

## **Part 1 General**

### **1.1 SCOPE**

- .1 The work done under this contract shall include the furnishing of all materials, supplies, equipment, plant, tools, temporary heating, hoarding and lighting, transportation, labour and superintendence necessary for the construction of the work as herein specified and as shown on the drawings. The scope of the project involves works to mitigate ice build-up and safety issues on adjacent roadways as a result of springs and creek flow during cold weather months. Work shall consist of installation on a new outfall into the Lake, heat tracing of the manhole, heat tracing of existing 1400 diameter corrugated steel storm sewer outfall line at the intersection of Lakeview Drive and Balsam Street and modifications to the existing outfall. Work shall also include coordination of work with utility provider, all foundation and concrete work for utility pedestal, clearing and debris removal for utility trenching and restoration of existing landscape following completion of work.

### **1.2 WORK COVERED BY CONTRACT DOCUMENTS**

- .1 This Clause is intended as a general description of the work only. Nothing in this Clause shall be construed as negating or lessening the requirements of any other Clause in the Contract.
- .2 The work done under this Contract shall include the furnishing of all materials, supplies, tools, equipment, plant, temporary plumbing, heating and lighting, transportation, labour and superintendence necessary for the construction of work within the Waskesiu Townsite in Prince Albert National Park as specified herein and as shown on the drawings. The work shall include:
  - .1 Ingress and egress to site;
  - .2 New 300 mm outfall piping and lake outfall;
  - .3 Directional drilling;
  - .4 Modifications and heat tracing at existing manhole and outfall;
  - .5 Installation of utility pedestal and foundation;
  - .6 Cleaning and removal of grit from existing storm sewer piping and maintaining flow and ice free operation for duration of project;
  - .7 Restoring landscape including topsoil replacement, seeding and asphalt restoration;
  - .8 Clean up of site;
  - .9 Repair of defects in workmanship and / or materials for a period of one year after completion of the work.

### **1.3 CONTRACT METHOD**

- .1 Construct Work under a combination of stipulated lump sum price and unit price contract.

#### **1.4 CONTRACTOR USE OF PREMISES**

- .1 Limit use of premises to allow:
  - .1 Public usage as per section 01 14 00 – Work Restrictions.
- .2 Co-ordinate use of premises under direction of Engineer.
- .3 At completion of operations condition of existing work: equal to or better than that which existed before new work started.

#### **1.5 OWNER OCCUPANCY**

- .1 Owner will occupy premises during entire construction period for execution of normal operations.
- .2 Co-operate with Owner in scheduling operations.
- .3 The Owner will have the right to take possession of and use any completed portions or partially completed portions of the Work, whether the time for completing the entire Work or such portions has or has not expired but such taking possession of and use will not be deemed an acceptance of any work so taking possession of and used. If such prior use increases the cost of or delays the completion of, uncompleted work or causes refinishing of completed work, the Contractor shall be entitled to such extra compensation or extension of time or both as the Engineer may determine.

#### **1.6 EXISTING SERVICES**

- .1 Notify, Engineer and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give Engineer 48 hours notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to pedestrian and vehicular traffic.
- .3 Provide alternative routes for pedestrian and vehicular traffic.
- .4 Establish location and extent of service lines in area of work before starting Work. Notify Engineer of findings.
- .5 Provide adequate bridging over trenches which cross sidewalks or roads to permit normal traffic.
- .6 Where unknown services are encountered, immediately advise Engineer and confirm findings in writing.
- .7 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
- .8 Record locations of maintained, re-routed and abandoned service lines.
- .9 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

## **1.7 CONTRACT DOCUMENTS**

- .1 The Contract Documents are complementary and what is required by any one shall be as binding as if required by all. The intention of the Contract is that the Contractor shall provide all materials, supervision, labour, equipment and all else necessary for, or incidental to, the proper execution of the Work.
- .2 Words which have well known technical or trade meanings are used in the Contract Documents in accordance with such recognized meanings. Should there be any conflict within the Contract Documents the Contractor shall notify the Engineer. The Engineers decision on such questions arising from the interpretation of the Specifications and Drawings shall govern.
- .3 The marginal notes or headings in the Contract form no part of this Contract but shall be deemed to be inserted for the convenience of reference only.
- .4 In the case of discrepancies between the Contract Documents the following shall apply:
  - .1 Documents of later date shall govern.
  - .2 Figured dimensions shall govern over scaled dimensions.
  - .3 Drawings of larger scale shall govern over smaller scale drawings of the same date.
  - .4 Specifications shall govern over Drawings.
- .5 The apparent generality of the Specifications and Drawings as to any detail or the apparent omission from them of a detailed description shall be regarded as meaning that only the best general practice is to prevail and that only material and workmanship of the first quality are to be used.

## **1.8 DOCUMENTS REQUIRED**

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

## **Part 2 Products**

### **2.1 NOT USED**

- .1 Not used.

**Part 3            Execution**

**3.1                NOT USED**

.1            Not used.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1            Section 01 11 00 – Summary of Work.

**1.2                PROTECTION OF THE WORK, PROPERTY AND PUBLIC**

- .1            The Contractor shall comply with all applicable laws, and regulations and lawful orders of any public authority having jurisdiction for the safety of persons or property and to protect them from damage, injury or loss.
- .2            The Contractor shall provide and maintain all necessary watchmen, barriers, fences, warning signs and lights and take all precautions necessary for the protection and safety of workmen and the public. All excavations or obstructions shall be clearly marked between sunset and sunrise with warning flares or lights.
- .3            Should any of the Contractor's Work interfere with any existing roadway the Contractor shall provide and maintain necessary detour roads, and shall post such signs and warnings and protection as may be necessary for Public Convenience and Safety and shall make good any damage caused by such interference.
- .4            The Contractor shall protect the Work, the Owner's Property and the Property adjacent to the site of the Work from damage as a result of his operations under the Contract. He shall make good at his own expense any damage which may arise as a result of his operations under the Contract Documents and/or acts or omissions by the Owner, his agent, employees or Other contractors.

**1.3                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.

**1.4                EMERGENCIES**

- .1            The Engineer has authority in an emergency to stop the progress of the Work whenever in his opinion such stoppage may be necessary to ensure the safety of life, the Work, or neighbouring property. This includes authority to make changes in the Work, and to order, assess and award the cost of such work, extra to the Contract or otherwise, as may in his opinion be necessary. The Engineer shall within Two (2) days confirm in writing any such instructions. In such a case if work has been performed under direct order of the Engineer, the Contractor shall keep his right to claim the value of such work.

**1.5                ARCHAEOLOGICAL INTERESTS**

- .1            Immediate notice shall be given to the Engineer if evidence of archaeological finds are encountered during construction.

- .2 Items of historical, cultural or archaeological interest, such as cornerstones, headstones, commemorative plaques, inscribed tablets and similar objects found on site shall be left in place until specific instruction from the Engineer or Owner is given.

## **1.6 USE OF SITE AND FACILITIES**

- .1 The Contractor shall confine his apparatus, the storage of products and the operations of his workmen to the limits indicated by laws, ordinances, permits or by direction of the Engineer and shall not unreasonably encumber the premises with his materials. The Contractor shall not load or permit to be loaded any part of the Work with a weight that will endanger the safety of the Work.
- .2 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with Engineer and Owner to facilitate work as stated.
- .3 Maintain existing services to buildings and provide for personnel and vehicle access.
- .4 Where security is reduced by work provide temporary means to maintain security.
- .5 Closures: protect work temporarily until permanent enclosures are completed.

## **1.7 EXISTING SERVICES**

- .1 Notify, Engineer and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give Engineer 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 - Temporary Barriers and Enclosures.

## **1.8 NIGHT WORK**

- .1 Night work, from sunset to sunrise, will only be allowed if written permission is given beforehand by the Engineer. When any work is carried out at night, the Contractor shall supply at his own cost a sufficient number of lights to enable the work to be done in a satisfactory and safe manner.

## **1.9 SPECIAL REQUIREMENTS**

- .1 Contractor shall be required to ensure full bi-directional traffic flow all roadways and shall ensure no road closures or work is completed within the road right of ways in the Townsite during the following dates:
  - .1 May 16<sup>th</sup> -18<sup>th</sup>
  - .2 June 27<sup>th</sup> – July 5<sup>th</sup>
  - .3 August 1<sup>st</sup>- 3<sup>rd</sup>

.4 September 5<sup>th</sup>- 7<sup>th</sup>

It shall be up to the Contractor to confirm the above dates with the Owner prior to construction in the event of any changes or alternations occurring during tendering and or approval periods.

.2 At all times work shall allow at a minimum on lane of traffic flow. Complete road closure will not be permitted.

.3 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.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 None

**1.2 PRIME COST SUM ALLOWANCES**

- .1 Where the Contract Price includes Prime Cost Sum and/or cash allowances stated in the Contract Documents, such allowances, unless otherwise specified, cover the net cost to the Contract of services, products, construction, machinery and equipment, freight, unloading, handling, storage, installation and other authorized expenses incurred in performing the Work stipulated under the cash allowance.
- .2 The Contract Price, and not the cash allowance, includes the Contractor's overhead and profit in connection with such cash allowances.
- .3 Where the costs under a cost allowance are lower than the amount of the allowance, the allowance shall be adjusted accordingly.
- .4 The Contract Price shall be adjusted by written order to provide for any excess or deficit to each cash allowance.
- .5 Progress payments on account of authorized work under cash allowances shall be certified on the Engineer's monthly certificate for payment. A schedule shall be prepared jointly by the Engineer and the Contractor to show when items called for under cash allowances must be authorized by the Engineer for ordering purposes so that the progress of the Work will not be delayed.
- .6 Total amount Prime Cost Sum to be \$20,000 for Work specified in respective specification Sections as follows:
- .1 Section 1.3 includes allowance for purchase and installation of permanent utility connections for SaskPower.
  - .2 Section 1.4 include allowance of for recovering the cost of specific materials testing or inspection required by the Engineer or in accordance with the Specifications.

**1.3 UTILITY PRIME COST SUM**

- .1 The prime cost sum allowance for utilities is intended to cover the costs levied by telephone, power and gas providers for providing services to the facility. The costs of temporary services for the Contractor's use during construction are not included in the prime cost sum and are to be paid for by the Contractor as part of the lump sum price. It is the responsibility of the Contractor to coordinate location, moving and installation of all utilities.

**1.4 MATERIALS TESTING PRIME COST SUM**

- .1 Materials Testing Prime Cost Sum is solely for verification that the work conforms to the Specifications. This allowance is not for locating aggregate sources or process testing by the Contractor or suppliers. All such testing shall be included in the prices tendered.



Contractor shall pay all invoices from third party testing agencies and submit actual invoices to Engineer to verification. Contractor shall be permit to a 10% mark-up of costs associated with materials testing.

**Part 2            Products**

**2.1                NOT USED**

.1                Not Used.

**Part 3            Execution**

**3.1                NOT USED**

.1                Not Used.

**END OF SECTION**

**Part 1            General**

**1.1                REFERENCES**

- .1            Not Used.

**1.2                REQUIREMENTS**

- .1            Referenced specification Sections stipulate pertinent requirements for products and methods to achieve Work stipulated.
- .2            Co-ordinate affected related Work and modify surrounding Work to integrate Work under each Alternative or Request for Equal.

**1.3                ALTERNATE OR EQUAL**

- .1            Where the Drawings or Specifications specify a particular kind or make of material or equipment to be used, and allow for any equal material or equipment to be substituted, no such substitution shall be made unless the Engineer has given written approval for such substitution Three (3) days prior to the date on which Tenders for the Contract close.

**Part 2            Products**

**2.1                NOT USED**

- .1            Not Used.

**Part 3            Execution**

**3.1                NOT USED**

- .1            Not Used.

**END OF SECTION**

**Part 1            General**

**1.1                DEFINITIONS**

**.1                Contract Price**

The Contract Price means the total of the amount payable to the Contractor for Work carried out on a Unit Price Basis at the unit prices set out in the Tender Form plus the total of amount payable to the Contractor on a lump sum basis as set out in the Tender Form, less any unused portions of cash allowances, subject to the adjustments, additions, deductions and deletions as provided for in the Contract Documents, and all payable in Canadian Funds.

**.2                Certificate For Payment:**

Certificate issued by the Engineer constituting a representation to the Owner that the Work has progressed to the point indicated and that the Contractor is entitled to payment in the amount certified and that to the best of the Engineer's knowledge, information and belief, the quality of the Work is in accordance with the Contract Documents subject to an evaluation of the Work for compliance with the Contract Documents upon completion or to the results of any test called for in the Contract Documents, or to the correction of any defect in the Work not observed or discovered by the Engineer or pointed out to the Engineer by the Contractor, or to minor deviations from the Contract Documents correctable prior to completion or to any qualifications stated in the Engineer's certificate for payment.

**.3                Interim Completion Certificate:**

Certificate issued by the Engineer for work done up to the point of substantial completion establishing the date and deficient items of the contract.

**.4                Final Completion Certificate:**

Certificate issued by the Engineer when to the best of his knowledge, information and belief, the entire Work has been performed and complies with the requirements of the Contract Documents, except for defects in the Work not discovered by the Engineer or the making good of faulty workmanship or materials during the maintenance period.

**.5                Final Acceptance Certificate:**

Certificate issued by the Engineer following the end of the maintenance period certifying that to the best of his knowledge, information and belief the performance of the Contract has been completed (except for defects in the Work not discovered by the Engineer).

**1.2                PST EXEMPTION**

**.1                The Contractor shall be aware that Parks Canada is PST exempt.**

### **1.3 CERTIFICATE FOR PAYMENT**

- .1 By issuing a Certificate for Payment, the Engineer shall not thereby be considered to represent that they have made exhaustive or continuous on-site inspection to check the quantity and quality of the Work, or that they have approved construction means, methods, techniques, sequences or procedures.
- .2 No payment made by the Owner under the Contract and no partial or entire use of occupancy of the Work by the Owner shall constitute an acceptance of any Work of material not in accordance with the Contract Documents. The issuance of the Final Acceptance Certificate shall constitute a waiver by the Owner of all claims other than those in respect to the defects in the Work, neither observed nor discovered by the Engineer and claims which the Owner may have against the Contract as set forth in the Final Acceptance Certificate or claims that may arise. The acceptance by the Contractor of such Final Acceptance Certificate or any payment authorized therein shall constitute a waiver by him of all claims against the Owner except those previously made in writing and still unsettled.

### **1.4 APPLICATIONS FOR PROGRESS PAYMENT**

- .1 The Engineer will prepare Progress Certificates. Following receipt of Progress Certificates, Contractor shall provide an invoice in the amount showed owing.
- .2 Claims for material delivered to the site but not yet incorporated into the work, shall be supported by such evidence as the Engineer may reasonably require to establish the value and delivery of the products.

### **1.5 UNIT PRICE AND LUMP SUM TABLE ITEMS**

- .1 Prices to be accepted as full compensation:
  - .1 The quantities set out in the Tender Form are approximate only and no claim shall be made by the Contractor on account of any variation in these quantities. The price or prices provided for in the Contract Documents whether unit prices or stipulated sum or both shall be accepted by the Contractor, as full compensation for everything furnished or done by the Contractor under this Contract, including all work required but not included in the items herein mentioned, and for any damage or loss arising out of the nature of the Work or by action of weather, elements, or any unforeseen obstruction or difficulty encountered in the prosecution of the Work, and for all expenses incurred by or in the consequence of any delay or suspension or discontinuance of the Work and for all risks of every description connected with the Work as herein specified and for completing the Work as herein provided.
  - .2 The quantities of work performed will be determined by the Engineer and such determination shall be final and binding.

### **1.6 PAYMENT SUMMARIES**

- .1 Payment for each item will be as per the specification section identified with summaries as per below:
  - shown.
  - .1 Cleaning and Flushing of Lines

Payment to be made at the lineal meter price per meter of existing 600 mm, 1000 mm, and 1400 mm storm mains including flushing, removal by hydro vac or other means, and hauling off site all debris within the existing system to facilitate construction of the force main within the existing pipe. Contractor shall also be responsible for maintaining the existing storm piping to ensure it is free flowing and clear of all debris, ice build-up and impedences for the duration of the contract. Maintenance of the mains shall be considered incidental to the contract and no additional payment shall be made.

.2 300 HDPE DR 11 Storm Main

Payment to be made at the unit price tendered per lineal meter of force main including all tools, materials, labour required for supply of, excavation, placement, HDPE piping, specials and flanges to connect to appurtenances, insulation, concrete weights, jacketing, fusing, jointing and all temporary and permanent work required for installation of force main within the lake as noted.

.3 300 mm HDPE DR11 Tee

Payment to be made the unit price tender for each tee including all tools, materials, labour required for supply of, installation, insulation kits, jacketing, and fusing by electro or butt fusing as required.

.4 300 mm Gate Valve (Insulated and Heat Traced)

Payment shall be made at the unit rate tendered for each gate valve installed including supply, excavation, installation, welding, flanges, specials, mineral wool or Foamglas insulation, jacketing, backfilling and connections required.

.5 Tie In to Existing Manhole

Payment shall be made the unit price tendered for work required to install piping into or connecting to an existing manhole. Price shall include all tools, labour and materials required to core into the existing concrete for all sizes and types of penetrations, installation of piping as required complete with link seal and grouting of penetrations.

.6 Directional Drilling

Payment for directional drilling shall be at the lump sum price tendered for all directional drilling work identified and shall include locating including hydrovacating of all existing utilities, materials, equipment and temporary excavation to install the various pipe sizes identified and restoration of drilling areas following construction.

.7 Modifications to the Existing Outfall and Outfall Manhole

Payment for modifications to the Existing Outfall and Outfall manhole shall be at the lump sum unit price tendered including removal of existing grating, supply and installation of the new grating and insulated panel system, and all electrical work associated with installation of pedestal, pedestal foundation, clearing and brush removal for utility installation, trenching of lines to manhole, restoration of topsoil, seeding, asphalt pathway following completion, supply and installation of the heat trace cable for the proposed valve and within the existing outfall line.

.8 400 mm Base Course

Payment shall be at the unit price tendered per square meter of 400 mm base course installed and measured compacted in place.

.9 Prime Coat

Payment shall be at the unit price tendered per Litre of prime coat.

.10 75 mm Asphalt Surface Course

Payment shall be at the unit price tendered per square meter of 75 mm asphalt including supply, placement, compaction, installation of multiple lifts, tack coats and flush coats as required.

.11 Utility Prime Cost Sum

Payment shall be included from the Prime Cost Sum identified and shall be made as per the actual utility installation cost provided by the utility provider. Any temporary utilities used by the contractor for the duration of the contract shall be at the Contractor's expense.

.12 Material Testing

Payment shall be made as part of the Prime Cost Sum for material testing as per the actual invoice from the agreed testing agency with any markups identified in the specifications herein.

## 1.7 SUBSTANTIAL PERFORMANCE OF WORK

- .1 Contractor shall prepare and submit to Engineer a comprehensive list of items to be completed or corrected and apply for a review to establish interim Completion of Work or substantial performance of designated portion of Work.
- .2 Once notified, a joint inspection will be made.
- .3 Substantial Performance of the Work is as defined in the lien legislation applicable to the location where the Work is undertaken.
- .4 Completion of the Work is as defined in the lien legislation applicable to the location where the Work is undertaken.
- .5 No later than 10 days after receipt of list and application, Engineer will review Work to verify validity of application, and no later than 7 days after completing review, will notify Contractor if Work is substantially performed.
- .6 In the event the Owner and Engineer are in agreement that the work is not substantially complete, the cost of subsequent inspections will be tabulated and deducted from Progress Certificates.
- .7 On the date that:
  - .1 The Contractor has complied fully with the Contract Documents and all orders, rulings and direction made pursuant thereto; and
  - .2 The Work has been completed to the best of the Engineer's knowledge, information and belief;the Engineer shall issue a Final Completion Certificate.
- .8 If the Engineer is satisfied that the Work is substantially completed and acceptable for use by the Owner, he may at any time before issuing a Final Completion Certificate issue

an Interim Completion Certificate and shall describe therein the portions of Work not completed to his satisfaction and all things required to be done by the Contractor before the Final Completion Certificate can be issued.

- .9 Engineer shall issue a Certificate of Substantial Performance of Contract along with an Interim Completion Certificate listing the established date of substantial completion and any deficient items of the Contract.
- .10 If the Work is substantially complete, but cannot be put to use by the Owner on account of conditions reasonably beyond the control of the Contractor, the date of substantial completion shall be that time when the Contractor ceased work with the written permission of the Engineer.

## **1.8 DEFICIENCY LIST AND HOLDBACK**

- .1 A deficiency list and holdback amount will be submitted to the Contractor upon Substantial Completion.
- .2 No partial payments or releases of deficiency money will be paid until all deficiencies have been corrected. Upon receiving the deficiency list, the Contractor shall have 15 working days to rectify the noted deficiencies.

## **1.9 PROGRESSIVE RELEASE OF HOLDBACK**

- .1 Partial releases of holdback for subcontract(s) for this project will not be permitted. Release of the holdback to the general contractor will not be considered unless the project meets all of the following criteria:
  - .1 Project is used for intended purposes,
  - .2 97% complete based on total cost of construction,
  - .3 Start up, commissioning, performance testing and operator training has been completed to the satisfaction of the Engineer.

## **1.10 FINAL PAYMENT**

- .1 Submit application for final payment when Work is completed including all deficient items.
- .2 Engineer will, no later than 10 days after receipt of application for final payment, review Work to verify validity of application. Engineer will give notification that application is valid or give reasons why it is not valid, no later than 7 days after reviewing Work.
- .3 Engineer will issue Certificate of Final Completion for payment when application for final payment is found valid. In the event the payment is not deemed valid, the cost of subsequent inspections will be tabulated and deducted from Progress Certificates.

## **1.11 FINAL ACCEPTANCE**

- .1 The Engineer shall issue a Final Acceptance Certificate at the expiration of the maintenance period upon being satisfied that all maintenance has been carried out in accordance with the Contract Documents.

- .2 Upon the issuance of a Final Acceptance Certificate the Owner shall pay to the Contractor the unpaid balance of any monies then due under the terms of the Contract.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 32 16 – Schedule.

**1.2 ADMINISTRATIVE**

- .1 Attend project meetings throughout the progress of the work at the call of Engineer.
- .2 Prepare Contractor Progress reports for meetings.
- .3 Representative of Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

**1.3 PRECONSTRUCTION MEETING**

- .1 Within 10 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
- .2 Engineer, Contractor, major Subcontractors, field inspectors and Owner will be in attendance.
- .3 Establish time and location of meeting and notify parties concerned minimum 5 days before meeting.
- .4 Incorporate mutually agreed variations to Contract Documents into Agreement, prior to signing.
- .5 Agenda to include:
  - .1 Appointment of official representative of participants in the Work.
  - .2 Schedule of Work: in accordance with Section 01 32 16 – Schedule.
  - .3 Schedule of submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
  - .4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences in accordance with Section 01 52 00 - Construction Facilities.
  - .5 Delivery schedule of specified equipment.
  - .6 Site security requirements..
  - .7 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
  - .8 Owner provided products.
  - .9 Record drawings in accordance with Section 01 33 00 - Submittal Procedures.
  - .10 Maintenance manuals in accordance with Section 01 33 00 – Submittal Procedures.
  - .11 Start-up and Commissioning in accordance with section 01 91 13 – Commissioning.
  - .12 Monthly progress claims, administrative procedures, photographs, hold backs.
  - .13 Appointment of inspection and testing agencies or firms.

- .14 Insurances, transcript of policies.

#### **1.4 PROGRESS MEETINGS**

- .1 During course of Work and 2 weeks prior to project completion, schedule progress meetings at bi-weekly intervals.
- .2 Contractor, major Subcontractors involved in Work, Engineer and Owner are to be in attendance.
- .3 Notify parties minimum 10 days prior to meetings.
- .4 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.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.

**1.2 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.

**1.3 REQUIREMENTS**

- .1 The Contractor shall prepare and update as required a construction schedule and plan of operation which shall describe the proposed labour force and equipment, sequence and method of operation, and projected weekly progress to show completion of all work within the Contract time for completion.
- .2 The schedule shall be submitted to the Owner and the Engineer within Ten (10) days of the date of notice of award. The Contractor shall monitor the progress of the Work relative to the schedule and shall advise the Engineer of any revisions required as a result of delays as per appropriate sections following, indicating the results expected from the resultant change in schedule.

- .3 If the Contractor fails to adhere to such a change in schedule, due to factors within his control, he shall promptly adopt such other or additional means or methods of construction that will ensure completion in accordance with such schedule.
- .4 Prior to the issuance of the Final Completion Certificate, the Contractor shall not remove any equipment from the Work without the prior written consent of the Engineer.

#### **1.4 SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit to Engineer Bar (GANTT) Chart for planning, monitoring and reporting of project progress.

#### **1.5 PROJECT SCHEDULE**

- .1 Ensure Detail Schedules are practical and remain within specified Contract duration.
- .2 Plan to complete Work in accordance with prescribed milestones and time frame.
- .3 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.
- .4 Ensure detailed Project Schedule includes as minimum milestone and activity types as follows:
  - .1 Award.
  - .2 Shop Drawings, Samples.
  - .3 Permits.
  - .4 Mobilization.
  - .5 Excavation.
  - .6 Backfill.
  - .7 Building footings.
  - .8 Slab on grade.
  - .9 Structural Steel.
  - .10 Siding and Roofing.
  - .11 Interior Architecture (Walls, Floors and Ceiling).
  - .12 Plumbing.
  - .13 Lighting.
  - .14 Electrical.
  - .15 Piping.
  - .16 Controls.
  - .17 Heating, Ventilating, and Air Conditioning.
  - .18 Millwork.
  - .19 Fire Systems.
  - .20 Testing and Commissioning.
  - .21 Supplied equipment long delivery items.

.22 Engineer supplied equipment required dates.

## **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 Project meetings will occur on a bi-weekly basis for the duration of the contract.
- .2 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.
- .3 Weather related delays with their remedial measures will be discussed and negotiated.

## **1.8 DETAIL DRAWINGS AND INSTRUCTIONS**

- .1 During the progress of the Work, the Engineer shall furnish to the Contractor such additional instructions by means of drawings or otherwise to supplement the Contract Documents as may be necessary for the performance of the Work. All such additional instructions shall be consistent with Contract Documents and the Work shall be executed in conformity therewith. In giving such additional instructions, the Engineer shall have the authority to make minor changes in the Work, not inconsistent with the Contract.
- .2 If either the Contractor or the Engineer so request, they shall jointly prepare a schedule, subject to change from time to time in accordance with the progress of the Work, fixing the dates at which the various detail drawings will be required.
- .3 The Engineer shall furnish the drawings in accordance with this schedule. Upon request, a similar schedule shall be prepared fixing the dates for the submission of shop drawings, for the beginning of manufacture and installation of materials and for the completion of the various parts of the Work.

## **1.9 DELAYS**

- .1 If the Contractor is delayed in the completion of the Work by the Owner, Engineer, Other Contractor or any employee or agent of any of them, or by labour disputes, strikes or lockouts, flood, fires, earthquakes, acts of God, accidents, riots, war, insurrection, or by the operation of any law, ordinance or regulation not breached by the Contractor or anyone for whom the Contractor is responsible, or by changes ordered in the Work, then the time of completion shall be extended for a period of time equal to the time lost due to such delays.
- .2 No extension shall be made for such delays unless written notice of claim is given to the Engineer not later than Seven (7) days after the commencement of the delay providing, however, that in the case of a continuing cause of delay only one notice of claim shall be

necessary. The Engineer will record the period of such delay and will advise the Contractor and the Owner in writing of the extent of such delay. Failure by the Contractor to give such written notice to the Engineer within the said Seven (7) days will constitute a waiver on the Contractor's part of his right to such extension of time.

- .3 The Contractor, whenever he considers that he is entitled to an extension of time for completion of the whole or a portion of the Work, by the terms of the Contract, for any cause beyond the Contractor's control (other than those mentioned in the immediately preceding paragraphs) shall make application in writing to the Engineer for such extension. The application shall specify definitely the grounds on which he claims for an extension of time. The Engineer, upon receipt of his written claim, shall fully and fairly consider it, and fix such an extension period (if any) as, in his sole discretion, is fair and reasonable in the circumstances. Failure or neglect on the part of the Contractor to make application for an extension of time as above provided within Seven (7) days of the occurrence of the delay will constitute a waiver on the Contractor's part of any right to such extension of time. The Engineer shall have no authority to consider extensions of time due to causes within the Contractor's control.
- .4 Other than the right to claim an extension of time as provided herein, the Contractor shall not have or make any claim or demand nor bring any action, petition, or suit against the Owner for any damages, cost, loss of profits or otherwise, which the Contractor may sustain by reason of any delays, from whatever cause, arising in the progress of the Work.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not used.

**END OF SECTION**

## **Part 1           General**

### **1.1           COPIES FURNISHED**

- .1     The Engineer shall furnish the Contractor without charge, as many copies of all drawings and specifications as are reasonably necessary for the proper execution of the Work. All drawings, specifications and copies thereof and models furnished by the Engineer are property of the Engineer. They are not to be used on other work, and with the exception of the signed Contract, the Drawings and Specifications, are to be returned to the Engineer on request on the completion of the Work. Any models furnished by the Contractor or the Owner are the Property of the Owner.

### **1.2           SHOP DRAWING ADMINISTRATION**

- .1     The Contractor shall review, stamp with his approval and submit, all shop drawings and samples required by the Contract Documents or requested by the Engineer, in an orderly sequence so as to cause no delay in the Work or in the Work of any other Contractor. The Contractor shall inform the Engineer, in writing, of any deviation in Shop Drawings or Samples from the requirements of the Contract Documents at the time of submission. By approving and submitting Shop Drawings and Samples, the Contractor thereby represents that he has determined and verified all field measurements, field construction criteria, materials, catalogue numbers and similar data or will do so, and that he has checked and co-ordinated each Shop Drawing and Sample with the requirements of the Work and of the Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .2     The Engineer will review the Shop Drawings and Samples but only for conformation with the design concept of the project and with the information given in the Contract Documents. The Engineer's review of a separate item shall not indicate approval of such item or of any assembly in which the item functions.
- .3     The Contractor shall make any corrections requested by the Engineer and shall resubmit the required number of corrected copies of Shop Drawings or new Samples. The Contractor shall direct specific attention in writing or upon resubmission of Shop Drawings to revisions other than the corrections requested by the Engineer on any previous submission.
- .4     The Engineer's review of the Shop Drawings or Samples shall not relieve the Contractor of the responsibility for any deviation from the requirements of the Contract Documents unless the Contractor has informed the Engineer in writing of such deviation at the time of submission, and the Engineer has given written approval to the specific deviation. The Engineer's review and such approval shall not relieve the Contractor from responsibility from errors or omissions in the Shop Drawings or Samples.
- .5     No portion of the Work requiring a Shop Drawing or Sample submission shall be commenced until the Engineer has reviewed the submission. If either the Contractor or Engineer so request, they shall jointly prepare a schedule fixing the dates for submission and return of Shop Drawings.
- .6     Keep one reviewed copy of each submission on site.

### **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.
- .2 At the pre-construction meeting, the Engineer shall provide the Contractor with a list of required shop drawings / samples which will be required for the completion of the project.
- .3 The shop drawings noted on the list shall be submitted in electronic (.pdf) format and shall not exceed 10 MB per submittal. Electronic submission shall be to the email specified prior to construction and completed utilizing the naming convention provided by the Engineer. Printed and scanned copies may not be accepted.
- .4 The submittal must be reviewed and signed by the Contractor prior to submission for review. The Contractor should allow for a minimum of 10 working days for the review process. Certain submissions, such as coordination drawings, may require additional time.
- .5 Submit drawings stamped and signed by professional engineer registered or licensed in Saskatchewan as required.
- .6 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.
- .7 Adjustments made on shop drawings by Engineer are not intended to change Contract Price. If adjustments affect value of Work, state such in writing prior to proceeding with Work.
- .8 Make changes in shop drawings as Engineer may require, consistent with Contract Documents. When resubmitting, notify in writing of revisions other than those requested.
- .9 Accompany submissions with transmittal letter, containing:
  - .1 Date.
  - .2 Project title and number.
  - .3 Contractor's name and address.
  - .4 Identification and quantity of each shop drawing, product data and sample.
  - .5 Other pertinent data.
- .10 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.
- .11 Delete information not applicable to project.
- .12 Supplement standard information to provide details applicable to project.
- .13 If upon review by Engineer, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

#### **1.4 OPERATION AND MAINTANANCE MANUALS**

- .1 The Contractor shall provide three (3) hardcopies and one (1) digital copy (in .pdf format) of Operation and Maintenance Manuals within 30 days of completion. The manuals are incidental to the contract and as such, no payment shall be made for Operation/Maintenance manuals. For deficiency holdback and miscellaneous valuation purposes, the manuals shall be valued at \$25,000. Type, colour and quality of the binder shall be submitted to the Engineer for approval prior to submission of the Operation and Maintenance Manual.

Each Manual shall include:

- .1 As-built drawings (clearly marked on one set of white prints provided by the Engineer).
- .2 Instruction for the operation and maintenance of each component and equipment with clear and concise drawings.
- .3 Equipment lists with manufacturer's name, address, model no., serial no., and spare parts list.
- .4 List of Contractor and sub-contractors (name, address and phone numbers).
- .5 List of equipment suppliers (name, address, and phone numbers).
- .6 Construction photographs on USB drive.

**1.5 SAMPLES**

- .1 Submit for review samples as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to Engineer.
- .3 Notify Engineer 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 Engineer are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Engineer prior to proceeding with Work.
- .6 Make changes in samples which Engineer 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.

**END OF SECTION**

**Part 1            General**

**1.1               RELATED REQUIREMENTS**

- .1        Section 01 74 11 - Cleaning
- .2        Section 31 14 13 – Topsoil Removal and Replacement.

**1.2               REFERENCES**

- .1        Definitions:
  - .1        Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to 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.
- .2        Reference Standards:
  - .1        U.S. Environmental Protection Agency (EPA)/Office of Water
    - .1        EPA 832/R-92-005-92, Storm Water Management for Construction Activities, Chapter 3.

**1.3               ACTION AND INFORMATIONAL SUBMITTALS**

- .1        Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2        Prior to commencing construction activities or delivery of materials to site, provide Environmental Protection Plan for review and approval.
- .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        Names of persons responsible for ensuring adherence to Environmental Protection Plan.
  - .2        Descriptions of environmental protection personnel training program.
  - .3        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.

- .4 Drawings showing locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on site.
- .5 Traffic Control Plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Ensure plans include measures to minimize amount of mud transported onto paved public roads by vehicles or runoff.
- .6 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.
- .7 Spill Control Plan including procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.
- .8 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.
- .9 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, are contained on project site.
- .10 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.
- .11 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.

#### **1.4 FIRES**

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

#### **1.5 DRAINAGE**

- .1 Provide Erosion and Sediment Control Plan identifying type and location of erosion and sediment controls provided. Ensure plan includes monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations, EPA 832/R-92-005, Chapter 3 requirements.
- .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.

- .5 Contractor will be held responsible for all damage caused or resulting from water backing up, flowing over, through, from or along any part of the work or which any of the Contractors operations may cause to flow elsewhere.

## **1.6 SITE CLEARING AND PLANT PROTECTION**

- .1 Protect trees and plants on site and adjacent properties as indicated.
- .2 Wrap in burlap, trees and shrubs adjacent to construction work, storage areas and trucking lanes, and encase with protective wood framework from grade level to height of 2 m minimum.
- .3 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage. Avoid unnecessary traffic, dumping and storage of materials over root zones.
- .4 Minimize stripping of topsoil and vegetation.
- .5 Restrict tree removal to areas indicated or designated by Engineer

## **1.7 WORK ADJACENT TO WATERWAYS**

- .1 Construction equipment to be operated on land only.
- .2 Do not use waterway beds for borrow material.
- .3 Waterways to be free of excavated fill, waste material and debris.
- .4 Design and construct temporary crossings to minimize erosion to waterways.
- .5 Do not skid logs or construction materials across waterways.
- .6 Avoid indicated spawning beds when constructing temporary crossings of waterways.

## **1.8 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 sandblasting and other extraneous materials from contaminating air and waterways beyond application area.
  - .1 Provide temporary enclosures where required.
- .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

## **Part 2 Products**

### **2.1 NOT USED**

- .1 Not Used.

**Part 3            Execution**

**3.1                CLEANING**

- .1        Clean in accordance with Section 01 74 11 - Cleaning.
- .2        Ensure public waterways, storm and sanitary sewers remain free of waste and volatile materials disposal.

**END OF SECTION**

**Part 1            General**

**1.1               RELATED SECTIONS**

- .1        Section 01 21 00 – Allowances.

**1.2               REFERENCES**

- .1        Not Used.

**1.3               ENGINEERS FUNCTIONS DURING CONSTRUCTION**

- .1        The Engineer will be, in the first instance, the interpreter of the requirements of the Contract Documents and the judge of the performance hereunder by both parties to the Contract. The Engineer will rule on matters of interpretation or questions concerning performance of the Work by the Contractor raised by either party to the Contract or as the Engineer may observe. Notwithstanding the foregoing, there shall be no duty on the Engineer to observe or discover defects in the Work but only to rule on such matters as may be brought to his notice or as he may observe.
- .2        The Engineer will make periodic visits to the site and may also provide Resident Services during construction to determine in general, if the Work is proceeding in accordance with the Contract Documents, and to observe the quality and progress of the Work. As the Engineer will neither be nor become a guarantor of the Contractor's Work, the Engineer will not make exhaustive or continuous on-site inspections of the quality or quantity of the Work. The Engineer will not be responsible for, and will not have control or charge of constructions means, methods, techniques, sequences, or procedures, or for safety precautions and programs related thereto. The Engineer will not be responsible for the acts or omission of the Contractor, Subcontractors, or their agents, employees or other persons performing any of the Work. The Engineer's efforts will be directed towards providing assurance to the Owner that the completed Work will conform to the requirements of the Contract Documents. The Engineer will not be responsible for superintending the Contractor's Work or for the failure of the Contractor to perform the Work in accordance with the Contract Documents. During such visits and on the basis of his on-site observations, the Engineer will keep the Owner informed of the progress of the Work. The Engineer will endeavour to guard the Owner against deficiencies and defects in the Work of the Contractor and may reject or disapprove of any Work as failing to conform to the requirements of the Contract Documents.
- .3        The Engineer shall decide on questions arising under the Contract Documents whether as to the interpretation of the Specifications and Drawings or as to the performance of the Work, but should the Contractor hold such decisions to be at variance with the Contract Documents, or to involve changes in Work already built, fixed, ordered, or in hand in excess of the Contract, or to be given in error, he shall notify the Engineer before proceeding to carry them out. In the event of the Engineer and the Contractor failing to agree as to such excess or error and the Engineer deciding that the disputed Work is to be carried out, the Contractor shall act according to such decision. Any questions of excess of cost due to the aforesaid cause may be decided in the manner hereinafter.

- .4 Nothing contained in this Contract Document shall create any contractual relationship between the Engineer and the Contractor, his Subcontractors, his Suppliers or their agents, employees or other persons performing any of the Work.

#### **1.4 SUPERINTENDANCE AND CONTRACTOR'S RESPONSIBILITIES**

- .1 The Contractor shall employ a competent Superintendent who shall be in attendance at the place of the Work at all times during the progress of the Work. The Contractor may employ such assistants as required to assist the Superintendent. The Superintendent shall be satisfactory to the Engineer and shall not be changed except for good reason and only then after consultation with the Engineer. The Superintendent shall represent the Contractor at the place of Work and instructions given to him by the Engineer shall be held to have been given to the Contractor. Important directions shall be given to the Contractor in writing.
- .2 The Contractor shall have complete control of the Work and shall effectively direct and supervise the Work so as to ensure conformance with the Contract Documents using his best skill and attention. The Contractor shall be solely responsible for construction means, methods, sequences, techniques and procedures, for safety precautions and programs, and for co-ordinating all portions of the Work. At all times, the onus shall be and remain on the Contractor to carry out and complete the Work in accordance with the Contract Documents, and this onus shall not be discharged should the Engineer not observe any defects or deficiencies in the Work.
- .3 The Contractor shall have the sole responsibility for the design, erection, operation, maintenance, and removal of temporary structural and other temporary facilities, and the design and execution of construction methods required in their use. The Contractor shall engage and pay for registered Professional Engineering personnel, skilled in the appropriate discipline to perform these functions where required by law, or by the Contract Documents and in all cases where such temporary facilities and their method of construction are of such a nature that Professional Engineering skills are required to produce safe and satisfactory results.
- .4 The Contractor shall be solely responsible for construction safety at the site of the Work for compliance with the rules, regulations, and acts as required by the applicable construction safety legislation.

#### **1.5 LAYING OUT OF WORK**

- .1 Unless otherwise stipulated in the general requirements of the Contract Documents, all Work to be performed under this Contract is to be laid out by the Contractor, which shall include, but not be limited to batter boards, sight rails, stakes, marks and benchmarks as required.
- .2 The Engineer will lay out the Work governed by Sections 31 through 33 inclusive.
- .3 The Contractor shall provide the Engineer with reasonable assistance and with assistants acceptable to the Engineer as required to make any surveys and measurements for laying out the work and to check lines and grades and collect record information. Wherever possible, the Contractor shall make the same person available to the Engineer throughout the course of the Work.



- .4 The Contractor shall be responsible for the accuracy of the layout and preservation of all benchmarks, reference points and stakes.
- .5 The Contractor shall provide and pay for all stakes, lath, hubs, nails, markers, and tools required by the Engineer to lay out, check and record the Work.
- .6 The Contractor shall provide the Engineer with a minimum of 24 hours notice in advance of requiring survey stakes.
- .7 Before commencing work the Contractor shall satisfy himself as to the meaning and correctness of all stakes, markers and grade sheets.

## **1.6 INSPECTION**

- .1 The Owner and the Engineer or their authorized agent or representative, shall at all times have access to the Work, whenever it is in preparation or progress and the Contractor shall provide proper facilities for such access and inspection. If special tests, approval or inspections are required by the Contract Documents, the Engineer's instructions or the laws, or ordinances of the place of building, the Contractor shall give the Engineer timely notice of his readiness for inspection and if the inspection is by authority other than the Engineer of the date and time fixed for such inspection.
- .2 If the Contractor covers, or permits to be covered, any of the Work subject to inspection or testing, without consent of the Engineer it must, if required by the Engineer, be uncovered for examination and made good at the Contractor's expense.
- .3 The Engineer may order any part of the Work to be specially examined should he believe that such Work is not in accordance with the requirements of the Contract Documents. If such Work is found in accordance with the Contract the Owner shall pay the costs of re-examination and replacement. If such Work is found not in accordance with the Contract, the Contractor shall pay such costs unless the Contractor was not responsible for such deficiency under the terms of the Contract Documents.
- .4 No obligation shall arise on the Owner, or on the Engineer by reason of any inspection made pursuant to this article, nor shall any failure to make any inspection relieve the Contractor of the responsibility for the Work.

## **1.7 INDEPENDENT INSPECTION AGENCIES**

- .1 Independent Inspection/Testing Agencies will be engaged or approved of by Engineer for purpose of inspecting and/or testing portions of Work.
- .2 Allocated costs: to Section 01 21 00 – Allowances.
- .3 Provide equipment required for executing inspection and testing by appointed agencies.
- .4 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .5 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 Engineer.

**1.8 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.

**1.9 PROCEDURES**

- .1 Notify appropriate agency and Engineer 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.

**1.10 REJECTED WORK**

- .1 The Contractor shall promptly remove from the premises any defective work or materials which have been condemned by the Engineer as failing to conform to the Contract Documents, whether incorporated into the Work or not. The Contractor shall promptly replace and re-execute his own work in accordance with the Contract and without expense to the Owner, and shall bear the expense of making good all work of Other Contractors destroyed or damaged by such removal or replacement.
- .2 If the Contractor does not remove such condemned materials or work within the time fixed by written notice, the Owner may remove them and may store such material at the expense of the Contractor. If the Contractor does not pay the expense of such removal within Five (5) days thereafter, the Owner may upon Ten (10) days written notice sell such materials at auction or other private sale and shall account for the net proceeds thereof, after deducting all the costs and expenses that should have been borne by the Contractor.

**1.11 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 Engineer and may be authorized as recoverable.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3            Execution**

**3.1                NOT USED**

.1            Not Used.

**END OF SECTION**

**Part 1            General**

**1.1               RELATED SECTIONS**

- .1       Section 01 11 00 – Summary of Work.
- .2       Section 01 51 00 – Temporary Facilities
- .3       Section 01 71 00 – Examination and Preparation

**1.2               REFERENCES**

- .1       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.

**1.3               SUBMITTALS**

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

**1.4               INSTALLATION AND REMOVAL**

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

**1.5               MAINTAIN SEWAGE, WATER AND STORMWATER FLOW**

- .1       The Contractor shall ensure that there is minimum interruption to the sanitary sewer, storm sewer and water service during construction.
- .2       The Contractor shall bear the full cost of supplying, installing and operating any temporary pipe, fittings, and pumps that may be required to accommodate continuous sewer and water service. Complete shutdown of the sewer and water service will not be allowed without written approval from the Engineer.
- .3       Contractor shall be responsible for ensuring the existing storm sewer system remains open and clear for the duration of the project. This is to include all work and means to keep the storm sewer free from ice build up and/or any blockage.

**1.6               DEWATERING**

- .1       Provide temporary drainage and pumping facilities to keep excavations and site free from standing water.

**1.7               WATER SUPPLY**

- .1       Arrange for connection with appropriate utility company and pay costs for installation, maintenance and removal.

## **1.8 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 substances into atmosphere of occupied areas.
  - .3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
  - .4 Ventilate storage spaces containing hazardous or volatile materials.
  - .5 Ventilate temporary sanitary facilities.
  - .6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.
- .6 Permanent heating system of building shall only be allowed with prior written consent from Engineer. Be responsible for damage to heating system if use is permitted.
- .7 On completion of Work for which permanent heating system is used, ensure all filters, bearings are replaced and all ducting and equipment properly cleaned to new condition.
- .8 Ensure Date of Substantial Performance and Warranties for heating system do not commence until entire system is in as near original condition as possible and is certified by Engineer.
- .9 Pay costs for maintaining temporary heat, when using permanent heating system.
- .10 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
  - .1 Conform with applicable codes and standards.
  - .2 Enforce safe practices.
  - .3 Prevent abuse of services.

- .4 Prevent damage to finishes.
- .5 Vent direct-fired combustion units to outside.
- .11 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

## **1.9 TEMPORARY POWER AND LIGHT**

- .1 Arrange for connection with appropriate utility company. Pay costs for installation, maintenance and removal including temporary power for electric cranes and other equipment.
- .2 Provide and maintain temporary lighting throughout project. Ensure level of illumination on all floors and stairs is not less than 162 lx.

## **1.10 TEMPORARY COMMUNICATION FACILITIES**

- .1 Provide and pay for temporary communication lines necessary for own use and use of Engineer.

## **1.11 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 TEMPORARY EROSION AND SEDIMENTATION CONTROL**

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction, that complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 None.

**1.2 REFERENCES**

- .1 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.
- .2 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.

**1.3 INSTALLATION AND REMOVAL**

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

**1.4 SCAFFOLDING**

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

**1.5 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.
- .3 Provide protective coverings for finish surfaces of cars and entrances.



**1.6 SITE STORAGE/LOADING**

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

**1.7 SECURITY**

- .1 Provide and pay for responsible security personnel to guard site and contents of site after working hours and during holidays.

**1.8 EQUIPMENT, TOOL AND MATERIALS STORAGE**

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

**1.9 SANITARY FACILITIES**

- .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.

**1.10 PROTECTION AND MAINTENANCE OF TRAFFIC**

- .1 All work shall be carried out in a manner that provides for safe passage of local pedestrian and vehicular traffic. The Contractor is responsible to ensure all roads and detours are maintained in a passable condition, as approved by the Engineer, throughout the completion of the Work. Material, equipment and labour required to maintain roads and detours are to be supplied at the Contractor's expense.
- .2 Provide access and temporary relocated roads as necessary to maintain traffic.
- .3 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed.
- .4 Provide measures for protection and diversion of traffic, including provision of watch-persons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs
- .5 Protect travelling public from damage to person and property.
- .6 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.
- .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 Construct access and haul roads necessary.
- .9 Haul roads: constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided.
- .10 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.
- .11 Dust control: adequate to ensure safe operation at all times.
- .12 Provide snow removal during period of Work.

**1.11 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.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL**

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

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 14 00 – Work Restrictions.
- .2 Section 03 10 00 – Concrete Forming and Accessories
- .3 Section 03 30 00 – Cast-in-place Concrete
- .4 Section 03 35 00 – Concrete Finishing

**1.2 REFERENCES**

- .1 Canadian General Standards Board (CGSB)
  - .1 CGSB 1.59-7, Alkyd Exterior Gloss Enamel.
  - .2 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.
- .2 Canadian Standards Association (CSA International)
  - .1 CSA-O121-M1978(R2003), Douglas Fir Plywood.

**1.3 INSTALLATION AND REMOVAL**

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

**1.4 HOARDING**

- .1 Erect temporary site enclosures using 38 x 89 mm construction grade lumber framing at 600 mm centres and 1200 x 2400 x 13mm exterior grade fir plywood to CSA O121.
- .2 Apply plywood panels vertically flush and butt jointed.
- .3 Provide lockable truck entrance gate and at least one pedestrian door as directed and conforming to applicable traffic restrictions on adjacent streets. Equip gates with locks and keys.
- .4 Erect and maintain pedestrian walkways including roof and side covers, complete with signs and electrical lighting as required by law.
- .5 Provide barriers around trees and plants designated to remain. Protect from damage by equipment and construction procedures.

**1.5 GUARD RAILS AND BARRICADES**

- .1 Provide secure, rigid guard rails and barricades around deep excavations, open shafts, open stair wells, open edges of floors and roofs, and all underground utilities requiring excavation.

**1.6 ACCESS TO SITE**

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

**1.7 PUBLIC TRAFFIC FLOW**

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

**1.8 FIRE ROUTES**

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

**1.9 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.

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

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1            General**

**1.1                REFERENCES**

- .1       Owner's identification of existing survey control points and property limits.

**1.2                SITE CONDITIONS**

- .1       The Contractor shall be aware the project involves construction of a permanent dewatering facility to mitigate ice build-up and safety issues on adjacent roadways as a result of springs and creek flow during cold weather months.
- .2       The Contractor is solely responsible for obtaining all the information required for the preparation of his tender and for the execution of the work. He is not entitled to rely on any data or information included in the tender documents as to site or subsurface conditions, or test results indicating the quantity, suitability or otherwise of site subsurface materials to be used or encountered in carrying out the construction of the Work. It is recommended that tenderers thoroughly examine the site prior to submission of their Tender.

**1.3                PERMITS, NOTICES, LAWS AND RULES**

- .1       The Contractor shall apply and pay for all necessary permits or licenses required for the execution of the Work (but this shall not include the obtaining of permanent easements or rights of servitude). The Contractor shall give all necessary notices and pay all fees required by law and comply with all laws, ordinances, rules and regulations relating to the Work and to the preservation of the public health. The Contractor shall be responsible for the safety of all workmen and equipment on the Work in accordance with all applicable safety legislation passed by federal, provincial and local authorities governing construction safety.

**1.4                SURVEY REFERENCE POINTS**

- .1       Locate, confirm and protect control points prior to starting site work. Preserve permanent reference points during construction.
- .2       Make no changes or relocations without prior written notice to Engineer
- .3       Report to Engineer when reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.

**1.5                SURVEY REQUIREMENTS**

- .1       Establish permanent bench marks on site, referenced to established bench marks by survey control points. Record locations, with horizontal and vertical data in Project Record Documents.
- .2       Establish lines and levels, locate and lay out, by instrumentation.
- .3       Establish pipe invert elevations.
- .4       Stake batter boards.

- .5 Establish foundation and floor elevations.
- .6 Establish lines and levels for mechanical and electrical work.

## **1.6 EXISTING FEATURES**

- .1 The Contractor shall take all necessary precautions to insure that all existing features including trees, buried piping, buried cable and adjacent structures, etc., are adequately protected from damage. Damage shall be made good at the Contractor's expense. The Contractor shall provide the Engineer with a detailed work plan outlining the proposed method of installing the works.

## **1.7 EXISTING SERVICES**

- .1 Excavation in the vicinity of existing structures and utilities shall be carefully performed and any utility which crosses an excavation must be properly supported or shored to prevent settlement. Where trenching is to be done under existing utilities, such utilities shall be shored before excavation commences and the shoring left in place.
- .2 The existing location and elevation of any underground utilities are not guaranteed. Notwithstanding any other provision in the Contract Documents, the Contractor shall be responsible for determining the location and elevation of all sewer, water and gas mains, service lines, electric light, power or telephone conduits, or any other structures or utilities, and shall pay for any service supplied by the waterworks, sewer, gas, electric light, telephone company or department and the Contractor shall be responsible for notifying the appropriate utility, department, person or persons, of his intent to carry out operations in the vicinity of any such operations being there carried out. The Contractor shall deposit with the Engineer, letters from the appropriate authorities of the utilities involved stating that the Contractor has made satisfactory arrangements with the utilities for the location, protection, and inspection of the utility involved.
- .3 Before commencing work, establish location and extent of service lines in area of Work and notify Engineer of findings.
- .4 Remove abandoned service lines within 2 m of structures. Cap or otherwise seal lines at cut-off points as directed by Engineer.

## **1.8 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 Engineer of impending installation and obtain approval for actual location.
- .4 Submit field drawings to indicate relative position of various services and equipment when required.

**1.9 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.

**1.10 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 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1            General**

**1.1            RELATED SECTIONS**

**1.2**            Section 01 33 00   Submittal Procedures.

**1.3            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.

**1.4            MATERIALS**

.1            Required for original installation.

.2            The Contractor shall keep one copy of all Current Contract Documents and approved Shop Drawings, Addenda and other instructions on the Work, and these shall be maintained in good order and marked to record all changes made during Construction and shall be available to the Engineer and/or his representatives. The Drawings, marked to record all changes made during construction, shall be given to the Engineer for the Owner upon completion of the Work.

**1.5            PREPARATION**

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

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

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



- .4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.
- .5 Provide protection from elements for areas which are to be exposed by uncovering work; maintain excavations free of water.

## 1.6 EXECUTION

- .1 The Contractor shall do all cutting, fitting or patching of his work that may be required to make its several parts come together properly and fit it to receive or be received by work of any Other Contractors shown upon, or reasonably implied by the Contract Documents.
- .2 Execute cutting, fitting, and patching, including excavation and fill, to complete Work.
- .3 Fit several parts together, to integrate with other Work.
- .4 Any cost caused by ill-timed work shall be borne by the party responsible therefore. The Contractor shall not endanger any existing work by cutting, digging or otherwise and shall not cut or alter the Work of any Other Contractor save with the consent of the Engineer.
- .5 Uncover Work to install ill-timed Work.
- .6 Remove and replace defective and non-conforming Work.
- .7 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.
- .8 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.
- .9 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
- .10 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.
- .11 Restore work with new products in accordance with requirements of Contract Documents.
- .12 Fit Work to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .13 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with firestopping material to full thickness of the construction element.
- .14 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.
- .15 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

**Part 2            Products**

**2.1                NOT USED**

.1            Not Used.

**Part 3            EXECUTION**

.1            Not Used.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 None.

**1.2 PROJECT CLEANLINESS**

- .1 The Contractor shall at all times maintain the Work site free from the accumulation of waste products and debris or rubbish caused by his employees or work, and at the completion of the Work he shall remove his surplus products, tools, equipment, and rubbish from and about the Work and shall leave the Work clean and suitable for occupancy by the Owner unless otherwise specified. In case of dispute the Owner may remove the rubbish and charge the costs to the Contractor as the Engineer shall determine to be just.
- .2 Maintain Work in tidy condition, free from accumulation of waste products and debris.
- .3 Remove waste materials from site at daily regularly scheduled times or dispose of.
- .4 Clear snow and ice from access to building.
- .5 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .6 Provide on-site containers for collection of waste materials and debris.
- .7 Remove all food and food waste from site on daily basis. Remove all and any items which may attract wildlife to site.
- .8 Provide and use marked separate bins for recycling.
- .9 Dispose of waste materials and debris off site.
- .10 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.
- .11 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .12 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .13 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .14 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

### 1.3 FINAL CLEANING

- .1 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- .3 Prior to final review remove surplus products, tools, construction machinery and equipment.
- .4 Remove waste products and debris including that caused by Owner or other Contractors.
- .5 Remove waste materials from site at regularly scheduled times or dispose of as directed by Engineer.
- .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 fittings, walls, and floors.
- .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, fittings and equipment and ensure specified workmanship and operation.
- .13 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .14 Remove dirt and other disfiguration from exterior surfaces.
- .15 Clean and sweep roofs, gutters, areaways, and sunken wells.
- .16 Sweep and wash clean paved areas.
- .17 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.
- .18 Clean roofs, downspouts, and drainage systems.
- .19 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.
- .20 Remove snow and ice from access to building.

**Part 2            Products**

**2.1                NOT USED**

.1            Not Used.

**Part 3            Execution**

**3.1                NOT USED**

.1            Not Used.

**END OF SECTION**

## **Part 1            General**

### **1.1                SUMMARY**

#### **.1                Section Includes:**

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

#### **.2                Acronyms and Definitions:**

- .1            Cx - Commissioning.
- .2            O&M - Operation and Maintenance.
- .3            PI - Product Information.
- .4            PV - Performance Verification.
- .5            Start Up - Start Up shall be defined as trial testing and starting of equipment and processes for the first time and continued operation, as required. Prior to starting any major item of equipment, the contractor shall arrange for an inspection by an authorized and skilled representative of the equipment manufacturer. Start-up includes testing, flushing and operation of equipment, systems and all processes until plant commissioning. The contractor shall start up and operate all equipment, systems and processes for a period of seven (7) consecutive days prior to requesting commissioning and operator training. All costs related to the start-up shall be included in the submitted tendered price.
- .6            Commissioning - Commissioning shall be defined as performance confirmation of equipment, systems and processes. Prior to commissioning, the contractor shall submit a testing procedure to the Engineer for approval. All testing shall be in accordance with applicable codes, specifications and authorities having jurisdiction. All testing shall be conducted in the presence of the Engineer. Commissioning shall be for a one (1) day on-site and include qualified representatives of major equipment manufacturers, and shall continue until the Engineer is satisfied. The contractor shall ensure all equipment representatives are present during the scheduled commissioning. Commissioning cannot occur until the entire facility is ready for operation by the Owner.
- .7            Operator Training - Operator training shall be defined as providing operation and maintenance instruction to the Owner's designated representatives. Operation training can be conducted during commissioning, however, must also be conducted following the completion of performance confirmation testing of all equipment, systems and processes. Training shall be conducted by qualified manufacturers' representatives. In addition to training provided during commissioning, the contractor shall provide an additional two (2) days of on-site training during the maintenance period. Scheduling of the additional training will be provided by the Engineer. The contractor will be required to provide the services of qualified equipment manufacturers' representatives for the additional commissioning and training.

## **1.2 GENERAL**

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

## **1.3 COMMISSIONING OVERVIEW**

- .1 Cx shall include providing the services of qualified trade persons, tools and equipment for start-up, commissioning and operator training. The cost of start-up, commissioning and operator training will be included in the lump sum price tendered.
- .2 Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .3 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the built facility is constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.

## **1.4 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS**

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

## **1.5 PRE-CX REVIEW**

- .1 During Construction:
  - .1 Co-ordinate provision, location and installation of provisions for Cx.
- .2 Before start of Cx:
  - .1 Have completed Cx Plan up-to-date.
  - .2 Ensure installation of related components, equipment, sub-systems, systems is complete.
  - .3 Fully understand Cx requirements and procedures.
  - .4 Have Cx documentation shelf-ready.
  - .5 Understand completely design criteria and intent and special features.
  - .6 Submit complete start-up documentation to Engineer.
  - .7 Have Cx schedules up-to-date.
  - .8 Ensure systems have been cleaned thoroughly.
  - .9 Ensure "As-Built" system schematics are available.

## **1.6 CONFLICTS**

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

## **1.7 SUBMITTALS**

- .1 Submit proposed Start-Up and Cx procedures to Engineer and obtain written approval at least ten (10) days prior to start of Start-Up and Cx.
- .2 Provide additional documentation relating to Cx process required by Engineer.

## **1.8 STARTING AND TESTING**

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

## **1.9 WITNESSING OF STARTING AND TESTING**

- .1 Provide 10 days notice prior to start-up.
- .2 Engineer to witness of start-up and testing.
- .3 Contractor's Cx Agent to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

## **1.10 MANUFACTURER'S INVOLVEMENT**

- .1 Factory testing: manufacturer to:
  - .1 Coordinate time and location of testing.
  - .2 Provide testing documentation for approval by Engineer.



- .3 Arrange for Engineer to witness tests.
- .2 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review.
  - .1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
  - .2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.
- .3 Integrity of warranties:
  - .1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.
  - .2 Verify with manufacturer that testing as specified will not void warranties.
- .4 Qualifications of manufacturer's personnel:
  - .1 Experienced in design, installation and operation of equipment and systems.
  - .2 Ability to interpret test results accurately.
  - .3 To report results in clear, concise, logical manner.

#### **1.11 PROCEDURES**

- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.
- .2 Conduct start-up and testing in following distinct phases:
  - .1 Included in delivery and installation:
    - .1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.
    - .2 Visual inspection of quality of installation.
  - .2 Start-up: follow accepted start-up procedures.
  - .3 Operational testing: document equipment performance.
  - .4 System PV: include repetition of tests after correcting deficiencies.
  - .5 Post-substantial performance verification: to include fine-tuning.
- .3 Correct deficiencies and obtain approval from Engineer after distinct phases have been completed and before commencing next phase.
- .4 Document require tests on approved PV forms.

#### **1.12 START-UP DOCUMENTATION**

- .1 Assemble start-up documentation and submit Engineer for approval before commencement.
- .2 Start-up documentation to include:
  - .1 Factory and on-site test certificates for specified equipment.
  - .2 Pre-start-up inspection reports.
  - .3 Signed installation/start-up check lists.

- .4 Start-up reports,
- .5 Step-by-step description of complete start-up procedures, to permit or to repeat start-up at any time.

### **1.13 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS**

- .1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.
- .2 With assistance of manufacturer develop written maintenance program and submit Engineer for approval before implementation.
- .3 Operate and maintain systems for length of time required for commissioning to be completed.
- .4 After completion of commissioning, operate and maintain systems until issuance of certificate of interim acceptance.

### **1.14 TEST RESULTS**

- .1 If start-up, testing and/or PV produce unacceptable results, repair, replace or repeat specified starting and/or PV procedures until acceptable results are achieved.
- .2 Provide manpower and materials, assume costs for re-commissioning.

### **1.15 START OF COMMISSIONING**

- .1 Notify Engineer 10 days prior to start of Cx.
- .2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

### **1.16 COMMISSIONING PERFORMANCE VERIFICATION**

- .1 Carry out Cx:
  - .1 Under actual operating conditions, over entire operating range, in all modes.
  - .2 On independent systems and interacting systems.
- .2 Cx procedures to be repeatable and reported results are to be verifiable.
- .3 Follow equipment manufacturer's operating instructions.
- .4 EMCS trending to be available as supporting documentation for performance verification.

### **1.17 WITNESSING COMMISSIONING**

- .1 Engineer to witness activities and verify results.

**1.18 AUTHORITIES HAVING JURISDICTION**

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

**1.19 DEFICIENCIES, FAULTS, DEFECTS**

- .1 Correct deficiencies found during start-up and Cx to satisfaction of Engineer.
- .2 Report problems, faults or defects affecting Cx to Engineer in writing. Stop Cx until problems are rectified. Proceed with written approval from Engineer.

**1.20 COMPLETION OF COMMISSIONING**

- .1 Upon completion of Cx leave systems in normal operating mode.
- .2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx prior to issuance of Interim Certificate of Completion.
- .3 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by Engineer.

**1.21 ACTIVITIES UPON COMPLETION OF COMMISSIONING**

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

**1.22 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS**

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

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1            eneral**

**1.1            RELATED REQUIREMENTS**

- .1      Section 03 10 00 – Concrete Forming and Accessories.
- .2      Section 03 20 00 – Concrete Reinforcement.
- .3      Section 03 35 00 – Concrete Finishing.

**1.2            REFERENCES**

- .1      Abbreviations and Acronyms:
  - .1      Cement: hydraulic cement or blended hydraulic cement (XXb - where b denotes blended).
    - .1      Type GU or GUb - General use cement.
    - .2      Type MS or MSb - Moderate sulphate-resistant cement.
    - .3      Type MH or MHb - Moderate heat of hydration cement.
    - .4      Type HE or Heb - High early-strength cement.
    - .5      Type LH or LHb - Low heat of hydration cement.
    - .6      Type HS or HSb - High sulphate-resistant cement.
  - .2      Fly ash:
    - .1      Type F - with CaO content less than 8%.
    - .2      Type CI - with CaO content ranging from 8 to 20%.
    - .3      Type CH - with CaO greater than 20%.
  - .3      GGBFS - Ground, granulated blast-furnace slag.
- .2      Reference Standards:
  - .1      ASTM International
    - .1      ASTM C260-06, Standard Specification for Air-Entraining Admixtures for Concrete.
    - .2      ASTM C309-07, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
    - .3      ASTM C494/C494M-08a, 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 D412-06ae1, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
    - .6      ASTM D624-00 (2007), Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.
    - .7      ASTM D1751-04, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

- .8 ASTM D1752-04a, 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 CSA International
  - .1 CSA A23.1/A23.2-2004, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - .2 CSA A283-06, Qualification Code for Concrete Testing Laboratories.
  - .3 CSA A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

### **1.3 SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Contractor to submit mix design and associated testing results for Consultant's approval before placing any concrete.
- .3 Concrete compressive strength test results to be arranged and paid for by the Contractor and submitted to Consultant for review.
  - .1 Contractor entitled to claim testing costs plus 10% for overhead from the contract prime cost sum, upon submission of verifying invoices from the testing laboratory.
- .4 Concrete pour records: provide accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken.

### **1.4 QUALITY ASSURANCE**

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Contractor to arrange and pay for the mix design, as well as associated testing and results. Results to be provided to Consultant for review and approval.
- .3 Concrete testing results to be submitted to Consultant for review.
  - .1 Testing as per paragraph 3.3 Field Quality Control.
  - .2 Consulting Engineer has the right to request replacement of any portion of the structure represented by failed test results, at no extra cost to the owner.

### **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Delivery and Acceptance Requirements:
  - .1 Discharge of concrete shall be complete within 60 minutes of introduction of the mixing water to dry materials. In the event that concrete materials are to be heated, this time shall be reduced to 30 minutes.

- .1 Do not modify maximum time limit without receipt of prior written agreement from Consultant and concrete producer as described in CSA A23.1/A23.2.
- .2 Deviations to be submitted for review Consultant.
- .2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

## **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 Consultant and provide verification of compliance as described in PART 1 - QUALITY ASSURANCE.

### **2.3 MATERIALS**

- .1 Cement: to CSA-A3001, Type HS.
- .2 Water: to CSA-A23.1, water must be clean and free of oils, acids, alkali, organic matter, and other deleterious substances.
- .3 Aggregates: to CSA-A23.1/A23.2.
- .4 Admixtures:
  - .1 Air entraining admixture: to CAN-3-A266.1 and ASTM C260.
  - .2 Fly ash or other admixtures not specified shall not be used without prior review and approval of Consultant.
- .5 Curing compound: to CSA-A23.1/A23.2, Type 1 – chlorinated rubber.
- .6 Dampproofing: to CAN/CGSB-37.2, two coats of Bakcon 700-01 Dampproofing Asphalt Emulsion to exterior walls, or approved equal.

### **2.4 MIXES**

- .1 Performance Method for specifying concrete: to meet performance criteria to CSA A23.1/A23.2.
  - .1 Ensure concrete supplier meets performance criteria as established below and provide mix design, as well as test results for verification to Consultant.
  - .2 Proportion normal density concrete in accordance with CAN/CSA-A23.1 to provide the following properties:
    - .1 Durability and class of exposure: F-1.
    - .2 Minimum compressive strength at 28 days: 30 Mpa.
    - .3 Slump: 80 mm.

- .4 Aggregate size 20 mm maximum.
- .5 Air entrainment: 5-7%.
- .6 Maximum water-cement ratio: 0.45.
- .3 Concrete supplier's certification: both batch plant and materials meet CSA A23.1 requirements.

## **Part 3 Execution**

### **3.1 PREPARATION**

- .1 Obtain Consultant's approval before placing concrete.
  - .1 Provide 24 hours minimum notice prior to placing of concrete.
- .2 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.
  - .3 Concrete shall not be placed while subject to rain.
- .3 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .4 Protect previous Work from staining.
- .5 Clean and remove stains prior to application for concrete finishes.
- .6 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature, and test samples taken.
- .7 In locations where new concrete is dowelled to existing work, drill holes in existing concrete.
  - .1 Place deformed steel reinforcing bars and pack solidly with epoxy grout to anchor and hold dowels in positions as indicated.

### **3.2 INSTALLATION/APPLICATION**

- .1 Do cast-in-place concrete work to CSA A23.1/A23.2.
- .2 Cold weather requirements:
  - .1 Concrete placed when temperature of the surrounding atmosphere is 5 °C or lower, shall have a temperature of not less than 10 °C and not more than 35 °C.
  - .2 Contractor is to provide suitable means of maintaining surrounding temperature of at least 10 °C for a minimum of 5 day after placement. The Consultant may require an addition 14 day period of temperature above 5 °C.
  - .3 Following the curing period, temperature shall be decreased at a rate not exceeding 5 °C per day.
  - .4 Temperatures shall not be maintained by use of dry heat, means shall be taken to humidify any dry air.
  - .5 Prior to placement, contractor is to completely remove all snow, ice, and frost, and raise the temperature of the surrounding surfaces above the freezing point.

- .6 Frozen subgrade must be thawed to a sufficient depth that it will not freeze back up during the protection period.
- .3 Sleeves and inserts:
  - .1 Do not permit penetrations, sleeves, ducts, pipes or other openings to pass through joists, beams, column capitals or columns.
  - .2 Sleeves and openings greater than 100 x 100 mm not indicated, must be reviewed by Consultant.
  - .3 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain written approval of modifications from Consultant before placing of concrete.
  - .4 Confirm locations and sizes of sleeves and openings shown on drawings.
  - .5 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.
- .4 Anchor bolts:
  - .1 Set anchor bolts to templates in co-ordination with appropriate trade prior to placing concrete.
  - .2 Locate anchor bolts used in connection with expansion shoes, rollers and rockers with due regard to ambient temperature at time of erection.
- .5 Finishing and curing:
  - .1 Finish concrete to CSA A23.1/A23.2, as indicated in Section 03 35 00 – Concrete Finishing.

### 3.3 FIELD QUALITY CONTROL

- .1 Site tests: conduct tests as follows in accordance with Section 01 45 00 - Quality Control and submit reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
  - .1 Sample fresh concrete to CAN/CSA-A23.2-1C.
  - .2 Test slump to CAN/CSA-A23.2-5C.
  - .3 Test air content to CAN/CSA-A23.2-4C.
  - .4 Test compressive strength at 7 (one cylinder) and 28 (two cylinders) days, to CAN/CSA-A23.2-9C
    - .1 A minimum of one test shall be taken for each day's placement.
    - .2 Additional cylinders may be required by Engineer to be stored and cured on site in order to test adequacy of curing and protection on site.
- .2 No individual cylinder tested shall show a strength more than 3.5 MPa less than specified compressive strength.
  - .1 Consultant shall reserve the right to request replacement of any portion of the structure represented by failed compressive strength tests, at no extra cost to the owner.
- .3 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory approved by Consultant.
  - .1 Ensure testing laboratory is certified to CSA-A283.



- .4 Contractor to ensure test results are obtained and distributed to Consultant and other relevant parties.
- .5 Contractor to arrange and pay for costs of testing.
  - .1 Contractor entitled to claim testing costs plus 10% for overhead upon providing verifying invoices for tests.
- .6 Inspection or testing by Consultant will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.
- .7 Contractor is to keep a record of date, time, temperature of concrete, temperature of atmosphere, and general weather conditions during concrete pours. Temperature readings should be taken at multiple locations of the pour and results shall be provided to the Consultant.

### **3.4 CLEANING**

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Provide appropriate area on job site where concrete trucks and be safely washed.
  - .2 Divert unused admixtures and additive materials (pigments, fibres) from landfill to official hazardous material collections sites.
  - .3 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.
  - .4 Prevent admixtures and additive materials from entering drinking water supplies or streams.
  - .5 Using appropriate safety precautions, collect liquid or solidify liquid with inert, non-combustible material and remove for disposal.
  - .6 Dispose of waste in accordance with applicable local, Provincial/Territorial and National regulations.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

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

**1.2 REFERENCES**

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-25.20-95, Surface Sealer for Floors.
- .2 CSA International
  - .1 CAN/CSA-A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction//Methods of Test for Concrete.
- .3 South Coast Air Quality Management District (SCAQMD), California State
  - .1 SCAQMD Rule 1168-A2005 (June 2006), Adhesives and Sealants Applications.

**1.3 SUBMITTALS**

- .1 Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide manufacturer's printed product literature and data sheets for concrete finishing products and include product characteristics, performance criteria, physical size, finish and limitations.
  - .1 If applicable, provide any WHMIS and MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
  - .2 Include application instructions for concrete floor treatment products.

**1.4 DELIVERY, STORAGE AND HANDLING**

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

**Part 2 Products**

**2.1 PERFORMANCE REQUIREMENTS**

- .1 Submit product information declaring that components used meet performance requirements.

**2.2 CHEMICAL HARDENERS**

- .1 Concrete floor hardener: Sika Durag Premium or approved equal conforming to ASTM-C40, C88, C123, and C142, colour to be French Grey.

## **2.3 SEALING COMPOUNDS**

- .1 Surface sealer: Sika Florseal WB 18 & 25, or approved equal conforming to CAN/CGSB-25.20, colour to be French Grey.

## **2.4 CURING COMPOUNDS**

- .1 Curing compound can be used in lieu of moist-curing.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verify that slab surfaces are ready to receive work and elevations are as indicated on drawings.

### **3.2 FINISHING**

- .1 Finish concrete from surface to CAN/CSA-A23.1, classification: flat.
- .2 Floor slabs must be finished to correct elevations as shown on plans.
- .3 Wood or metal screeds must be used. Floor area shall be mechanically and manually steel trowelled to a smooth, level surface.
- .4 Contractor shall take special care to ensure floor slabs drain to floor drains as indicated on plans.
- .5 Saw cut control joints to CAN/CSA-A23.1, as soon as possible after finishing procedures and not later than 18 hours after placing of concrete.
- .6 Apart from floor slabs, all interior concrete to be finished to a smooth texture with all form tie holes and honeycombing filled.
  - .1 Finish shall be to the satisfaction of the Consultant. Before filling any voids with concrete or cement mortar, all loose concrete should be chipped away, and surface roughened for bonding and well soaked with water.
- .7 All concrete to be moist cured for a minimum of 7 days after placement. Curing compounds may be used in lieu of moist curing.

### **3.3 APPLICATION OF COMPOUNDS**

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

**3.5 PROTECTION**

- .1 Protect finished installation in accordance with manufacturer's instructions.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 05 51 29 – Metal Stairs and Ladders.

**1.2 REFERENCES**

- .1 ASTM International
  - .1 ASTM A53/A53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
  - .2 ASTM A269-08, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
  - .3 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .2 CSA International
  - .1 CSA G40.20/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .2 CAN/CSA G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
  - .3 CSA S16-09, Design of Steel Structures.
  - .4 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).
  - .5 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).

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for metal work and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Saskatchewan, Canada as required.
  - .2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.

**1.4 QUALITY ASSURANCE**

- .1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.

- .2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

## **1.5 DELIVERY, STORAGE AND HANDLING**

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

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Steel sections and plates: to CSA G40.20/G40.21, Grade 300W.
- .2 Steel pipe: to ASTM A53/A53M, galvanized finish.
- .3 Welding materials: to CSA W59.
- .4 Welding electrodes: to CSA W48 Series.
- .5 Bolts and anchor bolts: to ASTM A307.
- .6 Stainless steel tubing: to ASTM A269, Type 304L seamless welded with AISI No. 4 finish.
- .7 Grout: non-shrink, non-metallic, flowable, 15 MPa at 24 hours.

### **2.2 FABRICATION**

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

### **2.3 FINISHES**

- .1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m<sup>2</sup> to CAN/CSA-G164.
- .2 Shop coat primer: MPI-INT EXT 5.1A.

## **2.4 ISOLATION COATING**

- .1 Isolate aluminum from following components, by means of bituminous paint:
  - .1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.
  - .2 Concrete, mortar and masonry.
  - .3 Wood.

## **2.5 SHOP PAINTING**

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

## **2.6 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.

## **2.7 CHANNEL FRAMES**

- .1 Fabricate frames from steel, sizes of channel and opening as indicated.
- .2 Weld channels together to form continuous frame for jambs and head of openings, sizes as indicated.
- .3 Finish: galvanized.

## **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.
  - .2 Inform Engineer 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 Engineer.

### **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 Engineer such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.
- .4 Exposed fastening devices to match finish and be compatible with material through which they pass.
- .5 Supply components for work by other trades in accordance with shop drawings and schedule.
- .6 Make field connections with bolts to CSA S16 or Weld field connection.
- .7 Deliver items over for casting into concrete and building into masonry together with setting templates to appropriate location and construction personnel.
- .8 Touch-up rivets, field welds, bolts and burnt or scratched surfaces with primer after completion of:
- .9 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.

### **3.3 CHANNEL FRAMES**

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

### **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 metal fabrications installation.

**END OF SECTION**



**Part 1            General**

**1.1               RELATED SECTIONS**

- .1       Section 01 33 00 – Submittal Procedures.
- .2       Section 32 11 23.02 – Base Course for Roadways.

**1.2               REFERENCES**

- .1       American Society for Testing and Materials (ASTM)
  - .1       ASTM D4791-99, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.

**1.3               SAMPLES**

- .1       Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2       Allow continual sampling by Engineer during production.
- .3       Provide Engineer with access to source and processed material for sampling.
- .4       Pay cost of sampling and testing of aggregates which fail to meet specified requirements.

**Part 2           Products**

**2.1               MATERIALS**

- .1       Aggregate quality: sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material, clay lumps or minerals, or other substances that would act in deleterious manner for use intended.
- .2       Flat and elongated particles of coarse aggregate: to ASTM D4791.
  - .1       Greatest dimension to exceed five times least dimension.
- .3       Fine aggregates satisfying requirements of applicable section to be one, or blend of following:
  - .1       Natural sand.
  - .2       Manufactured sand.
  - .3       Screenings produced in crushing of quarried rock, boulders, gravel or slag.
- .4       Coarse aggregates satisfying requirements of applicable section to be one of or blend of following:
  - .1       Crushed rock.
  - .2       Gravel and crushed gravel composed of naturally formed particles of stone.
  - .3       Light weight aggregate, including slag and expanded shale.

## **2.2 SOURCE QUALITY CONTROL**

- .1 Inform Engineer of proposed source of aggregates and provide access for sampling at least 4 weeks prior to commencing production.
- .2 If, in the opinion of the Engineer, materials from proposed source do not meet, or cannot reasonably be processed to meet specified requirements, locate an alternative source or demonstrate that material from source in question can be processed to meet specified requirements.
- .3 Advise Engineer 4 weeks in advance of proposed change of material source.
- .4 Acceptance of material at source does not preclude future rejection if it fails to conform to requirements specified, lacks uniformity, or if its field performance is found to be unsatisfactory.

## **Part 3 Execution**

### **3.1 PREPARATION**

- .1 Handling
  - .1 Handle and transport aggregates to avoid segregation, contamination and degradation.
- .2 Stockpiling
  - .1 Stockpile aggregates on site in locations as indicated unless directed otherwise by Consultant. Do not stockpile on completed pavement surfaces.
  - .2 Stockpile aggregates in sufficient quantities to meet Project schedules.
  - .3 Stockpiling sites to be level, well drained, and of adequate bearing capacity and stability to support stockpiled materials and handling equipment.
  - .4 Separate different aggregates by strong, full depth bulkheads, or stockpile far enough apart to prevent intermixing.
  - .5 Do not use intermixed or contaminated materials. Remove and dispose of rejected materials as directed by Engineer within 48 h of rejection.
  - .6 Stockpile materials in uniform layers of thickness as follows:
    - .1 Max 1.5 m for coarse aggregate and base course materials.
    - .2 Max 1.5 m for fine aggregate and sub-base materials.
    - .3 Max 1.5 m for other materials.
  - .7 Uniformly spot-dump aggregates delivered to stockpile in trucks and build up stockpile as specified.
  - .8 Do not cone piles or spill material over edges of piles.
  - .9 Do not use conveying stackers.
  - .10 During winter operations, prevent ice and snow from becoming mixed into stockpile or in material being removed from stockpile.

### **3.2 CLEANING**

- .1 Leave aggregate stockpile site in tidy, well drained condition, free of standing surface water.

- .2 Leave any unused aggregates in neat compact stockpiles as directed by Engineer.
- .3 For temporary or permanent abandonment of aggregate source, restore source to condition meeting requirements of authority having jurisdiction.

**END OF SECTION**

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Equipment and materials necessary for excavation of existing material, trenching, backfilling and associated works for water and sewer and force mains, building services, lagoons, and roadways as identified.

**1.2 RELATED SECTIONS**

- .1 Section 33 05 13 – Manholes and Catch Basins.
- .2 Section 33 11 16 – Water and Force Mains.
- .3 Section 33 41 00 – Sanitary and Storm Mains.

**1.3 MEASUREMENT PROCEDURES**

- .1 Excavated materials will form part of the stipulated lump sum or unit prices including:
  - .1 Common excavation, hauling, placing, wetting or trying to optimum moisture content and compaction of the excavated material.
  - .2 Shoring, bracing, cofferdams, underpinning and de-watering of excavation.
  - .3 Installation including excavation and backfilling for underground pipe, concrete manhole or catchbasins, and utility installation.

**1.4 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM C117-04, Standard Test Method for Material Finer than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.
  - .2 ASTM C136-05, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - .3 ASTM D422-632002, Standard Test Method for Particle-Size Analysis of Soils.
  - .4 ASTM D698-00a, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup>) (600 kN-m/m<sup>3</sup>).
  - .5 ASTM D4318-05, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
  - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 Canadian Standards Association (CSA International)
  - .1 CAN/CSA-A3000-03, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
    - .1 CSA-A3001-03, Cementitious Materials for Use in Concrete.
  - .2 CSA-A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

## 1.5 DEFINITIONS

- .1 Common Excavation:
  - .1 Excavation of all materials, including hard pan, quicksand, frozen earth, and pieces of rock or masonry less than 0.25 m<sup>3</sup> in volume.
- .2 Rock Excavation:
  - .1 Removal of boulders, pieces of concrete or masonry, which requires blasting, drilling, wedging, or breaking up with power operated hand tools. Soft or disintegrated rock, concrete or masonry which can be removed with a hand pick, power operated shovel, or excavator, or loose or previously blasted rock will not be included as rock excavation.
- .3 Boulder Removal:
  - .1 Boulder removal is defined as the removal of boulders greater than 0.25 m<sup>3</sup> in volume and not requiring blasting.
- .4 Topsoil:
  - .1 Material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.
  - .2 Material reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and free from cobbles, stumps, roots, and other objectionable material larger than 25 millimetres in any dimension.
- .5 Sand:
  - .1 Material passing through a 4.75 mm (No. 4) sieve and not passing through a 0.075 mm (No. 200) sieve.
- .6 Gravel:
  - .1 Material passing through a 75 mm (3") and not passing the 4.75 mm (No. 4) sieve.
- .7 Waste material: excavated material unsuitable for use in Work or surplus to requirements.
- .8 Borrow material or Common Fill: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.
- .9 Recycled fill material: material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.
- .10 Unshrinkable fill: mixture of cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

## 1.6 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Preconstruction Submittals:
  - .1 Submit construction equipment list for major equipment to be used in this section prior to start of Work.

- .2 Submit records of underground utility locates, indicating: location plan of existing utilities as found in field.
- .3 Samples:
  - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.

## **1.7 QUALITY ASSURANCE**

- .1 Do work in accordance to Section 01 43 00 – Quality Assurance.
- .2 Qualification Statement: submit proof of insurance coverage for professional liability.
- .3 Submit design and supporting data at least 2 weeks prior to beginning Work.
- .4 Design and supporting data submitted to bear stamp and signature of qualified professional engineer registered or licensed in Province of Saskatchewan, Canada.
- .5 Keep design and supporting data on site.
- .6 Engage services of qualified professional Engineer who is registered or licensed in Province of Saskatchewan, Canada in which Work is to be carried out to design and inspect cofferdams, shoring, bracing and underpinning required for Work.
- .7 Health and Safety Requirements:
  - .1 Complete construction in accordance with Occupational Health and Safety Requirements defined by the Province of Saskatchewan.

## **1.8 EXISTING CONDITIONS**

- .1 Examine soil report.
- .2 Buried services:
  - .1 Before commencing work verify location of buried services on and adjacent to site.
  - .2 Arrange with appropriate authority for relocation of buried services that interfere with execution of work: pay costs of relocating services.
  - .3 Remove obsolete buried services within 2 m of foundations: cap cut-offs.
  - .4 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
  - .5 Confirm locations of buried utilities.
  - .6 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.
  - .7 Record location of maintained, re-routed and abandoned underground lines.
  - .8 Confirm locations of recent excavations adjacent to area of excavation.
- .3 Existing buildings and surface features:
  - .1 Conduct, with Engineer, 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 as directed by Engineer.

## **Part 2 Execution**

### **2.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL**

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion control plan, specific to site, that complies with EPA 832-R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

### **2.2 SITE PREPARATION**

- .1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.

### **2.3 PREPARATION/PROTECTION**

- .1 Protect existing features.
- .2 Keep excavations clean, free of standing water, and loose soil.
- .3 Where soil is subject to significant volume change due to change in moisture content, cover and protect to Engineer approval.
- .4 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.
- .5 Protect buried services that are required to remain undisturbed.

### **2.4 STRIPPING OF TOPSOIL**

- .1 Do in accordance with Section 31 14 13 – Topsoil Removal and Replacement.

### **2.5 STOCKPILING**

- .1 Stockpile fill materials in areas designated by Engineer as required.
  - .1 Stockpile granular materials in manner to prevent segregation.
- .2 Protect fill materials from contamination.
- .3 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.

## **2.6 COFFERDAMS, SHORING, BRACING AND UNDERPINNING**

- .1 Maintain sides and slopes of excavations in safe condition by appropriate methods and in accordance with Occupational Health and Safety Requirements and Health and Safety Act for the Province of Saskatchewan.
- .2 All necessary sheeting and bracing shall be erected to prevent movement of the sides of the excavation. All materials and necessary labour required in connection with shoring shall be provided by the Contractor as part of the Contract.
- .3 Sheeting should not be driven any further below the bottom of the trench than is necessary to ensure proper support for the sheeting.
- .4 During backfill operation:
  - .1 Unless otherwise indicated or directed by Engineer, remove sheeting and shoring from excavations.
  - .2 Do not remove bracing until backfilling has reached respective levels of such bracing.
  - .3 Pull sheeting in increments that will ensure compacted backfill is maintained at elevation at least 500 mm above toe of sheeting.
- .5 When sheeting is required to remain in place, cut off tops 1000 mm below established street or finish grades.
- .6 Upon completion of substructure construction:
  - .1 Remove cofferdams, shoring and bracing.
  - .2 Remove excess materials from site.

## **2.7 DEWATERING AND HEAVE PREVENTION**

- .1 Keep excavations free of water while Work is in progress.
- .2 Provide for Engineer's review details of proposed dewatering or heave prevention methods, including dikes, well points, and sheet pile cut-offs.
- .3 Avoid excavation below groundwater table if quick condition or heave is likely to occur.
  - .1 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 01 35 26 - Environmental Protection to approved runoff areas and in manner not detrimental to public and private property, or portion of Work completed or under construction.
  - .1 Provide and maintain temporary drainage ditches and other diversions outside of excavation limits.
- .6 Provide flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to storm sewers, watercourses or drainage areas.



## **2.8 EXCAVATION**

- .1 Excavate to lines, grades, elevations and dimensions as indicated.
- .2 Excavation must not interfere with bearing capacity of adjacent foundations.
- .3 Do not disturb soil within branch spread of trees or shrubs that are to remain.
  - .1 If excavating through roots, excavate by hand and cut roots with sharp axe or saw.
- .4 For trench excavation, unless otherwise authorized by Engineer 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. Excavate to provide uniform and continuous support for the pipe and fittings on solid undisturbed ground. Any over-excavation below the required grade will be backfilled at the Contractors expense with compacted sand or gravel approved by the Engineer.
- .5 Keep excavated and stockpiled materials safe distance away from edge of trench as directed by Engineer.
- .6 Restrict vehicle operations directly adjacent to open trenches.
- .7 Dispose of surplus and unsuitable excavated material in approved location.
- .8 Do not obstruct flow of surface drainage or natural watercourses.
- .9 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.
- .10 Remove unsuitable material from trench bottom including those that extend below required elevations to extent and depth as directed by Engineer.
- .11 Hand trim, make firm and remove loose material and debris from excavations.
  - .1 Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.
- .12 Install geotextiles in accordance with Section 31 32 19.01 – Geotextiles if required.

## **2.9 EXCAVATION IN ROCK**

- .1 Excavation in rock, or in a material which cannot provide an even uniform and smooth surface, or where large stones are encountered in the trench, remove material to provide a clear distance between any part or projection of the material and the surface of all pipe and fittings of not less than 150 mm for 600 mm outside diameter pipe or less and 225 mm for pipe having an outside diameter greater than 600 mm.
- .2 Backfill subgrade with approved sand or gravel compacted in 150 mm layers. Shape finished surface with hand tools to provide uniform and continuous support for the pipe.
- .3 Removal of rock by blasting will be permitted only when authorized by the Engineer. The use of explosives shall be governed by regulations laid down by the Explosives Act and any Provincial or Municipal Regulations. Blasting may only be carried out by licensed blasting personnel.

## **2.10 EXCAVATION IN UNSTABLE SUBGRADE**

- .1 Where the subgrade of the trench is unstable or will not properly support the pipe or where it contains material harmful to the pipe such as ashes, cinders, refuse, or organic material, excavate material to the width, depth and length authorized in writing by the Engineer and dispose of the material as directed. Backfill with approved sand or gravel compacted in 150 mm layers. Shape finished surface with hand tools to provide uniform and continuous support for the pipe.
- .2 When the subgrade cannot be made to properly support the pipe by replacing unsound material with compacted sand or gravel, construct a foundation for the pipe in accordance with supplementary drawings prepared by the Engineer. Compensation for the additional work will be allowed whether a unit price basis or force account basis as directed by the Engineer, as provided for under the General Conditions of the Contract.

## **2.11 BEDDING AND SURROUND OF UNDERGROUND SERVICES**

- .1 Place and compact granular material for bedding and surround of underground services as specified in Section 33 41 00 – Sanitary and Storm Mains.
- .2 Place bedding and surround material in unfrozen condition.

## **2.12 BACKFILLING**

- .1 Do not proceed with backfilling operations until completion of following:
  - .1 Engineer has inspected and approved installations.
  - .2 Engineer has inspected and approved of construction below finish grade.
  - .3 Inspection, testing, approval, and recording location of underground utilities.
  - .4 Removal of concrete formwork.
  - .5 Removal of shoring and bracing; backfilling of voids with satisfactory soil material.
- .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 150 mm compacted thickness. Compact each layer before placing each additional layer.
- .5 Backfill material pushed into the trench by a bulldozer must be rolled down the slope. Backfill material must be pushed down a ramp or slope of existing material and not directly on to the newly bedded pipe.
- .6 Backfill Classes:
  - .1 Class 4  
Class 4 backfilling consists of replacing the excavated material in the trench. Rocks or stones in excess of 150 mm dimension may be placed in this portion of the backfill, but must be placed by hand. Every attempt must be made to consolidate the backfill to avoid bridging and subsidence. Earth must be placed in layers into the trench and be compacted to a degree that will ensure that

settlement of the roadway surface shall not exceed 300 mm within a period of one year.

Subsidence of trenches will be the sole responsibility of the Contractor for 30 days from the date of substantial completion. From this time, until the end of the maintenance period, the contractor will be responsible for all trench subsidence in excess of 300 mm.

.2 Class 3

Class 3 backfilling consists of replacing the excavated material in layers and compacting by mechanical means to a density equivalent to that of the surrounding unexcavated material.

The Contractor must supply all water that may be required for compaction. No boulders, organic soils, rock or frozen lumps of earth will be permitted in the backfill. All surplus excavated material including boulders and pieces of concrete and masonry must be hauled away. The Contractor must replace any subsequent subsidence using compacted traffic gravel.

.3 Class 2

Replace the excavated material in layers and compact each layer to density not less than 95% of the maximum dry density as determined by the Standard Proctor Test. The Contractor must supply all water that may be required for compaction. No boulders, organic soils, rock or frozen lumps of earth shall be permitted in the backfill. All surplus excavated material including boulders and pieces of concrete and masonry shall be hauled away. The Contractor will replace any subsequent subsidence using compacted traffic gravel, unless otherwise specified by the Engineer.

.4 Class 1

Class 1 backfilling consists of backfilling with sand or gravel compacted in even layers not to exceed 150 mm, so that there is no subsequent subsidence of the trench.

The backfill must be compacted to a density of not less than 95% of the maximum dry density as determined by the Standard Proctor Test. All surplus excavated material shall be hauled away.

Damage to facilities or structures constructed on or adjacent to the Class 1 backfill, which results from the subsidence of backfill, shall be repaired by the Contractor at his cost.

.7 Backfilling around installations:

- .1 Place bedding and surround material as specified elsewhere.
- .2 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.
- .3 Place layers simultaneously on both sides of installed Work to equalize loading. Difference not to exceed 0.5 m.

**2.13 RESTORATION**

- .1 Upon completion of Work, remove waste materials and debris in accordance to Section 01 74 20 - Waste Management and Disposal, trim slopes, and correct defects as directed by Engineer.
- .2 Replace topsoil as directed by Engineer.
- .3 Reinstate lawns to elevation which existed before excavation.
- .4 Reinstate pavements and sidewalks disturbed by excavation to thickness, structure and elevation which existed before excavation.
- .5 Clean and reinstate areas affected by Work as directed by Engineer.
- .6 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1        Equipment and materials necessary for construction of aggregate base course used in roadways, curb, gutters, sidewalks, and walkways.

**1.2                RELATED SECTIONS**

- .1        Section 31 05 16 – Aggregate Materials.
- .2        Section 32 11 16.02 – Sub-Base Course for Roadways.
- .3        Section 31 32 19.01 – Geotextiles.

**1.3                MEASUREMENT PROCEDURES**

- .1        Installation of Aggregate Base Course will be included as part of unit price tendered per square meter to the depth indicated on the drawings. Measurement shall be compact-in-place. Price shall include all materials and labour for supplying, placing, compacting, watering or drying to achieve optimum moisture content as specified, and shaping to the lines and grades indicated.

**1.4                REFERENCES**

- .1        American Society for Testing and Materials (ASTM)
  - .1        ASTM C117-95, Standard Test Methods for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.
  - .2        ASTM C131-96, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
  - .3        ASTM C136-96a, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - .4        ASTM D698-00a, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft<sup>3</sup>) (600kN-m/m<sup>3</sup>).
  - .5        ASTM D1557-00, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000ft-lbf/ft<sup>3</sup>) (2,700kN-m/m<sup>3</sup>).
  - .6        ASTM D1883-99, Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.
  - .7        ASTM D4318-00, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- .2        Canadian General Standards Board (CGSB)
  - .1        CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
  - .2        CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Granular base: material in accordance with Section 31 05 16 - Aggregate Materials and following requirements:
  - .1 Crushed stone or gravel.
  - .2 Gradations to be within limits specified when tested to ASTM C136. Sieve sizes to CAN/CGSB-8.1.
    - .1 Gradation Method # 1 to:

Sieve Designation	% Passing
25 mm	100
19 mm	84-100
12.5 mm	73-100
9.5 mm	62-94
4.75 mm	45-82
2.00 mm	28-62
0.850 mm	18-43
0.425 mm	12-32
0.150 mm	7-18
0.075 mm	5-12
    - .2 Liquid limit: to ASTM D4318, maximum 25
    - .3 Plasticity index: to ASTM D4318, maximum 6, minimum 2.
    - .4 Los Angeles degradation: to ASTM C131. Max. % loss by weight: 30
    - .5 Soaked CBR: to ASTM D1883, min 55, when compacted to 100% of ASTM D1557.

**Part 3 Execution**

**3.1 PLACING**

- .1 Place granular base after existing base of subgrade is inspected and approved by Engineer.
- .2 Construct granular base to depth and grade in areas indicated using a motor grader.
- .3 Where no depth is indicated minimum thickness of:
  - .1 250 mm for paved roadways.
  - .2 200 mm for gravel surfaces.
- .4 Ensure no frozen material is placed.
- .5 Place material only on clean unfrozen surface, free from snow or ice.
- .6 Begin spreading base material on crown line or high side of one-way slope.

- .7 Place granular base materials using methods which do not lead to segregation or degradation.
- .8 For spreading and shaping material, use spreader boxes having adjustable templates or screeds which will place material in uniform layers of required thickness.
- .9 Place material to full width in uniform layers not exceeding 150 mm compacted thickness. Engineer may authorize thicker lifts (layers) if specified compaction can be achieved.
- .10 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- .11 Remove and replace portion of layer in which material has become segregated during spreading.

### **3.2 COMPACTION**

- .1 Compaction equipment to be capable of obtaining required material densities.
- .2 Efficiency of equipment not specified to be proved at least as efficient as specified equipment at no extra cost and written approval must be received from Engineer before use.
- .3 Equipped with device that records hours of actual work, not motor running hours.
- .4 Compact to density of not less than 100% maximum dry density in accordance with ASTM D1557.
- .5 Shape and roll alternately to obtain smooth, even and uniformly compacted base.
- .6 Apply water as necessary during compaction to obtain specified density.
- .7 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Engineer.
- .8 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

### **3.3 PROOF ROLLING**

- .1 For proof rolling use 8000 kg axle load test to show no visible rutting or weaving.
- .2 Obtain approval from Engineer to use non standard proof rolling equipment.
- .3 Proof roll at level in base as indicated. If non standard proof rolling equipment is approved, Engineer to determine level of proof rolling.
- .4 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.
- .5 Where proof rolling reveals areas of defective base:

- .1 Remove base, sub-base and subgrade material to depth and extent as directed by Engineer.
- .2 Backfill excavated subgrade with base material and compact in accordance with this section.
- .3 Use of geotextiles as per Section 31 32 19.01 may be used on approval or direction of Engineer.

### **3.4 SITE TOLERANCES**

- .1 Finished base surface to be within 15 mm of elevation as indicated but not uniformly high or low and show no depression more than 15 mm under a straight edge 3 m long placed parallel to the centre lines.

### **3.5 PROTECTION**

- .1 Maintain finished base in condition conforming to this section until succeeding base is constructed, or until granular base is accepted by Engineer.

**END OF SECTION**



**Part 1            General**

**1.1            SECTION INCLUDES**

- .1        Materials and application of asphalt prime to granular base surface prior to asphalt paving.

**1.2            RELATED SECTIONS**

- .1        Section 01 33 00 – Submittal Procedures.
- .2        Section 32 12 16 – Asphalt Paving.

**1.3            MEASUREMENT PROCEDURES**

- .1        Asphalt prime coat will be included as part of the unit price tender per square meter including all materials, labour, equipment, hauling, and placing required for installation of the asphalt prime coat.

**1.4            REFERENCES**

- .1        American Society for Testing and Materials International, (ASTM)
  - .1        ASTM D140-01, Standard Practice for Sampling Bituminous Materials.
- .2        Canadian General Standards Board (CGSB)
  - .1        CAN/CGSB-16.1-M89, Cutback Asphalts for Road Purposes.
  - .2        CAN/CGSB-16.2-M89, Emulsified Asphalts, Anionic Type, for Road Purposes.

**1.5            SUBMITTALS**

- .1        Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2        Submit two - 4 L samples of asphalt prime proposed for use in new, clean, air tight sealed, wide mouth, jars or bottles made with plastic, to Engineer, at least 2 weeks prior to commencing work.
- .3        Sample asphalt prime coat materials in accordance with ASTM D140.
- .4        Provide access on tank truck for Engineer to sample asphalt material to be incorporated into Work, in accordance with ASTM D140.

**1.6            QUALITY ASSURANCE**

- .1        Upon request from Engineer, submit manufacturer's test data and certification that asphalt prime material meets requirements of this Section in accordance with Section 01 33 00 - Submittal Procedures.

**1.7            MATERIAL**

- .1        Asphalt material: to CAN/CGSB-16.1 grade: MC-30 or CAN/CGSB-16.2 grade: SS-1.

- .2 Sand blotter: clean granular material passing 4.75 mm sieve and free from organic matter or other deleterious materials.
- .3 Water: clean, potable, free from foreign matter.

## **1.8 EQUIPMENT**

- .1 Pressure distributor to be:
  - .1 Designed, equipped, maintained and operated so that asphalt material can be:
    - .1 Maintained at even temperature.
    - .2 Applied uniformly on variable widths of surface up to 5 m.
    - .3 Applied at controlled rates from 0.5 to 2.7 L/m<sup>2</sup> with uniform pressure, and allowable variation from any specified rate not exceeding 0.1 L/m<sup>2</sup>.
    - .4 Distributed in uniform spray without atomization at temperature required.
  - .2 Equipped with meter registering metres of travel per minute, visibly located to enable truck driver to maintain constant speed required for application at specified rate.
  - .3 Equipped with pump having flow meter graduated in units of 5 L or less per minute passing through nozzles and readily visible to operator. Pump power unit to be independent of truck power unit.
  - .4 Equipped with easily read, accurate and sensitive device which registers temperature of liquid in reservoir.
  - .5 Equipped with accurate volume measuring device or calibrated tank.
  - .6 Equipped with nozzles of same make and dimensions, adjustable for fan width and orientation.
  - .7 Equipped with nozzle spray bar, with operational height adjustment.
  - .8 Cleaned if previously used with incompatible asphalt material.

## **Part 2 Execution**

### **2.1 APPLICATION**

- .1 Obtain Engineer's approval of granular base surface before applying asphalt prime.
- .2 Cutback asphalt:
  - .1 Heat asphalt prime to between 30 and 50 degrees C for pumping and spraying.
  - .2 Apply asphalt prime to granular base at rate as directed by Engineer, between 1.0 and 2.7 L/m<sup>2</sup>.
  - .3 Apply on dry surface unless otherwise directed by Engineer.
- .3 Anionic emulsified asphalt:
  - .1 Dilute asphalt emulsion with clean water at 1:1 ratio for application.
  - .2 Mix thoroughly by pumping or other method approved by Engineer.
  - .3 Apply diluted asphalt emulsion at rate directed by Engineer, between 0.5 and 2.7 L/m<sup>2</sup>.

- .4 Apply diluted asphalt emulsion on damp surface unless otherwise directed by Engineer.
- .4 Apply asphalt prime only on unfrozen surface.
- .5 Do not apply prime when air temperature is less than 10 degrees C or when rain is forecast within 2 hours.
- .6 Paint contact surfaces of curbs, gutters, headers, manholes and like structures with thin, uniform coat of asphalt prime material.
- .7 Where traffic is to be maintained, treat no more than one-half width of surface in one application.
- .8 Prevent overlap at junction of applications.
- .9 Do not prime surfaces that will be visible when paving is complete.
- .10 Apply additional material to areas not sufficiently covered as directed by Engineer.
- .11 Keep traffic off primed areas until asphalt prime has cured.
- .12 Permit prime to cure before placing asphalt paving.

## **2.2 USE OF SAND BLOTTER**

- .1 If asphalt prime fails to penetrate within 24 hours, spread sand blotter material in amounts required to absorb excess material.
- .2 Allow sufficient time for excess prime to be absorbed as directed by Engineer.
- .3 Apply second application of sand blotter as required.
- .4 Sweep and remove excess blotter material.

**END OF SECTION**

**Part 1            General**

**1.1            SECTION INCLUDES**

- .1        Materials and installation for asphalt concrete paving for roads and parking areas.

**1.2            RELATED SECTIONS**

- .1        Section 01 33 00 – Submittal Procedures.
- .2        Section 31 23 33.01 – Excavating, Trenching, and Backfilling.
- .3        Section 32 11 23.02 –Base Course for Roadways.
- .4        Section 32 12 13.23 – Asphalt Prime Coat.

**1.3            MEASUREMENT PROCEDURES**

- .1        Asphalt paving will be included as part of the unit price tendered per square meter including all materials, labour, equipment, hauling, placing, compacting required for install of new, replacement, or patching of hot mix asphalt concrete.

**1.4            REFERENCES**

- .1        American Association of State Highway and Transportation Officials (AASHTO)
  - .1        AASHTO M320-02, Standard Specification for Performance Graded Asphalt Binder.
  - .2        AASHTO R29-02, Standard Specification for Grading or Verifying the Performance Graded of an Asphalt Binder.
  - .3        AASHTO T245-97(2001), Resistance to Plastic flow of Bituminous Mixtures Using Marshall Apparatus.
- .2        Asphalt Institute (AI)
  - .1        AI MS2-1994 Sixth Edition, Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types.
- .3        American Society for Testing and Materials International, (ASTM)
  - .1        ASTM C117-95, Standard Test Method for Material Finer Than 0.075mm (No.200) Sieve in Mineral Aggregates by Washing.
  - .2        ASTM C123-98, Standard Test Method for Lightweight Particles in Aggregate.
  - .3        ASTM C127-01, Standard Test Method for Specific Gravity and Absorption of Coarse Aggregate.
  - .4        ASTM C128-01, Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate.
  - .5        ASTM C131-01, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
  - .6        ASTM C136-01, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.

- .7 ASTM D995, Standard Specification for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
- .8 ASTM D2419-02, Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
- .9 ASTM D3203-94(2000), Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures.
- .10 ASTM D4791-99, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.

## **1.5 PRODUCT DATA**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit viscosity-temperature chart for asphalt cement to be supplied showing either Saybolt Furol viscosity in seconds or Kinematic Viscosity in centistokes, temperature range 105 to 175 degrees C at least 4 weeks prior to beginning Work.
- .3 Submit manufacturer's test data and certification that asphalt cement meets requirements of this Section.
- .4 Submit manufacturer's test data and certification that hydrated lime meets requirements of this Section.

## **1.6 SAMPLES**

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit samples to a laboratory designated by the Engineer of following materials proposed for use at least 4 weeks prior to beginning Work.
  - .1 One 10 L container of asphalt cement.
  - .2 One 35 kg sample of surface course aggregate.
  - .3 5 kg of the mineral filler, if required.
- .3 Submit one sample of hot mix asphalt surface course for every 2000 square meters completed during construction or as specified by the Engineer. Sample from the paver or haul truck and forward to a laboratory designated by the Engineer. Tests required are shown below.
  - .1 Asphalt Content (all samples).
  - .2 Aggregate Gradation (all samples).
  - .3 V.M.A. (first four and every third after).
  - .4 Percent Air Voids (first four and every third after).
  - .5 Marshall Stability (first four and every third after).
  - .6 Flow Index (first four and every third after).
  - .7 Density (first four and every third after).
- .4 Submit two core samples for each block paved, or as determined by the Engineer. Tests required are shown below:
  - .1 Asphalt Content (all samples).
  - .2 Asphalt Density (all samples).

- .3 Aggregate Gradation (every second sample).

## **1.7 DELIVERY, STORAGE AND HANDLING**

- .1 Stockpile minimum 50 % of total amount of aggregate required before beginning asphalt mixing operation.
- .2 When necessary to blend aggregates from one or more sources to produce required gradation, do not blend in stockpiles.
- .3 Stockpile fine aggregate separately from coarse aggregate, although separate stockpiles for more than two mix components are permitted.
- .4 Provide approved storage, heating tanks and pumping facilities for asphalt cement.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Asphalt cement: to CAN/CGSB-16.3, group: AC6 which falls within the limits shown below.
- .1 Viscosity and Penetration (ASM D2171 and D5):  
Test of viscosity and penetration which falls within the graphic region described by the following co-ordinates.
- | Co-ordinate | Viscosity at 60°C | Penetration at 25°C |
|-------------|-------------------|---------------------|
| A           | 80                | 200                 |
| B           | 70                | 170                 |
| C           | 47                | 220                 |
| D           | 55                | 240                 |
- .2 Ductility at 25°C (ASTM D113)
- .1 Minimum of 100 cm
- .2 If ductility at 25°C is less than 100 cm, the material will be acceptable if its ductility at 15°C is greater than 100 cm.
- .3 Flash Point (COC) °C (ASTM D92)
- .1 Minimum of 235°C.
- .4 Thin Film Oven Test (ASTM D1754)
- .1 Minimum weight loss 0.6%
- .5 Penetration of Residue at 25°C (ASTM D5)
- .1 Minimum of 55% of original.
- .6 Solubility in Trichloroethylene (ASTM D2042)
- .1 Minimum 99.5%
- .7 Percent of Xylene in N-Heptane – Xylene for Negative Spot Test (AASHTO T102)
- .1 Minimum of 40.
- .2 Aggregates: in accordance with Section 31 05 16 - Aggregate Materials: General following requirements:

- .1 Crushed stone or gravel.
  - .2 Gradations: within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.1 & CAN/CGSB-8.2.
  - .3 Table


Sieve Designation	% Passing Surface Course
19 mm	100
12.5 mm	100-95
9.5 mm	75-95
4.75 mm	50-72
2.00 mm	31-51
0.850 mm	21-37
0.425 mm	14-27
0.150 mm	4-16
0.075 mm	4-10
  - .4 Fraction passing 0.425 sieve:
    - .1 Liquid limit less than 25.
    - .2 Plasticity index of not greater than 6.
  - .5 Do not use aggregates having known polishing characteristics in mixes for surface courses.
  - .6 Regardless of compliance with specified physical requirements, fine aggregates may be accepted or rejected on basis of past field performance.
- .3 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.

## 2.2 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. Minimum number of one roller for every 50 tonnes of asphaltic concrete laid per hour.
- .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 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 Engineer, may be used instead of tamping irons.
  - .3 Straight edges, 3.0 m in length, to test finished surface.

## 2.3 MIX DESIGN

- .1 Mix design to be approved by Engineer.
- .2 Mix design to be developed by testing laboratory approved by Engineer.
- .3 Design of mix: by Marshall method to requirements below.
  - .1 Compaction blows on each face of test specimens: 50.
  - .2 Mix physical requirements:

Property	Roads
Marshall Stability at 60EC	5.5 surface
kN min	course/4.5
	lower course
Flow Value mm	2-5
Air Voids in Mixture, %	3-5 surface
	course/2-6
	lower course
Voids in Mineral Aggregate,	15 surface
% min	course/13
	lower course
Index of Retained Stability %	75
minimum	
  - .3 Measure physical requirements as follows:
    - .1 Marshall load and flow value: to AASHTO T245.
    - .2 Compute void properties on basis of bulk specific gravity of aggregate to ASTM C127 and ASTM C128. Make allowance for volume of asphalt absorbed into pores of aggregate.
    - .3 Air voids: to ASTM D3203.
    - .4 Voids in mineral aggregates: to AI MS2, chapter 4.
    - .5 Index of Retained Stability: measure using Marshall Immersion Test for Bitumen.
  - .4 Do not change job-mix without prior approval of Engineer. When change in material source proposed, new job-mix formula to be reviewed by Engineer.
  - .5 Return plant dust collected during processing to mix in quantities acceptable to Engineer.



**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 lesser moisture content if required to meet mix design requirements.
  - .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 Engineer. Do not heat asphalt cement above 160 degrees.
  - .9 Make available current asphalt cement viscosity data at plant. With information relative to viscosity of asphalt being used, Engineer to review temperature of completed mix at plant and at paver after considering hauling and placing conditions.
  - .10 Maintain temperature of materials within 5 degrees C of specified mix temperature during mixing.
  - .11 Mixing time:
    - .1 In batch plants, both dry and wet mixing times as directed by Engineer. 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 Engineer but not less than 45s.
    - .3 Do not alter mixing time unless directed by Engineer.
- .2 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 hour.
- .3 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.

**3.2 PREPARATION**

- .1 When paving over existing asphalt surface, clean pavement surface. When levelling course is not required, patch and correct depressions and other irregularities to approval of Engineer before beginning paving operations.
- .2 Apply prime coat or tack coat in accordance with Section 32 12 13.23 - Asphalt Prime Coat and/or Section 32 12 13.16 - Asphalt Tack Coat prior to paving.

- .3 Prior to laying mix, clean surfaces of loose and foreign material.

### **3.3 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 Engineer 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.
- .6 Deliver loads continuously in covered vehicles and immediately spread and compact. Deliver and place mixes at temperature within range as directed by Engineer, but not less than 120 degrees C.

### **3.4 PLACING**

- .1 Obtain Engineer's approval existing surface and tack coat/prime coat prior to placing asphalt.
- .2 Place asphalt concrete to thicknesses, grades and lines as indicated by drawings or Engineer.
- .3 Placing conditions:
  - .1 Place asphalt mixtures only when air temperature is above 2 degrees C.
  - .2 When temperature of surface on which material is to be placed falls below 10 degrees 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 or as directed by Engineer.
  - .1 Lower course in 1 layer of 50 mm.
  - .2 Surface course in 1 layer of maximum 50 mm.
- .5 Where possible do tapering and levelling 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. Engineer to 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.
- .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 screed 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.
  - .5 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.

### **3.5 COMPACTING**

- .1 Do not change rolling pattern unless mix changes or lift thickness changes. Change rolling pattern only as directed by Engineer.
- .2 Roll asphalt continuously to density not less than 98 % of blow Marshall density to AASHTO T245.
- .3 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 weighing at least 3.6 kg per millimetre width of tread.
  - .2 Start rolling operations as soon as placed mix can bear weight of roller without excess displacement of material or cracking of surface.
  - .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 levelling 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 200mm 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.
- .4 Breakdown rolling:
  - .1 Begin 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 sections use operation approved by Engineer.
  - .4 Use only experienced roller operators.
- .5 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.
- .6 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.
  - .2 Conduct rolling operations in close sequence.

### **3.6 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.
- .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 degrees C prior to paving of adjacent lane.
    - .1 For airfield runway paving, avoid cold joint construction in mid 30 m of runway.
    - .2 If cold joint can not 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.

### **3.7 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 3.0 m straight edge placed in any direction.

### **3.8 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.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 – Submittal Procedures
- .2 Section 31 23 33.01 – Excavating, Trenching and Backfilling.
- .3 Section 31 05 16 – Aggregate Materials.
- .4 Section 33 41 00 – Sanitary and Storm Mains.

**1.2 MEASUREMENT PROCEDURES**

**.1 Manholes**

Manholes will be paid for at the unit price tendered per vertical metre measured from the cover to the lowest sewer invert, and shall include excavation, supply and installation of manhole base, walls, rungs, brickwork, manhole frames and covers and backfilling. Where manholes include a drop section, drop inlets will be paid for at the unit price tendered per vertical metre, which shall be payment for supply and installation of the Y or tee branch, elbow, pipe and concrete, and all other work necessary, exclusive of the manhole barrel, to install the drop inlet in the manhole. Measurement will be in metres from the invert of the incoming sewer to the invert of the drop section.

**.2 Catch Basins**

Catch Basins shall be paid for at the unit price tendered for each complete and shall include necessary excavation, the supply of all materials, installation of the catch basin with frame and cover, grade rings as required, and backfilling complete.

**.3 Connections to Existing Manholes**

The cost of connecting to existing manholes shall be included in the unit price as tendered and shall include all work, labour required to remove or core through existing concrete, insertion of piping, sealing and grouting.

**1.3 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A48/A48M-00, Standard Specification for Gray Iron Castings.
  - .2 ASTM C117-04, Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing.
  - .3 ASTM C136-05, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - .4 ASTM C139-05, Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.
  - .5 ASTM C478M-06, Standard Specification for Precast Reinforced Concrete Manhole Sections Metric.

- .6 ASTM D698-00a, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup>(600 kN-m/m<sup>3</sup>)).
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 Canadian Standards Association (CSA International)
  - .1 CAN/CSA-A23.1-0/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - .2 CAN/CSA-A3000-03(R2005), Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
    - .1 CSA-A3001-03, Cementitious Materials for Use in Concrete.
    - .2 CSA-A3002-03, Masonry and Mortar Cement.
  - .3 CAN/CSA-A165 Series-04, CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).
  - .4 CAN/CSA-G30.18-M92(R2002), Billet Steel Bars for Concrete Reinforcement.
  - .5 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

#### **1.4 SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
  - .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.
  - .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

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

### **Part 2 Products**

#### **2.1 MATERIALS**

- .1 Cast-in-place concrete:
  - .1 In accordance with Section 03 30 00 - Cast-in-Place Concrete.



- .2 Cement: to CAN/CSA-A3001, Type GU.
- .3 Concrete mix design to produce 20 MPa minimum compressive strength at 28 days and containing 25 mm maximum size coarse aggregate, with water/cement ratio to CAN/CSA-A23.1 and 100 mm slump at time and point of deposit.
  - .1 Air entrainment to CAN/CSA-A23.1, class F-1 exposure.
- .4 Concrete reinforcement: in accordance with Section 03 20 00 - Concrete Reinforcing.
- .2 Precast manhole units: to ASTM C478M.
  - .1 Top sections eccentric cone or flat slab top type with opening offset for vertical ladder installation.
  - .2 1050 mm Dia. unless otherwise specified in various lengths to achieve depths shown on drawings with maximum length of 1200 mm.
  - .3 Eccentric and Concentric reducer cones from 1050 mm to 600 mm at top.
  - .4 20 mm diameter galvanized steel or aluminum rungs embedded 375 mm apart in each section.
  - .5 Pre-cast or cast in place concrete bases minimum thickness 150 mm.
  - .6 Sulphate resistant precast concrete manholes free from cracks or defects
- .3 Joints: made watertight using rubber rings, bituminous compound, epoxy resin cement or cement mortar.
- .4 Mortar:
  - .1 Masonry Cement: to CAN/CSA-A3002.
  - .2 Mix mortar one part by volume of cement to two parts of clean, sharp sand mixed dry.
  - .3 Add only sufficient water after mixing to give optimum consistency for placement.
  - .4 Do not use additives.
- .5 Ladder rungs: to CAN/CSA-G30.18, No.25M billet steel deformed bars, hot dipped galvanized to CAN/CSA-G164.
  - .1 Rungs to be safety pattern (drop step type).
- .6 Adjusting rings: to ASTM C478M.
- .7 Concrete Brick: to CAN3-A165 Series.
- .8 Drop manhole pipe: same as sewer pipe.
- .9 Frames, gratings, covers to dimensions as indicated and following requirements:
  - .1 Metal gratings and covers to bear evenly on frames.
    - .1 Frame with grating or cover to constitute one unit.
    - .2 Assemble and mark unit components before shipment.
  - .2 Grey cast iron to ASTM A48/A48M to withstand heavy road traffic with clear opening of at least 500 mm coated with two applications of asphalt varnish. Minimum combined weight of frame and cover of 130 kg.

- .1 Titan Foundry TF-39 or equivalent frame and grated cover for Manholes with inlet; solid cover for Manholes without inlet.
- .2 Titan Foundry TF-33 COS or equivalent for rolled curb and gutter.
- .3 Titan Foundry TF-36 or equivalent for straight faced curb and gutter.
- .4 Titan Foundry or equivalent lifter rings as required.
- .10 Granular bedding and backfill: in accordance with Section 31 05 16 - Aggregate Materials and following requirements:

- .1 Crushed stone, gravel or sand.
- .2 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117 Sieve sizes to CAN/CGSB-8.1.
- .3 Table:

Sieve Designation	% Passing Stone/Gravel	Gravel/Sand
200 mm	-	-
75 mm	-	-
50 mm	-	-
38.1 mm	-	-
25 mm	100	-
19 mm	-	-
12.5 mm	65-90	100
9.5 mm	-	-
4.75 mm	35-55	50-100
2.00 mm	-	30-90
0.425 mm	10-25	10-50
0.180 mm	-	-
0.075 mm	0-8	0-10

- .4 Concrete mixes and materials: in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .11 Unshrinkable fill: in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

### **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 EXCAVATION AND BACKFILL**

- .1 Excavate and backfill in accordance with Section 31 23 33.01 - Excavating Trenching and Backfilling and as indicated.
- .2 Obtain approval of Engineer before installing manholes or catch basins.

#### **3.3 CONCRETE WORK**

- .1 Do concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete.

### 3.4 INSTALLATION

- .1 Construct units in accordance with details indicated, plumb and true to alignment and grade.
- .2 Complete units as pipe laying progresses.
- .3 Dewater excavation to approval of Engineer and remove soft and foreign material before placing concrete base.
- .4 Cast bottom slabs directly on undisturbed ground.
- .5 Precast units:
  - .1 Set precast concrete base on 150 mm minimum of granular bedding compacted to 100 % maximum density to ASTM D698.
  - .2 Make each successive joint watertight with approved rubber ring gaskets, bituminous compound, cement mortar, epoxy resin cement, or combination of these materials.
  - .3 Clean surplus mortar and joint compounds from interior surface of unit as work progresses.
  - .4 Plug lifting holes with concrete plugs set in cement mortar or mastic compound.
- .6 For sewers:
  - .1 Place stub outlets and bulkheads at elevations and in positions indicated.
  - .2 Bench to provide smooth U-shaped channel.
    - .1 Side height of channel to be 0.75 times full diameter of sewer.
    - .2 Slope adjacent floor at 1 in 20.
    - .3 Curve channels smoothly.
    - .4 Slope invert to establish sewer grade.
- .7 Compact granular backfill to 95% maximum density to ASTM D698.
- .8 Installing units in existing systems:
  - .1 Where new unit is 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.
  - .3 Where deemed expedient to maintain service around existing pipes and when systems constructed under this project are ready for operation, complete installation with appropriate break-outs, removals, redirection of flows, blocking unused pipes or other necessary work.
- .9 Place frame and cover on top section to approximately 200 mm below elevations indicated to facilitate finish grading.
  - .1 On completion of finish grading adjust using concrete rings to elevations indicated.
- .10 Clean units of debris and foreign materials.
  - .1 Remove fins and sharp projections.

- .2 Prevent debris from entering system.
- .11 Install safety platforms in manholes as indicated.

### **3.5 ADJUSTING TOPS OF EXISTING UNITS**

- .1 Remove existing gratings, frames and store for re-use at locations designated by Engineer.
- .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, then replace cone section.
    - .1 When amount of raise is less than 600 mm use standard manhole brick, modoloc or grade rings.
- .3 Monolithic units:
  - .1 Raise monolithic units by roughening existing top to ensure proper bond and extend to required elevation with cast-in-place concrete or brick.
  - .2 Lower monolithic units with straight wall by removing concrete to elevation indicated for rebuilding.
  - .3 When monolithic units with tapered upper section are lowered more than 150 mm, remove concrete for entire depth of taper plus as much straight wall as necessary, then rebuild upper section to required elevation with cast-in-place concrete.
  - .4 Install additional manhole ladder rungs in adjusted portion of units as required.
  - .5 Re-use existing gratings and frames.
  - .6 Re-set gratings and frames to required elevation on not more than 4 courses of brick.
    - .1 Make brick joints and join brick to frame with cement mortar, parge and trowel smooth.
    - .2 Re-set gratings and frames to required elevation on full bed of cement mortar, parge and trowel smooth.

### **3.6 FIELD QUALITY CONTROL**

- .1 Leakage Test:
  - .2 Install watertight plugs or seals on inlets and outlets of each new manhole and fill manhole with water.
  - .3 Leakage not to exceed 0.3% per hour of volume of manhole.
  - .4 If permissible leakage is exceeded, correct defects.
  - .5 Repeat until approved by Engineer.

**3.7            CLEANING**

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

**END OF SECTION**

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Materials and installation for water mains, force mains, hydrants, fittings, valves, valve boxes and other associated works.

**1.2 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 10 - Closeout Submittals.
- .3 Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .4 Section 03 20 00 - Concrete Reinforcement.
- .5 Section 03 30 00 - Cast-in-Place Concrete.

**1.3 MEASUREMENT PROCEDURES**

- .1 Water and Force Mains

The payment for water mains and force mains will be at the unit price tendered per linear metre and shall include supplying, hauling, laying and jointing of all pipe, plugs, specials, blocking and bracing, together with necessary excavation, bedding, testing, disinfection, swabbing, flushing, backfilling and disposal of surplus excavation material. Measurement will be along the main with no deductions for valves or fittings.

- .2 Insulated Force Mains

The payment for insulated force mains will be at the unit price tendered per linear metre and shall all labour, tools, materials, and work to install mains including insulation, jacketing, supplying, hauling, laying and fusing of all pipe, plugs, specials, blocking and bracing, together with necessary excavation, installation of pipe within existing mains, testing, swabbing, flushing, connections to piping backfilling as required and disposal of surplus excavation material. Measurement will be along the main with no deductions for valves or fittings.

- .3 Insulated Joints, Jackets and Kits

Payment for the supply and installation of insulated joints, jackets and kits for pipes, valves, fittings, and curb stops where specified on the drawings shall be included in the price tendered for the applicable item.

- .4 Valves

Valves and valve boxes will be paid for at the unit price tendered and shall include supply and installation of valve, valve boxes and extension stem as specified.

- .5 Fittings

The unit price tendered for fittings, tees, bends, and specials shall include the installation of all material, bolts, gaskets, couplers, reaction blocking, and cutting into existing pipes as required to complete the installation as specified.

.6 Connection to Existing Main

Payment for connecting to existing mains shall be made where it is necessary to cut into the main and install a special fitting. Payment will be made at the lump sum tendered and shall include all necessary locating, excavation, cutting and removal of existing pipe, supply and installation of specials and fittings, disposal of water, reconnecting of pipe and backfilling. Connection to mains and tie-ins of dissimilar construction methods as part of the contract and installed by the Contractor shall be considered incidental to the contract and no extra payment shall be made.

.7 Corrosion Protection

Payment for corrosion protection will be included in the unit price tendered for valves, fittings, hydrants, etc.

.8 Swabbing Water Mains and Force Mains

Payment for swabbing of water mains and force mains shall be included in the unit price tendered for water mains and force mains.

.9 Directional Drilling

Installation by directional drilling, as shown on the drawings shall be at the lump sum price tendered including all labour, equipment, tools, casing, receiving pits to complete the work. It may be advantageous to consider installation by directional drilling for other areas of the Work. Installation of the piping by directional drilling outside areas identified shall be considered incidental to the Contract.

## 1.4 REFERENCES

.1 American National Standards Institute/American Water Works Association (ANSI/AWWA)

- .1 ANSI/AWWA B300-99, Hypochlorites.
- .2 ANSI/AWWA B301-99, Liquid Chlorine.
- .3 ANSI/AWWA B303-00, Sodium Chlorite.
- .4 ANSI/AWWA C500-02, Metal-Seated Gate Valves for Water Supply Service (Includes Addendum C500a-95).
- .5 ANSI/AWWA C651-99, Disinfecting Water Mains.
- .6 ANSI/AWWA C800-01, Underground Service Line Valves and Fittings (Also Included: Collected Standards for Service Line Materials).
- .7 ANSI/AWWA C900-97, Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 Inch through 12 Inch (100 mm - 300 mm), for Water Distribution.

.2 American Society for Testing and Materials International, (ASTM)

- .1 ASTM C117-95, Standard Test Method for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.

- .2 ASTM C136-01, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
- .3 ASTM D698-00a, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
- .4 ASTM A307-02, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
- .5 ASTM B88M-99, Standard Specification for Seamless Copper Water Tube Metric.
- .6 ASTM D698-00a, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
- .7 ASTM D2657-97, Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
- .8 ASTM F714-01, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
- .3 American Water Works Association (AWWA)/Manual of Practice
  - .1 AWWA M17-1989, Installation, Field Testing, and Maintenance of Fire Hydrants.
- .4 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
  - .2 CGSB 41-GP-25M-77, Pipe, Polyethylene, for the Transport of Liquids.
- .5 Canadian Standards Association (CSA International)
  - .1 CSA B137 Series-02, Thermoplastic Pressure Piping Compendium. (Consists of B137.0, B137.1, B137.2, B137.3, B137.4, B137.4.1, B137.5, B137.6, B137.8, B137.9, B137.10, B137.11 and B137.12).
    - .1 CSA B137.1-02, Polyethylene Pipe, Tubing, and Fittings for Cold-Water Pressure Services.
    - .2 CSA B137.3-02, Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications.
  - .2 CAN/CSA-G164-M92(R1998), Hot Dip Galvanizing of Irregularly Shaped Articles.
- .6 Department of Justice Canada (Jus)
  - .1 Canadian Environmental Protection Act, 1999 (CEPA).
- .7 Transport Canada (TC)
  - .1 Transportation of Dangerous Goods Act, 1992 (TDGA)
- .8 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC-S520-1991, Hydrants.
  - .2 CAN4-S543-1984, Internal-Lug, Quick Connect Couplings for Fire Hose.
- .9 Saskatchewan Water Security Agency
  - .1 EPB 260A.



## **1.5 SUBMITTALS**

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit complete shop drawings and construction schedule for water mains 600 mm diameter and larger. Include method for installation of water main.
- .3 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .4 Inform Consultant of proposed source of bedding materials and provide access for sampling at least 4 weeks prior to commencing work.
- .5 Submit manufacturer's test data and certification that pipe materials meet requirements of this section at least 4 weeks prior to beginning work. Include manufacturer's drawings, information and shop drawings where pertinent.
- .6 Pipe certification to be on pipe.

## **1.6 CLOSEOUT SUBMITTALS**

- .1 Provide 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, maintenance and operating instructions in accordance with Section 01 78 10 - Closeout Submittals.
  - .1 Include top of pipe, horizontal location of fittings and type, valves, valve boxes, valve chambers and hydrants.

## **1.7 SCHEDULING OF WORK**

- .1 Schedule Work to minimize interruptions to existing services.
- .2 Submit schedule of expected interruptions to Engineer for approval and adhere to interruption schedule as approved.
- .3 Notify Engineer minimum of 24 h in advance of interruption in service.
- .4 Notify fire department of any planned or accidental interruption of water supply to
- .5 Advise local police department and Owner of anticipated interference with movement of traffic.

## **Part 2 Products**

### **2.1 PIPE, JOINTS AND FITTINGS**

- .1 High density polyethylene pressure pipe:
  - .1 NPS 1/2 to NPS 6: to CSA B137.1 type PE 3406, series 160 or as specified on the drawings.
  - .2 All piping installed by directional drilling shall be DR11.
  - .3 Joints to be thermal butt fusion joined, to ASTM D2657 unless otherwise specified.

- .4 Long term hydrostatic strength of 1600 psi to ASTM D2837
- .5 Raw material to contain carbon black, well dispersed, with a minimum of 2 percent.
- .6 No recycled compound except that generated in the manufacturer's own plant from resin of the same specification from the same raw material supplier.
- .7 Force main bends, tees, and other fittings shall be smooth radius; no chamfer type bends shall be permitted. All connections shall be butt fused or electrofuse couplers - no mechanical couplers shall be used.

## **2.2 INSULATED PIPE AND OUTER JACKET**

- .1 Pipe insulation material shall be rigid polyurethane foam, factory applied to a minimum thickness of 50 mm. Pipe insulation density shall be 0.035 to 0.046 gm/cm<sup>3</sup> in accordance with ASTM Specification D1622.
- .2 Pipe insulation shall be closed cell content - 90 percent minimum in accordance with ASTM Specification D2856. Maximum water absorption shall be 40 percent by volume in accordance with ASTM Specification D2842-69. Compressive strength shall be 206 kPa to 275 kPa in accordance with ASTM D1621.
- .3 Thermal conductivity shall be 0.161 to 0.174 kilocalorie/cm/m<sup>2</sup>/°C according to ASTM Specification #C-158.
- .4 The service temperature shall be between -45°C to 120°C.
- .5 The pipe shall be centred at +/-6.35 mm.
- .6 High density adhesive backed polyethylene jacket shall be factory applied, hot in two counterwound and overlapping layers so no seams align. Jacket shall be applied over mirror smooth urethane insulation surface with integral polymeric skin, such as Urecon's U.I.P. system or approved equivalent.
- .7 Factory applied jacket shall have a minimum density of 0.940 gm/cm<sup>3</sup>. Sealant shall be synthetic polymers or modified rubber mastic. Jacket thickness shall be a minimum of 1.27 mm. Maximum elongation shall be 400 percent (six month test) in accordance with ASTM Specification 0570-63. Tensile strength shall be 7.79 N/m at -40°C in accordance with ASTM Specification ASTM G14-17.

## **2.3 INSULATED PIPE JOINTS**

- .1 The pipe joints shall be insulated using preformed urethane half shells with heat shrink sleeves. All exposed ends of insulation shall be coated with approved water proofing sealant, as recommended by the supplier, after factory ends and field cutting and trimming has been carried out.

## **2.4 INSULATED KITS FOR FITTINGS**

- .1 Insulation kits for fittings shall consist of rigid urethane foam, with fully bonded fibre reinforced plastic, with glass reinforced polyester coating on all exterior surfaces, including ends. Kits shall be supplied complete with silicone caulking for seams, stainless steel attachment straps and clips and heat shrink sleeves to seal between pipe and kit.
- .2 The insulation for fittings shall be rigid polyurethane foam.

- .3 Fibre reinforced plastic coating shall be glass reinforced polyester and fully bonded to the insulation. The resin shall be Miapol 2T - 118 laminating resin or approved equal, and shall be black in colour with ultra violet inhibitor. The thickness of the coating shall be a minimum of 2.54 mm. Exterior surface of the coating shall be a resin-rich hot coat of a minimum of 0.25 mm thickness.

## **2.5 CORROSION PROTECTION**

- .1 Provide means of protection of all steel, iron, or exposed metal pipe and fittings on pipe in corrosive soils in accordance with local practices and authorities having jurisdiction to ANSI/AWWA C105/A21.5.
- .2 Fittings and pipe to be wrapped with Denso tape of Polyken Polyethylene pressure sensitive tape 0.3mm thick 100 mm wide or coat with bitumen if permitted by manufacturer.

## **2.6 VALVES AND VALVE BOXES**

- .1 Valves to open in counter clockwise.
- .2 Gate and plug valves: to ANSI/AWWA C500, standard iron body, wedge or double disc resilient seat gate type with ends to suit the type of pipe supplied complete with a 50 mm nut wrench.
- .3 Casing: adjustable cast iron to accommodate the depth of cover specified consisting of hood, top section with lid and stone disc in accordance with the drawings. Casing is to rest on the bottom of the valve and not on the stuffing box.
- .4 Extension stem: 25 mm square mild steel with bottom socket to fit a 50 mm square valve operating nub and extend to within 450 mm of the top of the casing when assembled. Provide valve wrench to fit valve extension stem.

## **2.7 FITTINGS AND SPECIALS**

- .1 Cast iron Class 250 to AWWA C110 with ends to suit the type of pipe supplied.

## **2.8 CONCRETE**

- .1 Cement used to conform to CAN/CSA-A5 specification Type 50 Sulphate resistance.
- .2 Concrete used in reaction blocking or structures to conform to CAN/CSA-23.1 with a minimum compressive strength of 20 MPa at 28 days.

## **2.9 PIPE BEDDING AND SURROUND MATERIAL**

- .1 Granular material to: Section 31 05 16 - Aggregate Materials and following requirements:
  - .1 Crushed or screened stone, gravel or sand.
  - .2 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.1.
- .2 Table

Sieve Designation (mm)	% Passing
------------------------	-----------

	Stone/Gravel	Gravel/Sand
200	-	-
75	-	-
50	-	-
38.1	-	-
25	100	-
19	-	-
12.5	65-90	100
9.5	-	-
4.75	35-55	50-100
2.00		30-90
0.425	10-25	10-50
0.180	-	-
0.075	0-8	0-10

- .3 Concrete mixes and materials required for bedding cradles, encasement, supports, thrust blocks: to Section 03 30 00 - Cast-in-Place Concrete.

## 2.10 BACKFILL MATERIAL

- .1 As indicated on drawings or in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

## Part 3 Execution

### 3.1 PREPARATION

- .1 Clean pipes, fittings, valves, and appurtenances of accumulated debris and water before installation.
- .1 Inspect materials for defects to approval of Engineer.
  - .2 Remove defective materials from site as directed by Engineer.

### 3.2 TRENCHING

- .1 Do trenching work in accordance with Section 31 23 33.01 - Excavating Trenching and Backfilling.
- .2 Trench depth to provide cover over pipe of not less than 3.0 m from finished grade or as indicated.
- .3 Trench alignment and depth require Engineer's approval prior to placing bedding material and pipe.

### 3.3 CONCRETE BEDDING AND ENCASEMENT

- .1 Do concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .1 Place concrete to details as indicated.
  - .2 Pipe may be positioned on concrete blocks to facilitate placing of concrete. When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.
  - .3 Do not backfill over concrete within 24 hours after placing.

### **3.4 GRANULAR BEDDING**

- .1 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to a depth of 100 mm below bottom of the pipe to 100 mm above the pipe crown for the full width of the trench.
- .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 95% of maximum density to ASTM D698.

### **3.5 PIPE INSTALLATION**

- .1 Lay pipes to manufacturer's standard instructions and specifications. Do not use blocks except as specified.
- .2 Join pipes in accordance with ANSI/AWWA C600 and manufacturer's recommendations.
- .3 Bevel or taper ends of PVC pipe to match fittings.
- .4 Handle pipe by methods approved by Engineer recommended by pipe manufacturer. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.
- .5 Lay pipes on prepared bed, true to line and grade.
  - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
  - .2 Take up and replace defective pipe.
  - .3 Correct pipe which is not in true alignment or grade or pipe which shows differential settlement after installation greater than 10 mm in 3 m.
- .6 Face socket ends of pipe in direction of laying. For mains on grade of 2% or greater, face socket ends up-grade.
- .7 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.
- .8 Keep jointing materials and installed pipe free of dirt and water and other foreign materials.
  - .1 Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .9 Position and join pipes with equipment and methods approved by Engineer.
- .10 Cut pipes in 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.
- .11 Align pipes before jointing.

- .12 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.
- .13 Avoid displacing gasket or contaminating with dirt or other foreign material.
  - .1 Remove disturbed or contaminated gaskets.
  - .2 Clean, lubricate and replace before jointing is attempted again.
- .14 Complete each joint before laying next length of pipe.
- .15 Minimize deflection after joint has been made.
- .16 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.
- .17 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by Engineer.
- .18 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.
- .19 Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.
- .20 Do not lay pipe on frozen bedding.
- .21 Do hydrostatic and leakage test and have results approved by Engineer before surrounding and covering joints and fittings with granular material.
- .22 Backfill remainder of trench.

### **3.6 CORROSION PROTECTION**

- .1 Wire brush clean pipe and fittings to remove dust, loose rust, loose mill scale and loose mill lacquer. Tightly adhering rust, scale and lacquer may be left in place. Remove all oil deposits by solvent washing with naphtha or varsol. Cover weld heads with one wrap of tape prior to spiral wrapping.
- .2 Spirally wrap tape to completely cover exposed surface of pipe and fittings starting on mill coating 75 mm from its edge using 15 mm over lap and extending 75 mm over adjacent mill coating. Wrapping is to be continuous and free of voids.

### **3.7 VALVE INSTALLATION**

- .1 Contractor must thoroughly examine and operate all valves and ensure they are without visible defects and are operating properly before installing them.
- .2 Install valves to manufacturer's recommendations at locations as indicated to the elevations established by the Engineer.
- .3 Install valve boxes centered and plumb over the wrench next of the valve and braced against lateral movement to the sides of the trench.

### **3.8 HYDRANTS**

- .1 Install hydrants at locations as indicated.
- .2 Install hydrants in accordance with AWWA M17.
- .3 Install 150 mm gate valve and cast iron valve box on hydrant service leads as indicated.
- .4 Set hydrants plumb, with hose outlets parallel with edge of pavement or curb line, with pumper connection facing roadway and with body flange set at elevation of 50 mm above final grade.
- .5 Place concrete thrust blocks as indicated and specified ensuring that drain holes are unobstructed.
- .6 To provide proper draining for each hydrant, excavate pit measuring not less than 1 x 1 x 0.5 m deep and backfill with coarse gravel or crushed stone to level 150 mm above drain ports.
- .7 Place appropriate sign on installed hydrants indicating whether or not they are in service during construction.
- .8 Where hydrants are placed in a water bearing stratum, or when directed by the Engineer, drain ports are to be plugged with “**NO DRAIN**” painted on the hydrant barrel in black letters 50 mm high by use of a good quality stencil.
- .9 Hydrants are to be left drained on completion of the Work.

### **3.9 THRUST BLOCKS AND RESTRAINED JOINTS**

- .1 For thrust blocks: do concrete Work in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .2 Anchor and place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants, fittings, and bends deflecting more than 11° against undisturbed ground as indicated or as directed by the Engineer. Bearing areas on the pipe and the ground are noted on standard drawings provided.
- .3 Keep joints and couplings free of concrete to ensure they are accessible for repair.
- .4 Do not backfill over concrete within 24 hours after placing.
- .5 For restrained joints: only use restrained joints approved by Engineer.

### **3.10 HYDROSTATIC AND LEAKAGE TESTING**

- .1 Do tests in accordance with ANSI/AWWA C600.
- .2 Provide labour, equipment and materials including pumps measuring tanks, pressure hoses, connecting plugs, caps and gauges required to fill mains, pumping to the required pressure and perform hydrostatic and leakage tests hereinafter described.
- .3 Provide evidence that pressure gauges used are accurate.

- .4 Notify Engineer at least 48 hours in advance of proposed tests.
  - .1 Perform tests in presence of Engineer.
- .5 Where section of system is provided with concrete thrust blocks, conduct tests at least 5 days after placing concrete or 2 days if high early strength concrete is used.
- .6 Testing is to take place after backfilling has been completed on all mains at the maximum rated pressure for the class of pipe installed.
- .7 Open valves, air releases, and/or hydrants within test sections and expel air from main by slowly filling main with potable water.
- .8 Maintain test pressure for a minimum of one hour by pumping additional water into the test section from a measuring tank.
- .9 Where HDPE pipe is used, test pressure to be 1.5 times the rated pressure of the pipe (1.5 times series number). To compensate for initial pipe stretch, maintain a minimum of 80% of the test pressure for 3 hours then maintain the test pressure for 1 hour. After completion of the initial expansion phase, i.e. a total of 4 hours, the test period should commence. After the test period, a measured amount of makeup water is to be added to return the pipe to the test pressure. The amount of makeup water cannot exceed the amount shown in Table 12.2 – P.E. Pipe.
- .10 Define leakage as amount of water supplied from water storage tank in order to maintain test pressure.
- .11 Where the entire test is not completed within 8 hours for any reason whatsoever, depressurize the pipe for a minimum of 8 hours prior to the next testing sequence.
- .12 Tables
  - .1 **PVC PIPE** – Allowable Loss in Litres per 100 Couplings for PVC Pipe (Based on AWWA C-603 – Table 1)

Pipe Diameter	Test Pressure (kPa)						
	<u>350</u>	<u>500</u>	<u>700</u>	<u>850</u>	<u>1000</u>	<u>1400</u>	<u>1550</u>
100 mm	2.7	3.3	3.8	4.2	4.7	5.4	5.7
150 mm	4.0	4.9	5.7	6.4	7.0	8.0	8.5
200 mm	5.4	6.5	7.6	8.5	9.3	10.7	11.4
250 mm	6.7	8.1	9.5	10.6	11.6	13.4	14.2
300 mm	8.0	9.8	11.4	12.7	13.9	16.1	17.1
350 mm	9.4	11.4	13.2	14.8	16.2	18.8	19.9
400 mm	10.7	13.0	15.2	16.9	18.5	21.5	22.7

- .2 **P.E. PIPE** – Allowable Loss in Litres per Hour per 100 Metres for HDPE Pipe



<u>Nominal Pipe Size</u>	<u>Allowance for Expansion Litres per Hour per 100 Metres of Pipe</u>		
	<u>1 Hour Test</u>	<u>2 Hour Test</u>	<u>3 Hour Test</u>
75 mm	1.2	2.5	3.7
100 mm	2.5	3.7	5.0
150 mm	3.7	6.2	11.2
200 mm	6.2	12.4	22.4
250 mm	9.9	16.1	26.1
275 mm	12.4	24.8	37.3
300 mm	13.7	28.6	42.2

- .13 Do not exceed allowable leakage as per chart above for each pipe material, including lateral connections.
- .14 Locate and repair defects if leakage is greater than amount specified.
- .15 Repeat test until leakage is within specified allowance for full length of main and all test sections. A test section will not be deemed acceptable if leakage exceeds the quantities shown in Tables 12.1 and 12.2 above
- .16 Any leak developing prior to the expiry of the maintenance period must be repaired by the Contractor.

### 3.11 BACKFILL

- .1 Place backfill material in unfrozen condition.
- .2 Place backfill material above pipe bedding surround, in uniform layers not exceeding 150 mm compacted thicknesses or as specified.
- .3 Under paving and walks, compact backfill (Class 2) to at least 95 % maximum density to ASTM D698.

### 3.12 FLUSHING, SWABBING AND DISINFECTING

- .1 Swab mains following hydrostatic and leakage tests for all mains and prior to flushing and disinfection for water mains. Swab mains using a polyurethane foam saw as manufactured by G.E. Shnier Company Ltd. or approved equal in accordance with manufacturer's instructions.
- .2 Flushing and disinfecting operations: witnessed by Engineer.
  - .1 Notify Engineer at least 48 hours in advance of proposed date when disinfecting operations will begin.
- .3 Flush water mains through available outlets with a sufficient flow of potable water to produce velocity of 1.5 m/s, within pipe for minimum 10 minutes, or until foreign materials have been removed and flushed water is clear.
- .4 Flushing flows as follows:

Pipe Size NPS

Flow (L/s) Minimum

Pipe Size NPS	Flow (L/s) Minimum
6 and below	38
8	75
10	115
12	150

- .5 Provide connections and pumps for flushing as required.
- .6 Open and close valves, hydrants and service connections to ensure thorough flushing.
- .7 When flushing has been completed to Engineer approval, chlorinate and disinfect according to AWWA C601 and C651-99.
- .8 Chlorine application to be close to point of filling water main and to occur at same time.
- .9 Operate valves, hydrants and appurtenances while main contains chlorine solution.
- .10 Flush line to remove chlorine solution after approval of Engineer.

### **3.13 SURFACE RESTORATION AND CLEAN UP**

- .1 After installing and backfilling over mains, restore surface to original condition as directed by Engineer.
- .2 After completion of work, ensure all work areas are left in a neat and presentable condition. On completion of all work or portion of the work and in the presence of the Engineer, inspect all valve boxes and operate all valves including all those existing at the time of construction to ensure no damage has occurred during the cleanup operation.
- .3 Dispose of all surplus excavated material, trees, brush, rock, boulders, pieces of concrete and pavement at a location approved by the Engineer.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1        Materials and installation for gravity sanitary and storm sewer mains.

**1.2                RELATED SECTIONS**

- .1        Section 01 33 00 – Submittal Procedures
- .2        Section 31 23 33.01 – Excavating, Trenching and Backfilling.
- .3        Section 31 05 16 – Aggregate Materials.
- .4        Section 31 37 00 – Rip Rap.
- .5        Section 33 05 13 – Manholes and Catch Basins.

**1.3                MEASUREMENT PROCEDURES**

- .1        Sewers

Measurements will be made in linear metres from centre to centre of manholes and the depths of excavation will be those determined by the Engineer at the time the grade stakes are set. The elevations of ground on the centre line of the proposed trench opposite the stake will be recorded, and the final estimate will be considered as the average of the depths taken every 15 m between every pair of manholes. The unit prices tendered shall cover the cost of supplying, hauling, laying and jointing all pipe, insulation, jacketing, heat tracing and specials, together with the necessary excavation, bedding, backfilling, connecting, testing and all other work required to install the sewer mains as specified.

- .2        Catch Basin Leads

Payment will be made at the unit price tendered per linear metre. Measurements shall be in linear metres along the top of the pipe from the outside face of the catch basin to the outside face of the sewer or manhole at the point of connection. The price tendered shall include necessary excavation, the supply of all materials, laying, bedding and jointing of the pipe, connection to catch basins, manholes and sewers, and backfilling complete.

- .3        Bedding

No separate payment will be made for Class C Bedding, the cost of which shall be included in the cost of installing sewer mains in part (.1) above. The payment for Class A and Class B bedding shall be at the unit price tendered per cubic metre of concrete or granular material placed as bedding.

- .4        Risers and Junctions

Risers shall be measured in vertical metres from the outside top of the sewer main to the cap of the riser. Payment for risers shall be made at the unit price tendered and shall include the supply of all labour and materials, the junction, form work, concrete, backfilling, plug and the supply and installation of the riser

marker. Junctions for building services, where required, shall not be paid for separately but shall be included in the unit price tendered for the sewer main.

.5 Video Inspection

Video inspections including flushing and cleaning with high pressure cleaner, digital video inspection on compact disc, still photography, recorded deflection measurement, voice and written log and commentary shall be paid for at the unit price tendered per linear metre of pipe inspected.

**1.4 REFERENCES**

.1 American Society for Testing and Materials International, (ASTM)

- .1 ASTM C117-95, Standard Test Method for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
- .2 ASTM C136-01, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
- .3 ASTM C443M-02, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric).
- .4 ASTM D698-00a, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup>(600 kN-m/m<sup>3</sup>)).
- .5 ASTM D2680-01, Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.
- .6 ASTM D3034-00, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- .7 ASTM F794-01, Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

.2 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.

.3 Canadian Standards Association (CSA International)

- .1 CAN/CSA-A3000-98(April 2001), Cementitious Materials Compendium (Consists of A5-98, A8-98, A23.5-98, A362-98, A363-98, A456.1-98, A456.2-98, A456.3-98).
  - .1 CAN/CSA-A5-98, Portland Cement.
- .2 CSA B1800-02, Plastic Non-pressure Pipe Compendium - B1800 Series (Consists of B181.1, B181.2, B181.3, B181.5, B182.1, B182.2, B182.4, B182.6, B182.7, B182.8 and B182.11).
  - .1 CSA B182.2-02, PVC Sewer Pipe and Fittings (PSM Type).
  - .2 CSA B182.4-02, Profile PVC Sewer Pipe and Fittings.
  - .3 CSA B182.11-02, Recommended Practice for the Installation of Thermoplastic Drain, Storm, and Sewer Pipe and Fittings.

.4 Department of Justice Canada (Jus)

- .1 Canadian Environmental Protection Act, 1999 (CEPA).

.5 Transport Canada (TC)

- .1 Transportation of Dangerous Goods Act, 1992 (TDGA)

## **1.5 DEFINITIONS**

- .1 A pipe section is defined as length of pipe between successive catch basins and/or manholes.

## **1.6 SUBMITTALS**

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Inform Engineer at least 4 weeks prior to beginning Work, of proposed source of bedding materials and provide access for sampling.
- .4 Submit manufacturer's test data and certification at least 2 weeks prior to beginning Work.
- .5 Certification to be marked on pipe.
- .6 Submit to Engineer 1 copy of manufacturer's installation instructions.

## **1.7 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 METAL PIPE**

- .1 Sanitary: Type PSM Poly Vinyl Chloride (PVC) to ASTM D3034.
  - .1 Standard Dimensional Ratio (SDR): 35.
  - .2 Bell and spigot type with rubber gasket joints.
- .2 Storm: Stainless Steel Piping to ANSI/SME 36.19.
  - .1 Acceptable Material: Schedule 40 316L Stainless Steel complete with welded joints and flanges.

### **2.2 INSULATION AND JACKETING**

- .1 Storm sewer piping shall include 50 mm of mineral wool insulation or Foamglas insulation for the full perimeter complete with Pittwrap HS jacket or approved equal. Heat tracing as per electrical.

### **2.3 PIPE BEDDING AND SURROUND MATERIAL**

- .1 Granular material in accordance with Section 31 05 16 - Aggregate Materials and following requirements:
  - .1 Crushed or screened stone, gravel or sand.

- .2 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.1.

.2 Table

Sieve Designation (mm)	% Passing Stone/Gravel	Gravel/Sand
200	-	-
75	-	-
50	-	-
38.1	-	-
25	100	-
19	-	-
12.5	65-90	100
9.5	-	-
4.75	35-55	50-100
2.00		30-90
0.425	10-25	10-50
0.180	-	-
0.075	0-8	0-10

**2.4 BACKFILL MATERIAL**

- .1 As indicated.

**2.5 JOINT MORTAR**

- .1 Portland cement: to CAN/CSA-A5, normal type 10.
- .2 Mortar: one part Portland cement to two parts clean sharp sand mixed with minimum amount of water to obtain optimum consistency for use intended. Do not use additives.

**Part 3 Execution**

**3.1 PREPARATION**

- .1 Clean pipes and fittings of debris and water before installation, and remove defective materials from site to approval of Engineer.

**3.2 TRENCHING**

- .1 Do trenching Work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Do not allow contents of sewer or sewer connection to flow into trench.
- .3 Trench alignment and depth to approval of Engineer prior to placing bedding material and pipe.
- .4 Water jetting of backfill under haunches of corrugated steel pipe may be permitted if recommended by manufacturer and approved by Engineer.

### **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 90 % maximum density to ASTM D698.
- .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 pipes to: ASTM C12.
- .2 Lay and join pipe in accordance with manufacturer's recommendations and to approval of Engineer.
- .3 Handle pipe using methods approved by Engineer.
  - .1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.
- .4 Lay pipes on prepared bed, true to line and grade with pipe inverts smooth and free of sags or high points. Install to grades indicated. Catch basin leads to be a minimum grade of 1.0%.
  - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
- .5 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- .6 Do not exceed maximum joint deflection recommended by pipe manufacturer.
- .7 Fittings, ends of pipe to jointed, and rubber rings should be wiped clean, dry and free from dirt or other deleterious material immediately before assembly.
- .8 Only lubricant recommended by the rubber ring manufacturer shall be applied to the rubber ring or the ends of the pipe.
- .9 Do not allow water to flow through pipes during construction except as may be permitted by Engineer.
- .10 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .11 Install plastic pipe and fittings in accordance with CSA B182.11.

- .12 Pipe jointing:
  - .1 Install gaskets in accordance with manufacturer's recommendations.
  - .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. Gaskets so disturbed shall be removed, cleaned and lubricated and replaced 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.
- .13 When any stoppage of Work occurs, restrain pipes as directed by Engineer, to prevent "creep" during down time.
- .14 Plug lifting holes with Engineer approved prefabricated plugs, set in shrinkage compensating grout.
- .15 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.
- .16 Make watertight connections to manholes and catch basins.
  - .1 Use shrinkage compensating grout when suitable gaskets are not available.
- .17 Use prefabricated saddles or approved field connections for connecting pipes to existing sewer pipes.
  - .1 Joint to be structurally sound and watertight.
- .18 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 Engineer has inspected pipe joints, surround and cover pipes as indicated.
- .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 95 % maximum density to ASTM D698.



- .6 Compact each layer from mid height of pipe to underside of backfill to at least 90 % maximum density to ASTM D698.
- .7 When field test results are acceptable to Engineer, place surround material at pipe joints.

### **3.6 BACKFILL**

- .1 Place backfill material in unfrozen condition.
- .2 Place backfill material (Class 3), above pipe surround, in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.
- .3 Under paving and walks, compact backfill (Class 2) to at least 95 % maximum density to ASTM D698.
- .4 Contractor to ensure backfill is installed as to manufacturer's recommendations where insulation and jacketing.

### **3.7 FIELD TESTING**

- .1 Repair or replace pipe, pipe joint or bedding found defective.
- .2 When directed by Engineer, draw tapered wooden plug with diameter of 50 mm less than nominal pipe diameter through sewer to ensure that pipe is free of obstruction.
- .3 Remove foreign material from sewers and related appurtenances by flushing with water.
- .4 Perform infiltration and exfiltration testing as soon as practicable after jointing and bedding are complete, and service connections have been installed.
- .5 Do infiltration and exfiltration test to ASTM C828.
  - .1 Perform tests in presence of Engineer.
  - .2 Notify Engineer 24 hours in advance of proposed tests.
- .6 Carry out tests on each section of sewer between successive manholes including service connections.
- .7 Television and photographic inspections:
  - .1 Carry out inspection of installed sewers by television camera, photographic camera or by other related means.
  - .2 Provide means of access to permit Engineer to do inspections.

**END OF SECTION**

## **Part 1            General**

### **1.1                DRAWINGS AND SPECIFICATIONS**

The intent of the drawings and specifications is to include all labour, products and services necessary for complete work, tested and ready for operation.

The drawings and specifications are complementary, and what is required by any one shall be as binding as if required by all.

It shall be the responsibility of the Contractor to supply and install all material necessary to complete the work.

Field verification of scale dimensions on drawings is directed, since actual locations, distances and levels will be governed by actual field conditions.

If discrepancies or omissions in the drawings or specifications are found, or if intent or meaning is not clear, advise the Engineer for clarification before submitting tender.

Responsibility to determine which Division provides various products and work rests with the Contractor. Additional compensation will not be considered because of differences in interpretation of specifications.

### **1.2                RELATED WORK**

These specifications shall form part of the contract documents and shall be read, interpreted and coordinated with all other Sections. The Instructions to Bidders, General conditions, General Requirements, Supplementary General Conditions and Amendments and Supplements thereto form a part of this Section and contain items related to the electrical work.

### **1.3                CODES, RULES, PERMITS AND FEES**

Comply with all laws, ordinances, rules, regulations, codes and orders of all authorities having jurisdiction relating to this work.

Complete installation to comply with all rules of the current edition of the Canadian Electrical Code, its latest amendments, local municipal codes and the current edition of the National Building Code.

Comply with C.S.A. Electrical Bulletins in force at time of tender submission.

Quality of work specified and/or shown on the drawings shall not be reduced by the foregoing requirements.

Submit to the Electrical Inspection Department having jurisdiction necessary number of drawings and specifications for examination and approval prior to commencement of work.

### **1.4                INSPECTION**

Provide for and pay for any inspections, permits, etc. associated with this work.

## **1.5 STANDARDS OF WORKMANSHIP**

Execute all work in a competent manner and to present an acceptable appearance when completed.

Employ a competent supervisor and all necessary licensed tradesmen to complete the work in the required time.

Arrange and install products to fit properly into designated building spaces.

Unless otherwise specified or shown, install products in accordance with recommendations and ratings of manufacturers.

The workmanship on this project shall be first class.

## **1.6 TESTS**

The installation shall be free of opens and grounds. On completion, measure insulation resistances and comply with Table 24 of Canadian Electrical Code.

Test all wiring and connections for continuity and grounds before equipment is energized

Before energizing system, check all connections and set and calibrate all relays and instruments for proper operation, obtain necessary clearances, approval and instructions from utility company.

Carry out all tests and furnish all equipment required to demonstrate safe and proper completion of the work, without cost to Owner.

Check load balance on all feeders and make necessary adjustments to provide a “balanced” load.

## **1.7 GUARANTEES**

Guarantee all work for one year, following final acceptance. This guarantee shall include all problems caused by improper installation or equipment failure.

Provide a copy of the warranty in the maintenance manual.

## **1.8 BREAKDOWN OF COSTS**

Immediately upon notice of contract award, submit to the Engineer a further break down of the tendered price.

Submit progressive breakdown with each progress claim.

## **1.9 PRODUCT DELIVERY SCHEDULE**

A schedule must be submitted by the Contractor to the Architect and Engineer showing projected ordering and delivery dates of all products to meet required construction schedule.

## **1.10 LIST OF PRODUCTS**

After contract award, supply a list of products and sub-contractors (if applicable) must be submitted to the Engineer showing manufacturers for each type of product and for each luminaire type.

## **1.11 SAMPLES**

Submit samples as required where specified in this section.

## **1.12 SHOP DRAWINGS**

After receiving approval of list of products, and prior to delivery of any products to job site and sufficiently in advance of requirements to allow ample time for checking, submit shop drawings for review as specified in these specifications.

Show details, dimensions, construction, size, arrangement, operating clearances, performance characteristics and capacities of products and parts of the work.

These drawings are to show in detail the design and construction of all the following: (1) electrical distribution panels, (2) control panels, (3) Motor Control Centres, (4) switchboards, (5) bus work, (6) generator sets, transfer switches, (7) transformers, (8) motor starters and (9) all other special apparatus. The shop drawings are to include the special features such as control relays and the wiring diagrams where applicable in connection to the work.

Manufacture of products shall conform to reviewed shop drawings.

Where applicable include wiring, single line and schematic diagrams.

Include wiring drawings or diagrams showing interconnection with work of other Sections.

Approval of these drawings by the Engineer is general and is not intended to serve as a check and shall not relieve the Contractor of responsibility for error or the necessity for checking the drawing himself or of furnishing the materials and performing the work as required by the plans and specifications. Additional copies of these drawings shall be furnished upon request for the use of other contractors whose work is in any way related under the Contract.

Keep one complete set of shop drawings at job site during construction.

## **1.13 PROJECT RECORD DRAWINGS**

Before commencing work, obtain two sets white prints of all drawings pertinent to the work. Keep drawings on site and, daily or weekly as necessary, record in coloured pencil all changes, alterations, or additions in runs of conduit, numbers and location of panels, luminaries and devices that may occur during progress of the work.

At the conclusion of the job, forward the marked up drawings to the Engineer for updating of the original documents.

## **1.14 MAINTENANCE MANUALS**

Before requesting final certificate, submit copies of the maintenance manual as specified in Part 21, Section A.

Include in the manuals information based on the following requirements:

Operation and maintenance instructions to be sufficiently detailed with respect to design elements, construction features and component function and maintenance requirements to permit effective operation, maintenance, repair, modification, extension and expansion of any portion or feature of the installation.

Technical data to be in form, of approved shop drawings, supplemented by bulletins, technical descriptions of items, and parts lists. Advertising or sales literature will not be acceptable.

Provide wiring and schematic diagrams and performance curves where necessary.

Include names and addresses of nearest supplier for all items included in the maintenance manuals.

Provide manual and seminar with Owner forces to ensure proper operation of building prior to substantial Performance.

### **1.15 TEST DATA**

In addition to test data submitted as part of the maintenance manuals, submit test results of equipment and cables to the Engineer as tests are completed.

Before energizing any portion of the electrical system, perform megger tests on all feeders and branch circuits. Result to conform to Canadian Electrical Code, to the satisfaction of the inspection authority having jurisdiction and the Engineer.

Upon completion of the building and immediately prior to final inspection and takeover, check the load balance on all feeders at distribution centres, panels, etc. Conduct tests by turning on all possible loads in building and checking the load current balance. If load unbalance exceeds 15 per cent, reconnect circuits to balance load.

Perform voltage checks throughout the building and adjust transformer tap settings to suit building normal operation.

Take clip-on ammeter readings on all phases of all mechanical equipment motors with motors operating under full load conditions. Test readings to be submitted to Mechanical section and to the Engineer.

During construction and up to final acceptance, this Contractor shall be required to make accessible any equipment or wiring for inspection purposes.

The contractor shall allow for five full days of testing (one journeyman, one helper) when the system is commissioned. Co-ordinate the commissioning with the mechanical equipment commissioning requirements. This testing shall be when the design team is present.

### **1.16 PRODUCT HANDLING**

Use all means necessary to protect the products of this Division before, during and after installation and to protect products and installed work of all other trades.

Immediately make good any damage by repair or replacement at no additional cost to the Owner and to the approval of the Architect.

Remove dirt, rubbish, grease, etc. resulting from all equipment surfaces.

---

## **Part 2 MATERIALS**

### **2.1 SELECTED PRODUCTS AND EQUIVALENTS**

Selected products are specified and/or shown on the drawings, and identified by manufacturer's name, type and catalogue number.

Equivalent products may be considered if sufficient information is submitted at least 5 working days before tender closure, to enable the Engineer to determine acceptability of such products. Submit list of proposed equivalent products in duplicate to the Engineer along with a stamped, self-addressed envelope. Submittals by fax will not be accepted.

Where materials, equipment and apparatus or other products are noted as being "equal to" the specified manufacturer, products of equal or superior quality by other manufacturers may be substituted without approval of the Engineer.

### **2.2 REVIEW OF PRODUCTS**

Immediately after notification of award of contract, review with the Engineer a list of products proposed, including any alternatives submitted with tender.

After approval of product list, no subsequent changes will be permitted except as specified hereafter.

### **2.3 SUBSTITUTION OF PRODUCTS**

After approval of the list of products, no substitution of any item, either specified, preapproved or approved during tender will be permitted without written approval of the Engineer.

To receive approval, proposed substitutions must equal or exceed the quality, finish and performance of those specified and/or shown, and must not exceed the space requirements allotted on the drawings.

Provide documentary proof of date of original order, equality, difference in price (if any) and delivery dates in the form of certified quotations from suppliers of both specified items proposed substitutions to the Engineer.

Include costs for any associated work to accommodate such substitutions, including Engineer's or Architect's time and revisions to the work of other divisions (if applicable).

### **2.4 QUALITY OF PRODUCTS**

All products provided shall be CSA approved and new, unless otherwise specified.

If products specified are not CSA approved, obtain approval of provincial regulatory authority. Pay all applicable charges levied and make all modifications required for approval.

Products provided, if not specified, shall be new, of a quality best suited to the purpose required and their use subject to approval by the Engineer.

## **2.5 UNIFORMITY OF MANUFACTURE**

Unless otherwise specifically called for in the specifications, uniformity of manufacture shall be maintained for similar products throughout the work.

## **2.6 PRODUCT FINISHES**

Finish all cabinets, panelboards, switchboards, equipment cabinets, cable trays, etc. in ANSI grey enamel unless otherwise specified.

Apply primer on all items which are to be finished on the job.

Touch up all damaged painted finishes with matching lacquer, or, if required by the Architect or Engineer, completely repaint or replace damaged surface.

## **2.7 SITE EXAMINATION**

Examine the site of work and become familiar with all features and characteristics affecting this work before submitting tender.

No additional compensation will be given for extra work due to existing conditions which such examination should have disclosed.

Report to the Engineer any unsatisfactory conditions which may adversely affect the proper completion of this work.

## **2.8 CO-ORDINATION WITH OTHER SECTIONS**

Examine the drawings and all sections of the specifications. Before commencing work, obtain a ruling from the Engineer if any conflict exists, otherwise no additional compensation will be made for any necessary adjustments.

Install anchors, bolts, pipe sleeves, hangar inserts, etc. in ample time to prevent delays.

Lay out the work and equipment with due regard to architectural, structural and mechanical features. Architectural and structural drawings take precedence over electrical drawings regarding locations of wall, doors and equipment. Maintain Canadian Electric Code clearances in front of electrical equipment.

Do not cut structural members without approval of the Structural Engineer and without prior consultation with the Electrical Engineer.

Examine previously constructed work and notify the Engineer of any conditions, which prejudice the proper completion of this work. Commencement of this work without such notification shall constitute acceptance of other work.

## **2.9 TEMPORARY LIGHTING AND POWER**

Provide grounded extension cords and temporary lights required for electrical work. Provide GFCI receptacles.

Temporary power service, temporary lighting and power distribution systems will be provided under other sections.

## **2.10 SEPARATION OF SERVICES**

Maintain separation between electrical wiring system and building piping, ductwork, etc. so that wiring system is isolated (except at approved connections to such systems) to prevent galvanic corrosion.

In particular contact between dissimilar metals, such as copper and aluminum, in damp or wet locations is not permitted.

Do not support wiring from pipes, ductwork, etc. Hangers for suspended ceilings may be used for the support of wiring only when approval is obtained from ceiling installer, and approved clips or hangers are used.

## **2.11 LOCATION OF OUTLETS AND LUMINAIRES**

Electrical drawings are, unless otherwise indicated, drawn to scale and approximate distances and dimensions may be obtained by scaling. Figured dimensions shall govern over scaled dimensions. Where exact dimensions and details are required, refer to Architectural and Structural drawings.

Outlet and equipment locations shown on the drawings are approximate. Locations may be revised to suit construction and equipment arrangements without additional cost to the Owner, provided that no additional labour or material is required and installation has not been completed.

No extra charge for materials and labour shall be added to the Contract for outlets moved with 10 feet from the location shown on the plans prior to rough-in.

Maintain luminaire locations where possible. Notify the Engineer of conflicts with other services.

## **2.12 IDENTIFICATION**

Provide engraved lamicoid nameplates with black lettering on white background with approved wording on all motor starters, disconnect switches (other than in panelboards), switchgear, panels, transformers, thermostats, and on other electrical equipment where needed to aid servicing and upkeep and to inform maintenance staff.

Clearly mark all exposed conduit, pull boxes, junction boxes, etc., to indicate the nature of service.

Provide neatly typed circuit directories on panelboards to indicate the area or equipment controlled by each branch circuit.

Label all receptacles with the circuit number. Industrial vinyl labelling, clear label with black text, is acceptable.

## **2.13 INSTRUCTIONS TO OWNERS' PERSONNEL**

Instruct Owner's personnel in operation and maintenance of electrical equipment and systems.

Pay all costs for such instruction, including any costs related to instruction by manufacturer's representatives.



## **2.14 RENOVATIONS IN EXISTING BUILDINGS**

Remove all existing luminaries, panels, feeders, outlet boxes, switches, receptacles, etc. not required for the renovated layout shown. All equipment removed and not reused shall become the property of the Contractor. Unless otherwise noted, all equipment installed in renovated areas shall be new. All wiring shall be installed concealed.

All existing luminaries that are relocated shall be removed, checked, serviced, cleaned and relamped prior to reinstallation. Provide new ballasts where necessary and as noted on the drawings.

All existing luminaries that remain shall be put in good operating condition. Provide new lamps and ballasts as required and clean all lenses.

In areas undergoing upgrading requiring removal and replacement of wall covering, remove existing devices and extend circuitry, provide extension rings and reinstall devices as required.

Existing outlets with 5'0" of the location of the devices shown on the drawings may be used for those devices. Provide blank cover plates for all existing outlets not reused.

## **2.15 EXCAVATION AND BACKFILLING**

Provide all excavation, bedding and sand or aggregate cover as required for the electrical installation, including backfill.

Level all trenches for underground conduit and duct lines with a 76 mm layer of sand. Conduit not encased in concrete shall be bedded in sand, painted with two coats of asphalt paint after placement and covered by a second 154 mm layer of compacted sand.

Complete all backfilling of electrical services and underground conduit runs. All concrete work directly related to electrical installation will be done if and as required by the Electrical Contractor.

Ensure existing utility underground services are located prior to trenching. Contact all affected agencies in advance.

## **2.16 SUBSTANTIAL COMPLETION**

Prior to requesting substantial completion inspection, the following items must be complete:

The Emergency Generator and transfer switch shall be tested as per these specifications.

Control panel must be operational and tested. All O & M Manuals are completed.

The controls systems shall be completely operational.

Project Record drawings must be submitted to Engineer for review.

Maintenance manuals must be submitted to Engineer for review.

All outlets must have cover plates installed.

All electrical equipment not located in service rooms must have covers and/or doors installed complete.

Any devices not installed must have the wiring made safe and terminated in an outlet box complete with cover.

## 2.17 CONDUIT

Conduit: rigid threaded, galvanized steel and/or electrical metallic tubing and PVC rigid conduit. **All PVC conduit and fittings shall be from the same manufacturer. All PVC conduit shall be the same shade and colour. PVC conduit that is faded and weathered shall not be installed.**

Couplings: rigid threaded galvanized steel, set screw and liquid tight and PVC socket weld.

Flexible conduit: steel armour and flexible plastic jacketed type with liquid-tight connectors.

Non-metallic duct: rigid PVC.

Install conduit concealed in all areas where possible, otherwise surface run parallel to building lines.

Install and attach surface mounted conduit with clamps for exposed runs.

Utilize EMT in concrete and GRC or PVC in concrete on grade or below grade where allowed on drawing.

Underground conduit to be rigid threaded galvanized steel or rigid PVC, encased in concrete if and where shown on plans and also in corrosive areas.

Make connection to mechanical motors and equipment with Teck cables or PVC jacketed flexible conduit and liquid-tight connectors.

Minimum size 21 mm conduit. 16 mm flexible conduit only permitted for fixture and control wiring. All flexible conduit of sufficient length to avoid transmission of vibration.

Co-ordinate installation of conduit in masonry work where allowed on drawing.

Do NOT install conduit larger than 27 mm in poured concrete slabs.

Install conduit free from dents and bruises. Plug ends to prevent entry of dirt or moisture. All empty conduits shall be left with a 14-gauge pull wire left in place.

Clean out conduit before installation of conductors.

Alter routing to avoid structural obstructions keeping crossovers to a minimum.

Seal conduit with fibreglass where conduits leave heated area and enter unheated area.

Flashing and pitch pockets making watertight joints shall be provided where conduit pass through roof or waterproofing membranes.

Install CSA approved expansion fittings complete with grounding jumpers where conduits cross building expansion joints. Provide bends or offsets in conduit adjacent to building expansion joints where conduit is installed above suspended ceilings.

## **2.18 WIRE AND CABLES**

Wire and cables shall be new and marked in accordance with code requirements for type, voltage, manufacture, etc. All wiring shall be copper unless otherwise noted.

Wiring shall be minimum #12 AWG Copper unless otherwise noted.

Power conductors sized #10 and smaller shall be of soft copper. Cables shall be rated 600 V, 90 degree C unless otherwise noted. Conductors shall be 90 degree rated type RW 90 XLPE.

Control cable shall be stranded TEW cable. Use TEW for all field wiring to and from control panels.

Teck cables shall be utilized in Hazardous locations where armoured cable is required or specified and as shown on the drawings. Teck cables shall be single or multiple conductors, 600 volt; RW90 X-Link insulated conductors, integral ground conductor, inner PVC jacket, aluminium interlocking armour and overall PVC jacket.

## **2.19 WIRING DEVICES**

Lighting Switches shall be of the AC quiet type, specification grade with totally enclosed framed toggle. All switches shall be supplied with white finish, unless otherwise noted. Switches shall be equal to Hubbell 1200-W series (120V) and 18200-W series (347V), 15A. Provide 20A switches where indicated. Pilot light switches shall be Hubbell 1200-PL series (lighted handle type).

Receptacles shall be specification grade, duplex, 3 wire U ground, with screw type terminals, double wiping spring bronze contacts. Finish colour shall be white, unless otherwise noted. Where weatherproof receptacles are specified, they shall be complete with gasket and spring loaded, twin hinged receptacle covers with built-in gasket. Duplex receptacles shall be equal to Hubbell 5252-WHI, 15A.

Cover plates shall be weatherproof unless noted, otherwise stainless steel.

Wiring Devices and Cover Plates shall be by one manufacturer, Bryant, G.E., Hubbell, Leviton or P&S.

Ground fault circuit interruption (GFI) duplex receptacles shall be equal to Hubbell GF-5252-WHI (specification grade). Mount GFI receptacles in horizontal position and provide weatherproof polycarbonate covers.

## **2.20 OUTLET BOXES**

Outlet Boxes shall be manufactured of code gauge galvanized steel unless specified otherwise and shall be sized for the number of wires entering box as required by the Electric Code.

Interior boxes shall be galvanized pressed sheet steel, blanked for conduit.

Exterior boxes shall be cast corrosion-resistant type, (Crouse Hinds FS and/or FD series).

Boxes for flush mounting switches, receptacle and telephone except in masonry walls to be No. 52151 box with matching plaster cover for single or two gang outlets. For larger boxes use GSB solid type or special units as required. In masonry use "deep" type boxes.

Boxes in masonry are to be approved type masonry boxes.

Connectors shall be provided with nylon insulated throats.

Install knockout fillers to prevent entry of foreign materials.

Provide double locknuts and insulated bushings on sheet metal boxes.

Provide vapour boxes for exterior walls and insulated ceiling.

Boxes shall be independently supported from connecting conduits.

No sectional or handy boxes shall be used.

In exterior walls ensure that there is a vapour barrier box and insulation behind outlet boxes to prevent condensation through boxes.

Coordinate location and mounting heights for outlets mounted above counter, benches, splash backs, etc. Refer to structural details. Where heating units occur, adjust outlet-mounting height to coordinate with same.

## **2.21 JUNCTION AND PULL BOXES**

Junction and Pull Boxes shall be of code gauge galvanized or painted steel with screw on metal cover. They shall be sized to accommodate conduit of sizes specified and to facilitate pulling in the size and type of cable required.

## **2.22 SERVICE AND DISTRIBUTION**

**(See also drawings for other specification details)**

The power system supplies for this project will be a new underground 120/240 volt, 1 phase, 3 wire service with ampacities as per drawings for manhole No. 20.

All equipment in this project shall operate on the above noted system(s) with specific exceptions on the drawings or in the specifications.

The Electrical Contractor shall co-ordinate and make necessary arrangements with the Utility for the installation and connection of the power services. See drawings for extent.

Service entrance conductors shall be rated sized as per drawings.

The service equipment shall be free standing as shown on the drawings and described in these specifications.

### **Manhole No. 20**

The main entrance service switchboard shall be rated at 200 amp, 120/240 volt, 1 phase, 3 wire and shall incorporate features as provided by Schneider Canada Square NQ switchboard or approved equal (see also section 39) designed and tested to CSA C22.2 No. 31 and be complete with copper bus, 200 amp frame, 200 amp trip breaker. Bus shall be braced for 18000AIC bus bracing.

## **2.23 MISCELLANEOUS DISTRIBUTION EQUIPMENT**

Furnish and install the miscellaneous distribution equipment as herein specified and shown on the associated electrical drawings. The equipment shall be rated at 240/120 volts, single phase, three wire for Manhole No. 20.

The overcurrent protection devices referenced herein are designed and manufactured according to the following appropriate specifications:

1. Switchgear Assemblies: CSA C22.2 No.31
2. Panelboards: CSA C22.2 No 29
3. Moulded Case Circuit Breakers: CSA C22.2 No 5
4. Enclosed Switches: CSA C22.2 No.4.

Shop Drawings shall indicate front and side enclosure elevations with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; one-line diagrams; equipment schedule; and switchboard instrument details.

Manufacturers shall be Square D or approved equal.

Substitutions must be submitted in writing three (3) weeks prior to original bid date with supporting documentation demonstrating that the alternate manufacturer conforms to all aspects of the specifications herein.

### **Incoming Main Device:**

Circuit protective device shall be Square D P frame molded case circuit breaker.

Breaker shall have common tripping of all poles and shall be trip free.

The circuit breaker shall be UL Listed for reverse connection without requiring special construction or labeling. The breaker(s) shall have quick-make, quick-break contacts with a maximum 5 cycle closing time. All circuit breakers shall be equipped with electrical accessories as noted on the drawings.

Circuit breaker(s) shall be factory sealed and shall have a date code on the face of the circuit breaker. Poles shall be labeled with respective phase designations.

Breaker faceplate shall indicate rated ampacity. Breaker faceplate shall indicate UL and IEC certification standards with applicable voltage systems and corresponding AIC ratings.

### **TVSS:**

Suppressors shall be listed in accordance with UL 1449, *Standard for Safety, Transient Voltage Surge Suppressors*, and UL 1283, *Electromagnetic Interference Filters*.

Suppressors shall be independently tested with the Category C3 high exposure waveform (20kV-1.2/50µs, 10kA-8/20µs) per ANSI/IEEE C62.41 - 1991.

Suppressors shall provide redundant suppression modules between each phase conductor and the neutral conductor and between the neutral conductor and ground.

Suppressor manufacturer shall provide certified test data confirming a "fail-short" failure mode.

Visible indication of proper suppressor connection and operation shall be provided. The indicator lights shall indicate which phase as well as which module is fully operable.

The suppressor shall incorporate copper bus bars for the surge current path. Small gauge round wiring or plug-in connections shall not be used in the path for surge current diversion. Surge current diversion modules shall use bolted connections to the bus bars for reliable low impedance connections.

Suppressors shall meet or exceed the following criteria:

Maximum single impulse current rating shall be no less than 160kA per phase.

Pulse life test: Capable of protecting against and surviving 5000 ANSI/IEEE C62.41 Category C transients without failure or degradation of UL 1449 clamp voltage by more than 10%.

The TVSS shall be constructed using surge current modules (MOV based). Each module shall be fused with user replaceable 200,000 AIR rated fuses. The status of each module shall be monitored on the front cover of the switchboard as well as on the module.

The TVSS shall be equipped with an audible alarm which shall actuate when any one of the surge current modules has failed. An alarm on/off switch shall be provided to silence the alarm and an alarm push-to-test switch shall be provided to test the alarm. Both switches and audible alarm shall be located on the front panel of the switchboard.

Terminals shall be provided for all of the necessary power and ground connections. Each terminal shall accommodate wire sizes of #8 to #1 AWG.

The suppressor shall have a response time no greater than 5 nanoseconds for any of the individual protection modes.

The suppressor will have a warranty for a period of five years, incorporating unlimited replacements of suppressor parts if they are destroyed by transients during the warranty period.

TVSS to be integrated by the panelboard manufacturer into the panelboard assembly.

#### **Inspection:**

Examine area to receive switchboard to provide adequate clearance for switchboard installation.

Check that concrete pads are level and free of irregularities.

Start work only after unsatisfactory conditions are corrected.

#### **Installation:**

Install switchboard in accordance with manufacturer's written guidelines, the CEC, and local codes.

---

**Field Quality Control:**

Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.

Measure, using a Megger, the insulation resistance of each bus section phase-to-phase and phase-to-ground for one minute each, at minimum test voltage of 1000 VDC; minimum acceptable value for insulation resistance is 1 megohms. NOTE: Refer to manufacturer's literature for specific testing procedures.

Check tightness of accessible bolted bus joints using calibrated torque wrench per manufacturer's recommended torque values.

Physically test key interlock systems to check for proper functionality.

**Adjusting:**

Adjust all operating mechanisms for free mechanical movement per manufacturers specifications.

Tighten bolted bus connections in accordance with manufacturer's instructions.

Adjust circuit breaker trip and time delay settings to values as instructed by the Engineer.

**Cleaning:**

Touch up scratched or marred surfaces to match original finish.

**2.24 HANGERS AND SUPPORTS**

Provide and correctly locate all hangers and inserts required for the installation of all work under this Contract. Inserts shall be galvanized Sasco, Cantruss or Flexibar for single, double and multiple runs. They shall be firmly secured to the formwork before concrete is poured.

Support outlet boxes, junction boxes, conduit and all electrical equipment independently with hangers and fastenings to building structural members. Perforated strapping or perforated pipe hangers shall not be used.

Concrete inserts shall be cast during pouring; otherwise drilled metal inserts shall be installed.

Supply and deliver to the site in ample time, inserts, anchors, bolts and sleeves to be built into the work of other trades with the necessary templates, adequate instructions and assistance in locating and installing as necessary.

Hangers in general shall be supported from inserts in concrete construction or from building structure using beam clamps for steel structures. Provide all additional angle or channel steel members required between beams for support of conduits, cables, luminaries, etc.

Use coach screws, lag screws or wood screws as appropriate in any wood construction.

Feeders, conduits and power ducts running vertically in a building shall be supported at each floor and between each floor if necessary.

## **2.25 FINISHES AND PAINTING**

All factory supplied equipment shall have finish coating factory applied whether finish be painted, galvanized or other, as required and as specified. "Touch Up" scratched or damaged factory finishes to Architect's approval. Leave bare metal surfaces ready for painting by removing dirt, rust, grease or mill scale to Architect's approval.

## **2.26 INSTALLATION**

Install wiring for 600/347, 120/240 volt distribution systems as follows:

Wire in conduit or teck cable for feeders as noted on the plans.

Wire in conduit for branch circuit wiring from panels.

All branch circuit wiring must be designed for maximum 3% voltage drop. See drawings for voltage drop tables and conductor sizing.

Where wire size is not indicated, ampacity must match or exceed rating of protective device.

Panels are specified as sequence bussed and all branch circuit wiring from these panels shall be such that where a common neutral is used for two or three circuits, these circuits shall be fed from adjacent breakers, so that single-pole breakers may be replaced with 2 or 3 pole breakers should this be required in the future. All circuits shall be balanced.

Feeders, sub-feeders, circuit wiring and ancillary items shall be colour coded for phase identification. Neutral conductors shall be full capacity with white covering and be continuous throughout the system without fuses, switches or breakers of any kind.

Install wiring continuously within raceways, splices will be permitted only at outlets and junction boxes. Sufficient slack wire shall be left at these points to permit proper connection of luminaries, devices, equipment, etc.

Any exposed conduits or cables shall be run parallel to or at right angles to building lines and in a neat manner. Conduits shall be thoroughly reamed and each threaded termination shall be provided with two lock nuts. Running threads for rigid conduit will not be accepted.

Install underground PVC conduit in accordance with manufacturer's recommendations. Care shall be taken to ensure that there are no sharp bends or kinks in the conduit and that conduit is adequately supported.

Internal raceways in the building:

Securely cap or plug all openings in conduit and ducts during the execution of the Work to prevent obstruction entering the openings.

At completion of the installation, the service entry ducts and the conduit system in the building shall be fished to clear all blocks.

Outlet and pull boxes shall be cleaned out and the system left free from water and moisture.



Provide all conduit, wire, fittings, disconnect switches, line voltage, controls and auxiliary materials as previously defined to wire into service all 3 phase motors, single phase motors and equipment included in other Sections unless specified otherwise.

Provide outlets for light, power and systems of the number and in the locations shown on the Drawings. All outlets shall be located accurately.

Where outlets are grouped (i.e. normal and isolated ground power, telephone, data and alarm) install tight together. Do not scale locations from plans. Where normal and isolated ground receptacles are shown together, install in multi-gang box with appropriate cover plate.

Install local lighting switches on the strike side of the door unless shown otherwise.

Install weatherproof receptacles flush with wall face.

Outlet boxes in walls and partitions shall not be mounted back-to-back; separate them by 6" minimum.

Mount single gang receptacles and switch boxes with their greatest dimension in the vertical direction.

Where devices are shown above fixed millwork, mount outlets 6" above counter or backsplash. Coordinate with millwork installer and ensure that outlets do not conflict with backsplash.

Install pull boxes in the locations shown on the Drawings and as further required by the Canadian Electrical Code. Boxes shall be located in inconspicuous spaces.

Install pull boxes in conduit runs where required to facilitate the pulling in of cable, and locate in inconspicuous accessible spaces.

Mount disconnect switches adjacent to or attached to motor or equipment it serves.

Provide flexible connections to mechanical equipment for vibration isolation. Connections to equipment roof mounted or in other damp or wet locations shall be liquid tight.

## **2.27 CONDUITS**

Conduit shall not be run through beams, except as permitted by the Engineer.

In those instances where conduits must pass through concrete beams, they shall be cast in place, spaced at least two conduit diameters apart, and installed straight through the beams without bends at point of entry and exit. Coordinate with Structural Engineer prior to rough-in.

Crossovers or groups of conduits in slabs shall receive approval of the Engineer.

Joints of conduit in concrete slabs shall be concrete tight.

Joints of conduits underground shall be watertight.

Where possible, conduits shall be installed in such a manner that they are not trapped for accumulation of water. Conduits turned up shall be capped to prevent the entrance of dirt and moisture during building construction. If considered necessary by the Architect, conduits shall be swabbed out and thoroughly cleaned internally before pulling in wires and cables. Conduit installed in a slab on grade shall not penetrate the waterproofing membrane and/or vapour barrier.

Unless absolutely necessary conduits shall not be installed through expansion joints. Where it is necessary to install conduits through expansion joints, a pre-manufactured expansion type conduit fitting shall be used.

Provide spare and future conduits as shown. Provide in each of these conduits a nylon fish wire. In addition on the end of each conduit for spare or future provide a stamped metal tag indicating intended purpose, or mark conduit with indelible ink pen or other approved means.

Cap conduits left underground for future extension and mark the location of the capped ends clearly on as-installed drawings.

To help maintain fire rating, conduits to floor mounted receptacles or other floor mounted outlets shall be run in floor slabs where possible i.e. conduit penetrations from ceiling spaces below up through floor slabs shall be minimized.

When conduit runs from Category 1 or 2 areas to non-classified spaces, provide type EYS conduit seals as manufactured by Crouse-Hinds or approved equal, unless detailed otherwise.

All conduits penetrating floor slabs or fire walls shall be sealed with CSA approved flame retardant compounds, to maintain adequate fire ratings.

## **2.28 ACCESS DOORS**

Supply and install access panels and doors for walls and ceilings as required. Ensure all concealed items requiring access are provided with a door of adequate size. Minimum size 12" x 12".

## **2.29 NAMEPLATES / LABELS**

Provide laminated plastic nameplates with engraved letters to identify the following:

- Distribution Centres
- Fused Switches/Breakers
- Panel Boards
- Motor Starters
- Disconnect Switches
- Contactors

Nameplates/labels shall give either the designated name of the equipment (Panel A) or its function (Starter for Exhaust Fan, Lighting Control, Thermostat, etc.)

Provide adhesive labels to identify the following:

- Empty conduits
- Junction boxes and pull boxes
- Receptacle circuit numbers on cover plates.

## **2.30 TESTING**

Conduct tests to all secondary equipment.

Ensure moving and working parts are lubricated where required.

Replace fuses burned out during start-up.

### **2.31 GROUNDING AND BONDING**

Provide bonding to all metal equipment, metallic waste water system, gas piping and building structure as required by Code.

### **2.32 LUMINAIRES**

Luminaires shall be of manufacturer and catalogue number as indicated on the luminaire schedule.

### **2.33 LUMINAIRE INSTALLATION**

Install luminaries accurately in line and level. Coordinate this work with other trades at the site to ensure that their work is not held up by the work of this Section and that the luminaries are installed on schedule.

Install luminaries in the standard manner for the type of luminaire and in accordance with the manufacturer's instructions. Secure methods of attachment shall be used throughout or as called for in Luminaire Schedule.

Any luminaries, which are not installed properly, shall be taken down and re-installed without expense to Owner.

Luminaires shall not be mounted above pipes, ducts or equipment. In event of unavoidably tight locations, hangers shall be provided to clear obstructions. Layouts of other trades shall be checked on job and planned cooperatively. Luminaires shall hang at one height.

Recessed luminaries in plaster ceiling shall be supplied complete with plaster trim frame and mounting brackets.

Check the ceiling finishes in all areas where recessed luminaries are being installed to ensure that the luminaries which are ordered for these areas are purchased with suitable ceiling trim for the particular ceiling finish. Luminaires and mountings shall be checked for their electrical and physical characteristics in relation to conditions due to building construction and mechanical equipment. Necessary adjustments shall be made to luminaries or hanging arrangement of shop drawings and before construction if decision on necessary changes is required.

### **2.34 REPLACEMENT**

All burned out or otherwise damaged lamps are to be replaced at the time of building acceptance.

### **2.35 EQUIPMENT**

Emergency lighting shall be as noted on drawing.  
Electric Heat shall be as noted on drawing.

### **2.36 MECHANICAL EQUIPMENT CONNECTIONS**

Provide a complete system of wiring to motors and 120 volt controls as specified herein and as shown on the drawings.

Unless specifically noted otherwise, wire and leave in operation all electrically-operated equipment supplied under this Contract. Examine the drawings and shop drawings of all divisions for the extent of electrically-operated equipment supplied by other divisions.

Liaise with Mechanical Division to ensure that the motors specified conform to the voltage system available in design under this Section.

All control wiring diagrams shown on the drawings illustrate typical control circuits applicable to the equipment. Control circuits may vary with the different manufacturers of equipment. Verify all control circuits with the suppliers of the equipment and make any corrections that may be required.

Unless specifically noted otherwise, supply all 120/208 volt pushbuttons, relays, starters, etc. necessary for the operation of equipment. Check all starters, relay coils and thermal elements to ensure that they provide the necessary protection for motors.

Do not operate motors and controls until approval is obtained from the trade providing equipment.

Examine drawings and shop drawings of other Sections to obtain exact location of motors and equipment shown on drawings. Where necessary, obtain conduit locations from other trades drawings and shop drawings.

Assist in placing in operation all mechanical equipment having electrical connections.  
In general, all control wiring will be by this Section unless otherwise noted.

## **2.37 ELECTRICAL TESTING**

### **GROUND GRID RESISTANCE TESTING**

- Measure ground grid resistance of substation using the Fall of Potential or Three Terminal method.
- Several points shall be used to obtain a Earth Resistance Curve.
- Check ground grid resistance.

## **EXECUTION**

1. Perform testing in conjunction with the Electrical Contractor and coordinate the number of trips to site to allow for interim connections as the project stages dictate. Ensure that the timing of the testing services will not affect various project stages requirements
2. Provide 4 copies of all reports for insertion into O & M Manuals.