 Bearings: heavy duty grease lubricated ball or roller self aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 100,000 h.
  - .3 Housings:
    - .1 Volute with inlet cones: fabricated steel for wheels 300 mm or greater, steel, for smaller wheels, braced, and with welded supports.
    - .2 For horizontally and vertically split housings provide flanges on each section for bolting together, with gaskets of non-oxidizing non-flammable material.
    - .3 Provide bolted or latched airtight access doors with handles.
  - .4 Variable volume control devices:
    - .1 Mounted by fan manufacturer.
    - .2 Variable Frequency Drives: Refer to Section. 23 05 14.
-

- 
- 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 V-belt drive and guard inside or outside casing.
  - .3 Fabricate casing of zinc coated or phosphate treated steel of 163 mm thickness reinforced and braced for rigidity. Provide removable panels for access to interior. Uncoated, steel parts shall be painted over with corrosion resistant paint to CAN/CGSB-1.181. Finish inside and out, over prime coat, with rust resistant enamel. Internally line cabinet with 50 mm thick rigid acoustic insulation, pinned and cemented.
- 2.4 UTILITY SETS
- .1 Characteristics and construction: for centrifugal fans.
  - .2 Preassemble single width centrifugal fan with back draft dampers and 12 mm mesh birdscreens.
  - .3 Provide belt driven sets with adjustable motor bed plate and variable pitch driver sheave.
- 2.5 IN-LINE CENTRIFUGAL FANS
- .1 Characteristics and construction: as for centrifugal fan wheels, with axial flow construction and direct or belt drive.
  - .2 Provide AMCA arrangements 1 or 9 as indicated with stiffened flanges, smooth rounded inlets, and stationary guide vanes.
- 2.6 Kitchen Hood Exhaust Fan
- .1 Constructed to NFPA 96 standards, rated for kitchen hood exhaust application. Utility style fan construction.
  - .2 Heavy gauge steel, continuously welded housing shafts: Precision turned, grounded, and polished. Statically and dynamically balanced.
  - .3 Heavy duty self-aligning bearings.
-

- 2.6 Kitchen Hood Exhaust Fan (Cont'd)
- .4 Motor to be out of stream compatible with VFD applications (Inverter Duty).
  - .5 Corrosion resistant painted finish. rated for 500°F surface temperatures.
  - .6 Fan housing to be complete with grease cleanout access door.

PART 3 - EXECUTION

- 3.1 FAN INSTALLATION
- .1 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48, flexible electrical leads and flexible connections in accordance with Section 23 33 00.
  - .2 Provide sheaves and belts required for final air balance.
  - .3 Bearings and extension tubes to be easily accessible.
  - .4 Access doors and access panels to be easily accessible.
- 3.2 ANCHOR BOLTS AND TEMPLATES
- .1 Size anchor bolts to withstand seismic acceleration and velocity forces as specified.





PART 1 - GENERAL

- 1.1 RELATED SECTIONS .1 Section 01 33 00 - Submittal Procedures.  
.2 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.  
.3 Section 01 78 00 - Closeout Submittals.
- 1.2 PRODUCT DATA .1 Submit product data in accordance with Section 01 33 00.  
.2 Indicate the following:  
.1 Capacity.  
.2 Throw and terminal velocity.  
.3 Noise criteria.  
.4 Pressure drop.  
.5 Neck velocity.  
.6 Free area.
- 1.3 SAMPLES .1 Submit samples in accordance with Section 01 33 00.
- 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 20.  
.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.
- .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 Concealed fasteners.
- .3 Concealed manual volume control damper operators.
- .4 Colour: standard or as directed by Departmental Representative.

- 2.2 MANUFACTURED UNITS .1 Grilles, registers and diffusers of same generic type to be product of one manufacturer.

- 2.3 SUPPLY GRILLES AND DIFFUSERS .1 General: with opposed blade dampers, front operated diffusers to be maximum security risk resistant grade for penitentiary application.
- .2 Type SD1: steel, 25 mm border, 4-way deflection, horizontal face and vertical rear bars. Finish: White.
- .3 Type SD2: steel, 25 mm border, 4-way deflection, vertical face and horizontal rear bars complete with modulating damper, room thermostat, duct temperature sensor and associated controls. Finish: White.
-

2.4 RETURN AND  
EXHAUST GRILLES AND  
REGISTERS

- .1 General: rated for maximum security environment.
- .2 Type RG1: steel, 19 mm border, single 0° deflection, horizontal face bars. Finish: White.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with manufacturers instructions.
- .2 Install with flat head security screws in countersunk holes where fastenings are visible.
- .3 Bolt grilles, registers and diffusers, in place, complete with security screws.
- .4 Provide concealed safety chain on each grille, register and diffuser where required. Installed above 2400mm A.F.F.



PART 1 - GENERAL

- 1.1 SUMMARY .1 Section Includes:  
.1 Mechanical louvers; intakes; vents; and reinforcement and bracing for air vents, intakes and gooseneck hoods.
- .2 Related Sections:  
.1 Section 01 33 00 - Submittal Procedures.  
.2 Section 01 35 29 - Health and Safety Requirements.  
.3 Section 01 61 00 - Common Product Requirements.  
.4 Section 01 74 11 - Cleaning.  
.5 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.  
.6 Section 09 91 13 - Exterior Painting.
- 1.2 REFERENCES .1 National Fire Protection Association (NFPA)  
.1 ANSI/NFPA 96-2011, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .2 ASTM International  
.1 ASTM E90-09, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)  
.1 Material Safety Data Sheets (MSDS).
- .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
- .5 Society of Automotive Engineers (SAE)
- 1.3 SYSTEM DESCRIPTION .1 Performance Requirements:  
.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.
-

- 1.4 SUBMITTALS .1 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00. Include product characteristics, performance criteria, and limitations.
    - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).
    - .2 Indicate following:
      - .1 Pressure drop.
      - .2 Face area.
      - .3 Free area.
      - .4 Colour.
  - .2 Quality assurance submittals: submit following in accordance with Section 01 33 00.
    - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
    - .2 Instructions: submit manufacturer's installation instructions.
      - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.
  - .3 Test Reports:
    - .1 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E90.
- 1.5 QUALITY ASSURANCE .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.
- 1.6 DELIVERY, STORAGE, AND HANDLING .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with Section 01 61 00.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
    - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
-

PART 2 - PRODUCTS

- 2.1 GOOSENECK HOODS
- .1 Thickness: to ASHRAE and SMACNA.
    - .1 Kitchen: to ANSI/NFPA 96.
    - .2 Elsewhere: to ASHRAE SMACNA.
  - .2 Fabrication: to ASHRAE and SMACNA.
    - .1 Kitchen: to ANSI/NFPA 96.
    - .2 Elsewhere: to ASHRAE SMACNA.
  - .3 Joints: to ASHRAE and SMACNA a.
  - .4 Supports: as indicated.
  - .5 Complete with integral birdscreen of 2.7 mm diameter stainless steel wire. Use 12 mm mesh on exhaust 19 mm mesh on intake.
  - .6 Vertical backdraft dampers on two faces.
- 2.2 FIXED LOUVRES - ALUMINUM
- .1 Construction: welded with exposed joints ground flush and smooth.
  - .2 Material: extruded aluminum alloy AA 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: 150 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 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, or anodized. Colour: to Departmental Representative approval.
-

- 2.3 FIXED LOUVRES .1 General: aluminum in welded steel frame, complete with anchors.
- .2 Blades:  
.1 Extruded aluminum set at 45 degrees, Z-shaped with drip lips.  
.2 Stormproof design for outside air intakes.  
.3 Braced against wind pressures.  
.4 Maximum length without mullions of same material: 1250 mm.
- .3 Frame: galvanized structural steel, welded construction. Paint welds after construction to Section 09 91 13.
- .4 Screen: 12 mm exhaust 19 mm intake mesh, 2 mm diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.
- .5 Finish: Anodized or factory applied enamel. Colour: to Departmental Representative's approval.

PART 3 - EXECUTION

- 3.1 MANUFACTURER'S INSTRUCTIONS .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- 3.2 INSTALLATION .1 In accordance with manufacturer's and SMACNA recommendations.
- .2 Reinforce and brace as indicated.
- .3 Anchor securely into opening. Seal with caulking to ensure weather tightness.
- 3.3 CLEANING .1 Proceed in accordance with Section 01 74 11.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.



PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 61 00 - Common Product Requirements.
  - .3 Section 01 74 20 - Construction/Demolition Waste Management and Disposal.
  - .4 Section 01 78 00 - Closeout Submittals.
- 1.2 REFERENCES
- .1 Definitions:
    - .1 Certified Ratings: catalogued or published ratings obtained from tests carried out by manufacturer or independent testing agency designated by manufacturer and signifying adherence to codes and standards.
  - .2 Reference Standards:
    - .1 Canadian Standards Association (CSA International)
    - .2 National Fire Protection Association (NFPA)
      - .1 NFPA 96-2011, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations, 2008 Edition.
    - .3 Underwriter's Laboratories of Canada (ULC)
- 1.3 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Provide submittals in accordance with Section 01 33 00.
  - .2 Product Data:
    - .1 Provide manufacturer's printed product literature and datasheets for hood, grease filter, and grease extractor, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Shop Drawings:
    - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
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- 1.4 MAINTENANCE  
MATERIALS  
SUBMITTALS
- .1 Extra stock parts:  
.1 Provide one complete set of filters for each filter unit or filter bank in accordance with Section 01 78 00.
- 1.5 DELIVERY,  
STORAGE AND  
HANDLING
- .1 Deliver, store and handle in accordance with Section 01 61 00.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials in accordance with Section 01 74 20.
- PART 2 - PRODUCTS
- 2.1 DESIGNATED  
SUPPLIER
- .1 Halton; no substitution.
- 2.2 DISWASHER AND  
SINK HOODS
- .1 Complete system including:  
.1 Hood.  
.2 Lifetime washable aluminum filter.  
.3 Light unit with bulb.  
.4 Welded stainless steel construction ( 18 gauge) condensate channels baffle plates, drain tap.
- .2 All associated load accessories.
- .3 Capacity:as per drawings.
- 2.3 GREASE  
EXTRACTOR TYPE
- .1 General:  
.1 Configuration as indicated on drawings.  
.2 Complete with back panel on wall mounted units.  
.3 ULC label, CSA seal.
- .2 Materials:  
.1 Type 304 stainless steel, 16 gauge.  
.2 Finishes:  
.1 Exposed stainless steel surfaces to be No.4 brushed satin finish.
-

2.3 GREASE  
EXTRACTOR TYPE  
(Cont'd)

- .2 Materials:(Cont'd)
  - .2 Finishes:(Cont'd)
    - .2 Accessories to be stainless steel or polished chrome plate.
    - .3 Stainless steel facia panels, as indicated.
  - .3 Fire detection and suppression system: in accordance with NFPA 96.
  - .4 Control system:
    - .1 Automatic demand control ventilation system complete with motorized dampers (one per hood); IR sensors, control panel capable of calculating the flow requirement and controlling the associated exhaust fan. Provide BacNET interface to connect to BAS.
  - .5 Cleaning system:
    - .1 Nozzle type detergent spray cleaning system.
    - .2 System to conform to Sanitary Standards of Food and Beverage Industry 3A and USPHS standards.
  - .6 Performance: as indicated on drawings.
    - .1 Pressure drop max through unit up to duct collar: as per drawings.

PART 3 - EXECUTION

3.1 APPLICATION

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

3.2 INSTALLATION

- .1 Install hoods in accordance with manufacturers instructions.
- .2 Install filter/filter media prior to acceptance.

3.3 CLEANING

- .1 Clean in accordance with Section 01 74 11.
    - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
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3.3 CLEANING .2 Waste Management: separate waste materials  
(Cont'd) \_\_\_\_\_ for reuse and recycling in accordance with  
Section 01 74 20.

PART 1 - GENERAL

- 1.1 REFERENCES
- .1 Air-Conditioning, Heating and Refrigeration Institute (AHRI)
    - .1 AHRI-550/590-12, Performance Rating of Water Chilling Packages Using the Vapor Compression Cycle.
  - .2 Canada Green Building Council (CaGBC)
    - .1 LEED Canada For New Construction and Major Renovations 2009.
    - .2 LEED Canada For Core and Shell 2009.
  - .3 CSA International
    - .1 CSA B52-05 SMART, Mechanical Refrigeration Code.
  - .4 Environment Canada, (EC)/Environmental Protection Services (EPS)
    - .1 EPS 1/RA/2-1996, Environmental Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Submit submittals in accordance with Section 01 33 00.
  - .2 Product Data:
    - .1 Submit manufacturer's instructions, printed product literature and data sheets for rotary-screw/scroll air cooled chillers and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Shop Drawings:
    - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
    - .2 Indicate:
      - .1 Equipment including connections, piping and fittings, valves, strainers, control assemblies and ancillaries, identifying factory and field assembled.
      - .2 Wiring as assembled and schematics.
      - .3 Dimensions, construction details, recommended installation and support, mounting bolt hole sizes and locations and point loads.
      - .4 Type of refrigerant used.
-

1.2 ACTION AND  
INFORMATIONAL  
SUBMITTALS  
(Cont'd)

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- .4 Sustainable Design Submittals:
  - .1 Construction Waste Management:
    - .1 Submit project Waste Management Plan Waste Reduction Workplan highlighting recycling and salvage requirements.
    - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50 75% of construction wastes were recycled or salvaged.
  - .2 Regional Materials: submit evidence that project incorporates required percentage 10 20% of regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.

1.3 CLOSEOUT  
SUBMITTALS

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- .1 Submit in accordance with Section 01 78 00.
- .2 Operation and Maintenance Data: submit operation and maintenance data for rotary-screw/scroll air cooled chillers for incorporation into manual.
- .3 Data to include:
  - .1 Description of equipment giving manufacturers name, model type and year, capacity and serial numbers.
  - .2 Provide part load performance curves.
  - .3 Details on operation, servicing and maintenance.
  - .4 Recommended spare parts list.

1.4 DELIVERY,  
STORAGE AND  
HANDLING

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

- 1.4 DELIVERY,  
STORAGE AND  
HANDLING  
(Cont'd)
- .3 Storage and Handling Requirements:(Cont'd)
    - .3 Replace defective or damaged materials with new.
  - .4 Develop Construction Waste Management Plan Waste Reduction Workplan related to Work of this Section and in accordance with Section 01 74 201.
  - .5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding and packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 20.

PART 2 - PRODUCTS

- 2.1 GENERAL
- .1 Provide complete air cooled screw type chiller package including: compressor; evaporator; condenser, motor and motor starter; controls; control centre; piping; wiring; refrigeration and oil change; ready for connection to chilled water circuit condenser water circuit interlocks, and electric power source, installed in welded steel frame with heavy gauge panels and access doors finished to manufacturers standard. Provide duplex pump package integral to the chiller.
- 2.2 CAPACITY
- .1 Certified ratings based on AHRI 550/590 as per drawings.
    - .1 Refrigerant:410A.
  - .2 Unit to be capable of operating within line voltages of 575V.
- 2.3 COMPRESSOR
- .1 Hermetic screw or scroll design.
  - .2 Unloaded start with capacity modulation by continuous linear modulation of slide valve in response to load change.
  - .3 Compressor to include suction and discharge shut-off valves; oil sight glass; separate circuit crankcase heater; and cylinder unloading device.

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- 2.3 COMPRESSOR .4 Provide nameplate to show capacity at design  
(Cont'd) temperature, type of refrigerant used and  
total weight in system.
- 2.4 COMPRESSOR .1 Hermetic type with overload protection and  
MOTOR manual restart: 575 V.
- 2.5 EVAPORATOR .1 Steel shell and seamless copper tube,  
gasketed heads, direct expansion: to CSA B52.  
Insulated to  $R=0.53 \text{ m}^2 \cdot \text{degrees C/W}$  minimum.
- 2.6 CONDENSER .1 Air cooled:  
.1 Aluminum fins mechanically bonded to  
copper tube, pressure tested to 3.1 MPa.  
.2 Direct driven, steel or aluminum  
propeller type fan, statically and  
dynamically balanced. Motor with overload  
protection, permanently lubricated ball  
bearings, 575V.
- 2.7 CONTROL CENTRE .1 To EEMAC standard and include:  
.1 Control circuit ON/OFF switch.  
.2 Oil pressure safety switch.  
.3 High and low pressure safety switch.  
.4 Water temperature controller.  
.5 Suction and discharge pressure gauges  
and shut-off valves.  
.6 Chilled water flow switch.  
.7 Compressor short cycling and restart  
delay timer.  
.8 Starting sequence switches.  
.9 Compressor and fan motor circuit  
breakers.  
.10 Reset low water temperature cut-out  
switch.  
.11 Motor contactors, control relays and  
indicator lights to include: "start-stop"  
switch; anti-recycle 30 minute time  
delay; low chilled water temperature  
cutout and automatic reset; excess purge  
signal light and reset switch;  
manual/automatic oil pump operating  
switch and signal light; oil heater  
signal light; manual reset power failure  
and signal light; chilled water flow  
interruption light metre to indicate
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- 2.7 CONTROL CENTRE .1 (Cont'd)  
(Cont'd)
- .11 (Cont'd)  
number of compressor starts and elapsed running time.
  - .12 Field power and control circuit terminal blocks.
  - .13 Alarm for refrigerant leakage.
  - .14 Connection to BAS (BACNet) and compatibility with existing Delta controls.

PART 3 - EXECUTION

- 3.1 EXAMINATION .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for rotary-screw water chiller installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.
  - .4 Chiller pump start-up and ventilation.
  - .5 Communication with BAS.

- 3.2 APPLICATION .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

- 3.3 GENERAL .1 Provide appropriate protection apparatus.
- .2 Install unit as indicated, to manufacturers recommendations, and in accordance with EPS 1/RA/2.
  - .3 Ensure adequate clearances for servicing and maintenance.
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- 3.3 GENERAL (Cont'd) .4 Manufacturer to approve installation, to supervise startup and to instruct operators. Include 3 days per unit.
- 3.4 CLEANING .1 Progress Cleaning: clean in accordance with Section 01 74 11.  
.1 Leave Work area clean at end of each day.  
.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.  
.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
- 3.5 PROTECTION .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by rotary-screw water chiller installation.

PART 1 - GENERAL

1.1 RELATED  
SECTIONS

.1 Section 01 91 00 - Commissioning.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/Air Conditioning and Refrigeration Institute (ARI)
- .1 ANSI/ARI 210/240-2008, Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
  - .2 ARI 270-2009, Sound Rating of Outdoor Unitary Equipment.
- .2 ANSI/UL 465-1984, Air Conditioners, Central Cooling.
- .3 Canadian Standards Association (CSA)
- .1 CSA B52-05 SMART, Mechanical Refrigeration Code.
  - .2 CSA C22.1 HB-12, Canadian Electrical Code, Handbook.
- .4 National Roofing Contractors Association (NRCA)
- .5 National Fire Protection Association
- .1 NFPA 90A-2009/2012, Installation of Air Conditioning and Ventilating Systems.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 101 33 00.
- .2 Indicate:
- .1 Equipment, piping, and connections, together with valves, strainers, control assemblies, thermostatic controls, auxiliaries and hardware, and recommended ancillaries which are mounted, wired and piped ready for final connection to building system, its size and recommended bypass connections.
  - .2 Piping, valves, fitting shipped loose showing final location in assembly.
  - .3 Control equipment shipped loose, showing final location in assembly.
  - .4 Dimensions, internal and external construction details, recommended method of installation with proposed structural
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- 1.3 SHOP DRAWINGS (Cont'd)
- .2 Indicate:(Cont'd)
    - .4 (Cont'd)
      - steel support, mounting curb details, sizes and location of mounting bolt holes; include mass distribution drawings showing point loads.
    - .5 Detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories, controllers.
    - .6 Fan performance curves.
    - .7 Details of vibration isolation.
    - .8 Estimate of sound levels to be expected across individual octave bands in dB referred to A rating.
    - .9 Type of refrigerant used.
- 1.4 CLOSEOUT SUBMITTALS
- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.
  - .2 Indicate:
    - .1 Brief description of unit, indexed, with details of function, operation, control, and service for components.
  - .3 Manufacturer's installation instructions shall govern and unless otherwise noted, operation, maintenance and service of items. Include names and addresses of spare part suppliers.
  - .4 Include following:
    - .1 Provide for units, manufacturer's name, type, year, number of units, and capacity.
- 1.5 WASTE MANAGEMENT AND DISPOSAL
- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
  - .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 Roof mounted, self-contained single zone unit with gas burner and DX refrigeration and bear label of CSA and ULC.
- .2 Units to consist of cabinet and frame, supply fan, heat exchanger, burner, control, air filter, refrigerant cooling coil, compressor, condenser coil and fans, motorized outside air damper, return damper, motorized gravity exhaust damper, economizer.
- .3 Prefabricated roof curb to conform to requirements of National Roofing Contractors Association (NRCA), minimum height 450 mm.
- .4 Conform to ANSI/ARI 210/240, rating for unit larger than 40 kW nominal.

2.2 CABINET

- .1 Cabinets: weatherproofing tested and certified to AGA rain test standards.
- .2 Framing and supports: 2 mm thick welded steel, galvanized after manufacture, with lifting lugs at top of unit.
- .3 Outer casing: weathertight 0.8 mm thick galvanized steel with baked enamel finish, complete with flashing.
- .4 Access: hinged doors or panels with quick locking door handle type fasteners.
- .5 Insulation: neoprene coated glass fiber on surfaces where conditioned air is handled, 50 mm thick, 32 kg/m<sup>3</sup> density.

2.3 FANS

- .1 Centrifugal, forward curved impellers, statically and dynamically balanced. Multi V-belt drive with adjustable variable pitch motor pulley, rubber isolated hinge mounted motor fan and motor integrally mounted on isolation base, separated from unit casing with flexible connections and spring isolators. Vibration isolators.
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- 2.4 AIR FILTERS .1 50 mm thick, 85% efficiency, metal framed, throwaway, standard to unit manufacturer.
- 2.5 HEAT EXCHANGERS AND BURNERS .1 Gas fired, multiple flue passes, with primary heating surface of 316 stainless steel or aluminized steel; secondary heating surface, stainless steel tubes.
- .1 Gas burner: factory mounted, wired and fire tested complete with operating and safety controls.
  - .2 Forced or induced draft continuous port steel type.
  - .3 Spark ignited pilot with pilot flame safety shut-off.
- 2.6 REFRIGERATION .1 Conform to CSA B52 and ANSI/UL 465 requirements.
- .2 Compressor/condenser section:
    - .1 Hermetic compressors, vibration isolated with flexible suction and discharge connections, oil sight glass, oil pressure switch, crankcase heater with control to liquid line solenoid valve.
    - .2 Fans: propeller type with single piece spun Venturi outlets and zinc plated guards. Motors shall be sequenced for head pressure control.
    - .3 Electrical system shall have operating controls, oil and refrigerant pressure protection, motor overload protection, weatherproof electrical wiring with weatherproof, rain tight disconnect.
    - .4 Include refrigerant piping with sight glass, filter and valves.
    - .5 Condenser: staggered copper tube aluminum fin coil assembly.
    - .6 Refrigerant: 410A.
  - .3 Evaporator:
    - .1 Rated to ANSI/ARI 210/240.
    - .2 Thermostatic expansion valve, with adjustable super heat and external equalizer.
    - .3 Coil: NPS 1/2 or NPS 5/8 od staggered seamless copper tubes expanded into aluminum fins, and insulated condensation pan.
    - .4 Cooling coil condensate drain pans: designed to avoid standing water, to be easily cleaned or removable for cleaning.
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- 2.6 REFRIGERATION .3 Evaporator:(Cont'd)  
(Cont'd) .4 (Cont'd)  
Drain connection to have deep seal trap  
and be complete with trap seal primer.
- 2.7 CONTROLS .1 Single zone cooling control:  
.1 Room thermostat to activate cooling  
relay in control circuit cycling  
compressor. Provide safeties and pressure  
controls. Condenser fans to operate in  
sequence.  
.2 When call for cooling is satisfied,  
relay is de-energized closing liquid line  
solenoid valve. On two compressor units  
provide separate circuits to evaporator  
and condenser and manual double pole  
double throw switch for lead-lag unit  
choice.
- .2 Single Zone Heat-Cool Unit  
.1 Low voltage, adjustable room thermostat  
controls burner operation, compressor and  
supply fan shall maintain room  
temperature setting.  
.2 Thermostat: include system selector  
switch day-night heat-cool-off and fan  
control switch (on-auto).
- .3 Night mode: unit cycles as unit heater with  
100% recirculation on winter or summer cycles  
unit off.
- .4 Night set-back: Provide controls for night  
set- back.
- 2.8 CAPACITY .1 As indicated on drawings.
-

PART 3 - EXECUTION

- 3.1 INSTALLATION
- .1 Install as per manufacturers' instructions on roof curbs as indicated. Provide curb adapters to suite unit installation.
  - .2 Manufacturer to certify installation, supervise start-up and commission unit.
  - .3 Run drain line from cooling coil condensate drain pan to discharge on roof.
- 3.2 START-UP
- .1 General:
    - .1 In accordance with Start-up and Verification Testing - General Requirements.
  - .2 Verify accessibility, serviceability of components including motorized dampers, filters coils, fans, motors, operators, humidifiers, sensors, electrical disconnects.
  - .3 Verify accessibility, cleanability, drainage of drain pans for coils, humidifiers.
- 3.3 PERFORMANCE VERIFICATION (PV)
- .1 General:
    - .1 In accordance with Start-up and Verification Testing - General Requirements, supplemented as specified herein.
  - .2 Rooftop Air Handling Units
    - .1 Set zone mixing dampers for full cooling, except that where diversity factor forms part of design set that % of zone dampers to full heating.
    - .2 Set outside air and return air dampers for minimum outside air.
    - .3 Set face and bypass dampers so face dampers are fully open and bypass dampers are fully closed.
    - .4 Check for smooth, vibrationless correct rotation of supply fan impeller.
    - .5 Measure supply fan capacity.
    - .6 Adjust impeller speed as necessary and repeat measurement of fan capacity.
    - .7 Measure pressure drop each component of air handling unit.
-



3.3 PERFORMANCE  
VERIFICATION (PV)  
(Cont'd)

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- .2 (Cont'd)
- .8 Set outside air and return air dampers for the % of outside air required by design and repeat measurements of fan capacity.
  - .9 Reduce differences between fan capacity at minimum and maximum outside air less than 5%.
  - .10 Set face and bypass dampers to full bypass and repeat measurement of fan capacity.
  - .11 Reduce difference between fan capacity with F&BPD fully closed to bypass and fully open to bypass to less than 5%.
  - .12 Reduce difference between fan capacity at full cooling and fan capacity at full heating to less than 5%.
  - .13 OAD: Verify for proper stroking, interlock with RAD.
  - .14 Measure DBT, WBT of SA, RA, EA.
  - .15 Measure air cooled condenser discharge DBT.
  - .16 Measure flow rates (minimum and maximum) of SA, RA, EA, relief air.
  - .17 Simulate maximum cooling load and measure refrigerant hot gas and suction temperatures and pressures.
  - .18 Use smoke test to verify no short-circuiting of EA, relief air to outside air intake or to condenser intake.
  - .19 Simulate maximum heating load and:
    - .1 Verify temperature rise across heat exchanger.
    - .2 Perform flue gas analysis. Adjust for peak efficiency.
    - .3 Verify combustion air flow to heat exchanger.
    - .4 Simulate minimum heating load and repeat measurements.
  - .20 Measure radiated and discharge sound power levels under maximum heating demand and under maximum cooling demand with compressors running.
  - .21 Verify operating control strategies, including:
    - .1 Heat exchanger operating and high limit.
    - .2 Early morning warm-up cycle.
    - .3 Freeze protection.
    - .4 Economizer cycle operation, temperature of change-over.
    - .5 Alarms.
    - .6 Voltage drop across thermostat wiring.
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- 3.3 PERFORMANCE VERIFICATION (PV)  
(Cont'd) .2 (Cont'd)
- .21 (Cont'd)
    - .7 Operation of remote panel including pilot lights, failure modes.
  - .22 Set zone mixing dampers for full heating and repeat measurements.
  - .23 Measure leakage past zone mixing dampers by taking temperature measurements. Reduce leakage to less than 5%.
  - .24 Check for smooth, vibrationless, correct rotation of return fan impeller.
  - .25 Measure return fan capacity.
  - .26 Adjust impeller speed as necessary and repeat measurement of return fan capacity.
  - .27 Check capacity of heating unit.
  - .28 Refer to other sections of these specifications for PV procedures for other components.
- 3.4 COMMISSIONING REPORTS .1 In accordance with Section 01 91 00: Reports supplemented as specified herein. Include:
- .1 Report forms as specified Section 01 91 00: Report Forms and Schematics.
- 3.5 TRAINING .1 In accordance with Section 01 91 00: Training of O&M Personnel, supplemented as specified herein.

PART 1 - GENERAL

1.1 RELATED  
SECTIONS

- .1 This section shall be read in conjunction with specification Section 21 05 01 - Mechanical General Requirements, Commissioning Sections 25 01 11 & 01 91 13, Demo Training Section 01 79 00, Building Management Manual 01 91 51 Measurement & Verification Section 25 00 01 all mechanical sections, and all other disciplines related to the project.

1.2 GENERAL

- .1 The word "provide" shall be interpreted as "supply and install".
- .2 Provide for coordination between HVAC contractor, plumbing contractor, electrical contractor & kitchen contractor for all points.
- .3 The work covered by this specification and related sections consists of providing shop drawings, equipment, labour, materials, engineering, technical supervision, and transportation as required to furnish, install, and integrate a fully operational BAS to monitor and control the facilities listed herein, and as required to provide the operation specified in strict accordance with these documents, and subject to the terms and conditions of the contract. The work in general consists of but is not limited to, the following:
- .1 The preparation of submittals and provision of all related services.
  - .2 Operator workstations located as listed in the specifications.
  - .3 Furnish and install Network Control Units (NCU's), all control devices, conduit and wiring, in the facility as required to provide the operation specified.
  - .4 The specification defines the scope of work for the project and coordinates the responsibilities of the Mechanical and Electrical trade contractors pertaining to control products or systems, furnished by each trade, that will be integrated by this Division. All labor, material, equipment and software not specifically referred to herein or on the plans, that are required to meet the functional
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- 1.2 GENERAL .3 (Cont'd)  
(Cont'd)
- .4 (Cont'd)  
intent of this specification, shall be provided without additional cost to the Owner.
- .5 Furnish and load all software required to implement a complete and operational BAS.
- .6 Furnish complete operating and maintenance manuals and field training of operators, programmers, and maintenance personnel.
- .7 Perform acceptance tests and commissioning as indicated.
- .8 Provide full documentation for all application software and equipment.
- .9 Miscellaneous work as indicated in these specifications.
- .4 Reference mechanical & electrical drawings.
- 1.3 SHOP DRAWINGS .1 Submit shop drawings in accordance with Section 21 05 01 - Mechanical General Requirements.
- .2 Indicate on control diagrams, positions, model numbers, setting of proportional band, gain and authority percent, setpoint and reset schedules, and wiring layouts.
- .3 Provide valve, damper & actuator schedule indicating size, configuration, capacity and locations.
- .4 Provide technical literature on system components.
- .5 The following data/information shall be submitted:
- .1 Complete sequence of operation.
- .2 Control system CAD or Visio generated drawings including all pertinent data to provide a functional operating system.
- .3 Valve and damper actuator schedules showing size, configuration, pressure drop, capacity and location of all equipment.
- .4 Data sheets for all hardware and software control components.
- .5 Thermostat/sensor locations.
- .6 Computer panel locations.
- .7 Architectural diagram including connection to WAN (if applicable).
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- 1.3 SHOP DRAWINGS .5 (Cont'd)  
(Cont'd) .8 Provide as part of the submittal five copies of all data and control drawings.
- 1.4 MAINTENANCE DATA .1 Provide maintenance literature including manufacturer's recommended schedules and repair components for incorporation into manual specified in Section 21 05 01 - Mechanical General Requirements.
- .2 Data to include:
- .1 Index sheet, listing contents in alphabetical order.
  - .2 Manufacturer's equipment parts list of all functional components of the system, Auto-CAD disk of system schematics, including wiring diagrams.
  - .3 Description of sequence of operations.
  - .4 As-Built interconnection wiring diagrams.
  - .5 Operator's Manual.
  - .6 Trunk cable schematic showing remote electronic panel locations, and all trunk data.
  - .7 List of connected data points, including panels to which they are connected and input device (ionization detector, sensors, etc.).
  - .8 Conduit routing diagrams.
  - .9 Details on operation servicing and maintenance.
  - .10 Recommend spare parts list.
- .3 Data to be edited specifically for this equipment voided of all non-applicable options.
- 1.5 WARRANTY .1 Provide all services, materials and equipment necessary for the successful operation of the entire BAS system for a period of one year after substantial completion.
- .2 The adjustment, required testing, and repair of the system includes all computer equipment, transmission equipment and all sensors and control devices.
- .3 The on-line support services shall allow the local BAS subcontractor to dial out over telephone lines to monitor and control the facility's building automation system. This
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- 1.5 WARRANTY (Cont'd) .3 (Cont'd)  
(Cont'd)
- remote connection to the facility shall be within 2 hours of the time that the problem is reported. This coverage shall be extended to include normal business hours, after business hours, weekends and holidays.
- If the problem cannot be resolved on-line by the local office, the national office of the building automation system manufacturer shall have the same capabilities for remote connection to the facility. If the problem cannot be resolved with on-line support services, the BAS manufacturer shall dispatch the appropriate personnel to the job site to resolve the problem within 3 hours of the time that the problem is reported.
- 1.6 MAINTENANCE .1 Contractor shall provide preventive maintenance contract that covers service incidental to continued proper performance of system during warranty period.
- 1.7 DESCRIPTION OF WORK .1 The BAS/ATC systems shall be supplied and installed completely under the BAS/ATC Contractor. Control components shall be mounted and wired by the BAS/ATC Contractor except as noted in Item 1.7 & 1.8. Provide the necessary control points to monitor alarm and control the end devices as described in the sequence of operation.
- .2 The engineering, installation, calibration, software programming and checkout necessary for complete and fully operational BAS/ATC systems, as specified hereafter, shall be provided by the BAS/ATC Contractor.
- .3 Provide a building automation linking the air handling units, heating plant, all pumps, control valves, exhaust fans, etc. to one central control station c/w graphic display.
- .4 Provide controllers for all VAV terminal devices c/w field installation and provide all 120/24 V transformers. Mount on face plate of junction box cover and provide 24 V wiring from junction boxes indicated on electrical drawings to control devices, including boxes and all interconnecting wiring respectively.
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1.7 DESCRIPTION OF  
WORK  
(Cont'd)

- .5 Provide all control valves & temperature sensors on the hot water heating systems including room sensors. Supply control valves & temperature wells to mechanical contractor to install.
- .6 Boilers:
- .1 Provide outdoor air sensor wiring to each boiler.
  - .2 Wiring to temperature sensors & between the boilers.
  - .3 Refer to Section 23 52 00 - Packaged Boilers - Condensing, Items 2.2.4 & 2.3.4.
  - .4 Connect to BAS via BACnet.
- .7 Provide pressure, temperature, humidity, CO<sub>2</sub> sensors for AHUs.
- .8 Provide interconnecting wiring of all split air conditioning units.
- .9 Refrigerant Detection Systems:
- .1 Provide wiring of refrigerant detection/exhaust system supplied by chiller manufacturer.
  - .2 Provide exhaust damper actuators & all interconnection wiring. Refer to Detail 16 on Drawing M8.7.
- .10 Fan status current sensing provided.
- .11 Dampers:
- .1 Dampers for AHU and exhaust fans supplied by Divisions 21, 22 & 23.
  - .2 Provide damper actuation c/w field installation.
- .12 General Notes:
- .1 Provide all insertion type sensors as indicated on drawings 8.1-8.9.
  - .2 Provide all necessary electrical labour and material to connect, test and commission all control devices and power for the control panels.
  - .3 All wiring in mechanical room, risers and exposed ceiling spaces shall be in conduit as per Div. 26 standards. Horizontal runs which are concealed in ceiling plenums can be plenum rated cable.
  - .4 Provide one (1) common outdoor air pressure, humidity & temperature as reference points.
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1.7 DESCRIPTION OF WORK  
(Cont'd)

- .12 General Notes:(Cont'd)
- .5 Provide continuous point history (i.e.: AO/AI every 30 minutes for 24 hours; DI/DO event log to a maximum of 10) the history will continuously insert the new data over the oldest recorded data. Refer to M&V section.
  - .6 Provide all control points list.
  - .7 Division 25 shall be responsible for wiring the following devices:
    - .1 Boiler flow switches, safeties, interlock & BACnet interface controls.
    - .2 VFD controls & BACnet interfaces.
    - .3 FF heat unit heater and fan coils.
    - .4 24V wiring between 120V/24 transformer and control devices. Transformer supplied by Div. 23, wired 120V & 24V by Div. 25.
    - .5 Provide wiring from alarms at eyewash stations. Eyewash stations & audible alarms by Div. 23, wired by Div. 25.
    - .6 All control devices indicated.
  - .8 Provide a complete commissioning procedure for review by Engineer. Once accepted proceed with full commissioning of all systems.
  - .9 Refer to drawings for devices which are installed by Divisions 21, 22 & 23 and Division 26 respectively. All other installations shall be the responsibility of Division 25.
  - .10 Supply control valves, flow switches, temperature wells & gauge taps for Div. 23 to install, wired by Div. 25.
  - .11 Accessories: Installation of automatic dampers. To include assembly of multiple section dampers with required interconnecting linkages, shafts and brackets and extend the required number of shafts through the ducts for externally mounted damper motors. Jack shafts will be assembled with sealed roller or ball bearings of stainless steel construction.
  - .12 Equipment Wiring Systems:
    - .1 Controls contractor (Div. 25) shall provide all 120V & low voltage wiring for all BAS systems from the 120V junction boxes provided by Div. 26.
  - .13 Air handling units (VFD's)
  - .14 Pump VFD's
  - .15 Fan VFD's
  - .16 Kitchen control panel (by Halton)
  - .17 Boilers



1.7 DESCRIPTION OF WORK  
(Cont'd)

- .12 General Notes:(Cont'd)  
.18 Metering system

1.8 WORK BY OTHERS

- .1 Mechanical contractor (Div. 23) shall install all wells, valves, taps, automatic dampers, flow stations, etc. furnished by BAS contractor (Div. 25).
- .2 Electrical contractor (Div. 26) shall provide the following:
- .1 120V circuits and junction boxes as shown on electrical drawings.
  - .2 Install all meters provided by Div. 25.
  - .3 Install the two (2) UPS units for the Tower & Lab supplied by Div. 25
  - .4 Master electrician inspection of all electrical work by Div. 25.

1.9 QUALITY ASSURANCE

- .1 The BAS system shall be designed and installed, commissioned and serviced by manufacturer employed, factory trained personnel. Manufacturer shall have an in-place support facility within 100 miles of the site with technical staff, spare parts inventory and necessary test and diagnostic equipment. Distributors or licensed installing contractors are not acceptable.

The manufacturer shall provide full time, on site, experienced project manager for this work, responsible for direct supervision of the design, installation, start up and commissioning of the BAS.

The contractor shall be regularly engaged in the manufacturing, installation and maintenance of BAS systems and shall have a minimum of ten (10) years of demonstrated technical expertise and experience in the manufacture, installation and maintenance of BAS systems similar in size and complexity to this project. A maintained service organization consisting of at least ten (10) competent servicemen for a period of not less than ten years and provide a list of 10 projects, similar in size and scope to this project, completed within the last five years.

- .2 Materials and equipment shall be the catalogued products of manufacturers regularly

1.9 QUALITY  
ASSURANCE  
(Cont'd)

- .2 (Cont'd)  
engaged in production and installation of automatic temperature control systems and shall be manufacturer's latest standard design that complies with the specification requirements.
- .3 All BAS peer-to-peer network controllers, central system controllers and local user displays shall be UL Listed under UL 916, category PAZX; ULC ORD-C100, category UUKL7; and under Standard UL 864, categories UUKL, UDTZ, and QVAX. All floor level controllers shall comply, at a minimum, with UL 916 category PAZX; Standard UL 864, categories UDTZ, and QVAX.
- .4 All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference and be so labeled.
- .5 The manufacturer of the building automation system shall provide documentation supporting compliance with ISO-9002 (Model for Quality Assurance in Production, Installation, and Servicing) and ISO-14001 (The application of well-accepted business management principles to the environment). The intent of this specification requirement is to ensure that the products from the manufacturer are delivered through a Quality System and Framework that will assure consistency in the products delivered for this project.
- .6 This system shall have a documented history of compatibility by design for a minimum of 15 years. Future compatibility shall be supported for no less than 10 years. Compatibility shall be defined as the ability to upgrade existing field panels to current level of technology, and extend new field panels on a previously installed network.

Compatibility shall be defined as the ability for any existing field panel microprocessor to be connected and directly communicate with new field panels without bridges, routers or protocol converters.

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- 1.10 ITEMS TO BE INTERFACES BUT NOT FURNISHED UNDER THIS SECTION
- .1 Section 23 05 14 - Variable Frequency Drives
  - .2 Section 23 36 00 - Air Terminal Units.
  - .3 Section 23 73 10 - Custom Air Handling Units.
  - .4 Division 26 - Distribution Equipment Low Voltage.
  - .5 Meters:
    - .1 Main DCW meter (provide interface for pulse output)..
  - .6 Section 23 52 00 - Packaged Boilers - Condensing.
- 1.11 AGENCY LISTINGS
- .1 UL 916 Energy Management Systems.
  - .2 NFPA (Fire) 15 Subparagraph J. Class A. Emissions requirements.
- 1.12 GENERAL PROVISIONS
- .1 The General Provisions of the Contract, including the General Conditions and supplementary General Conditions, apply to the work specified in this Section.
- 1.13 QUALIFICATIONS
- .1 Shall be an authorized distributor of any of the products listed in Part 2 - Products.
  - .2 Shall have at least 5 years experience in the installation and maintenance of DDC control systems. Shall have experience, local reference projects, a proven record in the implementation Open Protocols and Interoperable Systems.
  - .3 Shall have a local staff of trained personnel capable of installation, engineering, technical support, operator instruction, and with full service capabilities.
  - .4 Shall have a local office and be able to offer emergency service 24 hrs./day, 365 days/year.
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PART 2 - PRODUCTS

- 2.1 DESIGNATED SUPPLIER .1 Delta Controls; no substitution.
- 2.2 GENERAL .1 BUILDING AUTOMATION SYSTEM (BAS). This contractor shall be responsible for the hardware and software for the enterprise framework and system integration required for the complete Building Automation System. The BAS shall be comprised of Network Control Units (NCU) connected to the Building Automation System local area network (BAS LAN). The BAS shall utilize BACnet/IP (ASHRAE standard SPC-135A-95 - Annex L) for communication between NCUs. The system includes Network Control Unit(s) (NCU), software and programming of the NCU, Operator Workstation(s) (OWS) software and hardware, development of all graphical screens, setup of schedules, logs and alarms, network management and connection of the NCU to the local area network.
- .2 The failure of any single component shall not interrupt the control strategies of other operational devices. System expansion shall be through the addition of end devices, controllers, and other devices described in this specification.
- 2.3 OPERATOR WORKSTATION, PORTABLE & PERIPHERALS .1 OPERATOR WORKSTATION (OWS)  
.1 Controls contractor shall provide interface between existing OWS and all new controls, update control sequences and building graphics.
- 2.4 LOCAL AREA NETWORK, NETWORK MANAGEMENT, INTRANET, & INTERNET ACCESS .1 LOCAL AREA NETWORK  
.1 The Server and OWS shall communication to the NCU's utilizing standard Ethernet to IEEE 802.3 Standards. Any break in the BAS LAN between NCU and Server or OWS shall result in an alarm notification at the OWS and Server. The BAS LAN shall be a 100 Megabits/sec Ethernet network capable of supporting BACnet, Java, XML, HTTP, and CORBA IIOP.

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- 2.4 LOCAL AREA NETWORK, NETWORK MANAGEMENT, INTRANET, & INTERNET ACCESS (Cont'd)
- .1 (Cont'd)
    - .1 (Cont'd)
      - .1 Ethernet; IEEE standard 802.3
      - .2 Cable; 100 Base-T, UTP-8 wire, category 5 to TBITS6.9
      - .3 Minimum throughput; 100 Mbps
- 
- 2.5 BUILDING MANAGEMENT SOFTWARE
- .1 Provide building management software compatible with existing control system.
  - .2 The software shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimum knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification.
  - .3 Operator's workstation software shall contain an easy-to-operate system allowing configuration of system-wide controllers, including management and display of the controller programming. This system shall provide the capability to configure controller binary and analog inputs/outputs.
  - .4 Provide software which enables the non programmer operator to easily perform tasks which are likely to be part of his daily routine.
  - .5 Upon operator's request, the system shall present the condition of any single point, any system, and area or the whole system on printer or CRT. The output device shall be by operator's choice. Analog values and status displayed on the CRT shall be updated whenever new values are received. Points in alarm shall be flagged by blinking, inverse video different colour, bracketed, or by some other means to differentiate them from points not in alarm.
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2.5 BUILDING  
MANAGEMENT SOFTWARE  
(Cont'd)

- .6 REAL TIME DISPLAYS The OWS, shall at a minimum, support the following graphical features and functions:
  - .1 Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the GUI shall support the use of scanned pictures.
  - .2 Graphic screens shall have the capability to contain objects for text, real-time values, animation, colour spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.
  - .3 Graphics shall support layering and each graphic object shall be configurable for assignment to one a layer. A minimum of six layers shall be supported.
  - .4 Any computer on the BAS LAN shall be capable of displaying the systems in a graphical and dynamic format utilizing a standard web browser. Screen refresh shall be automatic. Manual refresh is not acceptable.
- .7 ON-LINE HELP
  - .1 Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in TML format.
- .8 SYSTEM DIAGNOSTICS
  - .1 The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.
- .9 ERROR MESSAGES
  - .1 Inform operator of all errors in data, errors in entry instructions, failure of equipment to respond to requests or commands, or failure of communications between components of EMCS.

2.5 BUILDING  
MANAGEMENT SOFTWARE  
(Cont'd)

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- .9 (Cont'd)
    - .2 Error messages to be comprehensive and communicate clearly to operator precise nature of problem.
  
  - .10 PASSWORD PROTECTION / SECURITY
    - .1 Each operator shall be required to log on to that system with a user name and password in order to view, edit add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.
  
  - .11 TREND DATA
    - .1 System shall periodically gather historically recorded selected samples of object data stored in the field equipment (global controllers, field controllers) and archive the information on the operator's workstation (server) hard disk. Archived files shall be appended with new sample data, allowing samples to be accumulated over several years. Systems that write over archived data shall not be allowed, unless limited file size is specified. Samples may be viewed at the operator's terminal in a trendlog. Logged data shall be stored in spreadsheet format. Operator shall be able to scroll through all trendlog data. System shall automatically open archive files as needed to display archived data when operator scrolls through the data vertically. All trendlog information shall be displayed in standard engineering units.
    - .2 Software shall be included that is capable of graphing the trend logged object data. Software shall be capable of creating two-axis (x,y) graphs that display up to six object types at the same time in different colors. Graphs
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2.5 BUILDING  
MANAGEMENT SOFTWARE  
(Cont'd)

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- .11 (Cont'd)
  - .2 (Cont'd)  
shall show object type value relative to time.
  - .3 Operator shall be able to change trend log setup information as well. This includes the information to be logged as well as the interval at which it is to be logged. All input, output, and value object types in the system may be logged. All operations shall be password protected. Setup and viewing may be accessed directly from any and all graphics object is displayed on.
- .12 GRAPHICS
- .1 The operator's workstation shall display all data associated with the project. The operator's terminal software shall accept Windows BITMAP (\*.bmp) format graphic files for display purposes. Graphic files shall be created using scanned, full color photographs of system installation, AutoCAD drawing files of field installation drawings and wiring diagrams from as-built drawings. Operator's terminal shall display all data using 3-D graphic representations of all mechanical equipment.
  - .2 System shall be capable of displaying graphic file, text, and dynamic object data together on each display. Information shall be labeled with descriptors and shall be shown with the appropriate engineering units. All information on any display shall be dynamically updated without any action by the user. Terminal shall allow user to change all field-resident BAS functions associated with the project, such as setpoints, weekly schedules, exception schedules, etc. from any screen no matter if that screen shows all text or a complete graphic display. This shall be done without any reference to object addresses or other numeric/mnemonic indications.
  - .3 All displays shall be generated and customized in such a manner by the local DDC system supplier that they fit the project as specified. Canned displays shall not be acceptable. Displays shall use standard English for labeling and readout. Systems requiring factory programming for graphics or DDC logic are
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2.5 BUILDING  
MANAGEMENT SOFTWARE  
(Cont'd)

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- .12 (Cont'd)
    - .3 (Cont'd)

specifically prohibited. All graphics and DDC programming shall be supported locally by the installing contractor without factory dependency or assistance.
  
  - .13 ALARMS
    - .1 The system shall be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator. When the Alarm Console is enabled, a separate alarm notification window will supercede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable.
    - .2 System shall provide log of alarm messages. Alarm log shall be archived to the hard disk of the system operator's terminal. Each entry shall include a description of the event-initiating object generating the alarm, time and date of alarm occurrence, time and date of object state return to normal, and time and date of alarm acknowledgement.
    - .3 Alarm messages shall be in user-definable text English or other specified language and shall be entered either at the workstation or OWS.
  
  - .14 ARCHIVING
    - .1 Store back-up copies of all controllers databases in at least one OWS and the server.
    - .2 Provide continuous supervision of integrity of all controller databases. If controller loses database, system to automatically download new copy of database to restore proper operation.
    - .3 Data base back up and downloading to occur over LAN without operator intervention. Operator to be able to manually download entire controller data base or parts thereof.
-

2.5 BUILDING  
MANAGEMENT SOFTWARE  
(Cont'd)

.15 REPORTS

- .1 Provide a report facility to generate and format for display, printing, or permanent storage, as selected by the operator, the reports as specified in this section. If display output (CRT) is requested, it shall be scrollable; scroll bars will be used to allow easy and flexible movement within the report. Output to be sorted by area, system point.
- .2 Periodic/Automatic Report: Provide the software to automatically generate any report specified, the user will be able to specify the type of report, start time and date, interval between reports (hourly, daily, weekly, monthly) and output device. The software will allow the operator to modify the periodic/automatic reporting profile at any time.
- .3 As a minimum, the following reports shall be configured on the system:
  - .1 Dynamic Reports
  - .2 Summary Report
  - .3 Trend Reports
  - .4 Historical Data Collection
  - .5 Critical Alarm Summary
  - .6 Maintenance Alarm Summary
  - .7 Alarm Summary
  - .8 Disable Point Summary
  - .9 Run Time Summary
  - .10 Schedule Summary
  - .11 User Record Summary

.16 PROGRAMMING METHOD

- .1 The OWS software shall provide the ability to perform system programming and graphic display engineering as part of the complete software package. Access to the programming functions and features of the software shall be through password access as assigned by the system administrator.

2.6 PROGRAMMABLE  
CONTROLLERS

.1

- .1 BAS shall employ either BACnet or LonTalk communications and be compatible with existing BAS system. BAS proposals based on proprietary protocols will only be considered as an alternate to an open protocol communication system. All BACnet controllers shall meet or exceed the requirements of ANSI/ASHRAE Standard 135 and must be BTL listed. All

2.6 PROGRAMMABLE  
CONTROLLERS  
(Cont'd)

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- .1 (Cont'd)  
LonTalk controllers shall use FTT-10 transceivers and support LonTalk standard network variable types (SNVTs) as defined by the LonMark Interoperability Association.
  - .2 The LCU/TCU's shall communicate with the NCU connection at a baud rate of not less than 78.8 kbps. The NCU shall communicate at 100 mbps ethernet IP. The application control program shall be resident within the same enclosure as the input/output circuitry, which translates the sensor signals. A system must in its point entirety be in the same controller as its associated program.
  - .3 All control sequences within or programmed into the LCU/TCU shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained. Controller memory shall not be lost during a power failure. The user shall have the capability of loading or re-loading all software via the OWS or the local terminal port.
  - .4 Power Fail restart - In the event of the loss of normal power, there shall be an orderly shutdown of all controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all controller configuration data, and battery back-up shall be provided to support the real-time clock and all volatile memory for a minimum of 30 hours. .5 Upon restoration of normal power, the controller shall automatically resume full operation without manual intervention. The controllers shall incorporate random start sequences to ensure a power spike does not result.
  - .5 System architecture shall allow for point expansion in one of the following ways:
    - .1 The addition of input/output cards to an existing System Application Controller.
    - .2 A slave controller may be used to expand point capacity.
    - .3 20% expansion capacity for all point types in system and 10% in all DDC panels.
-

2.7 NETWORK CONTROL UNIT (NCU) .1

The NCU shall employ the BACnet protocol for communication to native BACnet controllers using protocols and BAS LAN types contained in the ASHRAE Standard 135A. The NCU shall utilize BACnet/IP (ASHRAE standard SPC-135A - Annex - L) for communication between NCU's.

.2 The Network Control Unit (NCU) shall provide the interface between the BAS LAN and the BAS sub LAN and provide global supervisory control functions over the control devices connected to the NCU. It shall be capable of executing application control programs to provide:

- .1 Calendar functions
- .2 Scheduling
- .3 Trending
- .4 Alarm monitoring and routing
- .5 Time synchronization
- .6 Integration of LonWorks controller data and BACnet controller data
- .7 Network Management functions for all LonWorks based devices

.3 The Network Control Unit must provide the following hardware features as a minimum:

- .1 One Ethernet Port B 100 Mbps
- .2 One RS-232 port/RS 485 port capable of supporting modbus
- .3 One LonWorks Interface Port B 78KB FTT-10A
- .4 Battery Backup
- .5 Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)

.4 Event Alarm Notification and actions

- .1 The NCU shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
- .2 The NCU shall be able to route any alarm condition to any defined user location whether connected to the BAS LAN, or remotely through the building LAN.

.5 The following shall be recorded by the NCU for each alarm (at a minimum):

- .1 Time and date
  - .2 Location (building, floor, zone, room number, etc.)
  - .3 Equipment (air handler #, access way, etc.)
-

- 2.7 NETWORK CONTROL .5 (Cont'd)  
UNIT (NCU)  
(Cont'd)
- 
- .4 Acknowledge time, date, and user who issued acknowledgement.
- .5 Number of occurrences since last acknowledgement.
- .6 DATA COLLECTION AND STORAGE - The NCU shall have the ability to collect data for any property of any object and store this data for future use.
- .1 All log data shall be stored in a relational database in the NCU and the data shall be accessed from a server and/or a standard Web Browser.
- .2 All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.
- .3 All log data shall be available to the user in the following data formats:
- .1 HTML
- .2 XML
- .3 Plain Text
- .4 Comma or tab separated values
- .7 AUDIT LOG - Provide and maintain an Audit Log that tracks all activities performed on the NCU. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached it's user-defined buffer size. Provide the ability to archive the log locally (to the NCU), to another NCU on the network, or to a server. For each log entry, provide the following data:
- .1 Time and date
- .2 User ID
- .3 Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.
- .8 DATABASE BACKUP AND STORAGE - The NCU shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval. Copies of the current database and, at the most recently saved database shall be stored in the NCU. The age of the most recently saved database is dependent on the user-defined database save interval.
-

2.8 LOCAL CONTROL  
UNITS (LCU)

- .1 The Local Control Units (LCU) shall be microprocessor-based with a minimum word size of 16 bits. They shall also be multi-tasking, realtime digital control processors consisting of modular hardware with plug-in enclosed processors, communication controllers, power supplies and input/output point modules. Controller size shall be sufficient to fully meet the requirements of this specification and the attached point list.
- .2 Each LCU shall have sufficient memory, to support its own operating system and databases, including:
  - .1 Control processes
  - .2 Energy management applications
  - .3 Alarm management applications
  - .4 Historical/trend data for points specified
  - .5 Maintenance support applications
  - .6 Custom processes
  - .7 Manual override monitoring
- .3 Each LCU shall support:
  - .1 Monitoring of the following types of inputs, without the addition of equipment outside the DDC Controller cabinet:
    - .1 Analog inputs of 4-20 mA, 0-10 Vdc, thermistors or 1000 ohm RTD's.
    - .2 Digital inputs from dry contact closure, pulse accumulators, voltage sensing.
  - .2 Each LCU shall be capable of providing the following control outputs without the addition of equipment outside the DDC controller cabinet:
    - .1 Digital outputs (contact closure for motor starters up to size 4).
    - .2 Analog outputs of 4-20 mA or 0-10 Vdc.
- .4 Each LCU shall have a minimum of 10% spare capacity for each point type for future point connection. Provide all processors, power supplies and communication controllers complete so that the implementation of a point only requires the addition of the appropriate point input/output termination module and wiring. As a minimum, provide one of each type of point available on the controller.
- .5 Provide sufficient internal memory for the specified control sequences and have at least 25% of the memory available for future use.

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- 2.8 LOCAL CONTROL UNITS (LCU)  
(Cont'd)
- .6 The LCU shall provide local LED status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device. Graduated intensity LED's or analog indication of value shall also be provided for each analog output. Status indication shall be visible without opening the panel door.
- .7 The LCU shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all panel components. The controller shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication.
- 2.9 TERMINAL CONTROL UNITS (TCU)
- .1 Controllers shall include all point inputs and outputs necessary to perform the specific control sequences. As a minimum, 50% of the point outputs shall be of the universal type; that is, the outputs may be utilized either as modulating or two-state, allowing for additional system flexibility. Analog outputs shall be industry standard signals such as 24V floating control, allowing for interface to a variety of modulating actuators.
- .2 Each controller performing space temperature control shall be provided with a matching room temperature sensor. Each room temperature sensor shall include a terminal jack integral to the sensor assembly. The terminal jack shall be used to connect a portable operator's terminal to control and monitor all hardware and software points associated with the controller.
- .3 Each room sensor shall also include the following auxiliary devices:
- .1 Setpoint Adjustment: The setpoint adjustment dial shall allow for modification of the temperature by the occupant. Setpoint adjustment may be locked out, overridden or limited as to time or temperature through software by an authorized operator at the central workstation, DDC controller, or via the portable operator's terminal.
  - .2 Temperature Indicator: None required.
  - .3 Override Switch: Required.
-

2.9 TERMINAL  
CONTROL UNITS (TCU)  
(Cont'd)

- .4 Each controller shall perform its primary control function independent of other TCU controller LAN communication, or if LAN communication is interrupted. Reversion to a fail-safe mode of operation during LAN interruption is not acceptable. The controller shall receive its real-time data from the NCU controller time clock to insure LAN continuity. Each controller shall include algorithms incorporating proportional, integral, and derivative (PID) gains for all applications. All PID gains and biases shall be field-adjustable by the user via terminals as specified herein. This functionality shall allow for tighter control of space conditions and shall facilitate optimal occupant comfort and energy savings.
- .5 Provide each TCU with sufficient memory to accommodate point databases, operating programs, local alarming and local trending. All databases and programs shall be stored in non-volatile EEPROM, EPROM and PROM. Operating programs shall be field selectable for specific applications. In addition, specific applications may be modified to meet the user's exact control strategy requirements, allowing for additional system flexibility. Controllers that require factory changes of all applications are not acceptable.
- .6 The controller shall include a differential pressure transducer that shall connect to the terminal unit manufacturer's standard averaging air velocity sensor to measure the average differential pressure in the duct. The controller shall convert this value to actual air flow. Single point air velocity sensing is not acceptable. The differential pressure transducer shall have a measurement range of 0 to 4000 fpm (0 to 20.4 m/s) and measurement accuracy of "5% at 400 to 4000 fpm (2 to 20 m/s), insuring primary air flow conditions shall be controlled and maintained to within "5% of setpoint at the specified parameters.
- .7 Each controller shall include provisions for manual and automatic calibration of the differential pressure transducer in order to maintain stable control and insuring against over time. Calibration shall be accomplished by stroking the terminal unit damper actuator to a 0% position so that a 0 cfm air volume reading is sensed. The controller shall automatically accomplish this whenever the



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- 2.9 TERMINAL CONTROL UNITS (TCU) (Cont'd) .7 (Cont'd)  
system mode switches from occupied to unoccupied or vice versa. Manual calibration may be accomplished by either commanding the actuator to 0% via the POT or by depressing the room sensor override switch. Calibration of the transducer at the controller location shall not be necessary.
- .8 It shall be possible to view and reset the space temperature, temperature setpoint, maximum airflow setting, minimum airflow setting, and actual airflow, through the BAS LAN.
- 2.10 CONTROLLER SOFTWARE .1 GENERAL REQUIREMENTS
- .1 Software shall include but not be limited to definitions and operating systems executive, communications, application programs, operator interface, and control description logic.
- .2 Software to include any "firmware" or instructions which are programmed into ROM or other non-volatile memory.
- .3 The overall design philosophy of software with special emphasis on operator interfacing must use management by exception philosophy, i.e. report abnormalities by order of event occurrences.
- .4 All initial programming of all controllers shall be done by this contractor.
- .2 OBJECT LIBRARIES
- .1 A standard library of objects shall be included for development and setup of application logic, user interface displays, system services, and communication networks.
- .2 The objects in this library shall be capable of being copied and pasted into the user's database and shall be organized according to their function. In addition, the user shall have the capability to group objects created in their application and store the new instances of these objects in a user-defined library.
- .3 In addition to the standard libraries specified here, the supplier of the system shall maintain an on-line accessible (over the Internet) library,
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- 2.10 CONTROLLER SOFTWARE (Cont'd)
- .2 (Cont'd)
  - .3 (Cont'd)  
available to all registered users to provide new or updated objects and applications as they are developed.
  - .4 All control objects shall conform to the control objects specified in the BACnet specification. All control objects shall conform to the objects as specified in the BACnet specification.
    - .1 Analog Input Object
    - .2 Analog Output Module
    - .3 Binary Input Module
    - .4 Binary Output Module
    - .5 PID Loop Object
    - .6 Comparison Object
    - .7 Math Object
    - .8 Custom Programming Object
    - .9 Interlock Object
    - .10 Temperature Object
    - .11 Composite Object
  - .5 The library shall include applications or objects for the following functions, at a minimum:
    - .1 Scheduling Object.
    - .2 Calendar Object.
    - .3 Duty Cycling Object.
    - .4 Temperature Override Object.
    - .5 Start-Stop Time Optimization Object.
    - .6 Demand Limiting Object.
- 2.11 PORTABLE OPERATOR'S TERMINAL (POT)
- .1 The BAS contractor shall provide industry standard, commercially available portable operator terminals (laptop computer) with a LCD display and a full-featured keyboard. BAS contractor shall configure/program POT to plug directly into all DDC Controllers, as described below. BAS contractor to provide a user-friendly, English language-prompted interface for quick access to system information, not codes requiring look-up charts. Contractor to provide one (1) portable operator terminal.
  - .2 Functionality of the portable operator's terminal connected at any DDC Controller:
    - .1 Access all DDC Controllers and ASCs on the network.
    - .2 Backup and/or restore DDC Controller data bases for all system panels, not just the DDC Controller connected to.
-

- 2.11 PORTABLE OPERATOR'S TERMINAL (POT)  
(Cont'd)
- .2 (Cont'd)
    - .3 Display all point, selected point and alarm point summaries.
    - .4 Display trending and totalization information.
    - .5 Display all system dynamic graphics.
    - .6 Add, modify and/or delete any existing or new system point.
    - .7 Command, change setpoint, enable/disable any system point.
    - .8 Program and load custom control sequences as well as standard energy management programs.
    - .9 Acknowledge alarms
  - .3 Functionality of the portable operator's terminal connected to any application specific controller:
    - .1 Provide connection capability at either the Floor Level Network Controller or a related room sensor to access controller information.
    - .2 Provide status, setup and control reports.
    - .3 Modify, select and store controller data base.
    - .4 Command, change setpoint, enable/disable any controller point.
  - .4 Connection of a POT to a DDC Controller, or ASC Controller shall not interrupt nor interfere with normal network operation in any way, prevent alarms from being transmitted or preclude centrally-initiated commands and system modification.
  - .5 Portable operator terminal access to controller shall be password-controlled. Password protection shall be configurable for each operator based on function, points (designating areas of the facility), and edit/view capability.
- 2.12 WORKSTATION OPERATOR INTERFACE
- .1 Basic Interface Description:
    - .1 Operator workstation interface software shall minimize operator training through the use of English language prompting, 30 character English language point identification, on-line help, and industry standard PC application software. Interface software shall simultaneously communicate with up to 4 Building Level Networks and share data
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- 2.12 WORKSTATION .1 (Cont'd)  
OPERATOR INTERFACE .1 (Cont'd)  
(Cont'd)
- 
- between any of the 4 networks. The software shall provide, as a minimum, the following functionality:
- .1 Real-time graphical viewing and control of environment
  - .2 Scheduling and override of building operations
  - .3 Collection and analysis of historical data
  - .4 Point database editing, storage and downloading of controller databases.
  - .5 Alarm reporting, routing, messaging, and acknowledgment
  - .6 Display dynamic data trend plot.
  - .7 Definition and construction of dynamic color graphic displays.
  - .8 Program editing
  - .9 Transfer trend data to 3rd party software
  - .10 Scheduling reports
  - .11 Operator Activity Log
  - .12 Open communications via OPC Server
  - .13 Open communications via BACnet Client & Server
  - .14 Utilities forecasting software feature to forecast future utility charges based on previous trends using metering and utility rates (user defined).
- .2 Workstation interface shall be web-based to allow dial into BAS via internet, while maintaining local security access features.
- .3 Provide a graphical user interface which shall minimize the use of keyboard through the use of a mouse or similar pointing device and "point and click" approach to menu selection.
- .4 The software shall provide a multi-tasking type environment that allows the user to run several applications simultaneously. BAS software shall run on the existing operating. These Windows applications shall run simultaneously with the BAS software. The mouse or Alt-Tab keys shall be used to quickly select and switch between multiple applications. The operator shall be able to work in Microsoft Word, Excel, and other Windows based software packages, while concurrently annunciating on-line BAS alarms and monitoring information.
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- 2.12 WORKSTATION .1 (Cont'd)  
OPERATOR INTERFACE .5 Provide functionality such that any of  
(Cont'd) the following may be performed  
simultaneously on-line, and in any  
combination, via user-sized windows.  
Operator shall be able to drag and drop  
information between applications,  
reducing the number of steps (i.e. Click  
on a point on the alarm screen and drag  
it to the dynamic trend graph application  
to initiate a dynamic trend).
- .1 Dynamic color graphics and graphic control
  - .2 Alarm management, routing to designated locations, and customized messages
  - .3 Year in advance event and report scheduling
  - .4 Dynamic trend data definition and presentation
  - .5 Graphic definition and construction
  - .6 Program and point database editing on-line.
- .6 If the software is unable to display several different types of displays at the same time, the BAS contractor shall provide at least two operator workstations.
- .7 Report and alarm printing shall be accomplished via Windows Print Manager, allowing use of network printers.
- .8 Operator specific password access protection shall be provided to allow the user/manager to limit workstation control, display and data base manipulation capabilities as deemed appropriate for each user, based upon an assigned password. Operator privileges shall "follow" the operator to any workstation logged onto (up to 999 user accounts shall be supported).
- .9 Reports shall be generated on demand or via pre-defined schedule and directed to either LCD displays, printers or disk. As a minimum, the system shall allow the user to easily obtain the following types of reports:
- .1 A general listing of all or selected points in the network
  - .2 List of all points currently in alarm
  - .3 List of all points currently in override status
  - .4 List of all disabled points
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- 2.12 WORKSTATION .1 (Cont'd)  
OPERATOR INTERFACE .9 (Cont'd)  
(Cont'd)
- .5 List of all points currently locked out
  - .6 List of user accounts and access levels
  - .7 List all weekly schedules
  - .8 List of holiday programming
  - .9 List of limits and deadbands
  - .10 Custom reports from 3rd party software
  - .11 System diagnostic reports including, list of DDC panels on line and communicating, status of all DDC terminal unit device points
  - .12 List of programs
  - .10 Scheduling and Override:
    - .1 Provide a calendar type format for simplification of time-of-day scheduling and overrides of building operations. Schedules reside in the PC workstation, DDC Controller, and HVAC Mechanical Equipment Controller to ensure time equipment scheduling when PC is off-line, PC is not required to execute time scheduling. Provide override access through menu selection or function key. Provide the following spreadsheet graphic types as a minimum:
      - .1 Weekly schedules
      - .2 Zone schedules, minimum of 200 unique zones
      - .3 Scheduling for up to 365 days in advance
      - .4 Schedule reports to print at PC.
  - .11 Collection and Analysis of Historical Data:
    - .1 Provide trending capabilities that allow the user to easily monitor and preserve records of system activity over an extended period of time. Any system point may be trended automatically at time-based intervals or change of value, both of which shall be user-definable. Trend data may be stored on hard disk for future diagnostics and reporting. Additionally, trend data may be archived to network drives or removable disk media for future retrieval.
    - .2 Trend data reports shall be provided to allow the user to view all trended point data. Reports may be customized to include individual points or predefined groups of at least six
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- 2.12 WORKSTATION .1 (Cont'd)  
OPERATOR INTERFACE .11 (Cont'd)  
(Cont'd) .2 (Cont'd)
- points. Provide additional functionality to allow predefined groups of up to 250 trended points to be easily transferred on-line to Microsoft Excel. DDC contractor shall provide custom designed spreadsheet reports for use by the owner to track energy usage and cost, equipment run times, equipment efficiency, and/or building environmental conditions. DDC contractor shall provide setup of custom reports including creation of data format templates for monthly or weekly reports.
- .3 Provide additional functionality that allows the user to view real-time trend data on trend graph displays. A minimum of ten points may be graphed, regardless of whether they have been predefined for trending. The dynamic graphs shall continuously update point values. At any time the user may redefine sampling times or range scales for any point. In addition, the user may pause the graph and take "snapshots" of screens to be stored on the workstation disk for future recall and analysis. Exact point values may be viewed and the graphs may be printed. A minimum of 8 true graphs shall run simultaneously. Operator shall be able to command points directly on the trend plot by double clicking on the point.
- .2 Dynamic Color Graphic Displays:
- .1 Create color graphic floor plan displays and system schematics for each piece of mechanical equipment, including air handling units, chilled water systems and room level terminal units, shall be provided by the BAS contractor as indicated in the point I/O schedule of this specification to optimize system performance, analysis and speed alarm recognition.
- .2 The operator interface shall allow users to access the various system schematics and floor plans via a graphical penetration scheme, menu selection or text-based commands. Graphics software shall permit the importing of AutoCAD or scanned pictures for use in the system. Customized floor plate graphics shall be provided indicating zones. Graphics are
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- 2.12 WORKSTATION OPERATOR INTERFACE (Cont'd)
- .2 Dynamic Color Graphic Displays:(Cont'd)
- .2 (Cont'd)  
to include architectural elements (imported from AutoCAD) and walls. Pre-configured graphics shall be included for application specific controls.
- .3 Dynamic temperature values, humidity values, flow values and status indication shall be shown in their actual respective locations and shall automatically update to represent current conditions without operator intervention and without pre-defined screen refresh rates.
- .1 Sizable analog bars shall be available for monitor and control of analog values; high and low alarm limit settings shall be displayed on the analog scale. The user shall be able to "click and drag" the pointer to change the setpoint.
- .2 Provide the user the ability to display blocks of point data by defined point groups; alarm conditions shall be displayed by flashing point blocks.
- .3 Equipment state can be changed by clicking on the point block or graphic symbol and selecting the new state (on/off) or setpoint.
- .4 State text for digital points can be defined up to eight characters.
- .4 Colors shall be used to indicate status and change as the status of the equipment changes. The state colors shall be user definable.
- .5 The windowing environment of the PC operator workstation shall allow the user to simultaneously view several applications at a time to analyze total building operation or to allow the display of a graphic associated with an alarm to be viewed without interrupting work in progress.
- .6 Off the shelf graphic software, Microgafx Designer or Corel Draw software shall be provided to allow the user to add, modify or delete system graphic displays.
- .7 A clipart library of HVAC and automation symbols shall be provided including fans, valves, motors, chillers, AHU systems, standard ductwork diagrams and laboratory symbols. The user shall have the ability to add custom symbols to the clipart library.
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2.12 WORKSTATION  
OPERATOR INTERFACE  
(Cont'd)

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- .2 Dynamic Color Graphic Displays:(Cont'd)
    - .8 A dynamic display of the site specific architecture showing status of controllers, PC workstations and networks shall be provided.
  
  - .3 System Configuration & Definition:
    - .1 Network wide control strategies shall not be restricted to a single DDC Controller or HVAC Mechanical Equipment controller, but shall be able to include data from any and all other network panels to allow the development of Global control strategies.
    - .2 Provide automatic backup and restore of all DDC controller and HVAC Mechanical Equipment controller databases on the workstation hard disk. In addition, all database changes shall be performed while the workstation is on-line without disrupting other system operations. Changes shall be automatically recorded and downloaded to the appropriate DDC Controller or HVAC Mechanical Equipment Controller. Changes made at the DDC Controllers or HVAC Mechanical Equipment Controllers shall be automatically uploaded to the workstation, ensuring system continuity.
    - .3 System configuration, programming, editing, graphics generation shall be performed on-line. If programming and system back-up must be done with the PC workstation off-line, the BAS contractor shall provide at least 2 operator workstations.
  
  - .4 Alarm Management:
    - .1 Alarm Routing shall allow the user to send alarm notification to selected printers or PC location based on time of day, alarm severity, or point type.
    - .2 Alarm Notification shall be provided via two alarm icons, to distinguish between routine, maintenance type alarms and critical alarms. These alarm icons shall be displayed when user is working in other Windows programs. The BAS alarm display screen shall be displayed when the user clicks on the alarm icon.
    - .3 Alarm Display shall list the alarms with highest priority at the top of the display. The alarm display shall provide selector buttons for display of the associated point graphic and message. The
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- 2.12 WORKSTATION OPERATOR INTERFACE (Cont'd)
- .4 Alarm Management:(Cont'd)
- .3 (Cont'd)  
alarm display shall provide a mechanism for the operator to sort alarms.
- .4 Alarm messages shall be customizable for each point to display detailed instructions to the user regarding actions to take in the event of an alarm.
- .5 Remote notification of messages:
- .1 Workstation shall be configured to send out messages to numeric pagers, alphanumeric pagers, Blackberry hand-held portable on Telus/Mike Network and e-mail accounts based on a point's alarm condition.
- .2 There shall be no limit to the number of points that can be configured for remote notification of alarm conditions and no limit on the number of remote devices which can receive messages from the system.
- .3 On a per point basis, system shall be configurable to send messages to an individual or group and shall be configurable to send different messages to different remote devices based on alarm message priority level.
- .4 Remote devices may be scheduled as to when they receive messages from the system to account for operators' work schedules.
- .5 System must be configurable to send messages to an escalation list so that if the first contact does not respond, the message is sent on to other contacts.
- .6 Message detail shall be configurable on a per user basis.
- .7 Workstation shall have the ability to send manual messages allowing an operator to type in a message to be sent immediately.
- 2.13 FIELD DEVICES
- .1 General:
- .1 Control devices of each category to be of same type and manufacturer.
- .2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof, vibration-proof, heat resistant assembly.
- .3 Operating conditions: 0 - 32°C with 10 - 90% RH (non-condensing) unless otherwise specified.
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- 2.13 FIELD DEVICES .1 General:(Cont'd)  
(Cont'd)
- .4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
  - .5 Transmitters to be unaffected by external transmitters (eg. walkie talkies).
  - .6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
  - .7 Outdoor installations: use weatherproof construction in 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 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: 100/1000 ohm at 0°C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored leadwires. Coefficient of resistivity: 0.00385 ohms/ohm°C.
    - .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 or 150 mm as indicated. Strap-on pipe temperature sensors are acceptable only where system shut-down & drainage is not possible.
  - .2 Sensors:
    - .1 Room type: wall mounting, in slotted type covers having brushed aluminum finish, with guard as indicated. Element 10-50 mm long with ceramic tube or equivalent protection. Sensor shall have an operator adjustment and an override button. The setpoint slide adjustment can be software limited by the BAS. Thermistor, 100,000 ohm, accuracy of plus or minus 0.5°C.
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- 2.13 FIELD DEVICES .2 Temperature Sensors:(Cont'd)  
(Cont'd)
- .2 Sensors:(Cont'd)
- .2 General purpose duct type: suitable for insertion into ducts at any angle, insertion length 460 mm or as indicated.
- .3 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.
- .3 Temperature Transmitters:
- .1 Requirements:
- .1 Input circuit: to accept 3-lead, 100 ohm at 0°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°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°C.
- .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°C to plus 50°C, plus or minus 0.5°C.
- .2 0 to 100°C, plus or minus 0.5°C.
- .3 0 to 50°C, plus or minus 0.25°C.
- .4 0 to 25°C, plus or minus 0.1°C.
- .5 10 to 35°C, plus or minus 0.25°C.
- .4 Humidity Sensors:
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- 2.13 FIELD DEVICES .4 Humidity Sensors:(Cont'd)  
(Cont'd)
- .1 Requirements:
    - .1 Range: 5 - 100% RH minimum.
    - .2 Operating temperature range: 0 - 60°C.
    - .3 Absolute accuracy:
      - .1 Duct sensors: plus or minus 5%.
      - .2 Room sensors: plus or minus 2%.
    - .4 Sheath: stainless steel with integral shroud for specified operation in air streams of up to 10 m/s.
    - .5 Maintenance: by simple field method such as washing with solvent or mild detergent solution so as to remove anticipated airborne contaminants.
    - .6 Maximum sensor non-linearity: plus or minus 2% RH with defined curves.
    - .7 Room sensors: locate in air stream near RA grille as indicated.
    - .8 Duct mounted sensors: locate so that sensing element is between 1/3 and 2/3 distance across any duct dimension.
    - .9 Sensors to be unaffected by external transmitters such as walkie-talkies. Demonstrate to Engineer.
    - .10 Sensing element: Bulk Polymer.
  - .5 Humidity Transmitters:
    - .1 Requirements:
      - .1 Input signal: from RH sensor.
      - .2 Output signal: 4 - 20 mA onto 500 ohm maximum load.
      - .3 Input and output short circuit and open circuit protection.
      - .4 Output variations: not to exceed 0.2% of full scale output for supply voltage variations of plus or minus 10%.
      - .5 Output linearity error: plus or minus 1.0% maximum of full scale output.
      - .6 Integral zero and span adjustment.
      - .7 Temperature effect: plus or minus 1.0% full scale/6 months.
      - .8 Long term output drift: not to exceed 0.25% of full scale output/ 6 months.
  - .6 Differential Pressure (kPa) Transmitters:
    - .1 Requirements:
      - .1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
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- 2.13 FIELD DEVICES .6 (Cont'd)
- (Cont'd)
- .1 Requirements:(Cont'd)
    - .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.
  - .7 Differential Pressure (Pa) Transmitters:
    - .1 Requirements:
      - .1 Output signal: 4 - 20 mA into 500 ohm maximum load.
      - .2 Output variations: less than 0.2% full scale for supply voltage variations of plus or minus 10%.
      - .3 Integral zero and span adjustment.
      - .4 Temperature effects: not to exceed plus or minus 1.5% full scale/50°C.
      - .5 Output short circuit and open circuit protection.
      - .6 The unit to have a 12.5 mm N.P.T. conduit connection. The enclosure shall be an integral part of the unit.
      - .7 Pressure ranges: see I/O Summaries.
  - .8 Fan System Static Pressure Sensors:
    - .1 Requirements:
      - .1 Multipoint element with self-averaging manifold.
        - .1 Maximum pressure loss: 160 Pa at 10 m/s. (Air stream manifold).
      - .2 Accuracy: plus or minus 0.5% of actual duct static pressure.
  - .9 Fan System Static Pressure Transmitters:
    - .1 Requirements:
      - .1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.
      - .2 Calibrated span: not to exceed 150% of duct static pressure at maximum flow.
      - .3 Accuracy: 0.4% of span.
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2.13 FIELD DEVICES .9  
(Cont'd)

(Cont'd)

.1 Requirements:(Cont'd)

.4 Repeatability: within 0.5% of output.

.5 Linearity: within 1.5% of span.

.6 Deadband or hysteresis: 0.1 of span.

.7 External exposed zero and span adjustment.

.8 The unit to have a 12.5 mm N.P.T. conduit connection. The enclosure shall be an integral part of the unit.

.10 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 setpoint 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 Hot water: 860 kPa.

.2 Low pressure steam, compressed air: 1050 kPa. Range: 0 to 200 kPa. Accuracy: plus or minus 3 kPa.

.3 Medium pressure steam, compressed air: 1050 kPa. Range: 0 to 700 kPa. Accuracy: plus or minus 7 kPa.

.4 High pressure steam: 2100 kPa. Range: 0 to 2100 kPa. Accuracy: plus or minus 14 kPa.

.5 For fan operation: Range: 0 to 3000 Pa. Adjustable differential: 10 to 300 Pa.

.7 Provide sensors with isolation valve and snubber between sensor and pressure source.

.8 Sensors on steam service: provide pigtail syphon.

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- 2.13 FIELD DEVICES .11 Temperature Switches:  
(Cont'd)
- .1 Requirements:
    - .1 Range: see I/O summaries.
    - .2 Temperature sensor: liquid, vapour or bimetallic type. Operate automatically. Reset automatically, except as follows:
      - .1 Freeze protection: manual reset.
      - .2 Fire detection: manual reset.
    - .3 Adjustable setpoint and differential.
    - .4 Accuracy: plus or minus 1°C.
    - .5 Snap action rating: 120V, 15 amps or 24V DC as required. Switch to be DPST for hardwire and EMCS connections.
    - .6 Type as follows:
      - .1 Room: for wall mounting on standard electrical box with protective guard as indicated.
      - .2 Duct, general purpose: insertion length = 460 mm.
      - .3 Thermowell: stainless steel, with compression fitting for NPS 3/4 thermowell. Immersion length: 100 mm.
      - .4 Freeze detection: continuous element with 6000 mm insertion length, duct mounting, to detect coldest temperature in any 30 mm length.
      - .5 Strap-on: with helical screw stainless steel clamp.
  - .12 Tank Level Switches:
    - .1 Requirements:
      - .1 Indicate high/low fluid level and to alarm.
      - .2 For mounting on top of tank.
      - .3 Maximum operating temperature: 120°C.
      - .4 Mechanical switch or snap action contacts rated 15 amp at 120 V.
      - .5 Adjustable setpoint and differential.
  - .13 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.
-



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- 2.13 FIELD DEVICES (Cont'd)
- .13 Electrical Relays:(Cont'd)
    - .1 Requirements:(Cont'd)
      - .4 Relay to have visual status indication.
    - .14 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.
      - .15 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.
      - .16 Electronic Control Damper Operators:
        - .1 Requirements:
          - .1 Push-pull proportional type as indicated.

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- 2.13 FIELD DEVICES .16 Electronic Control Damper Operators:(Cont'd)  
(Cont'd)
- .1 Requirements:(Cont'd)
    - .2 Spring return for "fail-safe" in Normally Open or Normally Closed position on AHU mixing dampers & no spring return of fan coil units; however shall include end switches.
    - .3 Operator: size so as to control dampers against maximum pressure or dynamic closing pressure (whichever is greater).
    - .4 Power requirements: as required for application.
    - .5 Operating range: 0 - 20 V DC.
  - .17 Control Valves: (Two-position Application):
    - .1 Requirements:
      - .1 Construction: reference Section 15111, 15112 & 15113.
      - .2 Two port as indicated. Normally Open or Normally Closed, as indicated.
      - .3 Flow characteristics: linear or equal percentage as indicated.
      - .4 Rangeability: 50:1 minimum.
      - .5 Performance: refer to drawings for capacities.
      - .6 Minimum shut-off pressure: refer to drawings and valve specifications.
      - .7 Valve size for 2-position valves shall be line size with a pressure drop not exceeding 1 psi.
    - .2 Electronic Valve Actuators (for Two-position Valves):
      - .1 Requirements:
        - .1 Construction: steel, cast iron, aluminum.
        - .2 Control voltage: 0-20 V DC or 24 V AC.
        - .3 Return to normal position on loss of communication.
        - .4 Positioning time: to suit application (90 seconds maximum).
  - .18 Control Valves (Fully Modulating Application):
    - .1 The valve shall be pressure independent control type:
      - .1 Be pressure independent, and control pressure across the control valve orifice.
      - .2 Control the regulation of pressure by an integrated EPDM diaphragm design, stainless steel spring, pressure control disc, and shall require no internal maintenance or replaceable cartridges.
-

2.13 FIELD DEVICES .18 (Cont'd)  
(Cont'd) .1 (Cont'd)

Pressure control seat shall be brass construction with vulcanized EPDM.

.3 Provide user adjustable maximum flow within valve control range. Adjustment method shall indicate percentage of valve flow range and utilize spring locked method of adjustment.

.4 Regulate internal control valve differential pressure to provide 100% control valve authority at all positions of the valve, and maintain proportional/linear flow coil characteristics and maintain a linear flow characteristic.

.5 Accurately control the flow from 0-100% full rated flow with an operating pressure range of 3 to 60 psi.

.6 Be offered in sizes ranging ½ to 10", providing a flow range of 0 to 1232 gpm.

.7 Be available in union tailpiece kits for sizes ranging from ½ to 2, and flanges for sizes ranging from 2½ to 10". Flanges shall be ANSI standard bolt pattern.

.8 Provide back seated globe design to allow service of packing under pressure without leakage for valves up to 1¼.

.9 Valve shall provide class 4 shut-off on all sizes.

.10 Valve shall be completely field serviceable.

.11 At low flow settings the valve shall provide full range ability matching the sensor control loop.

.12 The manufacturer shall provide 3rd party operation and flow documentation to certify the characteristics of the valve.

.13 Valve sizing for modulating valves shall be line size with a pressure drop not exceeding 3 psi.

.2 The actuator shall:

.1 Be from the same manufacturer as the valve.

.2 Electronic actuator shall be self-learning, and have the ability to self-commission to match the set point flows of the valves.

.3 The actuator shall provide full stroke at each flow setting of the valve.

- 
- 2.13 FIELD DEVICES .18 (Cont'd)  
(Cont'd)
- .2 The actuator shall:(Cont'd)
- .4 Actuator mounting shall be integral with the valve body on sizes through  $\frac{1}{4}$ .
- .5 Actuator must be provided with wiring harness and plug assembly.
- .6 Have the ability to supply on/off, floating, proportional, safety spring and/or feedback options.
- .7 Be available in a thermostatic, thermal, or electronic version.
- .8 Provide a visible position indication.
- .9 Operate the valve through its full range and have a minimum close off pressure of 90 psi.
- .10 Have an option of selectable system characteristic for motorized actuators.
- .11 Power supply shall be 24VAC.
- .19 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 to handle requirements with additional space to accommodate future capacity as required by Engineer without adding additional cabinets.
- .3 Panels to be lockable with same key.
- .20 Thermostats:
- .1 Room thermostats shall be of the gradual acting type with adjustable sensitivity.
- .2 They shall have a bi-metal sensing element capable of responding to a temperature change of one-tenth of one degree. (Provide all thermostats with limit stops to limit adjustments as required.)
- .3 Thermostats shall be arranged for either horizontal or vertical mounting.
- .4 In the vertical position thermostat shall fit on a mullion of movable partitions without overlap.
- .5 Mount the thermostat covers with tamper-proof socket head screws.
- .21 Freezestats:
- .1 Install freezestats as indicated on the plans and provide protection for every square foot of coil surface area with one linear foot of element per square foot of
-

2.13 FIELD DEVICES .21 Freezestats:(Cont'd)  
(Cont'd) .1 (Cont'd)

coil. Freezestat to be equipped with  
local LED indicating light.

.1 Upon detection of low temperature,  
the freezestats shall stop the associated  
supply fans and return the automatic  
dampers to their normal position. Provide  
manual reset.

- 2.13 FIELD DEVICES (Cont'd)
- .22 Firestats:
    - .1 Provide manual reset, fixed temperature line voltage type with a bi-metal actuated switch.
      - .1 Switch shall have adequate rating for required load.
  - .23 Carbon Dioxide Sensor:
    - .1 Duct mounted remote sensor using infrared sensing technology.
    - .2 Output: four (4) 20 mA.
    - .3 Operating conditions: 0%-95% RH, non condensing, and 32°F to 100°F.
    - .4 Accuracy: +3%.
    - .5 Warranty: five (5) years.
  - .24 Water Meters:
    - .1 Bidirectional magnetic or turbine flow meter ANSI 150, glass lens, 3 wire cable none polarity, bronze construction accuracy ± 5%. Provide pulse output to BAS.

PART 3 - EXECUTION

- 3.1 PROJECT MANAGEMENT
- .1 Provide a designated project manager who will be responsible for the following:
    - .1 Construct and maintain project schedule
    - .2 On-site coordination with all applicable trades, subcontractors, and other integration vendors
    - .3 Authorized to accept and execute orders or instructions from owner/architect
    - .4 Attend project meetings as necessary to avoid conflicts and delays
    - .5 Make necessary field decisions relating to this scope of work
    - .6 Coordination/Single point of contact
- 3.2 INSTALLATION REQUIREMENTS
- .1 All electrical work performed in the installation of the BAS/ATC system as described in this specification shall be per the National Electrical Code (NEC) and per applicable state and local codes. Where exposed, conduit shall be run parallel to building lines properly supported and sized at a maximum of 40% fill. In no case shall field installed conduit smaller than ½" trade size be allowed. Where conductors are concealed, cable rated for use in return air plenums can

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- 3.2 INSTALLATION REQUIREMENTS (Cont'd)
- .1 (Cont'd)  
be used. However, cable must be run neatly with tie wraps to upper joist or handler to avoid interference with mechanical equipment. Sagging or loose cable within ceiling plenum will not be acceptable.
  - .2 Pre-installation sample of program graphic display shall be presented & submitted for Owner & Engineer's review & approval before proceeding to construction.
- 3.3 POINT SCHEDULE MATRIX - I/O SCHEDULE
- .1 Attach I/O schedule:
    - .1 The contractor shall collaborate with the owner directly to determine the owner's preference for naming conventions, etc. before entering the data in to the system.
- 3.4 START-UP AND COMMISSIONING
- .1 Follow commissioning plans.
  - .2 When installation of the system is complete, calibrate equipment and verify transmission media operation before the system is placed on-line. All testing, calibrating, adjusting and final field tests shall be completed by the manufacturer. Verify that all systems are operable from local controls in the specified failure mode upon panel failure or loss of power.
  - .3 Provide any recommendation for system modification in writing to owner. Do not make any system modification, including operating parameters and control settings, without prior approval of Engineer.
  - .4 After manufacturer has completed system start-up and commissioning. Joint commissioning of integrated system segments shall be completed.
- 3.5 ELECTRICAL WIRING AND MATERIALS
- .1 Install, connect and wire the items included under this Section & as noted in Item 1.7 Description of Work. This work includes providing required conduit, wire, fittings, and related wiring accessories. All conduit, wiring and equipment to conform to Div. 26 specifications.
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- 3.6 TEMPERATURE AND HUMIDITY SENSORS  
(Cont'd)
- .2 (Cont'd)  
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 Duct installations:
    - .1 Do not mount in dead air space.
    - .2 Location to be within sensor vibration and velocity limits.
    - .3 Securely mount extended surface sensor used to sense average temperature.
    - .4 Thermally isolate elements from brackets and supports so as to respond to air temperature only.
    - .5 Support sensor element separately from coils, filter racks.
  - .5 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%.
- 3.7 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.
- 3.8 MAGNEHELIC PRESSURE INDICATORS
- .1 Install adjacent to fan system static pressure sensor and duct system velocity pressure sensors (as specified).
  - .2 Locations to be as indicated and specified.
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|--|----|---|
| <u>3.9 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES</u> | .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 syphon between valve and sensor.  |
| <u>3.10 PRESSURE GAUGES</u>                            | .1 | Install where indicated c/w isolation valves.   |
| <u>3.11 TANK LEVEL SWITCHES</u>                        | .1 | Mount in top of tank in threaded coupling.  |
| <u>3.12 LIQUID LEVEL SWITCHES</u>                      | .1 | Suspend float in sump from flexible cord and with weight mounted not more than 50 mm above switch.  |
| <u>3.13 FIELD MOUNTED TRANSMITTERS AND SENSORS</u>     | .1 | Support properly on pipe stands or channel brackets.  |
|  | .2 | Install wall mounted devices on plywood panel attached properly to wall.  |
| <u>3.14 COMMISSIONING, TESTING AND ACCEPTANCE</u>      | .1 | Follow commissioning plans and as described hereafter.  |
|  | .2 | Perform a three-phase commissioning procedure consisting of field I/O calibration and commissioning, system commissioning and integrated system program commissioning to the satisfaction of Commissioning Agent. Document all commissioning information on commissioning data sheets which shall be submitted prior to acceptance testing. Commissioning work which requires shutdown of system or deviation from normal function shall be performed when the operation of the system is not required. The commissioning must be coordinated with the owner and construction manager to ensure systems are available when needed. Notify the operating personal in writing of the testing schedule so that authorized personnel from the |
-

3.14 COMMISSIONING, .2  
TESTING AND  
ACCEPTANCE  
(Cont'd)

(Cont'd)

owner and construction manager are present throughout the commissioning procedure.

.1 Prior to system program commissioning, verify that each control panel has been installed according to plans, specifications and approved shop drawings. Test, calibrate and bring on line each control sensor and device. Commissioning to include, but not be limited to:

.1 Sensor accuracy at 10, 50 and 90% of range.

.2 Sensor range.

.3 Verify analog limit and binary alarm reporting.

.4 Point value reporting.

.5 Binary alarm and switch settings.

.6 Actuator ranges.

.7 Fail safe operation on loss of control signal, electric power, network communications.

.3 After control devices have been commissioned (i.e. calibrated, tested and signed off), each BMS program shall be put on line and commissioned. The contractor shall, in the presence of the owner and construction manager, demonstrate each programmed sequence of operation and compare the results in writing. In addition, each control loop shall be tested to verify proper response and stable control, within specified accuracy's. System program test results shall be recorded on commissioning data sheets and submitted for record. Any discrepancies between the specification and the actual performance will be immediately rectified and retested.

.4 After all BMS programs have been commissioned, the contractor shall verify the overall system performance as specified. Tests shall include, but not be limited to:

.1 Data communication, both normal and failure modes.

.2 Fully loaded system response time.

.3 Impact of component failures on system performance and system operation.

.4 Time/Date changes.

.5 End of month/end of year operation.

.6 Season changeover.

.7 Global application programs and point sharing.

.8 System backup and reloading.

.9 System status displays.

3.14 COMMISSIONING, .4  
TESTING AND  
ACCEPTANCE  
(Cont'd)

- (Cont'd)
- .10 Diagnostic functions.
  - .11 Power failure routines.
  - .12 Battery backup.
  - .13 Smoke Control, stair pressurization, stair, vents, in concert with Fire Alarm System testing.
  - .14 Testing of all electrical and HVAC systems with other division of work.

.5 Submit for approval, a detailed acceptance test procedure designed to demonstrate compliance with contractual requirements. This Acceptance test procedure will take place after the commissioning procedure but before final acceptance, to verify that sensors and control devices maintain specified accuracy's and the system performance does not degrade over time.

.6 Using the commissioning test data sheets, the contractor shall demonstrate each point. The contractor shall also demonstrate all system functions. The contractor shall demonstrate all points and system functions until all devices and functions meet specification.

.7 The contractor shall supply all instruments for testing and turn over same to the owner after acceptance testing.

- .1 All test instruments shall be submitted for approval.  
Test Instrument Accuracy:  
Temperature:  $\frac{1}{4}^{\circ}\text{F}$  or  $\frac{1}{2}\%$  full scale, whichever is less.  
Pressure: High Pressure (psi):  
 $\frac{1}{2}$  psi or  $\frac{1}{2}\%$  full scale, whichever is less.  
Low Pressure:  $\frac{1}{2}\%$  of full scale (in w.c.)  
Humidity: 2% RH  
Electrical:  $\frac{1}{4}\%$  full scale

.8 After the above tests are complete and the system is demonstrated to be functioning as specified, a thirty day performance test period shall begin. If the system performs as specified throughout the test period, requiring only routine maintenance, the system shall be accepted. If the system fails during the test, and cannot be fully corrected within eight hours, the owner may request that performance tests be repeated.

3.15 TRAINING

- .1 The manufacturer shall provide factory trained instructor to give full instruction to designated personnel in the operation of the system installed. Instructors shall be thoroughly familiar with all aspects of the subject matter they are to teach. The manufacturer shall provide all students with a student binder containing product specific training modules for the system installed. All training shall be held during normal working hours of 8:00 am to 4:30 PM weekdays.
- .2 Provide 24 hours of training for Owner's designated operating personnel. Training shall include:
  - .1 Explanation of drawings, operations and maintenance manuals
  - .2 Walk-through of the job to locate control components
  - .3 Operator workstation and peripherals
  - .4 DDC controller and ASC operation/function
  - .5 Operator control functions including graphic generation and field panel programming
  - .6 Operation of portable operator's terminal
  - .7 Explanation of adjustment, calibration and replacement procedures
  - .8 Student binder with training modules
- .3 Since the Owner may require personnel to have more comprehensive understanding of the hardware and software, additional training must be available from the Manufacturer. If such training is required by the Owner, it will be contracted at a later date.

3.16 NAMEPLATES

- .1 Engraved lamacoid plastic: at all panels and manual devices including controllers to indicate system name or power source. Raised punched tape labels may be used on components mounted inside local panels.
  - .2 Provide laminated identification for all end devices. Reference point #, name and panel.
  - .3 All control devices (sensors, transducers, actuators and etc.) shall be labeled with system label, point name and point address were applicable.
-

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- 3.16 NAMEPLATES  
(Cont'd)
- .4 Space temperature sensors for the VAV boxes and Fan powered boxes shall be identified with a Ptouch type label on the inside cover identifying the VAV box name (what is seen on the BAS system Front End) of the VAV box that it is connected to.
  - .5 Space Sensors not associated to VAV Boxes shall be labeled with the label seen on the BAS Front End.
  - .6 All exposed control wiring shall be in conduit and colour coded.

PART 4 - SEQUENCE OF OPERATION

- 4.1 GENERAL
- .1 The following sequences are only a sample of the programming sequences required.
  - .2 Controls contractor's programmer & project engineer will meet one (1) month before programming will begin & review each system individually. At which point each sequence will be further defined & expanded on. Programming shall not begin until the final sequences are reviewed by the Engineer.
  - .3 Each input control point identified will be monitored and may also have multiple control sequence functions not yet identified.
  - .4 Each output control point identified will have a function if not already identified in the sequences.
  - .5 All control schedules & setpoints shall be setup to be adjustable by building operator.
- 4.2 AIR COOLED CHILLER(S) SYSTEM CONTROL
- .1 Chiller control package shall have the ability to adjust speed of chiller pumps.
  - .2 Cooling season:
    - .1 Pumps Pl<sub>a</sub>, Pl<sub>b</sub> (Part or Chiller Package):
    - .2 Chiller shall be staged ON based on chilled water supply temperature. If the chiller fails to start a critical alarm shall be announced at the CCF.
-

4.2 AIR COOLED  
CHILLER(S) SYSTEM  
CONTROL  
(Cont'd)

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- .3 Chilled Water Plant Summer Operation:
  - .1 Summer Operation General:
    - .1 Summer cooling sequence shall be enabled when ambient temperature rises above 16°C.
  - .2 Chiller:
    - .1 Chiller shall be energized to need desired chilled water demand valve shall open to maintain CHWS temperature of (5.5°C (40°F) adjustable).
  - .3 Chiller Pumps:
    - .1 The lead pump P1 & P2 VFD's shall modulate to maintain differential pressure set-point across the condenser water supply and return piping (15 psi adjustable).
- .4 2-way bypass valve will be controlled as required to maintain 100 kPa pressure differential (adjustable) to maintain minimum flow through the chiller as per manufacturer's recommendation.

4.3 KITCHEN  
EXHAUST FANS AND  
MAKE-UP AIR UNIT  
AND RETURN FAN  
SEQUENCE OF  
OPERATIONS

---

- .1 Coordination:
  - .1 Provide for coordination of all kitchen systems supply air, exhaust air and return air systems with kitchen contractor. Provide conduit for all controls wiring. Kitchen contractor shall provide wiring controls wiring from kitchen control panel to make up air unit and exhaust fan VFD's. Provide for supervision of kitchen controls to ensure sequence is properly implemented.
- .2 Exhaust Fans:
  - .1 Exhaust Fan EF9:
    - .1 On a call for exhaust from kitchen hood H7 at kitchen hood control panel EF9 shall energize ON. EF9 VFD shall modulate to maintain a flow rate as determine by the hood exhaust hood controller.
  - .2 Exhaust Fan EF10:
    - .1 On a call for exhaust from kitchen hoods H4, H5 or H6 at kitchen hood control panel EF8 shall energize ON. EF8 VFD shall modulate to maintain a flow rate as determined by the hood exhaust controller.
  - .3 Exhaust Fan EF20:
    - .1 On a call for exhaust from dishwasher condensate hoods H1, H2 or H3

- 4.3 KITCHEN  
EXHAUST FANS AND  
MAKE-UP AIR UNIT  
AND RETURN FAN  
SEQUENCE OF  
OPERATIONS  
(Cont'd)
- .2 Exhaust Fans:(Cont'd)
- .3 Exhaust Fan EF20:(Cont'd)
- .1 (Cont'd)  
at kitchen hood control panel EF20 shall energize ON.
- .4 When EF2 and/or EF3 are on EF7 VFD will be adjusted to a predetermined value.
- .5 The EF7 VFD values will be determined at the testing & balancing phase by the balancing contractor to ensure exhaust airflow rate increments are maintained.
- .6 Make Up Air Unit (HVVU-25) & Return Fan (HVVU-2R) Overall Sequence:
- .1 Unit will modulate supply/return fan speed, outdoor air dampers to maintain desired space temperature and a CO<sub>2</sub> level below 800 ppm and outdoor air dampers shall modulate to maintain a positive pressure in cafeteria with respect to kitchen of +0.1 in. w.c. (adjustable).
- .3 Kitchen Make-up Air Unit (HVVU-1S & HVVU-1R and TF-1):
- .1 The systems operation is controlled by standalone control unit located at each unit.
- .2 When the exhaust fan is energized the supply fan shall start and verify exhaust fan status, and the sequence of operation is as follows:
- .1 Open outdoor damper, steam heating & DX cooling shall be modulated in sequence to maintain supply air temperature setpoint.
- .2 The supply air setpoint shall be reset between the discharge limits by monitoring the space temperature sensor. TF-1 shall be energized when there is sufficient demand for exhaust from the kitchen (greater than 5000 L/s), and remain operating for a minimum of 10 minutes (adjustable through programming). Supply fan, return fan, cooling/heating controls and outdoor air dampers shall modulate to provide the required amount of air to match kitchen exhaust fan volumes, as well as desired space temperature. Supply air vs exhaust rate at all possible damper positions and exhaust fans status to be calibrated experimentally by measuring exhaust and supply and adjusting the programming sequence accordingly to calibrate supply, return, and exhaust fan VFD's to maintain



- 4.3 KITCHEN .3 (Cont'd)  
EXHAUST FANS AND .2 (Cont'd)  
MAKE-UP AIR UNIT .2 (Cont'd)  
AND RETURN FAN kitchen air slightly negative with  
SEQUENCE OF respect to cafeteria and surrounding  
OPERATIONS spaces.  
(Cont'd) .3 A low temperature air freezestat  
shall be hardwired to de-energize the  
supply fan when the temperature drops  
below 5°C, An alarm at CCF computer shall  
be energized, indicating fan shutdown.  
.4 Monitor heating coil return water  
temperature and alarm CCF if temperature  
is below 5°C de-energize supply fan if  
temperature is below 2°C.  
.5 When kitchen exhaust system is  
"off" the outdoor damper shall return to  
their normally closed position, cooling  
coil control valve and heating control  
valve will modulate in sequence to  
maintain desired space temperature.  
.6 During the unoccupied period, the  
supply fan will be duty cycled to warm-up  
or cool down the space as required and  
associated return fans will remain  
de-energized. Outdoor air damper to  
remain closed unless free cooling is  
available.  
.7 When there is a loss in power all  
dampers and valves return to their normal  
positions.
- 4.4 UNIT HEATERS, .1 Unit heaters, fans & fan coils will be  
FANS & FAN COILS controlled as required to maintain room  
temperature setpoint of 22°C for heating and  
25°C for cooling.



PART 1 - GENERAL

- 1.1 SUMMARY .1 Section Includes:
- .1 General requirements that are common to NMS sections found in Division 26 - Electrical 27 - Communications 28 - Electronic Safety and Security.
- 1.2 REFERENCES .1 Canadian Standards Association (CSA International)
- .1 CSA-C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
  - .2 CAN/CSA-C22.3 No. 1-10, Overhead Systems.
  - .3 CAN3-C235-83(R2006), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .2 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).
- .3 The Ontario Electrical Safety Code 2009, and all bulletins (Ontario).
- .4 Hydro requirements and local applicable codes and regulations.
- 1.3 DESIGN REQUIREMENTS .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
- .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification nameplates and labels for control items in English and French.
- .4 Use one nameplate or label for each language.
-

- 1.4 SUBMITTALS
- .1 Submittals: in accordance with Section 01 33 00.
  - .2 Product Data: submit WHMIS MSDS.
  - .3 Shop drawings:
    - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario within 3 weeks of Award of Contract.
    - .2 Submit electronically in pdf format.
    - .3 If changes are required, notify Departmental Representative of these changes before they are made.
  - .4 Quality Control: in accordance with Section 01 45 00.
    - .1 Provide CSA certified equipment and material.
    - .2 Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction for special approval before delivery to site.
    - .3 Submit test results of installed electrical systems and instrumentation.
    - .4 Permits and fees: in accordance with General Conditions of contract. Pay associated fees. Departmental Representative will provide drawings and specifications required by Electrical Inspection Department and Supply Authority at no cost.
    - .5 Submit, upon completion of Work, load balance report as described in PART 3 - Load Balance.
    - .6 Submit certificate of acceptance from Electrical Inspection Department authority having jurisdiction upon completion of Work to Departmental Representative.
  - .5 Manufacturer's Field Reports: submit to Departmental Representative, manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.
-

- 1.5 QUALITY ASSURANCE
- .1 Quality Assurance: in accordance with Section 01 45 00.
  - .2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction as per the conditions of Provincial Act respecting manpower vocational training and qualification.
    - .1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
    - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.
  - .3 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.
- 1.6 DELIVERY, STORAGE AND HANDLING
- .1 Material Delivery Schedule: provide Departmental Representative with schedule within 2 weeks after award of Contract.
  - .2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
- 1.7 SYSTEM STARTUP
- .1 Instruct Departmental Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.
  - .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
  - .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.
-

PART 2 - PRODUCTS

- 2.1 MATERIALS AND EQUIPMENT
- .1 Provide material and equipment in accordance with Section 01 61 00.
  - .2 Material and equipment to be CSA certified. Where CSA certified material and equipment is are not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval as described in PART 1 - Submittals.
  - .3 Factory assemble control panels and component assemblies.

- 2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS
- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

- 2.3 WIRING TERMINATIONS
- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

- 2.4 EQUIPMENT IDENTIFICATION
- .1 Identify electrical equipment with nameplates and labels as follows:
    - .1 Nameplates: lamicoïd 3 mm thick plastic engraving sheet, black face, white core, lettering accurately aligned and engraved into core mechanically attached with self tapping screws.
    - .2 Sizes as follows:

NAMEPLATE SIZES

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.

2.4 EQUIPMENT  
 IDENTIFICATION  
 (Cont'd)

- .4 Allow for minimum of twenty-five (25) letters per nameplate and label.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Identify equipment with Size 3 labels engraved "ASSET INVENTORY No. " as directed by Departmental Representative .
- .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.

2.5 WIRING  
 IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA-C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

2.6 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
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red
Telephone	Green	
Other	Green	Blue

2.6 CONDUIT AND CABLE IDENTIFICATION (Cont'd) .3 Colours:(Cont'd)

Communication Systems		
Fire Alarm	Red	
Emergency	Red	Blue
Voice		
Other	Red	Yellow
Security Systems		

- 2.7 FINISHES .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
- .1 Paint outdoor electrical equipment "equipment green" finish to.
  - .2 Paint indoor switchgear and distribution enclosures light gray.

PART 3 - EXECUTION

- 3.1 INSTALLATION .1 Do complete installation in accordance with CSA-C22.1 except where specified otherwise.
- .2 Do overhead and underground systems in accordance with CAN/CSA-C22.3 No.1 except where specified otherwise.
- 3.2 NAMEPLATES AND LABELS .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.
- 3.3 CONDUIT AND CABLE INSTALLATION .1 Install conduit and sleeves prior to pouring of concrete.
- .1 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.



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- 3.3 CONDUIT AND CABLE INSTALLATION (Cont'd)
- .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.
- 3.4 LOCATION OF OUTLETS
- .1 Locate outlets in accordance with Section 26 05 32.
- .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.  
.1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.
- 3.5 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: 400 mm.  
.2 Above top of continuous baseboard heater: 200 mm.  
.3 Above top of counters or counter splash backs: 175 mm.  
.4 In mechanical rooms: 1200 mm.  
.3 Panelboards: as required by Code or as indicated.  
.4 Telephone and interphone outlets: 400 mm.  
.5 Wall mounted telephone and interphone outlets for non-accessible locations: 1200 mm.  
.6 Fire alarm stations: 1200 mm.  
.7 Fire alarm bells: 2100 mm.  
.8 Television outlets: 400 mm.  
.9 Wall mounted speakers: 2100 mm.
-

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- 3.5 MOUNTING HEIGHTS  
(Cont'd)
- .3 (Cont'd)  
.10 Clocks: 2100 mm.  
.11 Door bell pushbuttons: 1200 mm.
- 3.6 CO-ORDINATION OF PROTECTIVE DEVICES
- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.
- 3.7 FIELD QUALITY CONTROL
- .1 Load Balance:  
.1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.  
.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.  
.3 Provide upon completion of work, load balance report as directed in PART 1 - Submittals: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01 45 00:  
.1 Power distribution system including phasing, voltage, grounding and load balancing.  
.2 Circuits originating from branch distribution panels.  
.3 Lighting and its control.  
.4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.  
.5 Systems: fire alarm system,.  
.6 Insulation resistance testing:  
.1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.  
.2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.  
.3 Check resistance to ground before energizing.
- .3 Carry out tests in presence of Departmental Representative.
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- 3.7 FIELD QUALITY CONTROL  
(Cont'd)
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Manufacturer's Field Services:
- .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
- 3.8 CLEANING
- .1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.



PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 This section shall be read in conjunction with specification Section 26 05 00 - Electrical General Requirements, all electrical sections, and all other disciplines related to the project.
- 1.2 CODES AND STANDARDS
- .1 Institute of Electrical and Electronics Engineers (IEEE)
- .1 IEEE 242-2001, IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
- .2 IEEE 1584-2002, IEEE Guide for Performing Arc-Flash Hazard Calculations.
- .2 National Fire Protection Association (NFPA)
- .1 ANSI/NFPA (Fire) 70E, Standard for Electrical Safety in the Workplace, 2012 Edition.
- 1.3 SUBMITTALS
- .1 The short-circuit and protective device coordination studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.
- .2 The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. Two (2) bound copies of the complete final report shall be submitted, along with electronic pdf version.
- .3 The report shall include the following sections:
- .1 Executive Summary.
- .2 Descriptions, purpose, basis and scope of the study.
- .3 Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties.

- 1.3 SUBMITTALS .3 (Cont'd)  
(Cont'd)
- .4 Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection.
  - .5 Fault current calculations including a definition of terms and guide for interpretation of the computer printout.
  - .6 Details of the incident energy and flash protection boundary calculations.
  - .7 Recommendations for system improvements, where needed.
  - .8 One-line diagram.
- 1.4 QUALIFICATIONS .1 The short-circuit/device evaluation, protective device coordination and arc flash hazard analysis studies shall be performed or reviewed and sealed by a licensed Professional Electrical Engineer registered to practice in the Province of Ontario skilled in performing and interpreting the power system studies.
- .2 The licensed Professional Electrical Engineer shall be a full-time employee of the equipment manufacturer or an approved engineering firm.
  - .3 The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies.
- 1.5 GENERAL .1 Include all costs for preparation of a complete System Coordination/Short Circuit/Device Evaluation Study in accordance with IEEE 242, 'Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems', and IEEE 1584, 'Guide for Performing Arc-Flash Hazard Calculations'.
- .2 The scope of the studies shall include:
    - .1 The Study shall include all relevant distribution and protective devices within the scope of the project.
- 1.6 COORDINATION STUDY .1 The work of the Coordination Study shall include:
- .1 Liaison with the local Utility for information on relays and other protective devices, and system and

- 1.6 COORDINATION .1 (Cont'd)  
STUDY .1 (Cont'd)  
(Cont'd)
- .1 substation capacities which affect the coordination of this system for both primary and any standby feeders.
- .2 Liaison with distribution equipment and switchgear manufacturers to obtain actual trip curves of existing and proposed protective devices for new & existing equipment.
- .3 Sending a trained and qualified representative on site to gather data on existing equipment within the scope of the study; such as transformers, cables, and lengths, breakers, fuses, and all adjustable protective device settings. The information gathered will include the method of installation where such installation impacts upon the Study (e.g. method of cable installation reflecting upon the allowable ampacity of the cable).
- .4 Recommendations shall be included, listing all deficiencies within the scope of the study and proposing methods of correction for each deficiency.
- .2 The Coordination Study report shall include the following:
- .1 Each Time-Current graph shall be printed in colour. The selected colours will allow the end-user to easily discriminate between different device curves, especially on complicated graphs where devices overlap.
- .2 The Time-Current curves shall be drawn on special log-log graphs with time coordinate range of 0.01 to 1,000 seconds and current coordinate ranges of 4 orders. Separate graphs are to be provided for phase and ground protection for each portion of the system. The entire distribution system shall be subdivided into portions so that the curve for each device clearly shows its relationship to associated upstream and downstream devices. The coordination study should separate the emergency power from the normal power distributions. Each graph for a portion of the system shall include/show the following:
- .1 The portion of the distribution system represented by the devices on the graph shall be represented by a single

- 1.6 COORDINATION .2 (Cont'd)  
STUDY .2 (Cont'd)  
(Cont'd)
- .1 (Cont'd)  
line diagram drawn in the corner of the Time-Current coordination graph.
- .2 Each device curve shall end at the 3 phase symmetrical fault level calculated for that bus.
- .3 Cable, Bus, or Conductor damage curves shall be shown where appropriate. All Transformer inrush, damage and overload curves shall be shown.
- .4 Motor starting curves and protective devices shall be shown for all motors larger than 75 HP.
- .5 On the graphs, or on the same page as the graph, all protective device curves within the scope of the graph shall be shown with the following information:
- .1 Relay curves with text indicating; Manufacturer, Type, Current Transformer size, Tap or Pickup setting, Time Dial settings, and curve type.
- .2 Fuse curves with average melting curve for low voltage fuses and minimum melt and total clearing for high voltage fuses with text indicating; Manufacturer, Type, Ampacity, Voltage, and Speed.
- .3 Static-Trip Breaker curves with text indicating; Breaker and Trip Unit Manufacturer and type, Current Transformer and Sensor Type, and all trip unit settings.
- .4 Thermal-Magnetic Breaker curves with text indicating; Breaker type, Trip rating, and instantaneous trip settings.
- .3 Include tables within the Study that clearly list all protective devices within the scope of the study and all associated information. These tables are to be based on settings established and noted in the coordination curves. The tables shall be logically arranged and grouped to effectively present the following information. The tables shall include:
- .1 Relays; including manufacturer, type, curve, CT, and all protective settings.



- 1.6 COORDINATION .2 (Cont'd)  
STUDY .3 (Cont'd)  
(Cont'd)
- 
- .2 Transformers; including size, type, manufacturer, configuration, voltage, and impedance.
  - .3 Fuses; including manufacturer, type, ampacity, voltage, speed.
  - .4 Static Trip Units; including manufacturer, type, CT, sensor or plug, all protective settings.
  - .5 Thermal-Magnetic Trip Units; including manufacturer, rating, and instantaneous setting.
  - .6 Motor Protectors (Overloads); include manufacturer, type, rating, all protective settings.
  - .7 All protective devices shall be listed with clear descriptive text to identify their place within the distribution system.
  - .8 All protective devices shall have a reference to the Time-Current graph where they are shown.
- .4 The tables shall list all existing and recommended settings of all protective devices within the scope of the study. This will allow the end-user to identify and plan for required changes to protective device settings, and to determine which settings have been implemented and modified.
- 1.7 SHORT CIRCUIT/ .1 The work of the Short Circuit study shall  
DEVICE EVALUATION include:  
STUDY
- 
- .1 Evaluation and documentation of three phase single phase & ground fault short circuit fault levels at all distribution busses, motor control centres and main panel board locations within the scope listed above.
  - .2 The output of the short circuit study shall be a printed tabulation of asymmetrical and symmetrical RMS short circuit current values for both interrupting duty and momentary duty, including X/R ratios.
  - .3 All significant sources and impedances shall be evaluated, including but not limited to, Utility and Emergency Sources, motors, cables and their lengths, transformers, reactors, and any other devices impacting upon the available short circuit.

- 1.7 SHORT CIRCUIT/  
DEVICE EVALUATION  
STUDY  
(Cont'd)
- .2 The work of the device evaluation study shall include:
- .1 All pertinent interrupting devices within the scope of the job shall be listed with its interrupting rating or its series interrupting rating as applicable.
  - .2 A cross reference in table form shall be provided whether the protective devices at each bus are appropriate for the available fault current at each bus.

- 1.8 ARC FLASH  
HAZARD ANALYSIS
- .1 Arc Flash Hazard Analysis
- .1 The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA 70E, Annex D.
  - .2 The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.
  - .3 The Arc-Flash Hazard Analysis shall include all locations in the systems.
  - .4 Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm<sup>2</sup>.
  - .5 When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.
  - .6 The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum

1.8 ARC FLASH  
HAZARD ANALYSIS  
(Cont'd)

- .1 (Cont'd)
- .6 (Cont'd)  
motor contribution (all motors off).  
Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.
- .7 The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:
  - .1 Fault contribution from induction motors should not be considered beyond 3-5 cycles.
  - .2 Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).
- .8 For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.
- .9 When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.
- .10 Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.

- 1.8 ARC FLASH HAZARD ANALYSIS (Cont'd)
- .1 (Cont'd)
    - .11 Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific.
    - .2 The electrical contractor shall ensure that the recommendations of the study are implemented as part of the contract.

PART 2 - PRODUCTS

- 2.1 NOT USED .1 Not used.

PART 3 - EXECUTION

- 3.1 FIELD ADJUSTMENT
- .1 Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.
  - .2 Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
  - .3 Notify Owner in writing of any required major equipment modifications.
- 3.2 ARC FLASH WARNING LABELS
- .1 The contractor of the Arc Flash Hazard Analysis shall provide a 89 mm x 127 mm (6-5 in. x 5 in.) thermal transfer type label of high adhesion polyester for each work location analyzed.
  - .2 All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis

- 3.2 ARC FLASH .2 (Cont'd)  
WARNING LABELS have been presented to the owner and after any  
(Cont'd) system changes, upgrades or modifications have  
been incorporated in the system.
- .3 The label shall include the following  
information, at a minimum:
- .1 Location designation
  - .2 Nominal voltage
  - .3 Flash protection boundary
  - .4 Hazard risk category, PPE
  - .5 Incident energy
  - .6 Working distance
  - .7 Engineering report number, revision  
number and issue date.
  - .8 Labels shall be machine printed, with no  
field markings.
- .4 Arc flash labels shall be provided in the  
following manner and all labels shall be based  
on recommended overcurrent device settings.
- .1 For each 600, and applicable 208 volt  
panelboard, one arc flash label shall be  
provided.
  - .2 For each motor control center, one arc  
flash label shall be provided.
  - .3 For each low voltage switchboard, one  
arc flash label shall be provided.
  - .4 For each switchgear, one arc flash label  
shall be provided.
  - .5 For medium voltage switches one arc  
flash label shall be provided

- END OF SECTION -



PART 1 - GENERAL

<u>1.1 RELATED REQUIREMENTS</u>	.1	Section.
<u>1.2 REFERENCES</u>	.1	CSA International
	.1	CAN/CSA-C22.2 No. 18-98(R2003), Outlet Boxes, Conduit Boxes and Fittings.
	.2	CAN/CSA-C22.2 No. 65-03(R2008), Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).
	.2	Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
	.1	EEMAC 1Y-2-1961, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
	.3	National Electrical Manufacturers Association (NEMA)
<u>1.3 ACTION AND INFORMATIONAL SUBMITTALS</u>	.1	Submit in accordance with Section 01 33 00.
	.2	Product Data:
	.1	Submit manufacturer's instructions, printed product literature and data sheets for wire and box connectors and include product characteristics, performance criteria, physical size, finish and limitations.
<u>1.4 CLOSEOUT SUBMITTALS</u>	.1	Submit in accordance with Section 01 78 00.
	.2	Operation and Maintenance Data: submit operation and maintenance data for wire and box connectors for incorporation into manual.
<u>1.5 DELIVERY, STORAGE AND HANDLING</u>	.1	Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
	.2	Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

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1.5 DELIVERY,  
STORAGE AND  
HANDLING  
(Cont'd)

- .3 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect wire and box connectors from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 20.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Pressure type wire connectors to:  
CAN/CSA-C22.2 No. 65, with current carrying parts of copper sized to fit copper aluminum conductors as required.
  - .2 Fixture type splicing connectors to:  
CAN/CSA-C22.2 No. 65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
  - .3 Bushing stud connectors: to EEMAC 1Y-2 NEMA to consist of:
    - .1 Connector body and stud clamp for copper conductors.
    - .2 Clamp for copper conductors.
    - .3 Stud clamp bolts.
    - .4 Bolts for copper conductors.
    - .5 Sized for conductors as indicated.
  - .4 Clamps or connectors for armoured cable, TECK cable mineral, flexible conduit, as required to: CAN/CSA-C22.2 No. 18.
-



PART 3 - EXECUTION

- 3.1 EXAMINATION .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wire and box connectors installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.
- 3.2 INSTALLATION .1 Remove insulation carefully from ends of conductors and cables and:
- .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
  - .2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No.65.
  - .3 Install fixture type connectors and tighten to CAN/CSA-C22.2 No.65. Replace insulating cap.
  - .4 Install bushing stud connectors in accordance with NEMA.
- 3.3 CLEANING .1 Progress Cleaning: clean in accordance with Section 01 74 11.
- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
-

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

PART 1 - GENERAL

- 1.1 PRODUCT DATA .1 Provide product data in accordance with Section 01 33 00.
- 1.2 DELIVERY, STORAGE AND HANDLING .1 Packaging Waste Management: remove for reuse and return of pallets, crates, padding and packaging materials in accordance with Section 01 74 20.

PART 2 - PRODUCTS

- 2.1 BUILDING WIRES .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 600 1000 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE.
- 2.2 TECK 90 CABLE .1 Cable: in accordance with Section 26 05 00.
- .2 Conductors:
- .1 Grounding conductor: copper.
  - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
- .1 Cross-linked polyethylene XLPE.
  - .2 Rating: 1000 V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking galvanized steel.
- .6 Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project.
- .7 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 at 3,000 mm centers.
-

- 2.2 TECK 90 CABLE .7 Fastenings:(Cont'd)  
(Cont'd)
- .3 Threaded rods: 6 mm diameter to support suspended channels.
  - .8 Connectors:
    - .1 Watertight, approved for TECK cable.

- 2.3 ARMOURED CABLES .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90.
  - .3 Armour: interlocking type fabricated from galvanized steel strip.
  - .4 Connectors: anti short connectors.

PART 3 - EXECUTION

- 3.1 FIELD QUALITY CONTROL .1 Perform tests in accordance with Section 26 05 00.
- .2 Perform tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
  - .3 Perform tests before energizing electrical system.

- 3.2 GENERAL CABLE INSTALLATION .1 Lay cable in cable trays in accordance with Section 26 05 36.
- .2 Terminate cables in accordance with Section 26 05 20.
  - .3 Cable Colour Coding: to Section 26 05 00.
  - .4 Conductor length for parallel feeders to be identical.
  - .5 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
  - .6 Wiring in walls: typically drop or loop vertically from above to better facilitate
-

- 3.2 GENERAL CABLE INSTALLATION (Cont'd) .6 Wiring in walls:(Cont'd) future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .7 Provide dedicated neutral with each branch circuit.
- 3.3 INSTALLATION OF BUILDING WIRES .1 Install wiring as follows:  
.1 In conduit systems in accordance with Section 26 05 34.
- 3.4 INSTALLATION OF TECK 90 CABLE (0 -1000 V) .1 Group cables wherever possible on channels.  
.2 Install cable exposed, securely supported by straps or hangers.
- 3.5 INSTALLATION OF ARMOURED CABLES .1 Group cables wherever possible on channels.
- 3.6 INSTALLATION OF ALUMINUM SHEATHED CABLE .1 Group cables wherever possible on channels.



PART 1 - GENERAL

- 1.1 REFERENCES .1 American National Standards Institute  
/Institute of Electrical and Electronics  
Engineers ( ANSI/IEEE )  
.1 ANSI/IEEE 837-2002, IEEE Standard for  
Qualifying Permanent Connections Used in  
Substation Grounding.
- .2 CSA International  
.1 CSA Z32-09, Electrical Safety and  
Essential Electrical Systems in Health  
Care Facilities.
- 1.2 ACTION AND INFORMATIONAL  
SUBMITTALS .1 Submit in accordance with Section 01 33 00.  
.2 Product Data:  
.1 Submit manufacturer's instructions,  
printed product literature and data  
sheets for grounding equipment and  
include product characteristics,  
performance criteria, physical size,  
finish and limitations.
- 1.3 CLOSEOUT  
SUBMITTALS .1 Submit in accordance with Section 01 78 00.  
.2 Operation and Maintenance Data: submit  
operation and maintenance data for grounding  
equipment for incorporation into manual.
- 1.4 DELIVERY,  
STORAGE AND  
HANDLING .1 Deliver, store and handle materials in  
accordance with Section 01 61 00 and with  
manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver  
materials to site in original factory  
packaging, labelled with manufacturer's name  
and address.
- .3 Storage and Handling Requirements:  
.1 Store materials indoors in dry location  
and in accordance with manufacturer's  
recommendations in clean, dry,  
well-ventilated area.  
.2 Store and protect grounding equipment  
from nicks, scratches, and blemishes.
-

1.4 DELIVERY,  
STORAGE AND  
HANDLING  
(Cont'd)

- .3 Storage and Handling Requirements:(Cont'd)
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 20.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- .1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.
  - .2 Grounding conductors: bare stranded copper, tinned, soft annealed, size as required.
  - .3 Insulated grounding conductors: green, copper conductors, size as required.
  - .4 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
  - .5 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.
-



PART 3 - EXECUTION

- 3.1 EXAMINATION .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for grounding equipment installation in accordance with manufacturer's written instructions.
- .1 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.
- 3.2 INSTALLATION GENERAL .1 Install complete permanent, continuous grounding system including, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.
- .2 Install connectors in accordance with manufacturer's instructions.
  - .3 Protect exposed grounding conductors from mechanical injury.
  - .4 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process permanent mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837.
  - .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
  - .6 Soldered joints not permitted.
  - .7 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
  - .8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

- 3.2 INSTALLATION GENERAL  
(Cont'd)
- .9 Connect building structural steel and metal siding to ground by welding copper to steel.
- .10 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .11 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.
- 3.3 EQUIPMENT GROUNDING
- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting, cable trays.
- 3.4 GROUNDING BUS
- .1 Install copper grounding bus mounted on insulated supports on wall of electrical room and communication equipment room.
- .2 Ground items of electrical equipment in electrical room and IT equipment in communication equipment room to ground bus with individual bare stranded copper connections size 2/0AWG.
- 3.5 FIELD QUALITY CONTROL
- .1 Perform tests in accordance with Section 26 05 00.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.
-

- 3.6 CLEANING
- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
    - .1 Leave Work area clean at end of each day.
  - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
  - .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
    - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.



PART 1 - GENERAL

- 1.1 WASTE  
MANAGEMENT AND  
DISPOSAL
- .1 Separate and recycle waste materials in accordance with Section 01 74 20.
  - .2 Remove from site and dispose of all 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 materials from landfill to metal recycling facility as approved by Departmental Representative.
  - .5 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 - PRODUCTS

- 2.1 SUPPORT  
CHANNELS
- .1 U shape, size 41 x 41 mm, 2.5 mm thick.

PART 3 - EXECUTION

- 3.1 INSTALLATION
- .1 Secure equipment to masonry, tile and plaster surfaces with lead anchors or nylon shields.
  - .2 Secure equipment to poured concrete with expandable inserts.
  - .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.
-

- 3.1 INSTALLATION  
(Cont'd)
- .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 at 3 m on centre spacing.
  - .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 Departmental Representative.
  - .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

PART 1 - GENERAL

- 1.1 REFERENCES .1 Canadian Standards Association (CSA International)  
.1 CSA C22.1-12, Canadian Electrical Code, Part 1, 22nd Edition.
- 1.2 SUBMITTALS .1 Provide submittals in accordance with Section 01 33 00.  
.2 Product Data:  
.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.  
.3 Provide shop drawings: in accordance with Section 01 33 00.  
.1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- 1.3 DELIVERY, STORAGE AND HANDLING .1 Waste Management and Disposal:  
.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

PART 2 - PRODUCTS

- 2.1 SPLITTERS .1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.  
.2 Terminations: main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.  
.3 Spare Terminals: minimum three spare lugs on each connection or lug block sized less than 400 A.
-

- 2.2 JUNCTION AND PULL BOXES
- .1 Construction: welded steel enclosure.
  - .2 Covers Flush Mounted: 25 mm minimum extension all around.
  - .3 Covers Surface Mounted: screw-on flat covers.

PART 3 - EXECUTION

- 3.1 SPLITTER INSTALLATION
- .1 Mount plumb, true and square to building lines.
  - .2 Extend splitters full length of equipment arrangement except where indicated otherwise.

- 3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION
- .1 Install pull boxes in inconspicuous but accessible locations.
  - .2 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

- 3.3 IDENTIFICATION
- .1 Equipment Identification: to Section 26 05 00.
  - .2 Identification Labels: size 2 indicating system name voltage and phase or as indicated.



PART 1 - GENERAL

- 1.1 REFERENCES .1 Canadian Standards Association (CSA International)  
.1 CSA C22.1-12, Canadian Electrical Code, Part 1, 22nd Edition.
- 1.2 SUBMITTALS .1 Provide submittals in accordance with Section 01 33 00.
- 1.3 DELIVERY, STORAGE AND HANDLING .1 Deliver, store and handle materials in accordance with Section 01 61 00.  
.2 Waste Management and Disposal:  
.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 0.

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.  
.3 Gang boxes where wiring devices are grouped.  
.4 Blank cover plates for boxes without wiring devices.  
.5 347 V outlet boxes for 347 V switching devices.  
.6 Combination boxes with barriers where outlets for more than one system are grouped.
- 2.2 GALVANIZED STEEL OUTLET BOXES .1 One-piece electro-galvanized construction.  
.2 Single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
-

- 2.2 GALVANIZED STEEL OUTLET BOXES (Cont'd)
- .3 102 mm square or octagonal outlet boxes for lighting fixture outlets.
  - .4 Extension and plaster rings for flush mounting devices in finished plaster or tile walls.
- 2.3 MASONRY BOXES
- .1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.
- 2.4 CONCRETE BOXES
- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.
- 2.5 CONDUIT BOXES
- .1 Cast FS boxes with factory-threaded hubs and mounting feet for surface wiring of devices.
- 2.6 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE
- .1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63 mm with two double clamps to take non-metallic sheathed cables.
- 2.7 FITTINGS - GENERAL
- .1 Bushing and connectors with nylon insulated throats.
  - .2 Knock-out fillers to prevent entry of debris.
  - .3 Conduit outlet bodies for conduit up to 35 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. Do not install reducing washers.
  - .5 Vacuum clean interior of outlet boxes before installation of wiring devices.
  - .6 Identify systems for outlet boxes as required.



PART 1 - GENERAL

- 1.1 REFERENCES .1 Canadian Standards Association (CSA International)
- .1 CAN/CSA-C22.2 No. 18-98(R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
  - .2 CSA C22.2 NO. 45-M1981 (R2003), Rigid Metal Conduit.
  - .3 CSA C22.2 No. 56-04(R2009), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .4 CSA C22.2 No. 83-M1985(R2008), Electrical Metallic Tubing.
  - .5 CSA C22.2 No. 211.2-06(R2011), Rigid PVC (Unplasticized) Conduit.
  - .6 CAN/CSA-C22.2 No. 227.3-05, Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).
- 1.2 SUBMITTALS .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product data: submit manufacturer's printed product literature, specifications and datasheets.
    - .1 Submit cable manufacturing data.
  - .3 Quality assurance submittals:
    - .1 Test reports: submit certified test reports.
    - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
    - .3 Instructions: submit manufacturer's installation instructions.
- 1.3 WASTE MANAGEMENT AND DISPOSAL .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
  - .3 Ensure emptied containers are sealed and stored safely for disposal away from children.
-

## PART 2 - PRODUCTS

- 2.1 CONDUITS
- .1 Rigid metal conduit: to CSA C22.2 No. 45., galvanized steel threaded.
  - .2 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.
  - .3 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings with expanded ends.
  - .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.
- 2.2 CONDUIT FASTENINGS
- .1 One hole steel straps to secure surface conduits 50 mm and smaller.
    - .1 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 3 m on centre.
  - .4 Threaded rods, 6 mm diameter, to support suspended channels.
- 2.3 CONDUIT FITTINGS
- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.
  - .2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.
  - .3 Steel set screw connectors and couplings for EMT.
-

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.

.3 Weatherproof expansion fittings for linear  
expansion at entry to panel.

2.5 FISH CORD .1 Polypropylene.

PART 3 - EXECUTION

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

3.2 INSTALLATION .1 Install conduits to conserve headroom in  
exposed locations and cause minimum  
interference in spaces through which they  
pass.

.2 Conceal conduits except in mechanical and  
electrical service rooms.

.3 Use electrical metallic tubing (EMT) except  
in cast concrete.

.4 Use rigid pvc conduit underground.

.5 Use flexible metal conduit for connection to  
motors in dry areas.

.6 Use liquid tight flexible metal conduit for  
connection to motors or vibrating equipment in  
damp, wet or corrosive locations.

.7 Minimum conduit size for lighting and power  
circuits: 19 mm.

.8 Bend conduit cold:  
.1 Replace conduit if kinked or flattened  
more than 1/10th of its original  
diameter.

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- 3.2 INSTALLATION (Cont'd)
- .9 Mechanically bend steel conduit over 19 mm diameter.
  - .10 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
  - .11 Install fish cord in empty conduits.
  - .12 Run 2-25 mm spare conduits up to ceiling space and 2-25 mm spare conduits down to ceiling space from each flush panel.
    - .1 Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in surface type box.
  - .13 Remove and replace blocked conduit sections.
    - .1 Do not use liquids to clean out conduits.
  - .14 Dry conduits out before installing wire.
- 3.3 SURFACE CONDUITS
- .1 Run parallel or perpendicular to building lines.
  - .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
  - .3 Run conduits in flanged portion of structural steel.
  - .4 Group conduits wherever possible on 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.
- 3.4 CONCEALED CONDUITS
- .1 Run parallel or perpendicular to building lines.
  - .2 Do not install horizontal runs in masonry walls.
  - .3 Do not install conduits in terrazzo or concrete toppings.
-



3.5 CONDUITS IN  
CAST-IN-PLACE  
CONCRETE

- .1 Locate to suit reinforcing steel.
  - .1 Install in centre one third of slab.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed.
  - .1 Use cold mastic between sleeve and conduit.
- .5 Conduits in slabs: minimum slab thickness 4 times conduit diameter.
- .6 Encase conduits completely in concrete with minimum 25 mm concrete cover.
- .7 Organize conduits in slab to minimize cross-overs.

3.6 CONDUITS IN  
CAST-IN-PLACE SLABS  
ON GRADE

- .1 Run conduits 25 mm and larger below slab and encase in 75 mm concrete envelope.
  - .1 Provide 50 mm of sand over concrete envelope below floor slab.

3.7 CONDUITS  
UNDERGROUND

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (pvc excepted) with heavy coat of bituminous paint.

3.8 CLEANING

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



PART 1 - GENERAL

<u>1.1 REFERENCES</u>	.1	CSA International
	.1	CSA C9-02(R2011), Dry-Type Transformers.
	.2	National Electrical Manufacturers Association (NEMA)
<u>1.2 ACTION AND INFORMATIONAL SUBMITTALS</u>	.1	Submit in accordance with Section 01 33 00.
	.2	Product Data:
	.1	Submit manufacturer's instructions, printed product literature and data sheets for dry type transformers and include product characteristics, performance criteria, physical size, finish and limitations.
<u>1.3 CLOSEOUT SUBMITTALS</u>	.1	Submit in accordance with Section 01 78 00.
	.2	Operation and Maintenance Data: submit operation and maintenance data for dry type transformers for incorporation into manual.
<u>1.4 DELIVERY, STORAGE AND HANDLING</u>	.1	Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
	.2	Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
	.3	Storage and Handling Requirements:
	.1	Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
	.2	Store and protect dry type transformers from nicks, scratches, and blemishes.
	.3	Replace defective or damaged materials with new.
	.4	Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials as specified in Construction Waste Management Plan Waste

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1.4 DELIVERY, STORAGE AND HANDLING (Cont'd) .4 Packaging Waste Management:(Cont'd) Reduction Workplan in accordance with Section 01 74 20.

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PART 2 - PRODUCTS

2.1 DESIGN DESCRIPTION .1 Design 1.  
.1 Type: ANN to CSA C9.  
.2 Voltage taps:4-2½% taps, 2 FCAN, 2 FCBN.  
.3 Insulation: Class H, 150°C temperature rise.  
.4 Basic Impulse Level (BIL): standard.  
.5 Hipot: standard.  
.6 Average sound level: less than 45 dB.  
.7 Impedance at 170°C: less than 6.5%.  
.8 Enclosure: removable metal front panel. Sprinkler proof.  
.9 Floor mounted for 75 kVA and up, floor or wall mounted up to 45 kVA.  
.10 Finish: in accordance with Section 26 05 00.  
.11 Copper windings.  
.12 Winding configuration to be as noted on drawings.  
.13 Voltage Regulation to be 4% or better.

2.2 EQUIPMENT IDENTIFICATION .1 Provide equipment identification in accordance with Section 26 05 00.  
.2 Label size: 7.

PART 3 - EXECUTION

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

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- 3.4 PROTECTION .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by dry type transformers installation.

PART 1 - GENERAL

- 1.1 WORK INCLUDED .1 Provide [all wall mounted equipment in sprinklered areas with accessories] to prevent the entry of water into the enclosures in the event that the sprinkler system is activated.

PART 2 - PRODUCTS

- 2.1 MATERIALS .1 Gaskets on [on lighting, receptacle and distribution panelboards][doors and drip shield on switchboard].
- .2 Gaskets on doors and drip shields on fire alarm and communication systems panels and enclosures.
- .3 Louvres facing outward and downward where openings are required for heat dissipation. Expanded metal screening is not acceptable.
- .4 CSA certified sealing rings for rigid steel galvanized conduit and CSA certified raintight connectors for steel galvanized electrical metallic tubing (EMT).

PART 3 - EXECUTION

- 3.1 INSTALLATION .1 Install sealing rings and raintight connectors on all conduit terminations entering the top or side of all panel enclosures and for all conduit terminations for pull boxes, junction boxes, splitter troughs, wireways, auxiliary gutters, cable troughs and disconnect switches installed below the level of the sprinkler heads.





PART 1 - GENERAL

- 1.1 RELATED REQUIREMENTS .1 Section.
- 1.2 REFERENCES .1 CSA International  
.1 CSA C22.2 No. 29-11, Panelboards and Enclosed Panelboards.
- 1.3 ACTION AND INFORMATIONAL SUBMITTALS .1 Submit in accordance with Section 01 33 00.  
.2 Product Data:  
.1 Submit manufacturer's instructions, printed product literature and data sheets for panelboards and include product characteristics, performance criteria, physical size, finish and limitations.  
.3 Shop Drawings:  
.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.  
.2 Include on drawings:  
.1 Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.
- 1.4 CLOSEOUT SUBMITTALS .1 Submit in accordance with Section 01 78 00.  
.2 Operation and Maintenance Data: submit operation and maintenance data for panelboards for incorporation into manual.
- 1.5 DELIVERY, STORAGE AND HANDLING .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.  
.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
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1.5 DELIVERY,  
STORAGE AND  
HANDLING  
(Cont'd)

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- .3 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect panelboards from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 20.

PART 2 - PRODUCTS

2.1 PANELBOARDS

- .1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
    - .1 Install circuit breakers in panelboards before shipment.
    - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
  - .2 250 and 600 V panelboards: bus and breakers rated for (symmetrical) interrupting capacity or as per short circuit study.
  - .3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
  - .4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
  - .5 Minimum of 2 flush locks for each panel board.
  - .6 Two keys for each panelboard and key panelboards alike.
  - .7 Copper bus with neutral of same ampere rating of mains.
  - .8 Mains: suitable for bolt-on breakers.
  - .9 Trim with concealed front bolts and hinges.
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- 2.2 BREAKERS .1 Breakers: to Section 26 28 16.02.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

- 2.3 EQUIPMENT IDENTIFICATION .1 Provide equipment identification in accordance with Section 26 05 00.
- .2 Nameplate for each panelboard size 4 engraved as indicated.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.

PART 3 - EXECUTION

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

- 3.2 INSTALLATION .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
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- 3.2 INSTALLATION  
(Cont'd)
- .2 Install surface mounted panelboards on plywood backboards in accordance with Section 06 10 00. Where practical, group panelboards on common backboard.
  - .3 Mount panelboards to height specified in Section 26 05 00 or as indicated.
  - .4 Connect loads to circuits.
  - .5 Connect neutral conductors to common neutral bus with respective neutral identified.
  - .6 Where panels of different systems (i.e. Standard and Vital Power) supply a common patient care area, ground busses in panels to be interconnect with a minimum #6 AWG ground conductor.
- 3.3 CLEANING
- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
    - .1 Leave Work area clean at end of each day.
  - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
  - .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
    - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
- 3.4 PROTECTION
- .1 Protect installed products and components from damage during construction.
  - .2 Repair damage to adjacent materials caused by panelboards installation.

PART 1 - GENERAL

- 1.1 REFERENCES .1 CSA International
- .1 CSA C22.2 No. 42-10, General Use Receptacles, Attachment Plugs and Similar Devices.
  - .2 CAN/CSA-C22.2 No. 42.1-00(R2009), Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
  - .3 CSA C22.2 No. 55-M1986(R2008), Special Use Switches.
  - .4 CSA C22.2 No. 111-10, General-Use Snap Switches (Bi-national standard, with UL 20).
- 1.2 ACTION AND INFORMATIONAL .1 Submit in accordance with Section 01 33 00.
- SUBMITTALS .2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for wiring devices and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Shop Drawings:
    - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- 1.3 CLOSEOUT SUBMITTALS .1 Submit in accordance with Section 01 78 00.
- .2 Operation and Maintenance Data: submit operation and maintenance data for wiring devices for incorporation into manual.
- 1.4 DELIVERY, STORAGE AND HANDLING .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

1.4 DELIVERY,  
STORAGE AND  
HANDLING  
(Cont'd)

- .3 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect wiring devices from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 20.

PART 2 - PRODUCTS

2.1 SWITCHES

- .1 15 20 A, 120 V, 347 V, single pole, double pole, three-way, four-way switches to: CSA C22.2 No. 55 and CSA C22.2 No. 111.
- .2 Manually-operated general purpose AC switches with following features:
  - .1 Terminal holes approved for No. 10 AWG wire.
  - .2 Silver alloy contacts.
  - .3 Urea or melamine moulding for parts subject to carbon tracking.
  - .4 Suitable for back and side wiring.
  - .5 White toggle.
- .3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads and or heating loads.
- .4 Switches of one manufacturer throughout project.

2.2 RECEPTACLES

- .1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA C22.2 No. 42 with following features:
  - .1 White urea moulded housing.
  - .2 Suitable for No. 10 AWG for back and side wiring.
  - .3 Break-off links for use as split receptacles.
  - .4 Eight back wired entrances, four side wiring screws.

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- 2.2 RECEPTACLES .1 (Cont'd)  
(Cont'd)
- .5 Triple wipe contacts and rivetted grounding contacts.
- .2 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:
- .1 White urea moulded housing.
- .2 Suitable for No. 10 AWG for back and side wiring.
- .3 Four back wired entrances, 2 side wiring screws.
- .3 Other receptacles with ampacity and voltage as indicated.
- .4 Receptacles of one manufacturer throughout project.
- 2.3 COVER PLATES .1 Cover plates for wiring devices to: CSA C22.2 No. 42.1.
- .2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .3 Stainless steel, cover plates, thickness 2.5 mm for wiring devices mounted in flush-mounted outlet box.
- .4 Cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .5 Weatherproof spring-loaded cast aluminum cover plates, complete with gaskets for receptacles as indicated.
- 2.4 SOURCE QUALITY CONTROL .1 Cover plates from one manufacturer throughout project.
-

PART 3 - EXECUTION

- 3.1 EXAMINATION .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wiring devices installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.
- 3.2 INSTALLATION .1 Switches:
- .1 Install single throw switches with handle in "UP" position when switch closed.
  - .2 Install switches in gang type outlet box when more than one switch is required in one location.
  - .3 Mount toggle switches at height in accordance with Section 26 05 00.
- .2 Receptacles:
- .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
  - .2 Mount receptacles at height in accordance with Section 26 05 00.
  - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
  - .4 Install GFI type receptacles as indicated.
- .3 Cover plates:
- .1 Install suitable common cover plates where wiring devices are grouped.
  - .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.



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- 3.3 CLEANING
- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
    - .1 Leave Work area clean at end of each day.
  - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
  - .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
    - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
- 3.4 PROTECTION
- .1 Protect installed products and components from damage during construction.
  - .2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
  - .3 Repair damage to adjacent materials caused by wiring device installation.



PART 1 - GENERAL

1.1 REFERENCES .1 Canadian Standards Association (CSA International).  
.1 CSA-C22.2 No. 5-09, Molded-case circuit breakers, molded-case switches and circuit-breaker enclosures (Tri-national standard, with UL 489 and NMX-J-266-ANCE-2010), Includes Update No. 1 (2011).

1.2 ACTION AND INFORMATIONAL SUBMITTALS .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

1.3 WASTE MANAGEMENT AND DISPOSAL .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20 - Construction/Demolition Waste Management and Disposal.  
.2 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.  
.3 Separate for reuse and recycling and place in designated containers Steel Metal Plastic waste in accordance with Waste Management Plan.

PART 2 - PRODUCTS

2.1 BREAKERS GENERAL .1 Moulded-case circuit breakers, Circuit breakers, and Ground-fault circuit-interrupters: to CSA C22.2 No. 5  
.2 Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.  
.3 Common-trip breakers: with single handle for multi-pole applications.

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2.1 BREAKERS  
GENERAL  
(Cont'd)

.4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.  
.1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.

.5 Circuit breakers with interchangeable trips as indicated.

2.2 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 phase ground fault short circuit protection.

PART 3 - EXECUTION

3.1 INSTALLATION .1 Install circuit breakers as indicated.

PART 1 - GENERAL

1.1 PRODUCT DATA .1 Submit product data in accordance with  
Section 01 33 00.

1.2 WASTE  
MANAGEMENT AND  
DISPOSAL .1 Separate and recycle waste materials in  
accordance with Section 01 74 20.

PART 2 - PRODUCTS

2.1 DISCONNECT  
SWITCHES .1 Fusible, non-fusible, horsepower rated  
disconnect switch in CSA Enclosure, size as  
indicated.  
.2 Provision for padlocking in off switch  
position by three locks.  
.3 Mechanically interlocked door to prevent  
opening when handle in ON position.  
.4 Fuseholders: relocatable and suitable without  
adaptors, for type and size of fuse indicated.  
.5 Quick-make, quick-break action.  
.6 ON-OFF switch position indication on switch  
enclosure cover.

2.2 EQUIPMENT  
IDENTIFICATION .1 Provide equipment identification in  
accordance with Section 26 05 00.  
.2 Indicate name of load controlled on size 4  
nameplate.

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PART 3 - EXECUTION

3.1 INSTALLATION .1 Install disconnect switches complete with fuses if applicable.

PART 1 - GENERAL

- 1.1 REFERENCES .1 International Electrotechnical Commission (IEC)  
.1 IEC 60947-4-1-2009, Low-voltage switchgear and controlgear - Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor-starters.
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS .1 Provide submittals in accordance with Section 01 33 00.  
.2 Product Data:  
.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.  
.3 Shop Drawings:  
.1 Provide shop drawings: in accordance with Section 01 33 00.  
.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.  
.2 Provide shop drawings for each type of starter to indicate:  
.1 Mounting method and dimensions.  
.2 Starter size and type.  
.3 Layout and components.  
.4 Enclosure types.  
.5 Wiring diagram.  
.6 Interconnection diagrams.
- 1.3 CLOSEOUT SUBMITTALS .1 Provide maintenance materials in accordance with Section 01 78 00.  
.2 Submit operation and maintenance data for each type and style of motor starter for incorporation into maintenance manual.  
.3 Extra Materials:  
.1 Provide listed spare parts for each different size and type of starter.  
.1 3 contacts, stationary.  
.2 3 contacts, movable.  
.3 1 contacts, auxiliary.

- 1.3 CLOSEOUT SUBMITTALS (Cont'd)
- .3 Extra Materials:(Cont'd)
    - .1 (Cont'd)
      - .4 1 control transformers.
      - .5 1 operating coil.
      - .6 2 fuses.
      - .7 10 % indicating lamp bulbs used.
- 1.4 DELIVERY, STORAGE AND HANDLING
- .1 Deliver, store and handle in accordance with Section 01 61 00.
  - .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
  - .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets crates paddling and packaging materials in accordance with Section 01 74 20.

PART 2 - PRODUCTS

- 2.1 MATERIALS
- .1 Starters: to IEC 60947-4-1 with AC4 utilization category.
- 2.2 MANUAL MOTOR STARTERS
- .1 Single or three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
    - .1 Switching mechanism, quick make and break.
    - .2 Overload heaters, manual reset, trip indicating handle.
  - .2 Accessories:
    - .1 Toggle switch: heavy duty oil tight labelled as indicated.
    - .2 Indicating light: heavy duty oil tight type and colour as indicated.
    - .3 Locking tab to permit padlocking in "ON" or "OFF" position.
- 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.



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- 2.3 FULL VOLTAGE  
MAGNETIC STARTERS  
(Cont'd)
- .1 (Cont'd)
  - .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.
- .2 Combination type starters to include circuit breaker with operating lever on outside of enclosure to control circuit breaker, 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.
- .3 Accessories:
- .1 H.O.A. Selector switches: heavy duty oil tight labelled as indicated.
  - .2 Indicating lights: heavy duty oil tight type and color as indicated.
  - .3 2-N/O and 2-N/C spare auxiliary contacts unless otherwise indicated.
- 2.4 CONTROL  
TRANSFORMER
- .1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V 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 ACCESSORIES
- .1 Pushbutton: heavy duty, oil tight as required.
  - .2 Selector switches: heavy duty, oil tight as required.
  - .3 Indicating lights: heavy duty, oil tight, type and colour as indicated.
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2.6 FINISHES .1 Apply finishes to enclosure in accordance with Section 26 05 00.

2.7 EQUIPMENT IDENTIFICATION .1 Provide equipment identification in accordance with Section 26 05 00.

.2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.

.3 Magnetic starter designation label, white plate, black letters, size as per 26 05 00 engraved as indicated.

PART 3 - EXECUTION

3.1 INSTALLATION .1 Install starters and control devices in accordance with manufacturer's instructions.

.2 Install and wire starters and controls as indicated.

.3 Ensure correct fuses installed.

.4 Confirm motor nameplate and adjust overload device to suit.

3.2 FIELD QUALITY CONTROL .1 Perform tests in accordance with Section 26 05 00 and manufacturer's instructions.

.2 Operate switches and contactors to verify correct functioning.

.3 Perform starting and stopping sequences of contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

3.3 CLEANING .1 Clean in accordance with Section 01 74 11.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

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3.3 CLEANING  
(Cont'd)

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



PART 1 - GENERAL

- 1.1 SCOPE .1 These specifications describe pertinent material requirements and installation practices for Low Voltage AC Power Panel Surge Protective Devices (SPD), also known as Transient Voltage Surge Suppressors (TVSS). The contractor shall furnish and install the SPDs equipment having the electrical characteristics, ratings and modifications as specified herein and as shown on the contract drawings.
- 1.2 APPLICABILITY .1 SPDs shall be fully applicable for the purpose of protecting all facility AC electrical circuits from the hazardous effects of transient voltages. These transients may be generated externally by lightning induced energies, utility load factor corrections, and substation switching or they can be internally generated due to inductive and/or capacitive load switching.
- 1.3 SUITABILITY .1 SPDs shall be suitable for all service entrance switchboards, panelboards and motor control centres as indicated on the electrical floor plans. Products are to be configured for parallel installation - no series designs shall to be considered acceptable. Design products to allow installation as a stand-alone device allowing mounting adjacent to panelboards, MCCs. Installation is to be accomplished by a qualified electrical contractor.
- 1.4 RELATED SECTIONS .1 Section 06 10 12: Fire retardant treated plywood backboards.
- .2 Section 26 05 00 - Common Work Results - Electrical.
- .3 Section 26 05 28: Grounding - Secondary.
- .4 Section 26 05 29: Fastenings and Supports.
- .5 Section 26 05 20: Wire and Box Connectors - 0-1000 V.
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- 1.4 RELATED SECTIONS  
(Cont'd)
- .6 Section 26 05 21: Wires and Cables (0-1000 V).
  - .7 Section 26 05 34: Conduits, Conduit Fastenings and Conduit Fittings.
  - .8 Section 26 28 21: Moulded Case Circuit Breakers.
  - .9 Section 26 28 23: Disconnect Switches - Fused and Non-Fused.
- 1.5 REFERENCES
- .1 Institute of Electrical and Electronics Engineers (IEEE):
    - .1 IEEE C62.41-1991, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
    - .2 IEEE C62.45-2002, Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.
    - .3 IEEE C62.62-2000, Standard Test Specifications for Surge Protective Devices.
  - .2 Canadian Standards Association (CSA):
    - .1 CSA-C22.1-12, Canadian Electrical Code, Part I, (22nd Edition), Safety Standard for Electrical Installations.
  - .3 Underwriters Laboratories, Inc (UL):
    - .1 UL 1449(R2006), Standard for Transient Voltage Surge Suppressors.
    - .2 UL 1283 (5th Edition)- 2005, Standard for Electromagnetic Interference Filters.
  - .4 National Electrical Manufacturer's Association (NEMA):
    - .1 NEMA LS1 - 1992 (R2000), Low Voltage Surge Protective Devices (1000 volts or less).Withdrawn
  - .5 Other relevant standards:
    - .1 MIL-STD-220B, Method of Insertion-Loss Measurement.
- 1.6 DEFINITIONS
- .1 L-G: measurements from phase to equipment grounding conductor as line terminals of utilization equipment.
-

- 1.6 DEFINITIONS (Cont'd)
- .2 L-L: measurements from phase to phase in a polyphase system, or from one line to another line in a single phase system.
  - .3 L-N: measurement from phase(s) to neutral for both single and three phase systems.
  - .4 N-G: measurements from neutral to equipment grounding conductor at line terminal of utilization equipment.
  - .5 External mounted surge suppressor: Transient Voltage Surge Suppressor (TVSS) mounted outside of the power panel as a separate component.
- 1.7 SUBMITTALS
- .1 Product data: submit manufacturer's printed product literature, specifications and data sheets in accordance with Section 01 33 00.
  - .2 Maintenance data: submit operation and maintenance data, and engineering data for incorporation into manual specified in Section 01 78 00.
  - .3 Test reports: submit cover sheet of Test Report certifying compliance with UL 1449.
    - .1 Submit Test Reports in accordance with Section 01 33 00.
    - .2 Submit copy of Test Report certifying compliance with MIL-STD-220B for sound attenuation.
    - .3 Submit documentation showing equipment testing to ANSI/IEEE C62.41 and IEEE C62.45.
  - .4 SPD submittals shall include, but shall not be limited to, the following information:
    - .1 Data for each suppressor type indicating conductor sizes, conductor types, and connection configuration and lead lengths.
    - .2 Manufacturer's certified test data indicating the ability of the product to meet or exceed requirements of this specification.
    - .3 Drawings, with dimensions, indicating SPD mounting arrangement and lead length configuration, and mounting arrangement of any optional remote diagnostic equipment and assemblies.
-

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- 1.7 SUBMITTALS .4 (Cont'd)  
(Cont'd)
- .4 List and detail all protection systems such as fuses, disconnecting means and protective materials.
- .5 Indicate SPD wiring, bonding, and grounding connections on wiring diagrams for each system. Include installation details demonstrating mechanical and electrical connections to equipment to be protected.
- 1.8 QUALITY .1 Qualifications:  
ASSURANCE
- .1 All SPDs shall be manufactured by a single ISO-9001 registered company normally engaged in the design, development and manufacture of such devices for electrical and electronic system equipment protection.
- .2 Manufacturer shall be regularly engaged in the manufacture of surge suppression products for the specified categories for minimum of ten (10) years.
- .3 Manufacturer shall offer repair or replacement service for all materials and components incorporated in the Surge Protective Devices.
- .4 Technical assistance (no cost to customer) shall be provided by manufacturer through a factory representative or a local distributor and a factory staffed toll-free technical hotline.
- .5 Manufacturer shall provide a toll-free Customer Service number to facilitate all inquiries regarding product returns, warranty claims, purchasing requirements and payment or credit issues.
- .6 Equipment certification: "Listed" by Underwriters Laboratories, Inc. and shall exhibit the UL Listing Mark for the category "Transient Voltage Surge Suppressors" or TVSS. Provide UL Listing Card under category TVSS to confirm compliance to UL 1449 Standard and assigned Suppressed Voltage Ratings.
- .2 Pre-installation meetings:
- .1 Pre-installation meetings: conduct pre-installation meeting one week prior to commencing work of this Section and on-site installations to verify project requirements, substrate conditions and co-ordination with other building
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- 1.8 QUALITY ASSURANCE (Cont'd)
- .2 Pre-installation meetings:(Cont'd)  
.1 Pre-installation meetings:(Cont'd) subtrades, to review manufacturer's installation instructions and warranty requirements.
- 1.9 DELIVERY, STORAGE AND HANDLING
- .1 Deliver, store and handle in accordance with Section 01 61 00.
- .2 Store materials in dry, secure location and protect from weather.
- .3 Protect from moisture and humidity.
- .4 Store in accordance with manufacturer's written instructions.
- .5 Waste management and disposal in accordance with Section 01 74 20.
- 1.10 WARRANTY
- .1 For the work of this Section 26 43 13 the 12 month warranty period is extended to twenty (20) years.
- .2 Any SPD device that shows evidence of failure or incorrect operation, during twenty (20) year warranty period, shall be replaced by the manufacturer without question. Repairs to modules are not acceptable, only new and unused materials are to be allowed (Excludes installation labor and site preparations after the first year).
- .3 Since "Acts of Nature" or similar statements typically include the threat of lightning to which the SPD shall be exposed, any such clause limiting warranty responsibility in the general conditions of this specification shall not apply to this section. This is, the warranty shall cover the effects of lightning, single phasing, and all other electrical anomalies. The warranty shall cover the entire device, not just various components, such as modules only.
- .4 All SPD devices, subassemblies, and components are to be 100% tested and certified by the manufacturer to meet their published performance parameters. A certificate of compliance shall be provided with all goods delivered.
-

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Surge suppression device (SPD): In accordance with UL 1449, Standard for Safety, Transient Voltage Surge Suppressors and UL listed to UL 1283, Standard for Safety, Electromagnetic Interference Filters.
  - .2 SPD shall protect all modes and there shall be seven discrete suppression circuits: 3 modes connected Line to Ground, 3 modes connected Line to Neutral, and 1 mode connected Neutral to Ground for a 3 phase, 4 wire, plus ground voltage system. Line to Neutral to Ground is not an acceptable substitute for Line to Ground. Line to Neutral to Line and Line to Ground to Line (in combination) will be acceptable for Line to Line Protection.
  - .3 All SPDs must have passed the UL 1449 Fault Current Test with a rating of 200,000 AIC. Documentation substantiating this claim must be provided.
  - .4 SPDs shall use a separate path to building ground; equipment safety ground is not to be used as a transient ground path.
  - .5 Supplementary grounding and bonding connections required between the bonding bus or ground plane for each equipment cluster and other locations as indicated: #6 AWG core copper conductor and approved connections unless otherwise noted.
  - .6 All SPDs are to be MOV based and not include SAD technology as a means of suppression.
  - .7 Maximum continuous operating voltage (MCOV) of all components shall not be less than 125% for a 120V system and 115% for 208V, 240V, 347V, and 600V systems.
  - .8 Standard diagnostic features shall include green LEDs (one per phase - normally on) indicating power and suppression status and a form "C" dry relay contact.
  - .9 Extended diagnostics features are not required.
-

2.1 GENERAL  
(Cont'd)

- .10 EMI/RFI filtering: To MIL-STD-220B, 50 dB minimum at 100 kHz with insertion ratio 50:1.
- .11 Maximum response time: 0.5 nanoseconds.
- .12 Environmental requirements:
  - .1 Relative humidity: 0% to 95%.
  - .2 Operating temperature: -40°C to 65°C (-40°F to 149°F).
  - .3 Storage temperature: -55°C to 85°C (-67°F to 185°F).
  - .4 Operating frequency: 47 Hz to 63 Hz.
  - .5 Audible noise: Less than 45 dBA at 1.5 m (5 feet).

2.2 PERFORMANCE

- .1 SPD equipment shall meet or exceed the minimum performance criteria:
  - .1 SPD for this location shall be indicated as TVSS Type 1 on drawings.
  - .2 Service entrance applications, Category C location.
    - .1 240 kA per phase, 120 kA per mode, maximum suppression voltage ratings listed to UL 1449 as follows:

Voltage	L-N	L-G	N-G	MCOV
208Y/120V	400V	400V	400V	150V
600Y/347V	1200V	1200V	1200V	420V
  - .3 SPD for this location shall be indicated as TVSS Type 2 on drawings.
  - .4 Distribution applications, Category B location: 160 kA per phase, 80 kA per mode, maximum suppression voltage ratings listed to UL 1449 as follows:

Voltage	L-N	L-G	N-G	MCOV
208Y/120V	400V	400V	400V	150V
600Y/347V	1200V	1200V	1200V	420V
  - .5 SPD for this location shall be indicated as TVSS Type 3 on drawings.
  - .6 Subpanel applications, Category A location: 80 kA per phase, 40 kA per mode, maximum suppression voltage ratings listed to UL 1449 as follows:

Voltage	L-N	L-G	N-G	MCOV
208Y/120V	400V	400V	400V	150V
600Y/347V	1200V	1200V	1200V	420V
  - .7 SPDs shall be of compact design. The mounting position of the SPD shall allow a straight and short lead-length connection between the SPD and the point of connection in the panelboard.

2.2 PERFORMANCE  
(Cont'd)

- .1 (Cont'd)
- .8 Visual indication of proper SPD connection and operation shall be easily viewed on the front panel of the enclosure. Indicator lights shall indicate suppression circuit status, phase status, phase loss, reduced protection level and suppression fault.
  - .9 Provide a set of normally open/normally closed Form "C" dry contacts for remote monitoring.
  - .10 Enclosure type: minimum NEMA 4 rating.
  - .11 Device shall be certified (report to be submitted) to withstand a minimum of 20,000 Volts Category C3 (Combination wave - 20,000 Volts - 1.2x50  $\mu$ s Open Circuit Voltage (OCV) and 10,000 Amps - 8x20  $\mu$ s Short Circuit Current (SCC) as defined by ANSI/IEEE C62.41) impulses with less than 10% change in the baseline to final let-through voltage. This data shall be submitted as an independently verified and certified test report.
  - .12 Maximum value for attenuation for suppressor shall exceed a minimum of 33 dB. All measurements for this requirement shall be taken using the MIL STD 220A method and with only six 152.4 mm (6") of lead length extending outside of the normal exit location of leads for the enclosure. Test results taken with leads extending past 152.4 mm (6") are not acceptable or compliant. Additional or excessive lead length used in the test setup is NOT acceptable.

2.3 JOULE RATINGS  
AND RESONSE TIMES

- .1 Selection of TVSS devices shall not be made solely, or in part, based upon either of these two ambiguous specifications. These terms currently are no longer recognized by ANSI, NEMA, IEEE or IEC Standards as bonafide suppressor performance parameters. The key selection elements of a quality suppressor is its low clamping and its maximum surge handling capacity.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions.
  - .2 Do complete installation in accordance with CSA-C22.1 and ANSI/IEEE C62.41 and all other applicable codes.
  - .3 Locate surge suppressors as indicated and mount securely, plumb, true and square to adjoining surfaces.
  - .4 Install surface mounted surge suppressors on fire-retardant plywood backboards as recommended in manufacturer's written instructions. Where practical, group surge suppressors on common backboard with other equipment.
  - .5 Mount housings and enclosures on fire-retardant plywood backboard with top not higher than 1.8 m (6') above finished floor.
  - .6 Mount SPD as close as possible to panel being protected in a position that will minimize lead lengths between suppressor and control breaker(s) to which suppressor connects. Utilize conduit, preferably metallic, to accomplish these connections with a recommended minimum wire size of #10 AWG or a maximum of #4 AWG (for ease of dressing). Suppressor leads shall not be extended beyond manufacturer's recommended maximum length without specific engineering approval. The rationale for this is the longer connecting leads between the SPD and the power panel, the higher the residual transient voltage. The recommended length is a maximum of 152.4 mm (6").
  - .7 Connect SPD to service panel being protected via a circuit breaker for each phase, based on the number of poles and the connecting wire size, with a 30 amp maximum.
  - .8 Install SPD in a neat, workmanlike manner. Lead dress shall be as short and as straight as possible and be consistent with recommended industry practices for the application on
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- 3.1 INSTALLATION .8 (Cont'd)  
(Cont'd)  
which these units are installed. Bind phase, neutral, and ground conductors tightly, over entire run, from suppressor to service panel and always use the shortest length of connecting cable possible.
- 3.2 FIELD QUALITY CONTROL .1
- .1 Have manufacturer of products supplied under this Section review Work involved in the handling, installation/application, protection and cleaning of it's products. Submit written reports in acceptable format to verify compliance of Work with Contract in accordance with Section 01 33 00 and 01 78 00.
- .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits to review work at stages listed:
- .1 After delivery and storage of products, and when preparatory work on which the work of this Section depends is complete, but before installation begins.
- .2 Twice during progress of work at 66% and 99% complete.
- .3 Upon completion of the work, after cleaning is carried out.
- .4 Obtain reports within three (3) days of review and submit immediately to Departmental Representative.

PART 1 - GENERAL

- 1.1 SECTION INCLUDES .1 Materials, components, cabinets, instruments and installation for digital metering system.
- 1.2 RELATED SECTIONS .1 Section 26 05 00 - Common Work Results - Electrical.
- 1.3 REFERENCES .1 Institute of Electrical and Electronics Engineers (IEEE)  
.1 IEEE C37.91-2008, Guide for Protecting Power Transformers.  
.2 Canadian Standards Association, (CSA International)  
.1 CAN3-C17-M84(R2004), Alternating - Current Electricity Metering.  
.2 CAN/CSA-C22.2 No. 61010-1-04, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements (Adopted IEC 61010-1:2001, MOD) (Tri-National standard, with UL 61010-1 and ISA 82.02.01).  
.3 International Standards Organization (ISO)  
.1 ISO 9002 Quality Assurance Standard.
- 1.4 PRODUCT DATA .1 Submit product data in accordance with Section 01 33 00.  
.2 Indicate meter, instrument, outline dimensions, panel drilling dimensions and include cutout template.
- 1.5 WASTE MANAGEMENT AND DISPOSAL .1 Separate and recycle waste materials in accordance with Section 01 74 20.  
.2 Divert unused wiring materials from landfill to metal recycling facility as approved by Departmental Representative.  
.3 Fold up metal banding, flatten and place in designated area for recycling.
-

PART 2 - PRODUCTS

- 2.1 METER
- .1 Meter: Measurement Canada Revenue approved. Certified to CAN/CSA-C22.2 No. 61010-1. All inputs pass IEEE C37.91 surge withstand and fast transient tests Manufactured under ISO 9002 Quality Assurance Standard.
  - .2 Kilowatt-hour energy meter: to CAN3-C17.
  - .3 Combination energy and demand meter: to CAN3-C17.
- 2.2 DMS SYSTEM
- .1 DMS shall be a true RMS, bi-directional, four quadrant meter capable of measuring, calculating and directly displaying on the front panel display the following information in user programmable groups.
    - .1 Voltage, Current, kW, kVAR, kVA Power Factor, harmonics, demand, minimums and maximums for each phase and totals for all phases. KWh, kVARh, kVAh totals for all phases. Voltage and current unbalance, frequency, k-factor.
    - .2 Harmonic distortion for each voltage and current input, up to the 15th harmonic.
  - .2 DMS shall:
    - .1 Perform continuous true RMS measurement based on 64 samples-per-cycle sampling on all voltage and current signals.
    - .2 Readings shall be updated once per second.
    - .3 Require no PTs on voltage inputs for Delta or Wye (Star) systems up to 600 VAC.
    - .4 Retain all setup data in non-volatile memory (NVRAM).
    - .5 Voltage sag detection on any channel for power quality disturbance. Record voltage and current waveforms simultaneous either on alarm condition or on a user defined trigger.
    - .6 Include 512 kB of non-volatile memory with four fully programmable 16 channel data recorders.
    - .7 Support multiport communications that provides two ports for RS-485 communications. Interface via ION, DNP3.0, Modbus TCP and Modbus RTU
-



- 2.2 DMS SYSTEM  
(Cont'd)
- .2 DMS shall:(Cont'd)
  - .7 (Cont'd)  
protocols, through serial or Ethernet communications.
  - .8 Include 10BaseT Ethernet communications port and Ethergate networking capabilities
  - .9 Have an on-board WebMeter.
  - .10 Provide setpoint control to four digital output relays.

- 2.3 SHOP  
INSTALLATION
- .1 Install meters and instrument transformers in separate compartment of switchboards and panelboards as indicated.
  - .2 Install instruments on panelboards and switchboards.
  - .3 Ensure adequate spacing between current transformers installed on each phase.
  - .4 Verify correctness of connections, polarities of meters, instruments, potential and current transformers, transducers, signal sources, electrical supplies.

PART 3 - EXECUTION

- 3.1 METERING  
INSTALLATION
- .1 Install meters and instruments in location free from vibration and shock.
  - .2 Make connections in accordance with diagrams.
  - .3 Connect meter and instrument transformer cabinets to ground.
  - .4 Locate meters within 9 m of instrument transformers. Use 32 mm (1-1/4") conduit for interconnections. Use separate conduit for each set of current transformer connections, exclusive for metering.
  - .5 Perform all power supply and communications wiring connections in accordance with the guidelines set out in the product documentation.
  - .6 Make all voltage sensing connections to digital meter with 2A fuses.
-

- 3.1 METERING  
INSTALLATION  
(Cont'd)
- .7 Install appropriately sized current transformers on each phase with CT shorting blocks in accordance with the Canadian Electrical Code, 2006.
- .8 Install DMS as indicated.
- 3.2 FIELD QUALITY  
CONTROL  
CONTROL
- .1 Conduct tests in accordance with Section 26 05 00 and in accordance with manufacturer's written recommendations.
- .2 Perform simulated operation tests with metering, instruments disconnected from permanent signal and other electrical sources.
- .3 Verify correctness of connections, polarities of meters, instruments, potential and current transformers, transducers, signal sources and electrical supplies.
- .4 Perform tests to obtain correct calibration.
- .5 Do not dismantle meters and instruments.

PART 1 - GENERAL

- 1.1 REFERENCES
- .1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
    - .1 ANSI/IEEE C62.41-1991, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
  - .2 Canadian Standards Association (CSA International)
  - .3 National Electrical Manufacturers Association (NEMA)
    - .1 ANSI/NEMA C82.4-2002, American National Standard for Ballasts for High-Intensity Discharge and Low-Pressure Sodium (LPS) Lamps (Multiple-Supply Type).
  - .4 Underwriters' Laboratories of Canada (ULC)
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Provide submittals in accordance with Section 01 33 00.
  - .2 Product Data:
    - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
    - .2 Provide complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Departmental Representative.
    - .3 Photometric data to include: VCP Table where applicable spacing criterion.
  - .3 Quality assurance submittals: provide following in accordance with Section 01 45 00.
    - .1 Manufacturer's instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence, cleaning procedures and.
-

1.3 DELIVERY,  
STORAGE AND  
HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 20.
- .4 Divert unused metal materials from landfill to metal recycling facility.
- .5 Disposal and recycling of fluorescent lamps as per local regulations.
- .6 Disposal of old PCB filled ballasts.

PART 2 - PRODUCTS

2.1 LAMPS

- .1 Incandescent lamps to be - clear, A19, 100 Watt with 1000 hour lamp life, rough-service rated; or as indicated..
- .2 Fluorescent lamps to be - T8, 32 Watt, medium bi-pin, rapid-start, 30,000 hour lamp life, 2950 initial lumens, CRI 80; or as indicated.
- .3 Metal halide lamps to be - clear, BT37, 400 Watt, mogul base, horizontal burn, 4100 K, 15,000 hour lamp life, 36,000 initial lumens, CRI65, open or enclosed type to suit the luminaire; or as indicated.
- .4 Low pressure sodium lamps to be - clear, T21, 135 Watt, BY22d base, horizontal burn, 16,000 hour lamp life, 22,000 initial lumens; or as indicated.
- .5 High pressure sodium lamps to be - clear, ED18, 400 Watt, mogul base, 30,000 hour lamp life, 54,000 initial lumens; or as indicated.
- .6 Compact fluorescent lamps to be - 18 Watt, G24q-2 base, 12,000 hour lamp life, 12,000 initial lumens, 4100 K, CRI 80; or as indicated.

2.2 BALLASTS

- .1 Fluorescent ballast: CBM and CSA certified, energy efficient type, IC electronic IC electronic dimmable.
  - .1 Rating: 60 Hz voltage as indicated, for use with 2-32W, rapid start lamps.
  - .2 Totally encased and designed for 40 degrees Celsius ambient temperature.
  - .3 Power factor: minimum 95% with 95% of rated lamp lumens.
  - .4 Current crest factor: 1.7 maximum.
  - .5 Harmonics: 10% maximum THD.
  - .6 Operating frequency of electronic ballast: 20 kHz minimum.
  - .7 Total circuit power: 62 Watts.
  - .8 Ballast factor: greater than 0.90.
  - .9 Sound rated: Class A.
  - .10 Mounting: integral with luminaire.
- .2 Metal halide ballast:
  - .1 Rating: 60 Hz voltage as indicated, for use with 1-400W metal halide lamp. Provide circuitry for quartz re-strike standby light where indicated.
  - .2 Totally encased and designed for 40 degrees Celsius ambient temperature.
  - .3 Power factor: minimum 95 % with 95% of rated lamp lumens.
  - .4 Type: solid state.
  - .5 Input voltage range: plus or minus 10% of nominal.
  - .6 Minimum starting temperature: minus 30 degrees Celsius at 90% line voltage.
  - .7 Mounting: as indicated.
  - .8 Current crest factor: 1.7 maximum current.
- .3 High pressure sodium ballast: to ANSI C82.4 design.
  - .1 Rating: 60Hz voltage as indicated, for use with 1-400W high pressure sodium lamp.
  - .2 Totally encased and designed for 40 degrees Celsius ambient temperature.
  - .3 Power factor: minimum 95% with 95% of rated lamp lumens.
  - .4 Type: solid state.
  - .5 Input voltage range: plus 5% to minus 5% plus 10% to minus 10% of nominal.
  - .6 Minimum starting temperature: minus 40 degrees Celsius at 90% line voltage.
  - .7 Mounting: as indicated.
  - .8 Current crest factor: 1.7 maximum current.

- 
- 2.2 BALLASTS .4 Low pressure sodium ballast:  
(Cont'd)
- .1 Rating: 60 Hz voltage as indicated, for use with 1-35W low pressure sodium lamp.
  - .2 Totally encased and designed for 40 degrees Celsius ambient temperature.
  - .3 Power factor: minimum 95 % with 95% of rated lamp lumens.
  - .4 Type: constant wattage.
  - .5 Input voltage range: plus or minus 20% of nominal.
  - .6 Minimum starting temperature: minus 34 degrees Celsius at 90% line voltage.
  - .7 Mounting: as indicated.
- 2.3 FINISHES .1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.
- 2.4 OPTICAL CONTROL DEVICES .1 As indicated in luminaire schedule.
- 2.5 LUMINAIRES .1 As indicated in luminaire schedule.
- PART 3 - EXECUTION
- 3.1 INSTALLATION .1 Locate and install luminaires as indicated.
- .2 Provide adequate support to suit ceiling system.
- 3.2 WIRING .1 Connect luminaires to lighting circuits:  
.1 Install flexible or rigid conduit for luminaires as indicated.
- 3.3 LUMINAIRE SUPPORTS .1 For suspended ceiling installations support luminaires independently of ceiling.
-

3.4 LUMINAIRE  
ALIGNMENT

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

3.5 CLEANING

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





PART 1 - GENERAL

- 1.1 REFERENCES .1 CSA International  
.1 CSA C22.2 No. 141-10, Emergency Lighting Equipment.
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS .1 Submit in accordance with Section 01 33 00.  
.2 Product Data:  
.1 Submit manufacturer's instructions, printed product literature and data sheets for emergency lighting and include product characteristics, performance criteria, physical size, finish and limitations.
- 1.3 CLOSEOUT SUBMITTALS .1 Submit in accordance with Section 01 78 00.  
.2 Operation and Maintenance Data: submit operation and maintenance data for emergency lighting for incorporation into manual.
- 1.4 DELIVERY, STORAGE AND HANDLING .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.  
.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.  
.3 Storage and Handling Requirements:  
.1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.  
.2 Store and protect emergency lighting from nicks, scratches, and blemishes.  
.3 Replace defective or damaged materials with new.  
.4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 20.
-

- 1.5 WARRANTY .1 For batteries in this Section 26 52 00 -  
Emergency Lighting, 12 months warranty period  
is extended to 120 months.

PART 2 - PRODUCTS

- 2.1 EQUIPMENT .1 Emergency lighting equipment: to CSA C22.2  
No. 141.
- .2 Supply voltage: 120 V, AC.
- .3 Output voltage: 12 V DC.
- .4 Operating time: 60 minutes.
- .5 Battery: sealed, maintenance free.
- .6 Charger: solid state, multi-rate,  
voltage/current regulated, inverse temperature  
compensated, short circuit protected with  
regulated output of plus or minus 0.01 V for  
plus or minus 10% input variations.
- .7 Solid state transfer circuit.
- .8 Low voltage disconnect: solid state, modular,  
operates at 80% battery output voltage.
- .9 Signal lights: solid state, for 'AC Power ON'  
and 'High Charge'.
- .10 Lamp heads: integral on unit or remote as  
indicated, 345 degrees horizontal and 180  
degrees vertical adjustment. Lamp type:  
halogen, 12V MR16.
- .11 Cabinet: suitable for direct or shelf  
mounting to wall and c/w knockouts for  
conduit. Removable or hinged front panel for  
easy access to batteries.
- .12 Finish: White.
- .13 Auxiliary equipment:
- .1 Ammeter.
- .2 Voltmeter.
- .3 Test switch.
- .4 Time delay relay.
- .5 Battery disconnect device.
- .6 AC input and DC output terminal blocks  
inside cabinet.
- .7 Shelf Bracket.
-

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2.1 EQUIPMENT .13 Auxiliary equipment:(Cont'd)  
(Cont'd) .8 Cord and single plug connection for AC.  
.9 RFI suppressors.

2.2 WIRING OF .1 Conduit: type EMT.  
REMOTE HEADS .2 Conductors: RW-90 type in accordance with  
Section 26 05 21, sized in accordance with  
manufacturer's recommendations, minimum #10  
AWG. Larger wire sizes to account for voltage  
drop.

PART 3 - EXECUTION

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

3.2 INSTALLATION .1 Install unit equipment and remote mounted  
fixtures.  
.2 Direct heads.

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

---

- 3.3 CLEANING  
(Cont'd)
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
- 
- 3.4 PROTECTION
- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by emergency lighting installation.

PART 1 - GENERAL

- 1.1 REFERENCES
- .1 Canadian Standards Association (CSA International)
    - .1 CSA C22.2 No. 141-10, Unit Equipment for Emergency Lighting.
  - .2 National Fire Protection Association (NFPA).
  - .3 National Research Council Canada
    - .1 NRCC NBCC-2010, National Building Code of Canada 2010.
- 1.2 SUBMITTALS
- .1 Provide submittals in accordance with Section 01 33 00.
  - .2 Product Data:
    - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Submit WHMIS MSDS - Material Safety Data Sheets.
  - .4 Quality Assurance Submittals: submit following in accordance with Section 01 45 00.
    - .1 Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.
  - .5 Submit manufacturer's written material warranty for lamination of photo-luminescent exit signs.
- 1.3 WASTE MANAGEMENT AND DISPOSAL
- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.
-

PART 2 - PRODUCTS

- 2.1 STANDARD UNITS
- .1 Exit lights: to CSA C22.2 No.141 and NBC-2010 Clause 3.4.5.1.(2)(b).
  - .2 Housing: diecast aluminum housing, brush aluminum finish.
  - .3 Face and back plates: cast aluminum.
  - .4 Lamps: LED-12W 120, 347 V 25-year rated life.
  - .5 Green and white pictogram style.

PART 3 - EXECUTION

- 3.1 MANUFACTURER'S INSTRUCTIONS
- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.
- 3.2 INSTALLATION
- .1 Install exit lights to manufacturer's recommendations, listing requirements, NFPA standard and local regulatory requirements.
  - .2 Connect fixtures to exit light circuits.
  - .3 Connect emergency lamp sockets to emergency circuits.
  - .4 Ensure that exit light circuit breaker is locked in on position.
- 3.3 CLEANING
- .1 Proceed in accordance with Section 01 74 11.
  - .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

PART 1 - GENERAL

1.1 RELATED  
SECTIONS

- .1 Section 27 08 00 - Commissioning for Communications
- .2 Section 27 10 05 - Structured Cabling for Communication Systems
- .3 Section 28 05 00 - Commissioning for Electronic Safety and Security
- .4 Section 28 23 00 - Video Surveillance

1.2 SYSTEM  
DESCRIPTION

- .1 This project comprises a kitchen fit-up and consists of the supply and installation of new networking infrastructure including conduit, enclosures, cabling, connectivity and active equipment to support voice, data and digital network video surveillance. This installation will require both physical and software integration with certain existing infrastructure and systems.
  - .2 Voice and data will comprise one system. Backbone voice and data will terminate into the same enclosure from separate conduit systems. Horizontal voice and data will share conduit and be of the same Cat. 6 cable type. Active equipment will consist of Non-PoE Ethernet Switch.
  - .3 Network video surveillance, Security, will comprise it's own system. Backbone fibre will terminate into it's own enclosure. Horizontal cabling will be of cat. 6 cable type contained in it's own conduit system separate from voice and data above. Active equipment will include a Power Over Ethernet (PoE) Switch, Uninterruptible Power Supply (UPS) and Extended Battery Module (EBM).
  - .4 The Communications Contractor shall be responsible for the supply and installation of a structured cabling system based on using a star topology for the systems further indicated in this document.
  - .5 The specific scope of this project includes but is not limited to:
    - .1 Supply and installation of 4-pair UTP horizontal copper cabling and related
-

1.2 SYSTEM  
DESCRIPTION  
(Cont'd)

- .5 (Cont'd)
- .1 (Cont'd)
- accessories to support separate and completely functioning
- .1 voice and data networking system
  - .2 network based video surveillance system
  - .2 Supply and installation of twelve strand OM3 fibre backbone from previous nodes to each of new kitchen data and video surveillance enclosures (new nodes).
  - .3 Supply and installation of multi-pair cat. 5e cable (tie cable) from entrance point voice termination block to voice patch panel in new voice and data enclosure.
  - .4 Supply and installation of enclosures, permanently anchored to floor complete with patch panels, switches, and for video surveillance enclosure only, UPS and EBM.
  - .5 Complete testing of each cable in a timely fashion and in coordination with other trades and services to ensure a completely tested system prior to activation by the Client.
  - .6 Supply and installation of new conduit by Division 26 for cabling pathways for both systems.
    - .1 Voice and Data: Backbone conduit from building entrance to cabinet; Horizontal conduit from cabinet to work area outlets.
    - .2 Video Surveillance: Backbone conduit from building entrance to cabinet; from cabinet to cameras and video monitoring station.
  - .7 Supply as-built drawings as specified.
  - .8 Complete all final documentation requirements including documentation and site reviews to provide manufacturer's certification.
  - .9 The overall intent is to provide for a new finished, operational system and all items reasonable inferable as required by the plans, specifications and drawings if such items are unintentionally omitted.
- .6 Provision should be considered in the event it is deemed necessary to develop the kitchen in three phased areas:
- .1 Small Group Meal Preparation (SGMP)
  - .2 Dining Area
  - .3 Kitchen Area



- 1.3 INSTALLATION
- .1 The communications contractor shall install and distribute cabling using conduit, and/or surface raceways as indicated on drawings and as supplied and installed by Division 26.
  - .2 Leave areas clear where space has been designated as reserved for future equipment and equipment for other trades.
  - .3 Adequate space and provisions shall be left for removal of components and servicing of equipment, with minimum inconvenience to the operation of systems.
  - .4 Where equipment is shown to be 'roughed in only' obtain information from the PWGSC/CSC Representative before proceeding with the work.

PART 2 - PRODUCTS

- 2.1 GENERAL
- .1 All equipment and products supplied must be new and free of all manufacturer defects and delivery or installation damage.
  - .2 All equipment and products supplied shall meet all manufacturer listed characteristics as identified in the latest manufacturer catalogue.
  - .3 All products shall meet all applicable codes and standards and bare the UL/ULC label, be CSA approved and meet FCC/CRTC Regulations.
  - .4 All products must be provided in accordance with local, provincial and national fire ratings for the installation on this project.

- 2.2 MATERIAL HANDLING
- .1 The Communications Contractor is responsible for the delivery of all materials to site and transportation to the work place in accordance with all safety regulations and procedures.
  - .2 Provide and be responsible for lockable storage for all tools and material required to complete the installation through the duration of the project. Once the project is complete remove all tools and excess materials within 2 business days.
-

PART 3 - EXECUTION

- 3.1 CUTTING,  
PATCHING AND  
REPAIRING .1 Cutting and patching of all surfaces as applicable to the Telecommunications installation shall be the responsibility of and be performed by the Communications Contractor. All work shall be performed to the standards set by codes and standards, Building Management, General Contractor and the Client.
- 3.2 HOISTING  
FACILITIES .1 This Division shall provide its own hoisting facilities regardless of height required to perform work.
- 3.3 SAFETY .1 The Communications Contractor shall adhere to all safety laws, rules and regulations issued by the authorities having jurisdiction, General Contractor and the PWGSC Representative.
- .2 The Communications Contractor shall attend all Safety Program meetings requested by the General Contractor.
- .3 Provide adequate protection in public and work areas to pedestrian and other trade traffic using approved safety barriers, caution tape and signage.
- .4 At all times maintain clear fire exits, emergency routes and access to emergency equipment including fire hose cabinets, fire extinguishers and stand pipe connections.
- .5 Smoking and combustion of any materials is strictly prohibited on all sites.
- .6 Provide information to all employees of emergency and fire safety plans for the work site and facility.
- .7 Provide protection as required by the authorities having jurisdiction to all employees for work performed in typically inaccessible or concealed spaces.





PART 1 - GENERAL

1.1 RELATED  
SECTIONS

- .1 Section 27 05 28 - Pathways for Communications Systems.
- .2 Section 27 10 05 - Structured Cabling for Communications Systems.

1.2 REFERENCES

- .1 American National Standards Institute
  - .1 ANSI J-STD-607-A-2002, Joint Standard - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
  - .2 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA)
    - .1 TIA/EIA-606-2002, Administration Standard for the Commercial Telecommunications Infrastructure.
  - .3 Nationally Recognized Testing Laboratory (NRTL).
  - .4 Local electrical codes.
  - .5 Local building codes.

1.3 SYSTEM  
DESCRIPTION

- .1 Telecommunications grounding and bonding system consist of grounding busbars, bonding backbones, and other bonding conductors.
- .2 Provides ground reference for telecommunications systems within building and bonding to it of telecommunications rooms.
- .3 Metallic pathways, cable shields, conductors, and hardware within telecommunications spaces are bonded to telecommunications grounding and bonding system.

1.4 DELIVERY,  
STORAGE AND

- .1 Delivery and Acceptance Requirements: deliver materials to site in original factory
-

HANDLING

packaging, labelled with manufacturer's name  
and address.

- .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect security door systems from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials.

PART 2 - PRODUCTS

2.1  
TELECOMMUNICATIONS  
MAIN GROUNDING  
BUSBAR (TMGB)

- .1 Predrilled copper busbar, listed by NRTL, electrotin plated with holes 8 mm diameter for use with standard-sized lugs to: ANSI J-STD-607-A 2002.
- .2 Dimensions 6 mm thick, 100 mm wide, variable length to: ANSI J-STD-607-A 2002.
- .3 Shall be insulated from its support by a minimum of 50 mm.

2.2  
TELECOMMUNICATIONS  
GROUNDING BUSBAR  
(TGB)

- .1 Predrilled copper busbar, listed by NRTL, electrotin plated with holes 8 mm diameter for use with standard-sized lugs to: ANSI J-STD-607-A 2002.
  - .2 Dimensions 6 mm thick, 50 mm wide, variable mm long to: ANSI J-STD-607-A 2002.
-

2.3 BONDING  
CONDUCTOR FOR  
TELECOMMUNICATIONS  
(TBC)

- .1 Cable assemblies shall be UL Listed and CSA Certified and be a minimum of 6 AWG copper conductor, green insulated to: ANSI J-STD-607-A. It shall meet the length requirements in 2.3.2.
- .2 The gauge of the TBB, TBC and GE shall be determined based on the table below.

TBB Length in Linear meters (feet)	TBB Size (AWG)
Less than 4 (13)	6
4-6 (14-20)	4
6-8 (21-26)	3
8-10 (34-41)	2
10-13(34-41)	1
13-16(42-52)	1/0
16-20(53-66)	2/0
Greater than 20 (66)	3/0

2.4  
TELECOMMUNICATIONS  
BONDING BACKBONE  
(TBB)

- .1 See 2.3 - Bonding Conductor for Telecommunications for TBB size. Shall be green insulated marked to: ANSI J-STD-607-A 2002.
- .2 See Table in 2.3.2.

PART 3 - EXECUTION

3.1 BONDING  
CONDUCTORS GENERAL

- .1 When placed in ferrous metallic conduit or EMT longer than 1 m, bond to each end of conduit or EMT using 6 AWG copper conductor.

3.2 BONDING  
CONDUCTOR FOR  
TELECOMMUNICATIONS

- .1 Install minimum 6 AWG green insulated copper bonding conductor from each Security Equipment Interface Enclosure (telecommunications enclosure) to suitable service equipment (power) ground.
- .2 Use exothermic welding, approved 2 hole compression lugs, lugs 1 hole non-twisting lugs for connection.

- 3.3 BONDING TO TGB .1 Bond metallic raceways in telecommunications room telecommunications equipment room to TGB using 6 AWG green insulated copper conductor.
- .2 For cables within telecommunications room equipment room having shield or metallic member, bond shield or metallic member to TGB using 6 AWG green insulated copper conductor.
- 3.4 LABELLING .1 Apply warning labels to telecommunications bonding and grounding conductors.
- .2 Apply additional administrative labels to:  
TIA/EIA-606.



PART 1 - GENERAL

1.1 RELATED  
SECTIONS

- .1 Section 26 05 29 - Hangers and Supports
- .2 Section 26 05 31 - Splitters, Junction Boxes, Pull Boxes and Cabinets
- .3 Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings
- .4 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings
- .5 Section 27 05 26 - Grounding and Bonding for Communications Systems
- .6 Section 27 10 05 - Structured Cabling for Communications Systems

1.2 SYSTEM  
DESCRIPTION

- .1 Empty telecommunications raceways system consists of outlet boxes, cover plates, cabinets, conduits, cabletroughs, pull boxes, sleeves and caps, fish wires, service poles, service fittings, concrete encased ducts.
- .2 Conduit systems as shown on drawings, and supplied and installed by Division 26 shall be used to distribute UTP and fibre optic cabling.

1.3 WASTE  
MANAGEMENT AND  
DISPOSAL

- .1 Separate and recycle waste materials.
  - .2 Remove from site and dispose of all 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 conduit and wiring materials from landfill to metal recycling
-

1.3 WASTE  
MANAGEMENT AND  
DISPOSAL  
(Cont'd)

- .4 (Cont'd)  
facility as approved by Departmental  
Representative.
- .5 Fold up metal banding, flatten and place in  
designated area for recycling.

1.4 REFERENCES\_

- .1 Telecommunications Industry Association  
(TIA)/Electronic Industries Alliance(EIA):
    - .1 ANSI/TIA/EIA 568-C Series, Commercial  
Building Telecommunications Standard.
    - .2 ANSI/TIA/EIA 569-B, Commercial Building  
Standard for Telecommunications Pathways  
and Spaces.
    - .3 ANSI/TIA/EIA 606-A, Administration  
Standard for Commercial Telecommunications  
Infrastructure.
    - .4 ANSI J-STD-607-A, Commercial Building  
Grounding (Earthing)and Bonding  
Requirements for Telecommunications.
    - .5 ANSI/TIA/EIA 758-A, Customer Owned  
Outside Plant Telecommunications Cabling  
Standard.
  - .2 Canadian Standards Association (CSA):
    - .1 CSA C22.1-10, Canadian Electrical Code.
    - .2 CAN/CSA-C22.2 No. 18 - Outlet Boxes,  
Conduit Boxes, Fittings and Associated  
Hardware.
    - .3 CSA C22.2 No. 83.1 (CSA?UL) - Electrical  
Metallic Tubing - Steel
  - .3 Building Industry Consulting Services  
International (BICSI):
    - .1 BICSI Telecommunications Distribution  
Methods Manual, 12th Edition.
    - .2 BICSI Information Transport Systems  
Installation Manual, 4th Edition
    - .3 BICSI Customer Owned Outside Plant  
Manual, 4th Edition
-

PART 2 - PRODUCTS

- 2.1 MATERIAL
- .1 Conduits: EMT type, in accordance with Section 26 05 34.
  - .2 Junction boxes, cabinets: in accordance with Section 26 05 31.
  - .3 Outlet boxes, conduit boxes, and fittings: in accordance with Section 26 05 32.

PART 3 - EXECUTION

- 3.1 INSTALLATION
- .1 Install empty raceway system, including distribution system, fish wire, terminal cabinets, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves and caps, cabletroughs, service poles, miscellaneous and positioning material to constitute complete system.
  - .2 A pull box shall be placed in conduit runs where the sum of bends exceeds 180°, where the overall length of the conduit run is more than 30m, or if there is a reverse bend in the run.
  - .3 In all instances pull boxes shall be placed in straight sections of the conduit run and shall not be used in lieu of a bend. Corresponding ends of the conduit are to be aligned with each other. Conduit fittings shall not be used in place of pull boxes or bends.
  - .4 General conduit routing shall be as follows:
    - .1 Outdoor distribution.
    - .2 Indoor distribution.



PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 27 05 00 - Common Work Results for Communication Systems
  - .2 Section 27 10 05 - Structured Cabling for Communications
  - .3 Section 28 23 00 - Video Surveillance
- 1.2 WORK INCLUDED
- .1 The Communications Contractor shall commission the cabling infrastructure by completing detailed testing described further in this section and successfully completing requirements to ascertain a manufacturer's warranty for the complete copper and fibre solution.
  - .2 The Communications Contractor will be responsible for completing a "Permanent Link" test for 100% of all horizontal and backbone cabling installed for use as part of this project.
  - .3 The Communications Contractor will repair and/or replace all componenets at no additional cost to the client for all failed test results.
  - .4 All copper test results will be based on the balanced twisted pair test requirements as defined in:
    - .1 ANSI/TIA/EIA-568-C.2
  - .5 All fibre cabling testing will be based on the following testing standards:
    - .1 ANSI/TIA/EIA-568-C.0
    - .2 ANSI/TIA/EIA-568-C.3
  - .6 Provide verification that patch cords have been tested.
- 1.3 COPPER TEST PARAMETERS
- .1 The following test parameters will be used and measured for all (4) pairs in every copper cable based on Category of cable:
    - .1 Wire Map (continuity)
    - .2 Length
    - .3 Insertion Loss
    - .4 NEXT Loss
-



1.4 FIBRE TEST  
PARAMETERS  
(Cont'd)

- .3 Link attenuation test limits are based on the use of the One Reference Jumper Method specified by ANSI/TIA/EIA-526-14A, Method B and ANSI/TIA/EIA-526-7, Method A.1 and TSB 140.
- .4 Multimode Backbone Links shall be tested in both directions at both operating wavelengths. Tests shall be performed at 850nm and 1300nm in accordance with ANSI/TIA/EIA-526-14A and TSB 140.
- .5 Complete a test of each strand of fibre for length and attenuation. Performance test shall be below the total return loss budget. Provide testing for all fibre runs. Include a hard copy chart recording with the test documentation.
- .6 Fibre optic cable test result data shall contain the following information in a electronic database for each strand tested:
  - .1 The identification of the link/fibre in accordance with the identification and labelling method specified for the project.
  - .2 Insertion loss measured at each wavelength specified including the test limit calculated for the wavelength and margin.
  - .3 Link length for each optical fibre.

1.5 TEST  
DOCUMENTATION

- .1 Test results shall be prepared on a separate page for each test result and include:
    - .1 Cable Identity
    - .2 Date and Time of test
    - .3 Technicians Signature
    - .4 Make and Model of Tester Hardware and Software Version
    - .5 Copy of Tester Calibration Certificate
  - .2 Test results shall be supplied in electronic format matching tester used to conduct testing. Files to be MS Windows based and inclusive of viewing software if required.
  - .3 Test results shall be supplied by 2 hard copies in separate white 3-ring binders to the Technical Authority office within 5 business days of completion.
  - .4 The Cabling Contractor is also required to supply two copies on CD/DVD in Access, Paradox or any other ODBC compatible database format.
-

- 1.6 COMMUNICATIONS  
CABLING SYSTEM  
WARRANTY
- .1 The Contractor shall arrange for a not less than 20 year Manufacturer Warranty for a complete end-to-end solution for copper and fibre cabling.
  - .2 Provide a Manufacturer's Application Warranty that covers any current applications recognized by standards bodies for use over EIA/TIA568-C component and channel specifications.
  - .3 The Contractor shall provide a plaque and /or Warranty Certificate issued directly from the manufacturer at the completion of the project.

PART 2 - PRODUCTS

- 2.1 GENERAL
- .1 Level III field test instruments are required for measurements of category 6 cabling.
  - .2 Tester shall be calibrated prior to use on the project and proof of such calibration shall be available if requested.
  - .3 Tester shall be equipped with manufacturer approved and provided test cords. Field assemblies for testing will not be acceptable.
  - .4 The same tester type shall be used throughout the duration of the project.
  - .5 Technicians shall be specifically trained and approved to use the tester used in this project.

PART 3 - EXECUTION

- 3.1 GENERAL
- .1 Provide Maintenance and Operating Instructions for Owner's staff use.



PART 1 - GENERAL

1.1 RELATED  
SECTIONS

- .1 Section 27 05 00 - Common Work Results for Communication Systems
- .2 Section 27 05 26 - Grounding and Bonding for Communications Systems
- .3 Section 27 05 28 - Pathways for Communications Systems
- .4 Section 27 08 00 - Commissioning for Communications
- .5 Section 28 05 00 - Commissioning for Electronic Safety and Security
- .6 Section 28 23 00 - Video Surveillance

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International):
    - .1 CSA-C22.2 No. 214-02, Communications Cables (Bi-National standard with UL 444).
    - .2 CSA-C22.2 No. 232-M1988(R2004), Optical Fiber Cables.
    - .3 CSA 22.1-10, Canadian Electrical Code
  - .2 Telecommunications Industry Association (TIA)/Electronic Industries Alliance (EIA):
    - .1 TIA/EIA-568-C.0-(2009), Generic Telecommunications Cabling for Customer Premises.
    - .2 TIA/EIA-568-C.1-(2009), Commercial Building Telecommunications Cabling Standard.
    - .3 TIA/EIA-568-C.2-(2009), Balanced Twisted-Pair Telecommunication Cabling and Components Standard.
    - .4 TIA/EIA-568-C.3-(2008), Optical Fiber Cabling Components Standard.
    - .5 TIA/EIA-606-A-(2002), Administration Standard for the Commercial Telecommunications Infrastructure.
    - .6 ANSI/TIA/EIA 606-A, Administration Standard for Commercial Telecommunications Infrastructure.
    - .7 J-STD-607-A, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
-

- 1.2 REFERENCES                      .3    Building Industry Consulting Services  
      (Cont'd)
- .1    BISCI Telecommunications Distribution  
          Methods Manual, 12th edition  
      .2    BISCI Information Transport Systems  
          Installation Manual, 4th Edition.  
      .3    BISCI Customer Owned Outside Plant  
          Manual, 4th edition.  
      .4    BISCI Electronic Safety and Security  
          Design Reference Manual, 2nd Edition
- 1.3 DEFINITIONS                   .1    Refer to TIA/EIA-598-C, Annex A for  
      definitions of terms: optical-fiber  
      interconnect, distribution, and breakout  
      cables.
- 1.4 SYSTEM DESCRIPTION           .1    Structured telecommunications wiring system  
      consist of unshielded-twisted-pair and optical  
      fiber cables, terminations, connectors,  
      cross-connection hardware and related  
      equipment.
- 1.5 SUBMITTALS                   .1    Product Data  
      .1    Manufacturer's data sheets of all  
          products and devices. Include product  
          characteristics, performance criteria,  
          physical size, finish and limitations.
- .2    As-built Records and Drawings:  
          .1    Provide electronic drawings in AutoCAD  
              2008 format depicting all construction.  
          .2    Provide two (2) bound complete hard-copy  
              sets of as-built records to the Departmental  
              Representative.
- 1.6 DELIVERY, STORAGE AND HANDLING   .1    Waste Management and Disposal: separate waste  
      materials for reuse and recycling.
-

PART 2 - PRODUCTS

- 2.1 COMMUNICATIONS ENCLOSURE
- .1 44 Rack Unit, 19" gangable enclosure.
  - .2 Fully welded construction provides UL Listed load capacity of 1136 kg (2500 lbs), static load capacity of 4545 kg (10,000 lb), seismic certified capacity of 477 kg (1.050 lbs).
  - .3 1/8" thick structural steel braces
  - .4 14mm, 20mm, 27mm & 31mm (1/2", 3/4", 1" & 1-1/2") knock outs.
  - .5 Two wide pairs of 11 guage, 10-32 threaded rackrail with numbered increments (EIA-310-D compliant 482.6mm (19") rack units).
  - .6 Fully vented doors.
  - .7 Durable black textured powder coat finish.
  - .8 Overall Dimensions:
    - .1 Overall Height: 2112 mm (83.125")
    - .2 Usable Height: 1959 mm (77.125"), 44 Rack Units
    - .3 Overall Depth: 798 mm (31.40")
    - .4 Usable Depth: 737 mm (29.0")
  - .9 Cabinet Top: accepts and includes 4 x 4-1/2" quiet fans and fan controller
  - .10 Structured cable routing between front and rear sections.
  - .11 Include Horizontal Power Strip.
- 2.2 MULTIMODE OUTSIDE PLANT RISER LSZH FIBER CABLE
- .1 Optical fiber backbone cabling shall be designed for installation in harsh environments such as conduit and pathways subjected to wide temperature range. Outside Plant Loose Tube Low Smoke Zero Halogen is especially recommended where the interbuilding conduit system is above the frost line and likely to fill with water.
  - .2 The cables shall be CSA approved and stamped accordingly.
  - .3 Gel filled tubes containing 12, 250um individually coloured fibres.
-

- 
- 2.2 MULTIMODE  
OUTSIDE PLANT RISER  
LSZH FIBER CABLE  
(Cont'd)
- .4 Optical fiber cabling shall be fully dielectric with no metallic components in the cable.
  - .5 Type: OM3 50/125µm
  - .6 Rating: OFNR
  - .7 Strands: 12
  - .8 Color: Black
  - .9 Connector Type: SC
  - .10 Fully water-blocked core using dry water blocking system.
  - .11 Operating temperature range: -40°C to 75°C.
  - .12 Field of Application: Indoor, Outdoor
  - .13 Standards:
    - .1 ANSI/ICEA S-104-696
    - .2 ANSI/ICEA S-83-596
    - .3 ANSI/ICEA S-87-640
    - .4 ANSI/TIA-568-C.3
    - .5 Telcordia GR-20, GR-409
- 2.3 FIBRE  
ENCLOSURE
- .1 Holds up to three FAP or FMP adapter panels or FOSM splice modules.
  - .2 Fibre enclosure shall be 1U, rack mountable to EIA-310-D standard 482.6 mm (19") rack.
  - .3 Front and rear access via bidirectional sliding doors.
- 2.4 SC FIBER OPTIC  
ADAPTER
- .1 SC 10Gig Duplex Multimode Fiber Multimode Adapter
  - .2 Zirconia ceramic split sleeves
  - .3 Exceed TIA/EIA-568-B.3 requirements
  - .4 Complaint with TIA/EIA-604 FOCIS-3
-

<u>2.5 BLANK PANEL</u>	.1	Fibre adpater panel, blank, black.
<u>2.6 OM3 MULTIMODE DUPLEX PATCH CORD</u>	.1	SC to LC multimode duplex patch cord.
	.2	One duplex SC connector on one end and one duplex LC connector on the other end.
	.3	10Gig 50/125µm.
	.4	Fiber Cable Type: Jacketed
	.5	Fiber Count: 2
	.6	Length: 0.5m
<u>2.7 OM3 MULTIMODE DUPLEX PATCH CORD</u>	.1	SC to SC multimode duplex patch cord.
	.2	One duplex SC connector on one end and one duplex SC connector on the other end.
	.3	10Gig 50/125µm.
	.4	Fiber Cable Type: Jacketed
	.5	Fiber Count: 2
	.6	Length: 0.5m
<u>2.8 INDOOR RATED MULTIPAIR VOICE BACKBONE</u>	.1	25 Pair, Cat. 5e UTP Riser
	.2	24 awg bare copper wire insulated with polyethylene (non-plenum)
	.3	Standard Compliant with TIA/EIA-568-C.2, UL 444, C22.2 No. 214-02.
	.4	ETL Verified, Listed.
<u>2.9 INDOOR RATED HORIZONTAL UNSHIELDED TWISTED PAIR (UTP) COPPER CABLING</u>	.1	All horizontal cabling shall be UTP, 4 pair minimum 23 AWG, solid copper conductor, compliant with EIA/TIA cable category 6.
	.2	Meet the requirements of ANSI/TIA/EIA-568-C.2-1.
	.3	The cable shall be CSA certified and stamped with CMR rating.
	.4	For voice and data systems cable shall have a white outer jacket.

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2.9 INDOOR RATED .5 For security-network video surveillance  
HORIZONTAL system cable shall have a green outer jacket.  
UNSHIELDED TWISTED  
PAIR (UTP) COPPER  
CABLING  
(Cont'd)

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2.10 UTP PATCH PANEL.1 The UTP patch panel shall exceed  
ANSI/TIA-568-C.2 Category 6 and ISO 11801 2nd  
Edition Class E standards.  
.2 The patch panel shall meet requirements of  
IEEE 802.3af and IEEE 802.3at.  
.3 It shall mount to a standard EIA-310-D 482.6  
mm (19") rack.  
.4 Terminate 4-pair, 22 - 26 AWG, 100ohm, solid  
or stranded twisted pair cable  
.5 Number of Rack Spaces: 2  
.6 Patch Panel Style: Flat  
.7 Performance Level: Category 6  
.8 Number of Ports: 48

2.11 UTP .1 Cat. 6, T568A/B, 180° degree  
TERMINATION JACKS .1 Voice Termination: Blue  
.2 Data Termination: White  
.3 Video: Direct Attach (Male Connector)

2.12 VOICE/DATA .1 Four Port, Single Gang Faceplate  
OUTLET FACEPLATE .2 Colour same as electrical receptacle face  
plate.  
.3 Includes two snap-in lable fields. Supports  
TIA/EIA 606 Standard.  
.4 Oval mounting holes to assist proper  
alignment.  
.5 2 Blank Insert Modules per faceplacte.

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- 2.13 UTP PATCH CORDS.1 Length to suit , with factory-installed male plug at one end to mate with "RJ-45" jack and with factory-installed male plug at other end to mate with "RJ-45" jack Category 6, 4 pairs to: TIA/EIA-568-C.2.
- .1 Indoor rated for patching within telecommunications cabinets.
  - .2 Voice Patching - Blue
  - .3 Data Patching - White
  - .4 Video Patching - Green
- 2.14 24-PORT POWER OVER ETHERNET (PoE) SWITCH .1 For Security - Network Video Surveillance System Only.
- .2 24 RJ45 ports supporting Power over Ethernet, IEEE 802.3af.
  - .3 8 RJ45 ports supporting High Power over Ethernet, IEEE 802.at.
  - .4 Four shared SFP ports for Gigabit fibre uplinks (shared with last four RJ45 ports).
  - .5 Two built-in 10 Gigabit Ethernet SFP+.
  - .6 Total PoE Budget: 384 Watts
  - .7 Power Consumption: 545 Watts when all PoE in use.
  - .8 EIA-310-D 482.6mm (19") rack mountable with included rack mount kit.
  - .9 Operating Temperature: 32 to 122 degrees C.
  - .10 Operating Humidity: 90% maximum relative humidity, non-condensing
  - .11 CSA certified (CSA 22.2 #950), UL listed (UL 1950)/cUL IEC 950/EN 60950
- 2.15 24-PORT ETHERNET SWITCH .1 For Informatics - Data Network System Only.
- .2 24 RJ45 10/100/1000 Mbps switching ports
  - .3 4 Built-in shared SFP Gigabit Ethernet fibre ports for 100/1000 Mbps connectivity.
  - .4 Auto-sensing and auto-negotiating capabilities on all copper ports
  - .5 Power Consumption: 78.36 Watts
-

- 
- 2.15 24-PORT  
ETHERNET SWITCH  
(Cont'd)
- .6 EIA-310-D 482.6mm (19") rack mountable with included rack mount kit.
  - .7 Operating Temperature: 0°C to 50°C.
  - .8 Operating Humidity: 90% maximum relative humidity, non-condensing.
- 2.16 1000BASE-LX SFP.  
LC GBIC
- .1 Gigabit Ethernet "long-reach" fiber connectivity.
  - .2 It shall have a LC duplex connector.
  - .3 The SFP should fit into the SFP interface on the switch.
  - .4 It should Drive Gigabit Ethernet up to a distance of 550 m with 50/125µm OM3 or 62.5/125µm OM1 multimode fiber cables.
- 2.17 UPS - SECURITY  
NETWORK VIDEO CABINET ONLY
- .1 Requirement: Provide a minimum 20 minutes run time for all equipment operated via cabinet power Distribution.
  - .2 Online, double conversion.
  - .3 Capacity min. 2500 VA/2250 Watts
  - .4 Efficiency: +95% in high efficiency mode, +86% in online mode.
  - .5 Automatic bypass.
  - .6 Nominal Input Voltage: 120 V
    - .1 Input Connection: 5 - 30P, 6 ft. cord.
  - .7 Output Connections:
    - .1 6 NEMA 5-20R, 1 L5-30R
    - .2 Two configurable, individually controlled receptacles
  - .8 Battery:
    - .1 Type: VRLA 12V/9Ah
    - .2 Run Time: +3 minutes with internal batteries @ 100% load.
    - .3 Replacement: Hot-swappable with internal and external batteries.
    - .4 Recharge Time:
      - .1 Internal Batteries: 3 hours
      - .2 Extended Battery Module: 9 hours
-



- 2.17 UPS - SECURITY .9 Standard EIA-310-D 482.6mm (19") rack  
NETWORK VIDEO CABINET mountable  
ONLY  
(Cont'd) .10 Rack Height: 2U
- .11 Included Accessories: Rack mounting brackets,  
rack mounting support rails, Smart UPS  
signalling RS-232 cable, USB cable, Web/SNMP  
Management Card
- .12 Interface ports: DB-9 RS-232, RJ-45 10/100  
BASE-T, USB
- .13 Operating Environment:  
.1 Operating Temperature: 0 to 40 degrees C  
.2 Operating Relative Humidity: 0 - 95%
- .14 Approvals: BSMI, CSA, FCC Part 15 Class A,  
NOM, UL 1778, VCCI
- 2.18 EXTENDED RUN .1 The extended run battery pack should be  
BATTERY PACK compatible with the UPS.
- .2 With the UPS, the extended run battery pack  
should provide a minimum of 20 minutes of  
runtime.
- .3 Battery Type: VRLA
- .4 The extended run battery pack should be  
Standard EIA-310-D 482.6mm (19") rack  
mountable with included rack mounting kit.
- .5 Rack Height: 2U
- .6 Operating Environment:  
.1 Operating Temperature: 0°C to 40°C  
.2 Operating Relative Humidity: 0 - 95%
-

PART 3 - EXECUTION

- 3.1 INSTALLATION OF HORIZONTAL DISTRIBUTION CABLES
- .1 Install horizontal cables as indicated in conduits from telecommunication enclosure to individual camera, video surveillance monitors. Identify and label as indicated to: TIA/EIA-606-A.
  - .2 Terminate horizontal cables in telecommunications enclosure and at each individual device locations.
    - .1 Identify and label as indicated to: TIA/EIA-606-A.
  - .3 Harness slack cable in enclosure.
- 3.2 IMPLEMENT CROSS-CONNECTIONS
- .1 Implement cross-connections using patch cords as specified.
- 3.3 FIELD QUALITY CONTROL
- .1 Test horizontal UTP cables as specified below and correct deficiencies provide record of results as hard copy electronic record on CD or USB drive.
    - .1 Perform tests for Permanent Link on installed cables, including spares:
      - .1 Category 5e using certified level IIe tester to: TIA/EIA-568-C.1.
      - .2 Category 6 using certified level III tester to: TIA/EIA-568-C.2.
- 3.4 INTEGRATION
- .1 New backbone fibre cable from existing Informatics Node in \_\_\_\_ to new Kitchen Communications Equipment (Server) Room, new Informatics cabinet (node).
  - .2 New backbone fibre cable from existing Security node in \_\_\_\_\_ to new Kitchen Communications Equipment (Server) Room, new Video Surveillance Cabinet (Security node).
    - .1 At existing cabinet (node), fibre patch two strands to existing backbone fibre to video archiver room, or
    - .2 At existing cabinet (node), connect to switch via available fibre port or media converter to available copper port.
-

3.4 INTEGRATION      .3    New backbone, multipair copper cable from  
(Cont'd)

existing voice termination block at building service entrance to new Kitchen Communications Equipment (Server) Room, new Voice and Data cabinet (node), patch panel.

3.5 LABELLING      .1    All labelling of cable shall meet the legibility, defacement and adhesion requirements specified in UL 969. In addition the labels shall meet the general exposure requirements in UL 969 for indoor use.

.2    Cable Labels shall be of self-laminating vinyl construction with a white printing area and a clear tail that self laminates the printed area when wrapped around a cable. The clear area should be of sufficient length to wrap around the cable at least one and one-half times.

.3    All labels must be mechanically printed using a laser printer. Hand written labels are not permitted.

.4    Labels shall be adhered to the front of the workstation faceplate, at each end of the cable within 10cm of it's end, and on the distribution connector (patch panel/BIX designator strip).

.5    All fibre optic cables will be identified by means of Warning Labels located on all related conduit, pullboxes and patch panels in secure areas.

.6    Both ends of all fibre cables will be labelled indicating destination and number of strands.

.7    All ports on each fibre optic patch panel will be labelled to identify the backbone destinations. Both ends will be labelled with this same numbering scheme.



PART 1 - GENERAL

1.1 RELATED  
SECTIONS

- .1 Section 27 05 00 - Common Work Results for Communications Systems
- .2 Section 27 10 05 - Structured Cabling for Communications Systems
- .3 Section 28 13 27 - Security Door Supervision
- .4 Section 28 23 00 - Video Surveillance

1.2 WORK INCLUDED

- .1 Electronic Safety and Security Systems provide consolidation and integration capabilities for multiple security related systems. This project will involve Network Video Surveillance and Security Door Supervision as stand-alone systems.
  - .2 The objective is to bring the systems from a state of static completion to dynamic operation through verification and documentation to ensure they meet the design documentation and the End Users functional and operational needs.
  - .3 The security system shall be installed and tested to ensure all components are fully compatible as a system and can be integrated with existing and associated security subsystems.
  - .4 Upon request, be able to provide Certificate of Status as qualified and fully authorized system vendor for the manufacturers submitted.
  - .5 Provide documented record (Systems Verification Forms) of device installation compliance, along with device and system integration testing (Functional Performance) to the satisfaction of CSC departmental representative.
  - .6 Verification should expand on, but contain not less than the following minimum requirements:
    - .1 Cameras, Workstations and Network Switch devices are supported by UPS.
    - .2 Compatibility of all newly installed software with existing systems.
-

1.2 WORK INCLUDED .6 (Cont'd)  
(Cont'd)

.3 All Video Cameras are recorded by Archiver and available for viewing.

.4 Existing or expanded storage systems meet requirements.

.5 All cameras meet visibility requirements (position, focus, etc.) of CSC departmental representative.

PART 2 - PRODUCTS

2.1 GENERAL .1 NOT APPLICABLE

PART 3 - EXECUTION

3.1 GENERAL .1 The Security Contractor shall arrange to be available for all time required to tour site with manufacturer for any necessary warranty considerations, and/or CSC departmental representative or consultant to witness commissioning.

PART 1 - GENERAL

- 1.1 RELATED SECTIONS .1 Section 28 05 00 - Commissioning for Electronic Safety and Security
- 1.2 REFERENCES .1 Underwriters Laboratories of Canada (ULC)  
.1 CAN/ULC-S304-06, Signal Receiving Centre and Premise Burglar Alarm Control Units.  
.2 CAN/ULC-S306-03, Intrusion Detection Units.  
.3 ULC-S318-96, Standard for Power Supplies for Burglar Alarm Systems.  
.4 ULC-C634-M1986, Guide for the Investigation of Connectors and Switches for Use with Burglar Alarm Systems.
- .2 CSA International  
.1 Canadian Electrical Code 2009.
- 1.3 ACTION AND INFORMATIONAL SUBMITTALS .1 Product Data: Submit manufacturer's instructions, printed product literature and data sheets for security door supervision systems: control panels, door contact switches, keypad, audible/visual indicator and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit:  
.1 Functional description of equipment.  
.2 Technical data for devices.  
.3 Device location plans and cable lists.  
.4 Devices mounting location detail drawings.  
.5 Typical devices connection detail drawings.
- .3 Shop Drawings:  
.1 Shop drawings to indicate project layout, mounting heights and locations, wiring diagrams, detection device coverage patterns, contact operating gaps,.  
.2 Submit zone layout drawing indicating number and location of zones and areas covered.
-

- 
- 1.3 ACTION AND INFORMATIONAL SUBMITTALS  
(Cont'd)
- 
- .4 Certificates:  
.1 Submit UL Product Safety Certificates.  
.2 Submit verification Certificate that service company is ULC/UL List alarm service company.  
.3 Submit verification Certificate that intrusion alarm system is Certified Alarm System.
- .5 Manufacturer's Instructions: submit manufacturer's installation instructions.
- 1.4 DELIVERY, STORAGE AND HANDLING
- 
- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:  
.1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.  
.2 Store and protect security door systems from nicks, scratches, and blemishes.  
.3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials.
- 1.5 CLOSEOUT SUBMITTALS
- 
- .1 Operation and Maintenance Data: submit maintenance data for incorporation into manual.  
.1 Include:  
.1 System configuration and equipment physical layout.  
.2 Functional description of equipment.  
.3 Instructions of operation of equipment.  
.4 Illustrations and diagrams to supplement procedures.  
.5 Operation instructions provided by manufacturer.  
.6 Cleaning instructions.
-



- 1.6 WARRANTY .2 Manufacturer's Warranty: submit, for Departmental Representative's acceptance, manufacturer's standard warranty document executed by authorized company official.  
.1 Include manufacturer/dealer recommendations, information and support services for 1 years.

PART 2 - PRODUCTS

- 2.1 DESCRIPTION .1 System to consist of alarm control panel, intrusion switch and key switch bypass located at each door as identified on drawings as well as keypads and audible/visual indicator.  
.2 Design security door supervision system using only ULC/UL listed products.  
.3 Design detection system using ULC/UL listed alarm service company, company specializing in intrusion detection systems.

- 2.2 CONTROL PANEL .1 The control panel shall be a 16 zone panel expandable to 128 zones. Expansion shall be accomplished over a 4-wire Combus using a variety of input/output and functional modules.  
.2 The control panel shall include two addressable loops which shall accommodate up to 112 addressable input devices.  
.3 The system shall also be expandable with a 64 zone wireless receiver which shall connect to the system via the 4-wire Combus.  
.4 The control panel shall be capable of accepting addressable, hardwired and wireless expansion in any combination that suits the application.  
.5 The control panel shall include:  
.1 Two PGM outputs each with 2 application choices:  
.1 As standard PGM output - 59 programmable options.  
.2 As addressable loop - up to 112 addressable devices.  
.2 One supervised bell circuit.  
.3 One unswitched auxiliary power supply.
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- 2.2 CONTROL PANEL .5 The control panel shall include:(Cont'd)  
(Cont'd)
- .4 One Switched auxiliary power supply.
  - .5 Supervised digital alarm communicator with 4 formats:
    - .1 20bps, 1400/2300Hz handshake.
    - .2 Contact ID - SIA with auto-reporting codes.
    - .6 Three telephone numbers. 32 digits each.
    - .7 Three event initiated pager formats.
    - .8 Supervised battery charger.
    - .9 PC-Link connector for local upload/download.
    - .10 Eight system partitions and nine account codes.
    - .11 3,000 event buffer (2,800 viewable on keypad).
    - .12 59 programmable output options for:
      - .1 Bell zone, PGM outputs, relay outputs, transistor outputs
    - .13 Comprehensive scheduling:
      - .1 99 date schedules
      - .2 50 arm/disarm schedules
      - .3 16 automation schedules
      - .4 4 two year holiday schedules
      - .5 99 open/close suppression schedules
    - .14 Multiple communication capabilities.
    - .15 Upload/download capability.
- 2.3 MAGNETIC DOOR CONTACTS (SWITCHES) .1 Door switches: suitable for flush mounting wherever possible and surface mounting only when required.
- .2 Recessed Steel Door Contact w/Wire Leads, 3/4" Diameter, SPDT, White, 3/8" Gap Size. Single Pole-Double Throw.
  - .3 The steel door contacts shall be designed specifically for use in the steel doors commonly found in commercial building applications.
  - .4 The unique housing design features a rugged unibody construction with flexible ribbed sides for quick installs.
  - .5 The door contact shall have the following characteristics:
    - .1 Colour White
    - .2 Contact Configuration SPDT
    - .3 Electrical Configuration SPDT
    - .4 Enclosure Material ABS Plastic
    - .5 Gap Distance (Nominal) 9.5mm (0.375")
    - .6 Lead Distance (Nominal) 304mm (1')
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- 2.3 MAGNETIC DOOR CONTACTS (SWITCHES) (Cont'd) .5 (Cont'd)
- .7 Lead Type #22 wire / 0.15cm (0.05")
  - .8 Length (Nominal) 28.5mm (1.125")
  - .9 Loop Configuration Open or Closed
  - .10 Mounting Option- Magnetic Contacts Recessed
  - .11 Operating Temperature (Minimum) -40 C (-40 F)
  - .12 Operating Temperature (Maximum) 65 C (150 F)
  - .13 UL Rating UL / ULC
  - .14 Width 19mm (0.75")
- 2.4 END-OF-LINE RESISTORS .1 Mount end-of-line resistors to control supervisory current in each circuit, in control panel.
- 2.5 KEYPAD .1 The keypad shall provide a plain language interface using a large two line 32 character LCD display with adjustable brightness and contrast.
- .2 All system programming and user operations shall be able to be performed using the LCD keypads.
  - .3 Keypads are connected to the control panel(s) via a 4-wire system communications bus (Combus) which provides power for the keypads and acts as the system communication channel.
  - .4 Keypads are enrolled onto the system at the time of installation, and are supervised for low voltage and presence by the main panel.
  - .5 The keypad shall include a wall tamper switch.
- 2.6 AUDIBLE/VISUAL INDICATOR .1 Mounting in location as identified on drawing after confirmation with CSC representative.
- .2 Visual indicator should be four lights with different colour lenses to represent alarm status of four different zones: north, east, south, and west doors.
-

- 2.7 KEY SWITCH BYPASS .1 Provide each contact with two physical key switch bypasses to allow the door to be open without activating the alarm. One shall allow for 30 second timed access and the other shall be two state (on/off) to allow for access of an indeterminate amount of time.

PART 3 - EXECUTION

- 3.1 EXAMINATION .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for security door system installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.
- 3.2 INSTALLATION .1 Install complete door supervision system as indicated and in accordance with manufacturer's written installation instructions.
- .2 Install panel in basement Communications Equipment Room as indicated on drawing.
  - .3 Install keypads (as indicated on drawings):
    - .1 In Kitchen Supervisor office, and
    - .2 Atop of stairs, inside of entrance from outside door leading to basement stairs.
  - .4 Install device boxes with key switch bypass at every door as indicated on drawing.
  - .5 Conceal all wiring with EMT conduit and/or flexible metal conduit where required.
  - .6 Create four zones each to contain all doors on respective north, east, south and west zones.
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- 3.3 SEQUENCES OF OPERATION
- .1 System operation: when supervised door is opened, zone indicated on keypad and operates audible/visual indicator. When "acknowledged" at the keypad, audible signal is silenced.
  - .2 When deactivating switch is operated, supervised door on that zone opened without causing alarm. Zone trouble lamp illuminated when zone is deactivated but audible trouble signal not to sound.
  - .3 Fault in wiring of one zone to cause audible signal to sound even if zone in deactivated position.
- 3.4 SITE TESTS
- .1 Perform tests in accordance with Canadian Electrical Code.
  - .2 Test system components in presence of Departmental Representative to ensure correct operation of system. On completion of tests, submit to Departmental Representative certificate listing components tested.
  - .3 Visual verification: objective is to assess quality of installation and assembly and overall appearance to ensure compliance with Contract Documents. Visual inspection to include:
    - .1 Sturdiness of equipment fastening.
    - .2 Non-existence of installation related damages.
    - .3 Compliance of device locations with reviewed shop drawings.
    - .4 Compatibility of equipment installation with physical environment.
    - .5 Inclusion of all accessories.
    - .6 Device and cabling identification.
    - .7 Application and location of ULC approval decals.
  - .4 Technical verification: purpose to ensure that all systems and devices are properly installed and free of defects and damage. Technical verification includes:
    - .1 Measurements of coverage patterns
    - .2 Connecting joints and equipment fastening.
    - .3 Compliance with manufacturer's specification, product literature and installation instructions.
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- 3.4 SITE TESTS  
(Cont'd)
- .5 Operational verification: purpose to ensure that devices and systems' performance meet or exceed established functional requirements. Operational verification includes:
- .1 Operation of each device individually and within its environment.
  - .2 Operation of each device in relation with programmable schedule and or/specific functions.
- 3.5 CLEANING
- .1 Progress Cleaning:
    - .1 Leave Work area clean at end of each day.
  - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
  - .3 Waste Management: separate waste materials for reuse and recycling.
    - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
- 3.6 PROTECTION
- .1 Protect installed products and components from damage during construction.
  - .2 Repair damage to adjacent materials caused by security door system installation.

PART 1 - GENERAL

1.1 RELATED  
SECTIONS

- .1 Section 27 05 00 - Common Work Results for Communications Systems
- .2 Section 27 08 00 - Commissioning for Communications Systems
- .3 Section 27 10 05 - Structured Cabling for Communication Systems
- .4 Section 28 05 00 - Commissioning for Electronic Safety and Security

1.2 GENERAL

- .1 The Security Contractor shall be an authorized reseller of the current operational Genetec Omnicast IP Video Management Software system.
- .2 All equipment and materials used shall be standard components that are manufactured and used in the manufacturer's system.
- .3 All systems and components shall have been thoroughly tested and proven in actual use.
- .4 The overall intent is to provide fully functional integration of new network cameras into the existing system and all items reasonably inferable as required by the plans, specifications, and drawings, if such items are unintentionally omitted.

1.3 SYSTEM  
DESCRIPTION

- .1 The expansion of the existing video surveillance system will consist of 15 new, Power Over Ethernet, network dome cameras ceiling mounted throughout the new kitchen as indicated on the drawings.
  - .2 The current Genetec archiver system, if necessary, will be expanded to accommodate the addition of above cameras operating at 640 x 480 VGA resolution (4 CIF), 15 fps with a 10 MB cap for each camera.
  - .3 The cameras are to be viewed remotely on a video monitor in the kitchen office. Kitchen staff shall be allowed live viewing of all kitchen cameras and additionally, be provided
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- 1.3 SYSTEM DESCRIPTION (Cont'd)
- .3 (Cont'd)  
with the ability to review 24 hours of recorded video.
  - .4 A Network Video User Station (NVUS), a workstation, shall be rackmounted in the Security Network Cabinet in the basement as indicated on the drawings. Omnicast Client Software (Liveviewer/Security Centre) is to be installed on this workstation to support camera viewing.
  - .5 KVM,VGA and/or USB extenders shall be provided to transmit video and mouse signals through Cat. 6 network cabling from the remote workstation in the basement to the video monitor and mouse in the kitchen office.
  - .6 Security Network Cabinet will also contain: fibre backbone to archiver, cat. 6 cable distribution to cameras, PoE network switch and UPS.
- 1.4 CLOSEOUT SUBMITTALS
- .1 Operation and Maintenance Data: submit maintenance data for incorporation into manual. Include following:
    - .1 System configuration and equipment physical layout.
    - .2 Functional description of equipment.
    - .3 Manufacturer's Instructions for operation, adjustment and cleaning.
    - .4 Illustrations and diagrams to supplement procedures.
- 1.5 DELIVERY, STORAGE AND HANDLING
- .1 Deliver, store and handle materials in with manufacturer's written instructions.
  - .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
  - .3 Storage and Handling Requirements:
    - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
    - .2 Store and protect video surveillance materials from nicks, scratches, and blemishes.
    - .3 Replace defective or damaged materials with new.
-



- 1.6 WARRANTY .1 Manufacturer's Warranty: submit, for Departmental Representative's acceptance, manufacturer's standard warranty document executed by authorized company official.

PART 2 - PRODUCTS

- 2.1 GENETEC .1 The security contractor shall be an authorized reseller of Genetec systems and shall supply and install any additional camera and/or client workstation licenses to provide for a fully functional system.  
- OMNICAST IP VIDEO SURVEILLANCE SYSTEM

- 2.2 INDOOR PoE .1 The camera shall be compatible with the existing system.  
NETWORK DOME CAMERA
- .2 Camera Specifications
- .1 Vandal resistant
  - .2 Image Sensor: Progressive scan, RGB CMOS 1/4"
  - .3 Lens
    - .1 Varifocal with remote zoom and focus
    - .2 6 mm
    - .3 72° - 34° Horizontal angle of view
    - .4 F1.2
    - .5 DC-Iris
  - .4 Automatically removable infrared-cut filter.
  - .5 Minimum Illumination
    - .1 Color: 0.2 lux
    - .2 B/W: 0.04 lux
  - .6 Shutter Time
    - .1 1/25 000s to 1/6s
  - .7 Camera Angle Adjustment
    - .1 Pan 360°, tilt 170°, rotation 340°
  - .8 Video
    - .1 Video Compression: H.264, Motion JPEG
    - .2 Resolution: 800x600 to 160x190
    - .3 Frame Rate: 30 fps in all resolutions
  - .9 General
    - .1 Casing: Polycarbonate transparent cover, Aluminum inner camera module with encapsulated electronics, 1000kg (2200lb.) impact-resistant aluminum casing.
    - .2 Processor and Memory: ARTPEC-3, 128MB RAM, 128MB Flash

- 
- 2.2 INDOOR PoE .2 (Cont'd)  
NETWORK DOME CAMERA .9 (Cont'd)  
(Cont'd)
- .3 Power: Power over Ethernet IEEE802.3af Class 2
  - .4 Connectors: RJ-45 for 10BASE-T/100BASE-TX PoE
  - .5 Operating Temperature: 0°C to 50°C; (32°F to 131°F)
  - .10 Accessories Included: Mounting and connector kits, Installation Guide, User's Manual, Windows decoder 1 user licence.
- 2.3 NETWORK VIDEO .1 Features:  
USER STATION
- .1 Small Form Factor workstation
  - .2 Available 4U adjustable depth rackmounting kit
  - .3 Rack mount workstation in computer cabinet will provide remote access and similar front of screen experience to actually sitting at the workstation.
- .2 Specifications:
- .1 Windows 7 OS or compatible Windows version
  - .2 Processor: Intel Core i5-2400, 3.10 GHz, 95W, 6MB cache, 1333 MHz memory
  - .3 Chipset: Intel C206
  - .4 Memory: 4 GB ECC/nonECC DDR3 SDRAM, 1333MHZ (board:4 DIMM slots up to 16GB)
  - .5 Drive Controller: Integrated SATA 3 Gbps /6 Gbps controller
  - .6 Hard Drive: 250 GB SATA, 7200 RPM
  - .7 Optical Drive: DVD-ROM,DVD+/-RW
  - .8 Drive Bays: 1 internal 3.5" bay, and 1 shared with external 3.5" bay, 1 external 5.25" bay
  - .9 Integrated Graphics: Intel HD Graphics 2000
  - .10 Network: Intel 82579 Gbe Network Connection
  - .11 Ports: Front- 4USB 2.0, Rear- 6 USB 2.0, 1 serial, 2 PS/2, RJ-45 NIC, 1 VGA, 1 DisplayPort
  - .12 Chasis: 2U Rack workstation
    - .1 Height: 10.0 cm (3.95 in.)
    - .2 Width: 33.8 cm (13.3 in.)
    - .3 Depth: 15.0 cm (15.0 in.)
  - .13 Wattage: 240W 90% plus efficiency
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- 2.4 MINI KVM  
EXTENDER
- .1 Features:
    - .1 Two micro sized, compact units
    - .2 Pure hardware - No software conflicts, network independent
    - .3 Multi-platform support - PS/2, USB, SUN
  - .2 Specifications:
    - .1 System Cable: CAT6 cable 2x4x24 AWG Solid Wire
    - .2 Maximum Distance: 70m/230ft
    - .3 Mouse Support: 2 or 3 or 5 button PS/2, Wheelmouse, Intellimouse Explorer
    - .4 Support for all major operating systems
    - .5 Screen resolution: 1600 x 1200 @ 75Hz
    - .6 Operating Temperature: 0 to 40 degrees C
    - .7 Storage Temperature: -40 to 70 degrees C
    - .8 Dimensions: 89 x 46 x 23.5 mm
    - .9 Cables and Connectors (Transmitter):  
Built-in KVM, System - RJ45
    - .10 Cables and Connectors (Receiver):  
VGA-HDD15F, Keyboard - MiniDin6F, Mouse - MiniDin6F, System - RJ45
    - .11 Power Supply: Connected Computer (Transmitter), External power adapter 5VDC (Receiver)
- 2.5 KVM EXTENDER  
USB
- .1 Allows console to be extended up to 150m.
  - .2 System Cable: CAT5 FTP 2x4x24 AWG Solide Wire.
  - .3 Screen Resolution: Up to 1600 x 1200 @ 75Hz
  - .4 Operating Temperature: 0 to 40 degrees C
  - .5 Transmitter:
    - .1 Ports: VGA (1 for computer, 1 for monitor), 2 USB, RJ45
    - .2 Power Supply: From computer or external power adapter 12Vdc 1A
  - .6 Receiver:
    - .1 Ports: VGA, 2 USB, RJ45
    - .2 Power Supply: 12 Vdc 1A
  - .7 Included USB cables
- 2.6 VGA CABLE
- .1 Connectors: HD-15 Male to HD-15 Male
  - .2 Sufficient size to connect KVM extender to monitor.
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- 2.7 MONITOR
- .1 Diagonal Viewable Size: 558mm (22")
  - .2 Aspect Ratio: 16:9
  - .3 Optimal Resolution: 1920 x 1080 at 60Hz
  - .4 Contrast Ratio: 1000:1 (Typical)
  - .5 Response Time: 5 ms
  - .6 Device Type: Flat Panel Monitor
  - .7 Weight: Under 5 kg
  - .8 Connectivity: 1 VGA port
  - .9 Power Consumption: 25 W
  - .10 Voltage Required: 100 to 240 VAC
  - .11 VESA 100mm mounting compliant.
  - .12 Temperature Operating Range: 0 to 40 degrees C.
  - .13 Humidity Range Operating: 10%-80% (non-condensing)
- 2.8 ARTICULATING ARM
- .1 Wall mount articulating arm for flat panel screens.
  - .2 Supports mounting monitors up to and including 558mm (22") diagonal screen size.
  - .3 Should allow for the following movement:
    - .1 Roll:  $\pm 5^\circ$
    - .2 Swivel:  $\pm 90^\circ$
    - .3 Tilt:  $\pm 35^\circ$
  - .4 Integrated cable management
  - .5 Extends to 14.46"
  - .6 Retracts to 2.42"
  - .7 Wall plate dimensions: (L x W): 2.25" x 4.50"
  - .8 VESA 100mm mounting compliant.
-

PART 3 - EXECUTION

- 3.1 EXAMINATION .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for video surveillance installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.
- 3.2 INSTALLATION .1 Comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheet.
- .2 Install video surveillance equipment and components in accordance with ULC-S317.
  - .3 Install cable, boxes, mounting hardware, brackets, video cameras and system components in accordance with manufacturer's written installation instructions.
  - .4 Install components secure, properly aligned and in locations shown on reviewed shop drawings.
  - .5 Connect cameras to cabling in accordance with installation instructions.
- 3.3 FIELD QUALITY CONTROL .1 Schedule site visits to review Work at stages required.
- 3.4 SYSTEM STARTUP .1 Perform verification inspections and test in the presence of Departmental Representative.
- .1 Provide all necessary tools, ladders and equipment.

- 3.4 SYSTEM STARTUP .1 (Cont'd)  
(Cont'd)
- .2 Ensure appropriate subcontractors, and manufacturer's representatives and security specialists are present for verification.
- .2 Visual verification: objective is to assess quality of installation and assembly and overall appearance to ensure compliance with Contract Documents. Visual inspection to include:
- .1 Sturdiness of equipment fastening.
- .2 Non-existence of installation related damages.
- .3 Compliance of device locations with reviewed shop drawings.
- .4 Compatibility of equipment installation with physical environment.
- .5 Inclusion of all accessories.
- .6 Device and cabling identification.
- .3 Technical verification: purpose to ensure that all systems and devices are properly installed and free of defects and damage. Technical verification includes:
- .1 Measurements of tension and power.
- .2 Connecting joints and equipment fastening.
- .3 Measurements of signals (dB, lux, baud rate, etc).
- .4 Compliance with manufacturer's specification, product literature and installation instructions.
- .4 Operational verification: purpose to ensure that devices and systems' performance meet or exceed established functional requirements. Operational verification includes:
- .1 Operation of each device individually and within its environment.
- .2 Operation of each device in relation with programmable schedule and or/specific functions.
- .3 Operation control of camera lens, pan, tilt and zoom.
- .4 Switching of camera to any monitor.
- .5 Switching of system video recorder to selective monitor.
- .6 Set dwell times.
- .7 Demonstrate:
- .1 Sequence viewing of cameras on each monitor.
-

- 3.5 ADJUSTING .1 Remove protective coverings from cameras and components.
- .2 Adjust cameras for correct function.
- 3.6 CLEANING .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
- .1 Clean camera housing, system components and lens, free from marks, packing tape, and finger prints, in accordance with manufacturer's written cleaning recommendations.
- .3 Waste Management: separate waste materials for reuse and recycling.
- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
- 3.7 PROTECTION .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by video surveillance installation.





PART 1 - GENERAL

- 1.1 REFERENCES
- .1 Treasury Board of Canada Secretariat (TBS), Occupational Safety and Health (OSH)
    - .1 Fire Protection Standard-10.
  - .2 Underwriter's Laboratories of Canada (ULC)
    - .1 CAN/ULC-S524-06, Standard for the Installation of Fire Alarm Systems.
    - .2 CAN/ULC-S537-04, Standard for the Verification of Fire Alarm Systems.
  - .3 NBCC 2010, National Building Code of Canada.
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Submit in accordance with Section 01 33 00.
  - .2 Product Data:
    - .1 Submit manufacturer's instructions, printed product literature and data sheets for multiplex fire alarm system and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 Shop Drawings:
    - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
    - .2 Indicate on shop drawings:
      - .1 Detail assembly and internal wiring diagrams for control units. Consoles Auxiliary cabinets.
      - .2 Overall system riser wiring diagram identifying control equipment initiating zones signaling circuits; identifying terminations, terminal numbers, conductors and raceways.
      - .3 Details for devices.
      - .4 Details and performance specifications for control, annunciation and peripherals with item by item cross reference to specification for compliance.
      - .5 Step-by-step operating sequence, cross referenced to logic flow diagram.
-

- 1.3 CLOSEOUT  
SUBMITTALS
- .1 Submit in accordance with Section 01 78 00.
  - .2 Operation and Maintenance Data: submit operation and maintenance data for fire alarm system for incorporation into manual.
  - .3 Include:
    - .1 Instructions for complete fire alarm system to permit effective operation and maintenance.
    - .2 Technical data - illustrated parts lists with parts catalogue numbers.
    - .3 Copy of approved shop drawings with corrections completed and marks removed except review stamps.
    - .4 List of recommended spare parts for system.
- 1.4 MAINTENANCE  
MATERIAL SUBMITTALS
- .1 Submit maintenance materials in accordance with Section 01 78 00.
- 1.5 DELIVERY,  
STORAGE AND  
HANDLING
- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
  - .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
  - .3 Storage and Handling Requirements:
    - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
    - .2 Store and protect materials from nicks, scratches, and blemishes.
    - .3 Replace defective or damaged materials with new.
  - .4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 20.
-

PART 2 - PRODUCTS

- 2.1 DESCRIPTION .1 Existing system is Siemens MXL with main control panel located at M CCP.
- 2.2 INITIATING/  
INPUT CIRCUITS .1 Receiving circuits for alarm initiating devices such as manual pull stations, smoke detectors, heat detectors and water flow switches, wired in DCLA configuration to central control unit or DGP's/transponders.
- .2 Alarm receiving circuits (active and spare): compatible with smoke detectors and open contact devices.
- .3 Receiving circuits for supervisory, N/O devices. Devices: wired in DCLA configuration to central control unit or DGP's/transponders.
- 2.3 ALARM OUTPUT  
CIRCUITS .1 Alarm output circuit: connected to signals, wired in class A configuration to central control unit or DGP's/transponders.
- .1 Signal circuits' operation to follow system programming;.
- 2.4 WIRING .1 Twisted copper conductors: rated 300 V.
- .2 To initiating circuits: 18 AWG minimum, and in accordance with manufacturer's requirements.
- .3 To signal circuits: 16 AWG minimum, and in accordance with manufacturer's requirements.
- .4 To control circuits: 14 AWG minimum, and in accordance with manufacturer's requirements.
- 2.5 MANUAL ALARM  
STATIONS .1 Addressable manual pull station.
- .1 Pull lever, break glass rod, semi-flush wall mounted type, single action, electronics to communicate station's status to addressable module/transponder over 2 wires and to supply power to station. Station address to be set on station in field.
-

2.6 AUTOMATIC  
ALARM INITIATING  
DEVICES

- .1 Addressable thermal fire detectors, combination fixed temperature and rate of rise, non-restorable fixed temperature element, self-restoring rate of rise, fixed temperature 57 degrees C, rate of rise 8.3 degrees C per minute.
  - .1 Electronics to communicate detector's status to addressable module/transponder.
  - .2 Detector address to be set on detector in field.
  - .3 Low profile type.
  - .4 Base compatible with heat detectors.
- .2 Addressable variable-sensitivity smoke detectors.
  - .1 Ionization type.
  - .2 Electronics to communicate detector's status to addressable module/transponder.
  - .3 Detector address to be set on detector in field.
  - .4 Sensitivity settings: determined and operated by control panel. No shifting in detector sensitivity due to atmospheric conditions (dust, dirt) within certain parameters.
  - .5 Ability to annunciate minimum of 2 levels of detector contamination automatically with trouble condition at control panel.
  - .6 Low profile type.
  - .7 Base compatible with heat detectors.

2.7 AUDIBLE SIGNAL  
DEVICES

- .1 Bells: vibrating type, gongs of special alloy steel, 24 V dc, 90 db.

2.8 VISUAL ALARM  
SIGNAL DEVICES

- .1 Strobe type: flashing, 24 V dc.
- .2 Designed for surface mounting on ceiling or walls as indicated.
- .3 Synchronize.

2.9 ANCILLARY  
DEVICES

- .1 Remote relay unit to initiate fan shutdown.
-

PART 3 - EXECUTION

- 3.1 EXAMINATION .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for fire alarm installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.
- 3.2 INSTALLATION .1 Install systems in accordance with CAN/ULC-S524 and TB Fire Protection Standard.
- .2 Install manual alarm stations and connect to alarm circuit wiring.
  - .3 Locate and install detectors and connect to alarm circuit wiring. Mount detectors more than 1 m from air outlets. Maintain at least 600 mm radius clear space on ceiling, below and around detectors. Locate duct type detectors in straight portions of ducts.
  - .4 Connect alarm circuits to main control panel.
  - .5 Install bells and visual signal devices and connect to signalling circuits.
  - .6 Connect signalling circuits to main control panel.
  - .7 Install door releasing devices.
  - .8 Install remote relay units to control fan shut down.
  - .9 Sprinkler system: wire alarm and supervisory switches and connect to control panel.
  - .10 Connect fire suppression systems to control panel.
  - .11 Splices are not permitted.
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- 3.2 INSTALLATION  
(Cont'd)
- .12 Provide necessary raceways, cable and wiring to make interconnections to terminal boxes, annunciator equipment and CCU, as required by equipment manufacturer.
  - .13 Ensure that wiring is free of opens, shorts or grounds, before system testing and handing over.
  - .14 Identify circuits and other related wiring at central control unit, annunciators, and terminal boxes.
- 3.3 FIELD QUALITY CONTROL
- .1 Perform tests in accordance with Section 26 05 00 and CAN/ULC-S537.
  - .2 Fire alarm system:
    - .1 Test such device and alarm circuit to ensure manual stations, thermal and smoke detectors sprinkler system transmit alarm to control panel and actuate alarm & ancillary devices.
    - .2 Check annunciator panels to ensure zones are shown correctly.
    - .3 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of systems.
    - .4 Addressable circuits system style DCLA:
      - .1 Test each conductor on all DCLA addressable links for capability of providing 3 or more subsequent alarm signals on each side of single open-circuit fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.
      - .2 Test each conductor on all DCLA addressable links for capability of providing 3 or more subsequent alarm signals during ground-fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.
    - .5 Addressable circuits system style DCLB:
      - .1 Test each conductor on all DCLB addressable links for capability of providing 3 or more subsequent alarm signals on line side of single open-circuit fault condition imposed near
-

- 3.3 FIELD QUALITY CONTROL (Cont'd)
- .2 Fire alarm system:(Cont'd)
    - .5 (Cont'd)
      - .1 (Cont'd)

electrically most remote device on each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.
      - .2 Test each conductor on all DCLB addressable links for capability of providing 3 or more subsequent alarm signals during ground-fault condition imposed near electrically most remote device on each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.
    - .3 Provide final PROM program re-burn for system Departmental Representative incorporating program changes made during construction.
- 3.4 CLEANING
- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
    - .1 Leave Work area clean at end of each day.
  - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
  - .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.
    - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
    - .2 Place materials defined as hazardous or toxic waste in designated containers.
- 3.5 PROTECTION
- .1 Protect installed products and components from damage during construction.
  - .2 Repair damage to adjacent materials caused by fire alarm system installation.
-

3.6 CLOSEOUT  
ACTIVITIES

- .1 Provide on-site lectures and demonstration by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system.



PART 1 - GENERAL

1.1 RELATED  
SECTIONS

- .1 Section 013300 - Submittal Procedures
- .2 Section 013543 - Environmental Procedures
- .3 Section 015600 - Temporary Barriers and Enclosures
- .4 Section 017419 - Construction/Demolition Waste Management and Disposal
- .5 Section 321615 - Concrete walks, curbs and gutters
- .6 Section 330514 - Manholes and Catch Basins Structures
- .7 Section 331116 - Site Water Utility Distribution Piping
- .8 Section 334100 - Storm Utility Drainage Piping

1.2 DEFINITIONS

- .1 Excavation classes: two classes of excavation will be recognized; common excavation and rock excavation.
  - .1 Rock: any solid material in excess of 0.75 m<sup>3</sup> and which cannot be removed by means of heavy duty mechanical excavating equipment with 0.95 to 1.15 m<sup>3</sup> bucket. Frozen material not classified as rock.

SPEC NOTE: Paragraph level is uncertain

- .2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.
  - .2 Topsoil: material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.
  - .3 Waste material: excavated material unsuitable for use in Work or surplus to requirements.
  - .4 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.
-

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- 1.2 DEFINITIONS (Cont'd)
- .5 Unsuitable materials:
    - .1 Weak and compressible materials under excavated areas.
    - .2 Frost susceptible materials under excavated areas.
    - .3 Excessively wet material which can not achieve required compaction.
    - .4 Frost susceptible materials:
      - .1 Fine grained soils with plasticity index less than 10 when tested to ASTM D4318, and gradation within limits specified when tested to ASTM: CAN/CGSB8.2.
      - .2 Coarse grained soils containing more than 20% by mass passing 0.075mm sieve.
  - .6 Unshrinkable fill: very weak mixture of Portland cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.
- 1.3 SUBMITTALS
- .1 Submit samples in accordance with Section 013300 - Submittal Procedures
  - .2 Inform Departmental Representative at least 2 weeks prior to commencing work, of proposed source of fill materials and provide access for sampling.
- 1.4 WASTE MANAGEMENT AND DISPOSAL
- .1 Separate and recycle waste materials in accordance with Section 017419- Construction/Demolition Waste Management and Disposal.
- 1.5 PROTECTION OF EXISTING FEATURES
- .1 Protect existing features in accordance with Section 015600 - Temporary Barriers and Enclosures and applicable local regulations.
  - .2 Existing buried utilities and structures:
    - .1 Location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
    - .2 Prior to commencing excavation Work, notify Departmental Representative; establish location and state of use of buried utilities and structures.
-

1.5 PROTECTION OF  
EXISTING FEATURES  
(Cont'd)

- .2 (Cont'd)  
.2 (Cont'd)  
Departmental Representative to clearly  
mark such locations to prevent  
disturbance during Work.

SPEC NOTE: Paragraph level is uncertain

- .3 Confirm locations of buried utilities by  
careful test excavations in advance of  
main work.  
.4 Maintain and protect from damage, water,  
sewer, gas, electric, telephone and other  
utilities and structures encountered.  
.5 Where utility lines or structures exist  
in area of excavation, obtain direction  
of Departmental Representative before  
removing or re routing.  
.6 Record location of maintained, re routed  
and abandoned underground lines.

- .3 Existing buildings and surface features:  
.1 Conduct, with Departmental  
Representative, condition survey of  
existing buildings, trees and other  
plants, lawns, fencing, service poles,  
wires, rail tracks, pavement, survey  
bench marks and monuments which may be  
affected by Work.  
.2 Protect existing buildings and surface  
features from damage while Work is in  
progress. In event of damage, immediately  
make repair to approval of Departmental  
Representative.

1.6 BOREHOLE LOGS

- .1 Borehole logs are included in the  
specification following this section and are  
for information only.
-

PART 2 - PRODUCTS

- 2.1 MATERIALS
- .1 The material to be used for backfilling the service trenches should be compactable, i.e. free of organics and debris and with a natural moisture content which is within 2 percent of the optimum moisture content.
  - .2 Imported subgrade fill used for backfilling material shall conform to OPSS requirement for Granular 'B' or Select Subgrade Material.
  - .3 The on-site native soil above the groundwater table and the granular fill excavated from the site may be suitable for backfilling purposes. These materials if used for backfilling should not be stockpiled on-site for a long period of time, especially during wet weather periods since they are susceptible to moisture absorption.

PART 3 - EXECUTION

- 3.1 SITE PREPARATION
- .1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.
  - .2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.
- 3.2 STRIPPING OF TOP SOIL
- .1 Remove topsoil before any construction procedures commence to avoid compaction of topsoil.
  - .2 Commence topsoil stripping of areas as indicated after area has been cleared of brush, weeds, and grasses and removed from site.
  - .3 Strip topsoil to depths as indicated. Do not mix topsoil with subsoil.
  - .4 Stockpile in locations as directed by Departmental Representative. Stockpile height not to exceed 2m.
-

3.2 STRIPPING OF  
TOP SOIL  
(Cont'd)

- .5 Dispose of unused topsoil in locations as directed by Departmental Representative.
- .6 Handle topsoil only when it is dry and warm.
- .7 Remove vegetation from targeted area by non-chemical means and dispose of through mulching.
- .8 Remove brush from targeted area by non-chemical means and dispose of through mulching.
- .9 Protect stockpiles from contamination and compaction.
- .10 Topsoil that has been piled for long term storage will be covered with grass to maintain agricultural potential of soil.

3.3 STOCKPILING

- .1 Stockpile fill materials in areas designated by Departmental Representative. Stockpile granular materials in manner to prevent segregation.
- .2 Protect fill materials from contamination.
- .3 Contractor shall be responsible to protect the excavated native material from moisture if intend to reuse for backfilling.

3.4 COFFERDAMS,  
SHORING, BRACING  
AND UNDERPINNING

- .1 Construct temporary Works to depths, heights and locations as required.
- .2 Pull sheeting in increments that will ensure compacted backfill is maintained at an elevation at least 500 mm above toe of sheeting.

3.5 DEWATERING AND  
HEAVE PREVENTION

- .1 Keep excavations free of water while Work is in progress.
  - .2 Submit for Departmental Representative's review details of proposed dewatering or heave prevention methods, such as dikes, well points, and sheet pile cut offs.
  - .3 Avoid excavation below groundwater table if quick condition or heave is likely to occur.
-

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- 3.5 DEWATERING AND HEAVE PREVENTION  
(Cont'd)
- .3 (Cont'd)  
Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut offs, or other means.
- .4 Protect open excavations against flooding and damage due to surface run off.
- .5 Dispose of water in accordance with Section 013543- Environmental Procedure and in manner not detrimental to public and private property or any portion of Work completed or under construction.
- 3.6 EXCAVATION
- .1 Excavate to lines, grades, elevations and dimensions as indicated on detail drawing.
- .2 Remove concrete, paving and other obstructions encountered during excavation.
- .3 Excavation must not interfere with bearing capacity of adjacent foundations.
- .4 Take appropriate measures to prevent excavations from freezing.
- .5 Do not disturb soil within branch spread of trees or shrubs that are to remain. If excavating through roots, excavate by hand and cut roots with sharp axe or saw.
- .6 For trench excavation, unless otherwise authorized by Departmental Representative in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation.
- .7 Keep excavated and stockpiled materials a safe distance away from edge of trench as directed by Departmental Representative.
- .8 Restrict vehicle operations directly adjacent to open trenches.
- .9 Dispose of unsuitable material and debris (e.g., pavement, concrete, pipes etc.) in accordance with section 017419- Construction/Demolition Waste Management and Disposal. Dispose of surplus excavated material off site.
-

3.6 EXCAVATION  
(Cont'd)

- .10 Do not obstruct flow of surface drainage or natural watercourses.
- .11 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.
- .12 Notify Departmental Representative when bottom of excavation is reached.
- .13 Obtain Departmental Representative approval of completed excavation.
- .14 Remove unsuitable material from trench bottom to extent and depth as directed by Departmental Representative.
- .15 Correct unauthorized over excavation by backfilling with Granular B Type 1 compacted to not less than 95 % of standard proctor maximum dry density.
- .16 Hand trim, make firm and remove loose material and debris from excavations. Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.
- .17 Prepare a traffic management plan and obtain Departmental Representative's approval of the plan. All excavation work within 300mm of all electrical, communication, steam and chilled water pipes and other utilities shall be performed by hydro-vac equipment.

3.7 FILL TYPES

- .1 Type 1 fill (select subgrade material): conforming to OPSS 1010.
  - .2 Type 2 fill shall be granular B Type II conforming to OPSS 1010.
  - .3 Type 3 fill shall be granular B Type I conforming to OPSS 1010.
  - .4 Native Material as defined in section 2.1.3 above.
-

3.8 BEDDING AND  
SURROUND OF  
UNDERGROUND  
SERVICES

- .1 Place and compact granular material for bedding and surround of underground services as specified in Section 330514 - Manholes and Catch Basins Structures, Section 334100-Storm Utility Drainage Piping, and Section 331116-Site Water Utility Distribution Piping.
- .2 Place bedding and surround material in unfrozen condition.

3.9 BACKFILLING

- .1 Do not proceed with backfilling operations until Departmental Representative has inspected and approved installations.
- .2 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
- .3 Do not use backfill material which is frozen or contains ice, snow or debris.
- .4 Place backfill material in uniform layers not exceeding 300 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.
- .5 Backfilling around installations:
  - .1 Place bedding and surround material as specified elsewhere.
- .6 Do not backfill around or over cast in place concrete within 24 hours after placing of concrete.
- .7 Backfilling adjacent to fresh concrete is not permitted. See section 32 16 15.

3.10 RESTORATION

- .1 Upon completion of Work, remove waste materials and debris in accordance with Section 017419 - Construction/Demolition Waste Management and Disposal, trim slopes, and correct defects as directed by Departmental Representative.
- .2 Reinststate pavements and sidewalks disturbed by excavation to thickness, structure and elevation which existed before excavation.
- .3 Landscaped areas will be backfilled to within 150 mm of final grade.



3.10 RESTORATION .4 Clean and reinstate areas affected by Work as  
(Cont'd) directed by Departmental Representative.



PART 1 - GENERAL

1.1 RELATED SECTIONS .1 Section 31 23 10 Excavating, Trenching and Backfilling

1.2 DEFINITIONS .1 Refer to section 31 23 10.

PART 2 - PRODUCTS

2.1 MATERIALS .1 Not used.

PART 3 - EXECUTION

3.1 PROTECTION .1 Prevent damage to surroundings and injury to persons in accordance with Section 01 56 00 Temporary Barriers and Enclosures.

3.2 ROCK REMOVAL .1 Co ordinate this Section with Section 01 35 30 - Health and Safety Requirements.

.2 Explosive blasting is not permitted.

.3 Use rock removal procedures to produce uniform and stable excavation surfaces. Minimize over break, and to avoid damage to adjacent structures.

.4 Excavate trenches to lines and grades to minimum of 150mm below pipe invert indicated. Provide recesses for bell and spigot pipe to ensure bearing will occur uniformly along barrel of pipe.

.5 Cut trenches to widths as required to safely execute the work.

.6 Remove boulders and fragments which may slide or roll into excavated areas.

.7 Correct unauthorized rock removal at no extra cost, in accordance with Section 31 23 10 Excavating, Trenching and Backfilling.

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- 3.3 UNIT PRICE .1 Payment for rock excavation for watermain, sewers, manholes and services shall be based on quantities measured on site and the unit price quoted in the unit price table. Estimated quantity is shown in the unit price table. Unit price quoted shall be a composite unit price for the excavation of rock including backfilling, all labour, equipment, material and off site disposal of excavated rock and any other related work.
- 3.4 ROCK DISPOSAL .1 Dispose of surplus removed rock off site as indicated.
- .2 Do not dispose removed rock into landfill. Material must be sent to appropriate quarry location as approved by the Departmental Representative.

PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 013543 - Environmental Procedures
  - .2 Section 017419 - Construction/Demolition Waste Management and Disposal.
  - .3 Section 310517 - Aggregates: General.
  - .4 Section 321123 - Aggregate Base Courses
- 1.2 DEFINITIONS
- .1 Delivery and stockpile aggregates in accordance with Section 310517 - Aggregates.
- 1.3 WASTE MANAGEMENT AND DISPOSAL
- .1 Separate waste materials for reuse and recycling in accordance with Section 017419 - Construction/Demolition Waste Management and Disposal.
  - .2 Divert unused asphalt materials from landfill to a site to be approved by the Departmental Representative.

PART 2 - PRODUCTS

- 2.1 MATERIALS
- .1 Granular Sub Base - Granular B Type II as per OPSS 1010.
  - .2 Where the sub-grade is overburden the granular sub base shall have a minimum of 500 mm compacted thickness.
  - .3 Where the sub-grade is bedrock, granular sub base shall not be provided.
  - .4 Subgrade Fill used for grading beneath the access roads shall consist of material meeting the requirements of OPSS Select Subgrade Material (SSM). It should be compacted in lifts no thicker than 300 mm and compacted using suitable compaction equipment to at least 95% SPMDD (ASTM D698).
  - .5 Obtain Departmental Representative's approval of Subgrade Fill material before using it.
-

2.1 MATERIALS  
(Cont'd)

- .6 Obtain Departmental Representative's approval of the compacted subgrade before placing sub-base material over it.

PART 3 - EXECUTION

3.1 PLACING

- .1 Properly shape the subgrade and then proof roll with a heavy vibratory roller in the full-time presence of the Departmental Representative.
- .2 Any soft or spongy subgrade areas detected shall be sub-excavated to a depth of 500 mm and properly replaced with OPSS Granular
- .3 Select subgrade material shall be used to raise the grade to design level.
- .4 Subgrade transition zones between rock and soil and vice versa should be treated in accordance with Ontario Provincial Standards Nos. 205.010 to 205.050, November 2005.
- .5 Place granular sub base after subgrade is inspected and approved by Departmental Representative.
- .6 Construct granular sub base to depth and grade in areas indicated.
- .7 Ensure no frozen material is placed.
- .8 Place material only on clean unfrozen surface, free from snow or ice.
- .9 Place granular sub base materials using methods which do not lead to segregation or degradation.
- .10 Place material to full width in uniform layers not exceeding 150 mm compacted thickness. Departmental Representative may authorize thicker lifts (layers) if specified compaction can be achieved.
- .11 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- .12 Remove and replace portion of layer in which material has become segregated during spreading.

- 3.2 COMPACTION .1 Compact to density of not less than 100% Standard Proctor maximum dry density.
- .2 Shape and roll alternately to obtain smooth, even and uniformly compacted sub base.
- .3 Apply water as necessary during compaction to obtain specified density.
- .4 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Departmental Representative.
- .5 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.
- 
- 3.3 SITE TOLERANCES .1 Finished sub base surface to be within 10 mm of elevation as indicated but not uniformly high or low.
- 
- 3.4 PROTECTION .1 Maintain finished sub base in condition conforming to this section until succeeding base is constructed, or until granular sub base is accepted by Departmental Representative.





PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 013543 - Environmental Procedures
  - .2 Section 017419 - Construction/Demolition Waste Management and Disposal.
  - .3 Section 310517 Aggregates: General.
  - .4 Section 321119 - Granular Sub base.
- 1.2 DELIVERY, STORAGE AND HANDLING
- .1 Deliver and stockpile aggregates in accordance with Section 310517 - Aggregates.
- 1.3 WASTE MANAGEMENT AND DISPOSAL
- .1 Separate and recycle waste materials in accordance with Section 017419 - Construction/Demolition Waste Management and Disposal.
  - .2 Divert unused granular material from landfill to local facility as approved by Departmental Representative.

PART 2 - PRODUCTS

- 2.1 MATERIALS
- .1 Granular Base Course - 150 mm Granular A as per OPSS 1010.

PART 3 - EXECUTION

- 3.1 SEQUENCE OF OPERATION
- .1 Place granular base after sub base surface is inspected and approved by Departmental Representative.
  - .2 Placing
    - .1 Construct granular base to depth and grade in areas indicated.
    - .2 Ensure no frozen material is placed.
    - .3 Place material only on clean unfrozen surface, free from snow and ice.
-

- 3.1 SEQUENCE OF OPERATION  
(Cont'd)
- .2 (Cont'd)
- .4 Place material using methods which do not lead to segregation or degradation of aggregate.
- .5 Place material to full width in uniform layers not exceeding 150 mm compacted thickness. Departmental Representative may authorize thicker lifts (layers) if specified compaction can be achieved.
- .6 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- .7 Remove and replace that portion of layer in which material becomes segregated during spreading.
- .3 Compaction Equipment
- .1 Compaction equipment to be capable of obtaining required material densities.
- .4 Compacting
- .1 Compact to density not less than 100% SPMDD.
- .2 Shape and roll alternately to obtain smooth, even and uniformly compacted base.
- .3 Apply water as necessary during compacting to obtain specified density.
- .4 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Departmental Representative.
- .5 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.
- 3.2 SITE TOLERANCES .1 Finished base surface to be within plus or minus 10 mm of established grade and cross section but not uniformly high or low.
- 3.3 PROTECTION .1 Maintain finished base in condition conforming to this Section until succeeding material is applied or until acceptance by Departmental Representative.

PART 1 - GENERAL

1.1 RELATED  
SECTIONS

- .1 Section 013300 - Submittal Procedures.
- .2 Section 013543 - Environmental Procedures.
- .3 Section 017419 - Construction/Demolition  
Waste Management and Disposal.
- .4 Section 024113 - Selective Site Demolition.
- .5 Section 310517 - Aggregates: General.

1.2 REFERENCES

- .1 Ontario Provincial Standards Specifications  
(OPSS)
    - .1 OPSS 1151 - April 2007 - Material  
Specification for Superpave and Stone  
Mastic Asphalt Mixture.
    - .2 OPSS 1101 - April 2007 - Material  
Specification for Performance Graded  
Asphalt Cement.
    - .3 OPSS 1003 - November 2006 - Material  
Specification for Aggregates - Hot Mix  
Asphalt.
    - .4 OPSS 310 - November 2008 - Construction  
Specification for Hot Mix Asphalt.
  - .2 American Society for Testing and Materials  
(ASTM).
    - .1 ASTM D995 88, Specification for  
Requirements for Mixing Plants for Hot  
Mixed, Hot Laid Bituminous Paving  
Mixtures.
    - .2 ASTM D1559-89, Specification for  
Requirement for Analysis of Compacted  
Paving Mixtures.
    - .3 Asphalt Institute (AI).
    - .4 Asphalt Institute SP 2 2001, Superpave  
Mix Design.
    - .5 Ontario Ministry of Transportation  
Publications
      - .1 LS-261 Preparation of Marshall  
Specimens
      - .2 LS-262 Bulk Relative Density of  
Compacted Bituminous Mixtures
      - .3 LS-264 Theoretical Maximum Relative  
Density of Bituminous Paving Mixtures
      - .4 LS-265 Percent Air Voids in  
Compacted Dense Bituminous Pavement  
Mixtures
-

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- 1.2 REFERENCES .2 (Cont'd)  
(Cont'd) .5 (Cont'd)  
.5 LS-283 Resistance to Stripping of  
Asphalt Cement in Bituminous Mixtures by  
Immersion Marshall, Method of Test for  
.6 LS-602 Sieve Analysis of  
Aggregates, Method of Test for
- 1.3 PRODUCT DATA .1 Submittals in accordance with Section 013300  
- Submittal Procedures.  
.2 Submit asphalt concrete mix design and trial  
mix test results to Departmental  
Representative for approval at least 4 weeks  
prior to commencing work.
- 1.4 SAMPLES .1 Submit samples in accordance with Section  
013300- Submittal Procedures.  
.2 Inform Departmental Representative of  
proposed source of aggregates and provide  
access for sampling at least 4 weeks prior to  
commencing work.
- 1.5 WASTE .1 Separate waste materials for reuse and  
MANAGEMENT AND recycling in accordance with Section 017419-  
DISPOSAL Waste Management and Disposal.

PART 2 - PRODUCTS

- 2.1 MATERIALS .1 Wear Course  
.1 50 mm 12.5 SP Category C Asphalt  
(Performance Grade PG 58-34)  
.2 Base Course  
.1 60 mm 19.0 SP Category C Asphalt  
(Performance Grade PG 58-34)  
.3 Aggregates: to Section 310517 Aggregates:  
General and the following requirements:  
.1 OPSS 1003  
.2 Gradations:  
.1 Fine aggregates shall be graded so  
that when combined with other aggregates,  
they consistently meet the overall
-

2.1 MATERIALS  
(Cont'd)

- .3 Aggregates:(Cont'd)
- .2 Gradations:(Cont'd)
- gradation of the Hot Mix Asphalt (HMA) indicated.
- .2 Coarse aggregates shall be graded so that when combined with other aggregates, they consistently meet the overall gradation of the HMA indicated.
- .3 Gradation for Fine and Coarse Aggregates shall be in accordance with OPSS 1003.
- .3 Coarse aggregate: aggregate retained on 4.75 mm sieve and fine aggregate is aggregate passing 4.75 mm sieve when tested to MTO Test Number LS-602.
- .4 When dryer drum plant or plant without hot screening is used, process fine aggregate through 4.75 mm sieve and stockpile separately from coarse aggregate.
- .5 Separate stockpiles for coarse and fine aggregates not required for sheet asphalt.
- .6 Do not use aggregates having known polishing characteristics in mixes for surface courses.
- .7 Other physical properties requirements for coarse and fine aggregates: shall be in accordance with those requirements listed in OPSS 1003 for the HMA indicated.
- .8 Regardless of compliance with specified physical requirements, fine aggregates may be accepted or rejected on basis of past field performance.
- .4 Mineral filler:
- .1 Finely ground particles of limestone, hydrated lime, Portland cement or other approved non plastic mineral matter, thoroughly dry and free from lumps.
- .2 Add mineral filler when necessary to meet job mix aggregate gradation or as directed to improve mix properties.
- .3 Mineral filler to be dry and free flowing when added to aggregate.
- .5 Anti stripping additive: need for and amount of anti-stripping additive required to MTO Test Number LS-283. May be hydrated lime.
- .6 Water: to approval of Departmental Representative.

2.2 MIX DESIGN

- .1 Mix design to be approved by Departmental Representative.
- .2 Utilize a laboratory that has current CCIL Type A Certification or AMRL equivalent certification or other equivalent certified laboratory acceptable to the Departmental Representative to conduct all mix designs, designate the mix proportions, and prepare the job-mix formulae. For all mixes, except those that contain RAP, the mix design procedures and tests shall be in accordance to the Marshall Method in the Asphalt Institute Manual Series No. 2, MS-02, following the MTO Test Numbers LS-261, LS-262, LS-263, LS-264, LS-265, and LS-283 tests and the requirements detailed herein.
- .3 Design of mix: As per Requirement of OPSS 1151.
- .4 Mix physical requirements: shall conform to the physical requirements in OPSS 1151 Superpave mix.
- .5 Do not change job mix without prior approval of Departmental Representative. When change in material source proposed, new job mix formula to be approved by Departmental Representative.
- .6 Return plant dust collected during processing to mix in quantities acceptable to Departmental Representative.

PART 3 - EXECUTION

3.1 PLANT AND MIXING REQUIREMENTS

- .1 Batch and continuous mixing plants:
  - .1 To ASTM D995.
  - .2 Feed aggregates from individual stockpiles through separate bins to cold elevator feeders. Do not load frozen materials into bins.
  - .3 Feed cold aggregates to plant in proportions to ensure continuous operations.
  - .4 Calibrate bin gate openings and conveyor speeds to ensure mix proportions are achieved.
  - .5 Before mixing, dry aggregates to moisture content not greater than 1 % by mass or to a lesser moisture content if required to meet mix design requirements.

3.1 PLANT AND  
MIXING REQUIREMENTS  
(Cont'd)

- .1 (Cont'd)
- .6 Immediately after drying, screen aggregates into hot storage bins in sizes to permit recombining into gradation meeting job mix requirements.
- .7 Store hot screened aggregates in manner to minimize segregation and temperature loss.
- .8 Heat asphalt cement and aggregate to mixing temperature directed by Departmental Representative. Do not heat asphalt cement above maximum temperature indicated on temperature viscosity chart.
- .9 Make available current asphalt cement viscosity data at plant. With information relative to viscosity of asphalt being used, Departmental Representative to review temperature of completed mix at plant and at paver after considering hauling and placing conditions.
- .10 Maintain temperature of materials within 5 °C of specified mix temperature during mixing.
- .11 Mixing time:
  - .1 In batch plants, both dry and wet mixing times as directed by Departmental Representative. Continue wet mixing as long as necessary to obtain thoroughly blended mix but not less than 30s or more than 75s.
  - .2 In continuous mixing plants, mixing time as directed by Departmental Representative but not less than 45s.
  - .3 Do not alter mixing time unless directed by Departmental Representative.
- .2 Dryer drum mixing plant:
  - .1 To ASTM D995.
  - .2 Load aggregates from individual stockpiles to separate cold feed bins. Do not load frozen materials into bins.
  - .3 Feed aggregates to burner end of dryer drum by means of multi bin cold feed unit and blend to meet job mix requirements by adjustments of variable speed feed belts and gates on each bin.
  - .4 Meter total flow of aggregate by an electronic weigh belt system with indicator that can be monitored by plant operator and which is interlocked with asphalt pump so that proportions of aggregate and asphalt entering mixer remain constant.

3.1 PLANT AND  
MIXING REQUIREMENTS  
(Cont'd)

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- .2 Dryer drum mixing plant:(Cont'd)
- .5 Provide for easy calibration of weighing systems for aggregates without having material enter mixer.
  - .6 Calibrate bin gate openings and conveyor speeds to ensure mix proportions are achieved. Calibrate weigh bridge on charging conveyor by weighing amount of aggregate passing over weigh bridge in set amount of time. Difference between this value and amount shown by plant computer system to differ by not more than plus or minus 2 %.
  - .7 Make provision for conveniently sampling full flow of materials from cold feed.
  - .8 Provide screens or other suitable devices to reject oversize particles or lumps of aggregate from cold feed prior to entering drum.
  - .9 Provide system interlock stop all feed components if either asphalt or aggregate from any bin stops flowing.
  - .10 Accomplish heating and mixing of asphalt mix in approved parallel flow dryer mixer in which aggregate enters drum at burner end and travels parallel to flame and exhaust gas stream. Control heating to prevent fracture of aggregate or excessive oxidation of asphalt. Equip system with automatic burner controls and provide for continuous temperature sensing of asphalt mixture at discharge, with printing recorder that can be monitored by plant operator. Submit printed record of mix temperatures at end of each day.
  - .11 Mixing period and temperature to produce uniform mixture in which particles are thoroughly coated, and moisture content of material as it leaves mixer to be less than 2%.
- .3 Temporary storage of hot mix:
- .1 Provide mix storage of sufficient capacity to permit continuous operation and designed to prevent segregation.
  - .2 Do not store asphalt mix in storage bins in excess of 3 h.
- .4 While producing asphalt mix for this project, do not produce mix for other users unless separate storage and pumping facilities are provided for materials supplied to this project.
-



3.1 PLANT AND  
MIXING REQUIREMENTS  
(Cont'd)

- .5 Mixing tolerances:
  - .1 As per Table 7 of OPSS 310
  - .2 Permissible variation of asphalt cement from job mix: 0.30%.
  - .3 The temperature of the mixture as it is discharged from the mixer shall be controlled within the temperature range that corresponds to the performance grade asphalt cement manufacturer's recommending mixing temperature.
- .6 Addition of anti stripping agent:
  - .1 Plant to be equipped with pugmill to thoroughly mix aggregates and lime prior to entering the plant.
  - .2 Plant to be equipped with suitable conveyor systems capable of supplying aggregates and lime at constant rate.
  - .3 Plant and equipment used for addition of lime to be equipped with covers to control loss of lime.
  - .4 Plant to be equipped to control rate of lime incorporation to within 1/4%.
  - .5 Add water to aggregate prior to entering pugmill.
  - .6 Add water to lime sufficiently in advance to permit time to slake prior to entering pugmill.

3.2 EQUIPMENT

- .1 Pavers: mechanical grade controlled self powered pavers capable of spreading mix within specified tolerances, true to line, grade and crown indicated.
- .2 Rollers: sufficient number of type and weight to obtain specified density of compacted mix.
- .3 Vibratory rollers:
  - .1 Minimum drum diameter: 1200 mm.
  - .2 Maximum amplitude of vibration (machine setting): 0.5 mm for lifts less than 40 mm thick.
- .4 Haul trucks: sufficient number and of adequate size, speed and condition to ensure orderly and continuous operation and as follows:
  - .1 Boxes with tight metal bottoms.
  - .2 Covers of sufficient size and weight to completely cover and protect asphalt mix when truck fully loaded.

3.2 EQUIPMENT  
(Cont'd)

- .4 Haul trucks:(Cont'd)
  - .3 In cool weather or for long hauls, insulate entire contact area of each truck box.
  - .4 Use only trucks which can be weighed in single operation on scales supplied.
- .5 Hand tools:
  - .1 Lutes or rakes with covered teeth for spreading and finishing operations.
  - .2 Tamping irons having mass not less than 12 kg and bearing area not exceeding 310 cm<sup>2</sup> for compacting material along curbs, gutters and other structures inaccessible to roller. Mechanical compaction equipment, when approved by Departmental Representative, may be used instead of tamping irons.
  - .3 Straight edges, 4.5 m in length, to test finished surface.

3.3 PREPARATION

- .1 When paving over existing asphalt surface, clean pavement surface.
- .2 Apply tack coat prior to paving.
- .3 Prior to laying mix, clean surfaces of loose and foreign material.

3.4 TRANSPORTATION  
OF MIX

- .1 Transport mix to job site in vehicles cleaned of foreign material.
- .2 Paint or spray truck beds with limewater, soap or detergent solution, or non-petroleum based commercial product, at least daily or as required. Elevate truck bed and thoroughly drain. No excess solution to remain in truck bed.
- .3 Schedule delivery of material for placing in daylight, unless Departmental Representative approves artificial light.
- .4 Deposit mix from surge or storage silo to trucks in multiple drops to reduce segregation. Do not dribble mix into trucks.
- .5 Deliver material to paver at uniform rate and in an amount within capacity of paving and compacting equipment.

- 
- 3.4 TRANSPORTATION OF MIX  
(Cont'd)
- .6 Deliver loads continuously in covered vehicles and immediately spread and compact. Deliver and place mixes at temperature within range as directed by Departmental Representative, but not less than 135 ||C.
- 3.5 PLACING
- .1 Obtain Departmental Representative's approval of base and existing surface prior to placing asphalt.
- .2 Place asphalt concrete to thicknesses, grades and lines as indicated.
- .3 Placing conditions:
- .1 Place asphalt mixtures only when air temperature is above 5 ||C.
- .2 When temperature of surface on which material is to be placed falls below 10 ||C, provide extra rollers as necessary to obtain required compaction before cooling.
- .3 Do not place hot mix asphalt when pools of standing water exist on surface to be paved, during rain, or when surface is damp.
- .4 Place asphalt concrete in compacted lifts of thickness as indicated.
- .5 Where possible do tapering and leveling where required in lower lifts. Overlap joints by not less than 300 mm.
- .6 Place individual strips no longer than 500 m.
- .7 Spread and strike off mixture with self propelled mechanical finisher.
- .1 Construct longitudinal joints and edges true to line markings. Establish lines for paver to follow parallel to centerline of proposed pavement. Position and operate paver to follow established line closely.
- .2 When using pavers in echelon, have first paver follow marks or lines, and second paver follow edge of material placed by first paver. Work pavers as close together as possible and in no case permit them to be more than 30 m apart.
- .3 Maintain constant head of mix in auger chamber of paver during placing.
-

3.5 PLACING  
(Cont'd)

- .7 (Cont'd)
  - .4 If segregation occurs, immediately suspend spreading operation until cause is determined and corrected.
  - .5 Correct irregularities in alignment left by paver by trimming directly behind machine.
  - .6 Correct irregularities in surface of pavement course directly behind paver. Remove by shovel or lute excess material forming high spots. Fill and smooth indented areas with hot mix. Do not broadcast material over such areas.
  - .7 Do not throw surplus material on freshly screeded surfaces.
- .8 When hand spreading is used:
  - .1 Use approved wood or steel forms, rigidly supported to assure correct grade and cross section. Use measuring blocks and intermediate strips to aid in obtaining required cross section.
  - .2 Distribute material uniformly. Do not broadcast material.
  - .3 During spreading operation, thoroughly loosen and uniformly distribute material by lutes or covered rakes. Reject material that has formed into lumps and does not break down readily.
  - .4 After placing and before rolling, check surface with templates and straightedges and correct irregularities.
- .9 Provide heating equipment to keep hand tools free from asphalt. Control temperature to avoid burning material. Do not use tools at higher temperature than temperature of mix being placed.

3.6 COMPACTING

- .1 Roll asphalt continuously as per requirement of Table 9 of OPSS 310
- .2 General:
  - .1 Provide at least two rollers and as many additional rollers as necessary to achieve specified pavement density. When more than two rollers are required, one roller must be pneumatic tired type.
  - .2 Start rolling operations as soon as placed mix can bear weight of roller without excess displacement of material or cracking of surface.

3.6 COMPACTING  
(Cont'd)

- .2 General:(Cont'd)
- .3 Operate roller slowly initially to avoid displacement of material. Do not exceed 5 km/h for breakdown and intermediate rolling for static steel wheeled and pneumatic tired rollers. Do not exceed 9 km/h for finish rolling.
- .4 Use static compaction for leveling coarse less than 25 mm thick.
- .5 For lifts 50 mm thick and greater, adjust speed and vibration frequency of vibratory rollers to produce minimum of 25 impacts per metre of travel. For lifts less than 50 mm thick, impact spacing not to exceed compacted lift thickness.
- .6 Overlap successive passes of roller by minimum of 200 mm and vary pass lengths.
- .7 Keep wheels of roller slightly moistened with water to prevent pick up of material but do not over water.
- .8 Do not stop vibratory rollers on pavement that is being compacted with vibratory mechanism operating.
- .9 Do not permit heavy equipment or rollers to stand on finished surface before it has been compacted and has thoroughly cooled.
- .10 After traverse and longitudinal joints and outside edge have been compacted, start rolling longitudinally at low side and progress to high side. Ensure that all points across width of pavement receive essentially equal numbers of passes of compactors.
- .11 When paving in echelon, leave unrolled 50 to 75 mm of edge which second paver is following and roll when joint between lanes is rolled.
- .12 Where rolling causes displacement of material, loosen affected areas at once with lutes or shovels and restore to original grade of loose material before re rolling.
- .3 Breakdown rolling:
- .1 Commence breakdown rolling with static steel wheeled roller immediately following rolling of transverse and longitudinal joint and edges.
- .2 Operate rollers as close to paver as necessary to obtain adequate density without causing undue displacement.
- .3 Operate breakdown roller with drive roll or wheel nearest finishing machine. When working on steep slopes or super elevated

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- 3.6 COMPACTING (Cont'd)
- .3 Breakdown rolling:(Cont'd)
    - .3 (Cont'd)  
sections use operation approved by Departmental Representative.
    - .4 Use only experienced roller operators.
  - .4 Intermediate rolling:
    - .1 Use pneumatic tired, steel wheel or vibratory rollers and follow breakdown rolling as closely as possible and while paving mix temperature allows maximum density from this operation.
    - .2 Rolling to be continuous after initial rolling until mix placed has been thoroughly compacted.
  - .5 Finish rolling:
    - .1 Accomplish finish rolling with two axle or three axle tandem steel wheeled rollers while material is still warm enough for removal of roller marks. If necessary to obtain desired surface finish, use pneumatic tired rollers as directed by Departmental Representative.
    - .2 Conduct rolling operations in close sequence.
  - .6 Dust entire area of sheet asphalt pavements immediately after rolling to eliminate tendency to pick up under traffic.
- 3.7 JOINTS
- .1 General:
    - .1 Remove surplus material from surface of previously laid strip. Do not deposit on surface of freshly laid strip.
    - .2 Construct joints between asphalt concrete pavement and Portland cement concrete pavement as indicated.
    - .3 Paint contact surfaces of existing structures such as manholes, curbs or gutters with bituminous material prior to placing adjacent pavement.
  - .2 Transverse joints:
    - .1 Offset transverse joint in succeeding lifts by at least 600 mm.
    - .2 Cut back to full depth vertical face and tack face with thin coat of hot asphalt prior to continuing paving.
    - .3 Compact transverse joints to provide smooth riding surface. Use methods to prevent rounding of compacted surface at joints.
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- 3.7 JOINTS  
(Cont'd)
- .3 Longitudinal joints:
- .1 Offset longitudinal joints in succeeding lifts by at least 150 mm.
  - .2 Cold joint is defined as joint where asphalt mix is placed, compacted and left to cool below 100°C prior to paving of adjacent lane.
    - .1 If cold joint cannot be avoided, cut back by saw cutting previously laid lane, by at least 150 mm, to full depth vertical face, and tack face with thin coat of hot asphalt of adjacent lane.
  - .3 Overlap previously laid strip with spreader by 25 to 50 mm.
  - .4 Before rolling, carefully remove and discard coarse aggregate in material overlapping joint with lute or rake.
  - .5 Roll longitudinal joints directly behind paving operation.
  - .6 When rolling with static or vibratory rollers, have most of drum width ride on newly placed lane with remaining 150 mm extending onto previously placed and compacted lane.
- .4 Construct butt joints as indicated.
- 3.8 FINISH  
TOLERANCES
- .1 Finished asphalt surface to be within 5 mm of design elevation but not uniformly high or low.
  - .2 Finished asphalt surface not to have irregularities exceeding 5 mm when checked with 4.5 m straight edge placed in any direction.
- 3.9 DEFECTIVE WORK
- .1 Correct irregularities which develop before completion of rolling by loosening surface mix and removing or adding material as required. If irregularities or defects remain after final compaction, remove surface course promptly and lay new material to form true and even surface and compact immediately to specified density.
  - .2 Repair areas showing checking, rippling, or segregation.
  - .3 Adjust roller operation and screed settings on paver to prevent further defects such as rippling and checking of pavement.
-

3.10 TRAFFIC  
MARKINGS

- .1 Paint traffic markings in accordance with manufacturer's recommendations and as indicated.
- .2 Use paint thinner in accordance with manufacturer's requirements.
- .3 Application:
  - .1 Lay out pavement markings as indicated.
  - .2 Unless otherwise approved by Departmental Representative, apply paint only when air temperature is above 10°C, wind speed is less than 60 km/h and no rain is forecast within next 4h.
  - .3 Apply traffic paint evenly at rate of 3 m<sup>2</sup>/L.
  - .4 Do not thin paint unless approved by Departmental Representative.
  - .5 Paint lines to be of uniform colour and density with sharp edges.
  - .6 Thoroughly clean distributor tank before refilling with paint of different colour.
- .4 Tolerance:
  - .1 Paint markings to be within plus or minus 12 mm of dimensions indicated
- .5 Protection of Completed Works:
  - .1 Protect pavement markings until dry.



PART 1 - GENERAL

1.1 RELATED SECTIONS .1 Section 03 30 00 - Cast-in-place Concrete.  
.2 Section 31 23 10 - Excavating, Trenching and Backfilling.

1.2 REFERENCES .1 Canadian Standards Association (CSA)  
.1 CAN/CSA-A23.1/A23.2- [94], Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.

PART 2 - PRODUCTS

2.1 MATERIALS .1 Concrete mixes and materials: to Section 03300 - Cast-in-Place Concrete.  
.2 Reinforcing steel: to Section 032000 - Concrete Reinforcement.  
.3 Joint filler Curing Compound: to Section 033000- Cast-in-Place Concrete.  
.4 Granular base: 150 mm OPSS Granular A  
.5 Non-staining mineral type form release agent: chemically active release agents containing compounds that react with free lime to provide water soluble soap.  
.6 Fill material: to Section 312310 - Excavating, Trenching and Backfilling

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PART 3 - EXECUTION

- 3.1 GRADE PREPARATION
- .1 Do grade preparation work in accordance with Section 312310 - Excavating, Trenching and Backfilling.
  - .2 Construct embankments using excavated material free from organic matter or other objectionable materials. Dispose of surplus and unsuitable excavated material off site.
  - .3 Place fill in maximum 150 mm layers and compact to at least 100% of standard proctor maximum dry density.
- 3.2 GRANULAR BASE
- .1 Obtain Departmental Representative's approval of subgrade before placing granular base.
  - .2 Place granular base material to lines, widths, and depths as indicated.
  - .3 Compact granular base to at least 100% of standard proctor maximum dry density.
- 3.3 CONCRETE
- .1 Obtain Departmental Representative's approval of granular base and reinforcing steel prior to placing concrete.
  - .2 Do concrete work in accordance with Section 033000 - Cast-in-Place Concrete.
  - .3 Immediately after floating, give sidewalk surface uniform broom finish to produce regular corrugations not exceeding 2 mm deep, by drawing broom in direction normal to centre line.
  - .4 Provide edging as indicated.
  - .5 Slip-form pavers equipped with string line system for line and grade control may be used if quality of work acceptable to Departmental Representative can be demonstrated. Hand finish surfaces when directed by Departmental Representative.
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- 3.4 TOLERANCES .1 Finish surfaces to within 3 mm in 3 m as measured with 3 m straightedge placed on surface.
- 3.5 EXPANSION AND CONTRACTION JOINTS .1 Install tooled transverse contraction joints after floating, when concrete is stiff, but still plastic, at intervals of 1.5 m.
- .2 Install expansion joints at intervals of 6 m.
- .3 When sidewalk is adjacent to curb, make joints of curb and sidewalk coincide.
- 3.6 ISOLATION JOINTS .1 Install isolation joints around manholes and catch basins and along length adjacent to concrete curbs, catch basins, buildings, or permanent structure.
- .2 Install joint filler in isolation joints in accordance with Section 033000 - Cast-in-Place Concrete.
- .3 Seal isolation joints with sealant approved by Departmental Representative.
- 3.7 CURING .1 Cure concrete by adding moisture continuously in accordance with CAN/CSA-A23.1 to exposed finished surfaces for at least 1 day after placing, or sealing moisture in by curing compound approved by Departmental Representative.
- .2 Where burlap is used for moist curing, place two prewetted layers on concrete surface and keep continuously wet during curing period.
- .3 Apply curing compound evenly to form continuous film. In accordance with manufacturer's requirements.
- 3.8 BACKFILL .1 Allow concrete to cure for 7 days prior to backfilling.
- .2 Backfill to designated elevations with material approved by Departmental Representative. Compact and shape to required
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3.8 BACKFILL  
(Cont'd)

.2

(Cont'd)  
contours as indicated or as directed by  
Departmental Representative.

PART 1 - GENERAL

1.1 RELATED  
SECTIONS

- .1 Section 013300 - Submittal Procedures.
- .2 Section 013543 - Environmental Procedures
- .3 Section 017419 - Construction/Demolition  
Waste Management and Disposal.
- .4 Section 033000 Cast in Place Concrete.
- .5 Section 312310 Excavation, Trenching and  
Backfilling.
- .6 Section 334100 - Storm Utility Drainage  
Piping

1.2 REFERENCES

- .1 Ontario Provincial Standard Specifications  
(OPSS) and Drawings (OPSD)
    - .1 OPSS 407 - November 2004, Construction  
Specification for Maintenance Hole, Catch  
Basin, Ditch Inlet and Valve Chambers.
    - .2 OPSS 1301 - September 1996 - Material  
Specification for Cementing Materials
    - .3 OPSS 1351 - November 2004 - Material  
Specification for Precast Reinforced  
Concrete Components for Maintenance  
Holes, Catch Basins, Ditch Inlets, and  
Valve Chambers
    - .4 OPSS 1850 - November 2003 - Material  
Specification for Frames, Grates, Covers,  
and Gratings
    - .5 OPSD 400.100 - November 2001 - Cast  
Iron, Square Frame with Square Flat Gate  
for Catch Basins, Perforated Openings
    - .6 OPSD 705.010 - November 2004 - Precast  
Concrete Catch Basin, 600mm x 600mm,  
Depth-4.0m max
  - .2 Canadian Standards Association (CSA  
International)
    - .1 CAN/CSA A3000 - (April 2001),  
Cementitious Materials Compendium.  
Includes:
      - .1 CAN/CSA A5 98, Portland cement.
      - .2 CAN/CSA A8 98, Masonry Cement.
      - .3 CAN/CSA A23.5 98, Supplementary  
Cementing Materials.
    - .2 CSA A165 Series (R2000), CSA Standards  
on Concrete Masonry Units.
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- 1.2 REFERENCES (Cont'd)
- .3 American Society for Testing and Materials (ASTM International)
- .1 ASTM A48/A48M 00, Standard Specification for Gray Iron Castings.
- 1.3 SUBMITTALS
- .1 Submittals in accordance with Section 013300 - Submittal Procedures.
- .2 Submit manufacturer's test data and certification at least 4 weeks prior to beginning Work. Include manufacturer's drawings, information and shop drawings where pertinent.
- 1.4 WASTE MANAGEMENT AND DISPOSAL
- .1 Separate waste materials for reuse and recycling in accordance with Section 017419 - Construction/Demolition Management and Disposal.
- .2 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.
- .3 Divert unused materials from landfill to recycling facility for disposal approved by Departmental Representative.
- .4 Divert unused concrete materials from landfill to local facility as approved by.
- .5 Divert unused aggregate materials from landfill to facility for reuse as approved by Departmental Representative.
- .6 Fold up metal banding, flatten and place in designated area for recycling.
-

PART 2 - PRODUCTS

- 2.1 MATERIALS
- .1 Precast catch basin sections: to OPSS 407 and OPSS 705.010.
  - .2 Joints: to be made watertight using rubber rings, bituminous compound, epoxy resin cement or cement mortar.
  - .3 Mortar:
    - .1 Aggregate: to OPSS 1002
    - .2 Cement: to CAN/CSA A-3000/A8.
  - .4 Adjusting rings: to OPSS 1351.
  - .5 Steps: to OPSS 1351
  - .6 Frames, gratings, cover to dimensions as indicated and following requirements:
    - .1 Frames, Gratings, and Covers: to OPSS 1850.
    - .2 Metal gratings and covers to bear evenly on frames. A frame with grating or cover to constitute one unit. Assemble and mark unit components before shipment.
    - .3 Gray iron castings: to ASTM A48/A48M, strength class 30B.
    - .4 Castings: coated with two applications of asphalt varnish, sand blasted or cleaned and ground to eliminate surface imperfections.
    - .5 Catch basin frames and grates: to OPSS 400.100.
  - .7 Granular bedding and backfill: in accordance with Section 321123 - Aggregate Base Course and following requirements:
    - .1 Pipe Bedding and Surround - Minimum compacted thickness of 300 mm of Granular 'A' around all sides of structure.
    - .2 Backfill - with acceptable native material.
  - .8 Concrete mixes and materials: in accordance with Section 033000 Cast in Place Concrete.
-

PART 3 - EXECUTION

- 3.1 EXCAVATION AND BACKFILL
- .1 Excavate and backfill in accordance with Section 312310 Excavating Trenching and Backfilling and as indicated. Backfilling shall done with compacted granular material.
  - .2 Obtain approval of Departmental Representative before installing manholes or catch basins.
- 3.2 INSTALLATION
- .1 Construct units in accordance with details indicated, plumb and true to alignment and grade.
  - .2 Complete units as pipe laying progresses. Maximum of three units behind point of pipe laying will be allowed.
  - .3 Dewater excavation to approval of Departmental Representative and remove soft and foreign material before placing concrete base.
  - .4 Set precast concrete base on 150 mm minimum of granular bedding compacted to 98% standard proctor maximum dry density.
  - .5 Backfill excavations for catch basins and manholes with compacted granular material. Build a 3H: 1V frost taper within the upper 1.2 m.
  - .6 Precast units:
    - .1 Set bottom section of precast unit in bed of cement mortar and bond to concrete slab or base. Make each successive joint watertight with Departmental Representative approved rubber ring gaskets, bituminous compound, cement mortar, epoxy resin cement, or combination thereof.
    - .2 Clean surplus mortar and joint compounds from interior surface of unit as work progresses.
    - .3 Plug lifting holes with precast concrete plugs set in cement mortar or mastic compound.
    - .4 Wrap the joints between catch basins and manholes with non-woven geotextile.
-



3.2 INSTALLATION  
(Cont'd)

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- .7 For sewers:
    - .1 Place stub outlets and bulkheads at elevations and in positions indicated.
    - .2 Bench to provide a smooth U shaped channel.
  - .8 Compact granular backfill to 98% standard proctor maximum dry density.
  - .9 Installing units in existing systems:
    - .1 Where new unit is to be installed in existing run of pipe, ensure full support of existing pipe during installation, and carefully remove that portion of existing pipe to dimensions required and install new unit as specified.
    - .2 Make joints watertight between new unit and existing pipe.
  - .10 Where deemed expedient to maintain service around existing pipes and when systems constructed under this Project are ready to be put in operation, complete installation with appropriate break outs, removals, redirection of flows, blocking unused pipes or other necessary work.
  - .11 Place frame and cover on top section to elevation as indicated. If adjustment required use concrete ring.
  - .12 Clean units of debris and foreign materials. Remove fins and sharp projections. Prevent debris from entering system.
  - .13 Install safety platforms in manholes having depth of 5 m or greater, as indicated.
  - .14 Install subdrains along both sides of the road as shown in the drawings.
    - .1 The subdrain shall be 150 mm diameter perforated PVC 1.8 mm thick wrapped with approved filter cloth.
    - .2 The installation shall include boring and connection to the catch basin and placement of 300 mm Granular 'A' bedding, with 150 mm clear stone on all sides of the pipe.
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- 3.3 ADJUSTING TOPS OF EXISTING UNITS .1 Remove existing gratings, frames and store for re use at locations designated by Departmental Representative.
- .2 Sectional units:  
.1 Raise or lower straight walled sectional units by adding or removing precast sections as required.  
.2 Raise or lower tapered units by removing cone section, adding, removing, or substituting riser sections to obtain required elevation, and then replace cone section. When amount of raise is less than 600 mm use moduloc or grade rings.
- 3.4 SEALING OVER EXISTING UNITS .1 Fill with cast-in-place concrete.
- 3.5 LEAKAGE TEST .1 Testing shall be in accordance with OPSS 407.07.04.
- .2 Departmental Representative will issue Test Certificate for each manhole passing test.
- .3 Perform tests in presence of a Departmental Representative. Notify Departmental Representative 24hours in advance of the proposed tests.
- 3.6 ISOLATION JOINTS .1 Install isolation joints around manholes and catch basins and along length adjacent to concrete curbs, catch basins, buildings, or permanent structure.
- .2 Install joint filler in isolation joints in accordance with Section 033000 - Cast-in-Place Concrete.
- .3 Seal isolation joints with sealant approved by Departmental Representative.
- 3.7 CURING .1 Cure concrete by adding moisture continuously in accordance with CAN/CSA-A23.1 to exposed finished surfaces for at least 1 day after placing, or sealing moisture in by curing compound approved by Departmental Representative.
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- 3.7 CURING  
(Cont'd)
- .2 Where burlap is used for moist curing, place two prewetted layers on concrete surface and keep continuously wet during curing period.
  - .3 Apply curing compound evenly to form continuous film. In accordance with manufacturer's requirements.
- 3.8 BACKFILL
- .1 Allow concrete to cure for 7 days prior to backfilling.
  - .2 Backfill to designated elevations with material approved by Departmental Representative. Compact and shape to required contours as indicated or as directed by Departmental Representative.



PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 013543 - Environmental Procedures
  - .2 Section 017419 - Construction/Demolition Waste Management and Disposal
  - .3 Section 033000 Cast in Place Concrete.
  - .4 Section 312310 Excavating, Trenching, and Backfilling
  - .5 Section 321123 - Aggregate Base Courses
- 1.2 REFERENCES
- .1 Specifications of the City of Ottawa shall apply to and govern all phases of the work specified in this section and/or shown on the contract drawings.
  - .2 Ontario Provincial Standards Drawings (OPSD):
    - .1 OPSD 1103.010 (April 1999) - Concrete Thrust Blocks for Tees, Plugs and Horizontal Bends
    - .2 OPSD 1103.020 (April 1999) - Concrete Thrust Blocks for Vertical Bends
- 1.3 MATERIAL CERTIFICATION
- .1 Submit manufacturer's test data and certification that pipe materials meet requirements of this section at least 1 week prior to commencing work. Include manufacturer's drawings, information and shop drawings where pertinent.
- 1.4 RECORD DRAWINGS
- .1 Provide data to produce record drawings, including directions for operating valves, list of equipment required to operate valves, details of pipe material, location of air and vacuum release valves, hydrant details. Contractor is to provide water main as-built elevations and tie-down locations for all work completed.
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- 1.5 WASTE MANAGEMENT AND DISPOSAL
- .1 Dispose of unused disinfection material at official hazardous material collections site approved by Departmental Representative.
  - .2 Do not dispose of unused disinfection material into sewer system, into streams, lakes, onto ground or in other location where they will pose health or environmental hazard.

- 1.6 SCHEDULING OF WORK
- .1 Interruptions to existing water services will only be permitted with the approval of the Departmental Representative and will be limited to off hours only.
  - .2 Notify fire department of any accidental interruption of water supply to hydrants.

PART 2 - PRODUCTS

- 2.1 PIPES
- .1 Polyvinyl chloride pressure pipe conforming to AWWA C900 and CSA B137.3, Pressure Class 150, DR18, cast iron outside diameter dimensions, blue in colour and supplied complete with gaskets.
    - .1 Approved for use by City of Ottawa.
    - .2 Push-on joints as per AWWA C-111, complete with vulcanized synthetic rubber gaskets.

- 2.2 SERVICE CONNECTIONS
- .1 For Building Services 100mm diameter and larger and no closer than 3.0m from building foundations:
    - .1 Polyvinyl chloride pressure pipe: to AWWA C900 and CSA B137.3, Pressure Class 150, DR 18, cast iron outside dimensions, blue in colour and supplied with gaskets.
    - .2 Approved for use by the Departmental Representative.
  - .2 For Building Services smaller than 100mm diameter:
    - .1 Copper piping: to ASTM B88M type K, annealed..
    - .2 Valves, saddles etc. to OPSS.

- 
- 2.3 FITTINGS .1 Fittings:
- .1 Short body ductile iron fittings: to AWWA C-153.
    - .1 Cement lined per AWWA C-104.
    - .2 Mechanical or push-on joint.
  - .2 PVC fittings to AWWA C907 and CSA B137.5.
    - .1 Push-on joints.
- 2.4 RESTRAINING AND RETAINING RINGS .1 For use on PVC pipes:
- .1 The restraining devices shall meet the minimum requirements of ASTM F1674, have a working pressure of 1035 kPa complete with minimum 2:1 safety factor.
  - .2 Rings shall be designed for use on AWWA C-900 standard pressure class 150, DR18 PVC pipe. The restraint mechanism shall incorporate a series of machined serrations on the inside diameter of the clamping ring.
    - .1 The rings are to be manufactured from high quality ductile iron per ASTM A536, Grade 65-45-12.
    - .2 T-bolts, clamping bolts and nuts, type 304 stainless steel per ASTM F593.
    - .3 Approved for use by the Departmental Representative.
- 2.5 COUPLINGS .1 Couplings designed to withstand a hydrostatic test pressure of 1035 kPa.
- .1 Center Sleeve:
    - .1 Material:
      - .1 Steel Sleeves - carbon steel as per ASTM A36.A53/A512, minimum yield strength of 207 MPa.
      - .2 Cast sleeves - ductile iron as per ASTM A536, grade 64-45-12.
      - .3 Finish: shop finish enamelled.
      - .4 Ends to be smooth inside surface for uniform gasket seating.
        - .1 Minimum lengths:
          - .1 203 mm pipe and smaller: 152mm
          - .2 305 mm pipe: 203mm
          - .3 406 mm pipe: 228mm
        - .2 End Rings: ductile iron to ASTM A536.
        - .3 Nuts and Bolts: type 304 stainless steel per ANSI/AWWA C-111/A21.115, 25mm diameter.
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- 2.5 COUPLINGS .1 (Cont'd)  
(Cont'd)
- .1 Center Sleeve:(Cont'd)
    - .4 Gasket: grade 30 special compound rubber (SBR) recommended for water, salt solution, mild acids and bases with a temperature range between -40oC to +65oC. Approved for use by the Departmental Representative.
- 2.6 VALVES .1 Valves open clockwise
- .2 Gate valves to ANSI/AWWA C509, resilient seated:
    - .1 Application - for use on all 152mm and 305mm diameter water main.
    - .2 Material - cast iron or ductile iron, non-rising stem, complete with 50mm square operating nut in the vertical position, standard O-ring type steam seal.
    - .3 Pressure rating - minimum 1380 kPa.
    - .4 Joints:
      - .1 Mechanical joint ends - bell socket, plain end, and gland to ANSI/AWWA C-111, complete with cast iron gland rings, steel alloy bolts, and gaskets.
      - .2 Push-on joint ends - to ANSI/AWWA C-111.
      - .3 Finish: Two part spray epoxy coating or a fusion bonded epoxy coating, factory applied to exterior and interior surfaces in accordance with ANSI/AWWA C-550.
- 2.7 VALVE BOXES .1 Cast iron valve boxes: 130mm screw type manufactured from good quality grey iron.
- .2 Valve boxes to consist of six elements: base, bottom section, extension, top section, cap, and guide wheel.
- 2.8 VALVE CHAMBERS .1 Precast reinforced concrete, components in accordance with OPSS 1351 and ASTM C 478M.
- .2 Ladder rungs to be cast integral with unit; field installation not permitted.
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- 2.8 VALVE CHAMBERS .3 Frames and cover:  
(Cont'd)
- .1 Manufactured from good quality grey iron and shall be solid with clean surfaces, free from scales, lumps, flaws, blow holes, or other defects. No plugging or filling of defects or other methods of correcting defects shall be permitted.
  - .2 Casting minimum tensile strength of 138 MPa.
  - .3 Castings to conform to dimensions of W-15 and W-16.
  - .4 Cover to be marked
  - .5 Castings to be thoroughly coated with approved casting paint.
- 2.9 BALL VALVES .1 Ball valves for use on test tees:
- .1 Body and cap: cast high tensile bronze to ASTM B 62.
  - .2 Pressure rating: Class 125, 860 kPa steam, WP = 1.4 MPa WOG.
  - .3 Connections: Screwed ends to ANSI B1.20.1 and with hex shoulders.
  - .4 Stem: tamperproof ball drive.
  - .5 Stem packing nut: external to body.
  - .6 Ball and seat: replaceable hard chrome solid ball and Teflon seats.
  - .7 Stem seal: TFE with external packing nut.
  - .8 Operator: removable lever handle.
- 2.10 HYDRANTS .1 Post type hydrants: dry barrel, compression, open against pressure, dry top, three way type with two 64mm hose outlet nozzles and one 127mm pumper outlet nozzle. Rounded bonnet and complete with outlet nozzle cap chains.
- .2 Hydrants to CAN/ULC-S520, ANSI/AWWA C-502.
  - .3 Designed for a minimum working pressure of 1035 kPa.
  - .4 The upper and lower barrels shall be ductile iron complete with breakable flange and breakable bolts.
  - .5 Main valve: nominal diameter of valve opening shall be a minimum of 127mm.
  - .6 Drain valve: the hydrant is to be provided with a drain valve that closes as the main valve opens.
-

- 2.10 HYDRANTS  
(Cont'd)
- .7 Inlet connection to be mechanical joint, 152mm bell at base of hydrant to ANSI/AWWA C-111/A21.11. The base configuration and mechanical joint to be designed to accept retaining/restraining devices for both AWWA C-150 CL 52 ductile iron pipe and ANSI/AWWA C-900, DR 18 PVC pipe hydrant leads.
  - .8 Bury length: As approved by Departmental Representative.
  - .9 Hose Outlet Nozzle: 64mm hose outlet nozzles conforming to ULC S-513.
  - .10 Pumper Outlet Nozzle: As approved by Departmental Representative.
  - .11 Operator Nut: 32mm square, direction to open to be counter clockwise.
  - .12 The hydrant is to be factory primed and finish painted. Hydrant finish paint: colour red, exterior enamel to CAN/CGSB-1.88.
- 2.11 CATHODIC PROTECTION
- .1 Anodes are to be attached to all new ductile iron fittings and valves. The size and type of anode to be in accordance with Ontario Provincial Standards (OPSD).
- 2.12 BOLT CORROSION PROTECTION
- .1 Anti-corrosion petrolatum paste, tape and mastic approved for use by the Departmental Representative and in accordance with ANSI/AWWA C217.
- 2.13 HYDROSTATIC TEES
- .1 Ensure two test tees are provided in each valve chamber, upstream and downstream of the valve, as per W-34.
  - .2 52mm diameter.
- 2.14 TRACING WIRE
- .1 Tracing Wire to be TWU or RWU 10 gauge, 7 strands or more, copper 60oC or higher, 600V or approved equivalent.
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- 2.15 PIPE BEDDING AND SURROUND MATERIALS
- .1 Bedding material:
    - .1 150mm OPSS 1010 Granular 'A'.
  - .2 Pipe Surround material:
    - .1 To 300mm above the top of the pipe with OPSS 1010 Granular 'A'.circuit television as per OPSS409.
  - .3 Concrete mixes and materials required for bedding cradles, encasement, supports, thrust blocks: to Section 033000 Cast in Place Concrete.

- 2.16 BACKFILL MATERIAL
- .1 Approved native material or select subgrade material in accordance with Section 312310 -Excavation Trenching and Backfilling.

PART 3 - EXECUTION

- 3.1 PREPARATION
- .1 Clean pipes, fittings, valves, hydrants, and appurtenances of accumulated debris and water before installation. Carefully inspect materials for defects to approval of Departmental Representative. Remove defective materials from site.
  - .2 Existing water main and services to be abandoned shall be pressure grouted using a mixture of one part Portland cement and two parts clean washed sand, with only sufficient water added to allow placing.

- 3.2 TRENCHING
- .1 Do trenching work in accordance with Section 312310 Excavating Trenching and Backfilling.
  - .2 Trench depth to provide cover over pipe of not less than 2.4 m from finished grade or as indicated.
  - .3 Trench alignment and depth require Departmental Representative's approval prior to placing bedding material and pipe.

3.3 GRANULAR  
BEDDING

- .1 Place granular bedding material in uniform layers to depth as indicated.
- .2 Do not place material in frozen condition.
- .3 Shape bed true to grade to provide continuous uniform bearing surface for pipe.
- .4 Shape transverse depressions in bedding as required to suit joints.
- .5 Compact each layer full width of bed to at least 98% of standard proctor maximum dry density.
- .6 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding in accordance with Section 312310 Excavating Trenching and Backfilling.

3.4 PIPE  
INSTALLATION

- .1 Lay pipes to manufacturer's standard instructions and specifications.
- .2 Join pipes in accordance with ANSI/AWWA C600 and manufacturer's recommendations.
- .3 Handle pipe by methods approved by Departmental Representative. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.
- .4 Lay pipes on prepared bed, true to line and grade. Ensure barrel of each pipe is in contact with shaped bed throughout its full length. Take up and replace defective pipe. Correct pipe which is not in true alignment or grade or pipe which shows differential settlement after installation.
- .5 Face socket ends of pipe in direction of laying. For mains on a grade of 2% or greater, face socket ends up grade.
- .6 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.
- .7 Keep jointing materials and installed pipe free of dirt and water and other foreign materials. Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.

3.4 PIPE  
INSTALLATION  
(Cont'd)

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- .8 Position and join pipes with equipment and methods approved by Departmental Representative.
  - .9 Cut pipes in an approved manner as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
  - .10 Align pipes carefully before jointing.
  - .11 Install gaskets to manufacturer's recommendations. Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
  - .12 Avoid displacing gasket or contaminating with dirt or other foreign material. Gaskets so disturbed or contaminated shall be removed, cleaned, lubricated and replaced before jointing is attempted again.
  - .13 Complete each joint before laying next length of pipe.
  - .14 Minimize deflection after joint has been made.
  - .15 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.
  - .16 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by Departmental Representative.
  - .17 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.
  - .18 Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.
  - .19 Do not lay pipe on frozen bedding.
  - .20 Protect hydrants, valves and appurtenances from freezing.
  - .21 Upon completion of pipe laying and after Departmental Representative has inspected work in place, surround and cover pipes between
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- 3.5 SERVICE CONNECTIONS (Cont'd)
- .5 In order to relieve strain on connections, install service pipe in "Goose Neck" form "laid over" into horizontal position.
  - .6 Install rigid stainless steel liners in small diameter plastic pipes with compression fittings.
- 3.6 THRUST BLOCKS AND RESTRAINED JOINTS
- .1 For thrust blocks: do concrete work in accordance with Section 033000 Cast in Place Concrete.
  - .2 Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings and undisturbed ground as indicated or as directed by Departmental Representative in accordance with OPSD 1103.010 and OPSD 1103.020
  - .3 Keep joints and couplings free of concrete.
  - .4 Do not backfill over concrete within 24 h after placing.
- 3.7 HYDROSTATIC AND LEAKAGE TESTING
- .1 Do tests in accordance with OPSS Requirements.
- 3.8 STERILIZING
- .1 Before being placed into service, the main is to be thoroughly flushed and then chlorinated in accordance with the OPSS requirements using a portable sterilizing apparatus which will treat the pipeline with chlorine solution. No section or portion of the water main will be placed in service until bacteriological tests indicate complete sterilization.
  - .2 The costs of sterilizing and associated work shall be borne by the Contractor.
  - .3 Disinfection to be conducted by the contractor.
- 3.9 PIPE COUPLERS
- .1 The use of pipe couplers is to be minimized and is to be used only at locations approved by Departmental Representative.
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- 3.10 PIPE SURROUND
- .1 Upon completion of pipe laying and after Departmental Representative has inspected work in place, surround, and cover pipes as indicated.
  - .2 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
  - .3 Place layers uniformly and simultaneously on each side of pipe.
  - .4 Do not place material in frozen condition.
  - .5 Compact each layer from pipe invert to mid height of pipe to at least 98% of standard proctor maximum dry density.
  - .6 Compact each layer from mid height of pipe to underside of backfill to at least 98% standard proctor maximum dry density.

- 3.11 BACKFILL
- .1 At Open Structures
    - .1 A minimum of 2.0m separation is required between all new water services or hydrants and catch basins or open structures.
    - .2 Provide thermal insulation as OPSS standards
  - .2 Shallow Trenches
    - .1 Where depth of cover to top of new and existing watermain or water services is less than 2.4m, provide thermal insulation.
  - .3 Contractor shall assume that all existing watermain and water services have a cover of 1.8m.
  - .4 Contractor to allow for insulation of the new watermain and new water services and exposed section of existing watermain and water services where cover is less than 1.8m.

- 3.12 CONNECTION TO EXISTING WATERMAIN .1 Connect to existing water main at locations
- .1 All connections of new watermain and services to existing watermain and services shall be performed by the contractor. This shall be inclusive of excavation, backfill, and reinstatement.
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3.11 BACKFILL .2 Reinststate areas to original conditions unless  
(Cont'd) otherwise indicated.

END OF SECTION  
END OF SECTION



PART 1 - GENERAL

- 1.1 RELATED SECTIONS
- .1 Section 033000 Cast in Place Concrete
  - .2 Section 321123 - Aggregate Base Course
  - .3 Section 312310 Excavating, Trenching and Backfilling
- 1.2 REFERENCES
- .1 Ontario Provincial Standard Specifications (OPSS) and Drawings (OPSD)
    - .1 OPSS 410 - April 1999, Construction Specification For Pipe Installation in Open Cut.
- SPEC NOTE: Paragraph level is uncertain
- .2 OPSS 409 - April 1999, Construction Specification for Closed Circuit Television Inspection of Pipelines.
- .2 Canadian Standards Association (CSA)
    - .1 CAN/CSA A257 Series M92, Standards for Concrete Pipe.
    - .2 CSA B182.2 95, PVC Sewer Pipe and Fittings (PSM Type)
- SPEC NOTE: Paragraph level is uncertain
- .3 CSA B182.11 95, Recommended Practice for the Installation of Plastic Drain and Sewer Pipe and Pipe Fittings.
- .3 American Society for Testing and Materials (ASTM) Weak and compressible materials under excavated areas.
    - .1 ASTM C 76M 95a, Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe
- 1.3 SUBMITTALS
- .1 Submit shop drawings in accordance with Section 013300-Submittal Procedures.
  - .2 Inform Departmental Representative at least 4 weeks prior to commencing work, of proposed source of bedding materials and provide access for sampling.
-

- 1.3 SUBMITTALS  
(Cont'd)
- .3 Submit manufacturer's test data and certification at least 2 weeks prior to commencing work.
  - .4 Certification to be marked on pipe.
- 1.4 SCHEDULING
- .1 Schedule work to minimize interruptions to existing services and to maintain existing flow during construction.
  - .2 Submit schedule of expected interruptions for approval and adhere to approved schedule.

PART 2 - PRODUCTS

- 2.1 PLASTIC PIPE
- .1 Type PSM Poly Vinyl Chloride (PVC): to CSA B182.2.
    - .1 Standard Dimensional Ratio (SDR): 35.

SPEC NOTE: Paragraph level is uncertain

- .2 Locked in gasket and integral bell system.
- .3 Nominal lengths: 4 m.

- 2.2 PIPE BEDDING AND SURROUND MATERIAL
- .1 Bedding material:
    - .1 150mm of OPSS 1010 Granular 'A' below the pipe and up to pipe spring line

SPEC NOTE: Paragraph level is uncertain

- .2 Surround material:
  - .1 From top of bedding to 300mm above pipe with OPSS 1010 Granular 'A'

- 2.3 BACKFILL MATERIAL
- .1 Backfill for trenches in landscaped areas may consist of excavated material that is free of organic/topsoil, replaced and compacted in lifts. Trenches below paved areas should be backfilled with select sub-grade material as defined in section 312310. The material used within the upper 1.2 m and below the subgrade line must be similar to that exposed in trench walls to prevent differential frost heave and shall be placed in lifts and compacted to 95% of SPMDD.
-

PART 3 - EXECUTION

- 3.1 SITE PREPARATION .1 Clean pipes and fittings of debris and water before installation, and remove defective materials from site to approval of Departmental Representative.
- 3.2 TRENCHING .1 Do trenching work in accordance with Section 312310 Excavating, Trenching and Backfilling.
- .2 Do not allow contents of any sewer or sewer connection to flow into trench.
- .3 Trench alignment and depth to approval of Departmental Representative prior to placing bedding material and pipe.
- 3.3 GRANULAR BEDDING .1 Place bedding in unfrozen condition.
- .2 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth as indicated..
- .3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe. Do not use blocks when bedding pipes.
- .4 Shape transverse depressions as required to suit joints.
- .5 Compact each layer full width of bed to at least 98 % standard proctor maximum dry density.
- .6 Fill excavation below bottom of specified bedding adjacent to manholes or catch basins with compacted bedding material.
- 3.4 INSTALLATION .1 Lay and join pipe in accordance with manufacturer's recommendations and to approval of Departmental Representative.
- .2 Handle pipe using methods approved by Departmental Representative. Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.
-

3.4 INSTALLATION  
(Cont'd)

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- .3 Lay pipes on prepared bed, true to line and grade with pipe inverts smooth and free of sags or high points. Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
- .4 Commence laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- .5 Do not exceed maximum joint deflection recommended by pipe manufacturer.
- .6 Do not allow water to flow through pipes during construction except as may be permitted by Departmental Representative.
- .7 Whenever work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .8 Install plastic pipe and fittings in accordance with CSA B182.11.
- .9 Joints:
  - .1 PVC pipe:
    - .1 Install gaskets as recommended by manufacturer.

SPEC NOTE: Paragraph level is uncertain

- .2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
  - .3 Align pipes before joining.
  - .4 Maintain pipe joints free from mud, silt, gravel and other foreign material.
  - .5 Avoid displacing gasket or contaminating with dirt or other foreign material. Remove disturbed or dirty gaskets; clean, lubricate and replace before joining is attempted.
  - .6 Complete each joint before laying next length of pipe.
  - .7 Minimize joint deflection after joint has been made to avoid joint damage.
  - .8 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.
-

3.4 INSTALLATION  
(Cont'd)

- .10 When any stoppage of work occurs, restrain pipes as directed by Departmental Representative, to prevent "creep" during down time.
- .11 Plug lifting holes with Departmental Representative approved prefabricated plugs, set in shrinkage compensating grout.
- .12 Cut pipes as required for special inserts, fittings or closure pieces, as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .13 Make watertight connections to manholes and catch basins using cast in place gaskets. Use shrinkage compensating grout when suitable gaskets are not available and only with prior approval of Departmental Representative.
- .14 Use prefabricated saddles or approved field connections for connecting pipes to existing sewer pipes. Joint to be structurally sound and watertight.
- .15 Temporarily plug open upstream ends of pipes with removable watertight concrete, steel or plastic bulkheads.

3.5 PIPE SURROUND

- .1 Place surround material in unfrozen condition.
  - .2 Upon completion of pipe laying, and after Departmental Representative has inspected pipe joints, surround and cover pipes as indicated. Leave joints and fittings exposed until field testing is completed.
  - .3 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
  - .4 Place layers uniformly and simultaneously on each side of pipe.
  - .5 Compact each layer from pipe invert to mid height of pipe to at least 98 % standard proctor maximum dry density.
  - .6 Compact each layer from mid height of pipe to underside of backfill to at least 98 % standard proctor maximum dry density.
-

- 3.5 PIPE SURROUND (Cont'd) .7 When field test results are acceptable to Departmental Representative, place surround material at pipe joints.
- 3.6 BACKFILL .1 Place backfill material in unfrozen condition.
- .2 Place backfill material, above pipe surround, in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.
- .3 Compact backfill to at least 98 % standard proctor maximum dry density.
- .4 Television and photographic inspections:  
.1 Carry out inspection of installed sewers by closed circuit television as per OPSS409.  
.2 Notify Departmental Representative at least 24 hours prior to commencement of the T.V. inspection and the contractor shall ensure that representatives from the Departmental Representative are available to monitor and approve all phases of the T.V. inspection, including the inspection firm.  
.3 No T.V. inspection report will be accepted where the sewer system is contaminated with dirt.  
.4 The contractor shall supply two (2) copies of the video report of the T.V. inspection including:

SPEC NOTE: Paragraph level is uncertain

- .1 A written report giving a list of all service connections identifying catch basin connections with a picture and description of deficiencies only (with video tape footages listed in the report for easy cross-reference.)  
.2 The distance the camera is in the pipe shall be provided continuously throughout the tape. This description is to be done using the manhole numbers listed on the design drawings.
- .5 T.V. inspection shall be required for all storm sewers.
- .6 All deficiencies of the system that are, in the opinion of the Departmental Representative, detrimental to the proper
-



3.6 BACKFILL  
(Cont'd)

.6 (Cont'd)  
operation of the system, will be repaired by the contractor at no extra cost to this contract. After deficiencies have been completed the sewer sections that had deficiencies shall be re-televised completed with a supplemental report. The cost of the re-televised sections shall be included.

END OF SECTION  
END OF SECTION



