

**Project #: R.059705.001**

**Prince Albert, Saskatchewan  
Saskatchewan Penitentiary, 15<sup>th</sup> Street West  
New Fuel Tanks**

**Solicitation # EW525-151402/A**



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**Part 1            General**

**1.1                DEFINITIONS**

- .1        The "Owner" is Correction Services Canada (CSC).
- .2        In the specifications, references such as "indicated on the drawings", "specified", "scheduled", "called for", as similar phrases, shall be deemed to include work required by the Contract Documents.
- .3        The expression "provide" shall be deemed to include the provision, installation and finishing, maintenance, servicing and removal of the work described. All work damaged by temporary installations shall be repaired and made good at no extra cost to the Owner.
- .4        Unless the word "only" suffixes "supply" or "install" or other variation of those words according to the Subcontract wherein they are used, it is the express intent of this Contract that "supply and install" is implied. Unless otherwise specified, install Work in accordance with the manufacturer's printed directions and recommendations.
- .5        "Departmental Representative" is the Project Manager for Public Works and Government Services.
- .6        An "Approved Method" or "Accepted Method" means that which has the manufacturer's recommendation or which is generally accepted as good trade practice.

**1.2                GENERAL CONTRACTOR'S RESPONSIBILITIES**

- .1        The General Contractor shall have total control of the Work and shall effectively direct and supervise the Work so as to ensure conformity with the Contract Documents.
- .2        The General Contractor shall be solely responsible for construction means, methods, techniques, sequencing, safety, scheduling, and procedures and for coordinating the various parts of the Work.
- .3        The individual specification sections do not necessarily define trade scope, and it is the General Contractor's responsibility to define the responsibility of each subcontractor's trade scope in their respective construction contract.
- .4        The General Contractor is responsible for all coordination for the Project, including coordinating Subcontractors, and for ensuring that the Contract between the General Contractor and the Owner and Contracts between the Subcontractors and the Owner are coordinated and adhered to.

- .5 If items in this specification are noted as being done by the Subcontractor, it does not relieve the General Contractor from his responsibilities to coordinate such Work and to ensure such items are done in accordance with the Contract Documents and done within time allotted in the agreed upon schedule. Items noted as being done by the Subcontractor may be done by the General Contractor, if it is deemed to best suit the Work of this Contract. Where items are noted as being done by Subcontractors, the General Contractor is also responsible for such items.
- .6 In the case of a dispute, the General Contractor shall arbitrate disputes regarding trade scope. Extras will not be considered on the grounds of differences in interpretation of the Specification as to which Sub-contractor does what work.
- .7 The General Contractor will provide full-time site administration to ensure that all Subcontractors coordinate their work with Other Subcontractors and to ensure that the established construction schedule is maintained.
- .8 Each Subcontractor shall cooperate fully with the General Contractor and with all other Subcontractors.

### **1.3 SITE EXAMINATION**

- .1 Visit the site and compare the drawings and specifications with all existing site conditions including all conditions surrounding the site prior to submitting bid. Failure to visit the site in no way relieves the Trade Contractor from the necessity of furnishing any material, or performing any work in accordance with drawings and specifications, without additional cost to the Owner.
- .2 Submission of the bid is deemed to be evidence that the Trade Contractor has examined the site and is familiar with conditions under which work will be done.

### **1.4 WORKING LIMITS**

- .1 Confine all operations within the designated work area.

### **1.5 HARASSMENT**

- .1 For the purpose of this contract, harassment guidelines have been established to prevent conduct defined as harassment, between the Contractor, Subcontractors, Sub-subcontractors, the Owner and the Departmental Representatives.
- .2 Harassment is defined as unwanted attention, in verbal, written, graphic or physical form. Any such conduct which creates an offensive or intimidating working environment shall be considered as harassment.
- .3 For the purposes of these guidelines, all site shacks, offices, and general site will be considered to be "public" spaces. Material, either written or graphic, on view in "public" spaces, deemed to be offensive by the Departmental Representative or Owner, shall be removed.
- .4 Any conduct considered as harassment will be brought to the attention of the General Contractor. The General Contractor will be responsible to prevent further incidents.

- .5 The General Contractor shall ensure that all employees of the General Contractor, Subcontractors and Sub-subcontractors working on the construction site are familiar with and adhere to these guidelines.

## **1.6 RESPONSIBLE PERSONNEL**

- .1 Throughout the course of construction, the Contractor, mechanical Subcontractor, electrical Subcontractor and all other such subcontractors as deemed appropriate for the stage of construction, must designate and advise the Owner of a contact person and back-up contact person for working hours and non-working hours in the event of emergencies.
- .2 Update this list at construction meetings and provide to the Owner.

## **1.7 PUBLICITY**

- .1 All publicity relating to this project is subject to the approval of the Owner.
- .2 No mention of the Project in advertising or articles in any publication will be permitted unless approved by the Owner.
- .3 Publicity or advertising implying endorsement of a product by the Owner of a product will not be permitted.

## **1.8 PROJECT MEETINGS**

- .1 The General Contractor will schedule and administer project progress meetings throughout the progress of the Work on a weekly basis.
- .2 The General Contractor will distribute written notice of each meeting four days in advance of meeting date to the Departmental Representative, the Owner's representative, Subcontractors and/or other persons whose presence is required.
- .3 The General Contractor will provide physical space and make arrangements for meetings.
- .4 The General Contractor will record the minutes of progress meetings and will include significant proceedings and decisions. Parties requiring action will be identified in right column of minute page. The following items will be indicated:
  - .1 List of persons attending.
  - .2 Decisions taken.
  - .3 Instructions required or issued.
  - .4 All matters discussed.
- .5 The General Contractor will type, reproduce and distribute copies of minutes within three days after each meeting and transmit to meeting participants, affected parties not in attendance and the Owner.
- .6 The site meetings and site office are to be designated as "NO SMOKING" zones.
- .7 The General Contractor will conduct minuted subtrade meetings on a weekly basis, and distribute minutes to all affected parties, including Departmental Representative and Owner. All subtrades working onsite must attend.

## **1.9 SCHEDULES**

- .1 The General Contractor shall provide a Construction Progress schedule.
- .2 Each Trade Contractor must comply with the General Contractor's progress schedule and coordinate ordering of materials, labour and interface of work with other trades to ensure the schedule is adhered to.
- .3 Trade Contractors shall provide sufficient manpower loading to meet the schedule as provided by the General Contractor. Schedule can be revised and provided to Trade Contractors as work progresses. Trade Contractors will be expected to comply with those schedule revisions.
- .4 It is absolutely critical to maintain the project master schedule prepared by the General Contractor.
- .5 Inform the General Contractor immediately if the schedule cannot be met.
- .6 Each Trade Contractor shall provide to the General Contractor, a Submittal Schedule for Shop Drawings, material orders, Product Data and Samples, within 15 days after award of Contract.
- .7 Prepare schedule in form of a horizontal bar chart.
- .8 Provide horizontal time scale identifying the first work day of each week.
- .9 Format for listings: The chronological order of the start of each item of work.
- .10 Identification of listings: by systems description.
- .11 Submit initial schedules within 15 days after award of Contract.
- .12 Each Trade Contractor shall submit monthly progress claim schedules to the General Contractor prior to the first progress claim. The General Contractor shall assemble the progress claim schedules provided by Trade Contractors, and submit an overall progress claim schedule to the Owner and Consultant with the first progress payment.
- .13 Submit monthly progress claim schedule to the Owner at the time of the first progress claim.
- .14 Submit one opaque reproduction, plus 2 copies to be retained by the Departmental Representative.
- .15 Departmental Representative will review schedule and return reviewed copy within 10 days after receipt.
- .16 Resubmit finalized schedule within 6 days after return of reviewed copy.
- .17 Distribute copies of the revised schedule to:
  - .1 Job site office.
  - .2 Trade Contractors.
  - .3 Other concerned parties.

- .18 Instruct recipients to report to the General Contractor within ten (10) days, any problems anticipated by the timetable shown in schedule.
- .19 Submit monthly, three (3) coloured copies of schedule, indicating actual progress of Work and accepted revisions to original schedule.

#### **1.10 QUALITY CONTROL**

- .1 Provide the Owner and the Departmental Representative with access to the Work.
- .2 Give Owner and Departmental Representative minimum 48 hours' notice requesting review of Work is designated for special tests, reviews or acceptances by the Consultant's instructions, or the law of the place of Work.
- .3 If the Contractor covers or permits to be covered, Work that has been designated for special tests, reviews or acceptances before such is made, especially elevator, mechanical and electrical work in concealed spaces, uncover such Work, have the reviews or tests satisfactorily completed and make good such work.
- .4 Perform work in accordance with the latest edition of the National Building Code, Workers' Compensation Board of Saskatchewan, and all other codes of provincial or local application provided that any case of conflict or discrepancy, the more stringent requirement shall apply.
- .5 Meet or exceed requirements of specified standards, codes and documents.
- .6 Comply with all requirements and regulations of the Federal Department of Fisheries and Oceans and of Saskatchewan Environment and all other applicable regulations, with regards to sedimentation and erosion control measures. Provide the Consultant with a sediment and erosion control plan and report prior to commencement of construction.
- .7 Construct, regularly inspect, maintain and repair as necessary, such facilities until such time that the risk of silt and/or deleterious materials entering the storm sewer drainage system for the construction phase has passed.
- .8 The Owner may engage an Independent inspection and testing agencies for the purpose of inspecting and testing portions of the Work. Costs of such services will be borne by the Owner.
- .9 Equipment required for executing inspection and testing will be provided by appointed agencies.
- .10 Where materials are specified to be tested, deliver representative samples in required quantities to testing laboratory.
- .11 The Contractor will pay for the following testing and inspection services:
  - .1 Inspection and testing required by law, ordinances, rules, regulations or orders of public authorities.
  - .2 Inspection and testing performed exclusively for the Contractor's convenience.

- .3 Mill tests and certificates of compliance.
- .4 Tests specified to be carried out by the Contractor. Performance verification of mechanical and electrical equipment and systems.
- .5 After rectification, re-testing of work found deficient by previous tests.
- .12 Submit three (3) copies of inspection and test reports, including reports from independent testing agency, promptly to the Departmental Representative through the General Contractor.
- .13 Provide copies to:
  - .1 Subcontractor of work being inspected or tested.
  - .2 Manufacturer or fabricator of material being inspected or tested.
- .14 Perform all remedial work required as a result of deficiencies or work which does not meet the Contract documents, at no cost to the Owner. Additional tests required to ascertain if remedial work complies with contract documents will be borne by the Contractor.

**END OF SECTION**

**Part 1            General**

**1.1            PURPOSE**

- .1        To ensure that both the construction project and the institutional operations may proceed without undue disruption or hindrance and that the security of the Institution is maintained at all times.

**1.2            DEFINITIONS**

- .1        "Contraband" means:
  - .1        an intoxicant, including alcoholic beverages, drugs and narcotics,
  - .2        a weapon or a component thereof, ammunition for a weapon, and anything that is designed to kill, injure or disable a person or that is altered so as to be capable of killing, injuring or disabling a person, when possessed without prior authorization,
  - .3        an explosive or a bomb or a component thereof,
  - .4        currency over any applicable prescribed limit, and
  - .5        any item not described in paragraphs (a) to (d) that could jeopardize the security of a Penitentiary or the safety of persons, when that item is possessed without prior authorization.
- .2        "Unauthorized Smoking and related Items" means all smoking items including, but not limited to, cigarettes, cigars, tobacco, chewing tobacco, cigarette making machines, matches and lighters.
- .3        "Commercial Vehicle" means any motor vehicle used for the shipment of material, equipment and tools required for the construction project.
- .4        "CSC" means Correctional Service Canada.
- .5        "Departmental Representative" means Director, Warden or Superintendent of the Institution as applicable.
- .6        "Construction employees" means persons working for the General Contractor, contractors, the sub-contractors, equipment operators, material suppliers, testing and inspection companies and regulatory agencies.
- .7        "Departmental Representative" means the project manager from Public Works and Government Services Canada.
- .8        "Perimeter" means the fenced or walled area of the institution that restrains the movement of the inmates.
- .9        "Construction Area" means the area as shown on the contract drawings that the contractor will be allowed to work. This area may or may not be isolated from the security area of the institution.

### **1.3 PRELIMINARY PROCEEDINGS**

- .1 Prior to the commencement of work, the contractor will meet with the Departmental Representative to:
  - .1 Discuss the nature and extent of all activities involved in the Project.
  - .2 Establish mutually acceptable security procedures in accordance with this instruction and the institution's particular requirements.
- .2 The contractor will:
  - .1 Ensure that all construction employees are aware of the security requirements.
  - .2 Ensure that a copy of the security requirements is always prominently on display at the job site.
  - .3 Co-operate with institutional personnel in ensuring that security requirements are observed by all construction employees.

### **1.4 CONSTRUCTION EMPLOYEES**

- .1 Submit to the General Contractor and Departmental Representative a list of the names with date of birth of all construction employees to be employed in the Construction Area and a security clearance form for each employee.
- .2 Allow two (2) weeks for processing of security clearances. Employees will not be admitted to the Construction Area without a valid security clearance in place and recent picture identification such as a provincial driver's license. Security clearances obtained from other CSC institutions are not valid at this institution.
- .3 The Departmental Representative may require that facial photographs may be taken of construction employees and these photographs may be displayed at appropriate locations in the institution or in an electronic database for identification purposes. The Departmental Representative may require that Photo ID cards be provided for all construction workers. ID cards will then be left at the designated entrance to be picked upon arrival at Construction Area and shall be displayed prominently on the construction employees clothing at all time while employees are in the Construction Area.
- .4 Entry to Construction Area and Institutional Property will be refused to any person there may be reason to believe may be a security risk.
- .5 Any person employed in the Construction Area will be subject to immediate removal from Institutional Property if they:
  - .1 appear to be under the influence of alcohol, drugs or narcotics.
  - .2 behave in an unusual or disorderly manner.
  - .3 are in possession of contraband.

## **1.5 VEHICLES**

- .1 All unattended vehicles on CSC property shall have windows closed; doors and trunks shall be locked and keys removed. The keys shall be securely in the possession of the owner or an employee of the company that owns the vehicle.
- .2 The Departmental Representative may limit at any time the number and type of vehicles allowed within the Institution.
- .3 Drivers of delivery vehicles for material required by the project will not require security clearances but must remain with their vehicle the entire time that the vehicle is in the Construction Area.

## **1.6 PARKING**

- .1 The parking area(s) to be used by construction employees will be designated by the Departmental Representative. Parking in other locations will be prohibited and vehicles may be subject to removal.

## **1.7 SHIPMENTS**

- .1 All shipments of project material, equipment and tools shall be addressed in the Contractor's name to avoid confusion with the institution's own shipments. The contractor must have his own employees on site to receive any deliveries or shipments. CSC staff will NOT accept receipt of deliveries or shipments of any material equipment or tools.

## **1.8 TELEPHONES**

- .1 The Contractor will ensure that approved telephones, Facsimile machine and computers with Internet connections are located where they are not accessible to inmates. All computers will have an approved password protection that will stop an Internet connection to unauthorized personnel.
- .2 Wireless cellular and digital telephones, including but not limited to devices for telephone messaging, pagers, Blackberries, telephone used as 2-way radios, are not permitted within the perimeter of the Institution unless approved by the Departmental Representative. If wireless cellular telephones are permitted, the user will not permit their use by any inmate.

## **1.9 WORK HOURS**

- .1 Confirm hours with the institution and coordinate with the Departmental Representative.
- .2 Work will not be permitted during weekends and statutory holidays without the permission of the Departmental Representative. A minimum of seven days advance notice will be required to obtain the required permission. In case of emergencies or other special circumstances, this advance notice may be waved by the Departmental Representative.

## **1.10 OVERTIME WORK**

- .1 No overtime work will be allowed without permission of the Departmental Representative. Give a minimum forty-eight (48) hours advance notice when overtime work on the construction project is necessary and approved. If overtime work is required because of an emergency such the completion of a concrete pour or work to make the construction safe and secure, the contractor will advise the Departmental Representative as soon as this condition is known and follow the directions given by the Departmental Representative. Costs to the Crown for such events may be attributed to the Contractor.
- .2 When overtime work, weekend statutory holiday work is required and approved by the Departmental Representative, extra staff members may be posted by the Departmental Representative or designate, to maintain the security surveillance. The Departmental Representative may post extra staff for inspection of construction activities. The actual cost of this extra staff may be subject to reclamation by the Crown.

## **1.11 TOOLS AND EQUIPMENT**

- .1 Maintain a complete list of all tools and equipment to be used during the construction project. Make this inventory available for inspection when required.
- .2 Throughout the construction project maintain up-to-date the list of tools and equipment specified above.
- .3 Keep all tools and equipment under constant supervision, particularly power-driven and cartridge-driven tools, cartridges, files, saw blades, rod saws, wire, rope, ladders and any sort of jacking device.
- .4 Store all tools and equipment in approved secure locations.
- .5 Lock all tool boxes when not in use. Keys to remain in the possession of the employees of the contractor. Scaffolding shall be secured and locked when not erected and when erected, will be secured in a manner agreed upon with the Institutional designate.
- .6 All missing or lost tools or equipment shall be reported immediately to the Departmental Representative.
- .7 Security staff members will carry out checks of the Contractor's tools and equipment against the list provided by the Contractor. These checks may be carried out at the following intervals:
  - .1 At the beginning and conclusion of every construction project.
  - .2 Weekly, when the construction project extends longer than a one week period.
  - .3 The Contractor may be subject to random checks by security staff to ensure proper storage and security of tools throughout the project.
- .8 Certain tools/equipment such as cartridges and hacksaw blades are highly controlled items. The contractor will be given at the beginning of the day, a quantity that will permit one day's work. Used blades/cartridges will be returned to the Director's representative at the end of each day.

- .9 If propane or natural gas is used for heating the construction, the institution will require that an employee of the contractor supervise the construction site during non-working hours.

#### **1.12 PRESCRIPTION DRUGS**

- .1 Employees of the contractor who are required to take prescription drugs during the workday shall obtain approval of the Departmental Representative to bring a one day supply only into the Institution.

#### **1.13 SMOKING RESTRICTIONS**

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

#### **1.14 CONTRABAND**

- .1 Weapons, ammunition, explosives, alcoholic beverages, drugs and narcotics are prohibited on institutional property.
- .2 The discovery of contraband in the construction area and the identification of the person(s) responsible for the contraband shall be reported immediately to the Departmental Representative.
- .3 Contractors should be vigilant with both their staff and the staff of their sub-contractors and suppliers that the discovery of contraband may result in cancellation of the security clearance of the affected employee. Serious infractions may result in the removal of the company from the Institution for the duration of the construction.
- .4 Presence of arms and ammunition in vehicles of contractors, sub-contractors and suppliers or employees of these will result in the immediate cancellation of security clearances for the driver of the vehicle.

#### **1.15 SEARCHES**

- .1 All vehicles and persons entering institutional property may be subject to search.
- .2 When the Departmental Representative suspects, on reasonable grounds, that an employee of the Contractor is in possession of contraband or unauthorized items, he may order that person to be searched.
- .3 All employees entering the Construction Area may be subject to screening of personal effects for traces of contraband drug residue.

#### **1.16 MOVEMENT OF VEHICLES**

- .1 The contractor shall advise the Departmental Representative twenty four (24) hours in advance to the arrival on the site of heavy equipment such as concrete trucks, cranes, etc.
- .2 Vehicles being loaded with soil or other debris, or any vehicle considered impossible to search, must be under continuous supervision by CSC staff or Commissionaires working under the authority of the Departmental Representative.
- .3 With the approval of the Departmental Representative, certain equipment may be permitted to remain on the construction site overnight or over the weekend. This equipment must be securely locked, with the battery removed. The Departmental Representative may require that the equipment be secured with a chain and padlock to another solid object.

#### **1.17 MOVEMENT OF CONSTRUCTION EMPLOYEES ON INSTITUTIONAL PROPERTY**

- .1 Subject to the requirements of good security, the Departmental Representative will permit the Contractor and his employees as much freedom of action and movement as is possible.
- .2 However, notwithstanding paragraph above, the Departmental Representative may:
  - .1 Prohibit or restrict access to any part of the institution.
  - .2 Require that in certain areas of the institution, either during the entire construction project or at certain intervals, construction employees only be allowed access when accompanied by a member of the CSC security staff.
- .3 During the lunch and coffee/health breaks, all employees will remain within the construction area. Employees are not permitted to eat in the officer's lounge.

#### **1.18 SURVEILLANCE AND INSPECTION**

- .1 Construction activities and all related movement of personnel and vehicles will be subject to surveillance and inspection by CSC security staff members to ensure that established security requirements are met.
- .2 CSC staff members will ensure that an understanding of the need to carry out surveillance and inspections, as specified above, is established among construction employees and maintained throughout the construction project.

#### **1.19 STOPPAGE OF WORK**

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

**1.20 CONTACT WITH INMATES OF WORK**

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

**END OF SECTION**

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## **Part 1        General**

### **1.1        ADMINISTRATIVE**

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

### **1.2        SHOP DRAWINGS AND PRODUCT DATA**

- .1        The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2        Submit drawings stamped and signed by professional engineer registered or licensed in Province of Saskatchewan, Canada.
- .3        Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

- .4 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .5 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions other than those requested.
- .6 Accompany submissions with transmittal letter, 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.
- .7 Submissions include:
  - .1 Date and revision dates.
  - .2 Project title and number.
  - .3 Name and address of:
    - .1 Subcontractor.
    - .2 Supplier.
    - .3 Manufacturer.
  - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
  - .5 Details of appropriate portions of Work as applicable:
    - .1 Fabrication.
    - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
    - .3 Setting or erection details.
    - .4 Capacities.
    - .5 Performance characteristics.
    - .6 Standards.
    - .7 Operating weight.
    - .8 Wiring diagrams.
    - .9 Single line and schematic diagrams.
    - .10 Relationship to adjacent work.
- .8 After Departmental Representative's review, distribute copies.
- .9 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.

- .10 Submit electronic copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.
- .11 Submit electronic copies of test reports for requirements requested in specification Sections and as requested by Departmental Representative.
  - .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
  - .2 Testing must have been within 3 years of date of contract award for project.
- .12 Submit electronic copies of certificates for requirements requested in specification Sections and as requested by Departmental Representative.
  - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
  - .2 Certificates must be dated after award of project contract complete with project name.
- .13 Submit electronic copies of manufacturer's instructions for requirements requested in specification Sections and as requested by Departmental Representative.
  - .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
- .14 Submit electronic copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.
- .15 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .16 Submit electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.
- .17 Delete information not applicable to project.
- .18 Supplement standard information to provide details applicable to project.
- .19 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, electronic copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

- .20 The review of shop drawings by Public Works and Government Services Canada (PWGSC) is for sole purpose of ascertaining conformance with general concept.
  - .1 This review shall not mean that PWGSC approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.
  - .2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of Work of sub-trades.
- .21 Do not copy the contract documents for the purpose of shop drawing production, unless directed otherwise by the Consultant.
- .22 The Departmental Representative will NOT provide CADD disks of Contract Working drawings to aid the Contractor in the production of shop drawings.
- .23 Any proposed deviations from the Contract Documents must be boldly indicated as such on the shop drawings. No acceptance shall be inferred or assumed otherwise.

### **1.3 SAMPLES**

- .1 Submit for review samples in duplicate or as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to Departmental Representative's business address.
- .3 Notify Departmental Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .4 Where colour, pattern or texture is criterion, submit full range of samples.
- .5 Adjustments made on samples by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .6 Make changes in samples which Departmental Representative may require, consistent with Contract Documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.
- .8 Do not undertake any work until samples have been reviewed and accepted by the Departmental Representative.

### **1.4 MOCK-UPS**

- .1 Provide mock-ups for items as requested in the individual specification sections.
- .2 Construct sample areas at location designated by the Departmental Representative.

- .3 Sample installations must indicate materials, patterns, joints, colours, shades, installation methods and level of workmanship.
- .4 Adjust sample installations as required to conform to the referenced standards, the drawings, and this specification, and to gain acceptance by the Departmental Representative, at no additional cost to the Owner.
- .5 Accepted sample installations will become the standard for the project and may be incorporated into the Work. Any work which does not match the accepted mock-ups will be rejected and replaced to match accepted mock-ups.

## **1.5 PHOTOGRAPHIC DOCUMENTATION**

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

## **1.6 CERTIFICATES AND TRANSCRIPTS**

- .1 Immediately after award of Contract, submit Workers' Compensation Board status.

## **1.7 REGISTERED PROFESSIONAL ENGINEER'S CONFIRMATION LETTER**

- .1 For all sections of Work which require the Contractor or Subcontractor to provide professional engineering services, the Contractor's or Subcontractor's Registered Professional Engineer shall design and engineer components for the project which the Contractor's or Subcontractor's Registered Professional Engineer is responsible for, and shall sign and seal on shop drawings and supporting documentation. The Contractor's or Subcontractor's Registered Professional Engineer shall review all fabrication and installation of such components. At completion of the Work, each of the Contractor's and/or Subcontractor's Registered Professional Engineers shall provide to the Departmental Representative, a letter confirming that:
  - .1 All civil, structural, architectural, mechanical, electrical and other components are fabricated and erected in conformance with their design.
  - .2 All components are capable of supporting all the loads or capable of performance specified or indicated on the reviewed shop drawings.
  - .3 All changes to the contract documents have been reviewed and are acceptable.

- .4 All components have been designed, fabricated and installed to substantially comply with the applicable requirements of the National Building Code.
- .5 All components have been designed and installed to conform to the seismic restraint requirements of the National Building Code 2010.
- .6 The fabrication and installation of such components has been reviewed and accepted by the Contractor's and/or Subcontractor's Registered Professional Engineers.
- .7 All components are fabricated and erected in accordance with the reviewed shop drawings.

**END OF SECTION**

**Part 1            General**

**1.1            REFERENCES AND CODES**

- .1 Perform Work in accordance with National Building Code of Canada (NBC)-2010, including amendments up to tender closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.
- .2 Meet or exceed requirements of:
  - .1 Contract documents.
  - .2 Specified standards, codes and referenced documents, including, but not limited to, the following:
- .3 Canadian Council of Ministers of the Environment (CCME).
  - .1 CCME PN 1326-2003, Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products.
- .4 National Research Council Canada (NRCC).
  - .1 National Fire Code of Canada (NFCC)-2010.
- .5 Department of Justice Canada (Jus).
  - .1 Canadian Environmental Protection Act, 1999 (CEPA).
    - .1 Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations (SOR/2008-197).
- .6 Transport Canada (TC).
  - .1 Transportation of Dangerous Goods Act, 1992 (TDGA).

**1.2            BUILDING SMOKING ENVIRONMENT**

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

**1.3            NATIONAL PARKS ACT**

- .1 Perform Work in accordance with National Parks Act when projects are located within boundaries of National Park.

**END OF SECTION**

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**Part 1            General**

**1.1               SUBMITTALS**

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

**1.2               INSTALLATION AND REMOVAL**

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

**1.3               DEWATERING**

- .1       Provide temporary drainage and pumping facilities to keep excavations and site free from standing water, to the approval of the authorities having jurisdiction.
- .2       Keep excavations free of water while work is in progress.
- .3       Protect open excavations against flooding and damage due to surface run-off.
- .4       Handle discharged water in strict accordance with all applicable environmental regulations and to the satisfaction of the authority having jurisdiction. Dispose of water in a manner not detrimental to public and private property, or any portion of work completed or under construction.
- .5       Provide tanks, setting basins, or other treatment facilities to remove suspended solids or other materials before discharging to storm sewers, water courses or drainage areas, in accordance with local authority requirements.
- .6       Bear all costs for remedial work, and/or the cost to remove saturated material and install additional material to replace saturated material resulting from the failure to carry out the recommended dewatering techniques.

**1.4               WATER SUPPLY**

- .1       Provide continuous supply of potable water for construction use.
- .2       Provide all hoses and other means of distribution as required, from the designated source.
- .3       Arrange for connection with appropriate utility company and pay costs for installation, maintenance, consumption and removal.
- .4       Pay for utility charges at prevailing rates.

**1.5               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 15 degrees C in areas where construction is in progress, unless otherwise specified.
- .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 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
  - .1 Conform to applicable codes and standards.
  - .2 Enforce safe practices.
  - .3 Prevent abuse of services.
  - .4 Prevent damage to finishes.
  - .5 Vent direct-fired combustion units to outside.
- .7 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

## **1.6 TEMPORARY POWER AND LIGHT**

- .1 Provide and pay for temporary power during construction for temporary lighting and operating of power tools.
- .2 Provide all connections, cabling, switching and metering equipment to the approval of the local power supply authority.
- .3 Provide utility reduction items such as transformers, connection to utility source, distribution of utility, metering, consumption, maintenance and removal.
- .4 Arrange for connection with appropriate utility company. Pay costs for installation, maintenance and removal.

- .5 Provide and maintain temporary lighting throughout the project. Provide a level of illumination on all floors and stairs of not less than 15 foot candles. Replace burnt out or missing lamps.

## **1.7 TEMPORARY COMMUNICATION FACILITIES**

- .1 Provide and pay for temporary telephone and fax hook ups, lines and equipment, necessary for own use and use of Departmental Representative and Owner. Pay phone is not acceptable.

## **1.8 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**

- .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**

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**Part 1            General**

**1.1            REFERENCES**

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB 1.59-97, Alkyd Exterior Gloss Enamel.
  - .2 CAN/CGSB 1.189-2000, Exterior Alkyd Primer for Wood.
- .2 Canadian Standards Association (CSA International)
  - .1 CSA A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - .2 CSA O121-08 (R2013), Douglas Fir Plywood.
  - .3 CAN/CSA Z321-96 (R2006), Signs and Symbols for the Workplace.
- .3 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C', In Effect as of: May 14, 2004.
- .4 U.S. Environmental Protection Agency (EPA) / Office of Water
  - .1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

**1.2            SUBMITTALS**

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

**1.3            INSTALLATION AND REMOVAL**

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

**1.4            HOISTING**

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

## **1.5 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.
- .3 Every temporary support shall be as strong as the permanent support.
- .4 Do not place loads on concrete pads until they have obtained their permanent set and the Departmental Representative's authorization has been received.

## **1.6 CONSTRUCTION PARKING**

- .1 Parking may be permitted on site provided it does not disrupt performance of Work.
- .2 Provide and maintain adequate access to project site.

## **1.7 SECURITY**

- .1 Provide and pay for responsible security personnel to guard site and contents of site after working hours and during holidays, or
- .2 Ensure that access locations to the work site hoarding area are securely locked after working hours and during holidays, and that equipment and machinery, within the work site hoarding area, are properly locked or otherwise rendered inoperable to any unauthorized individuals.
- .3 Assume full responsibility for any losses or damages to materials, fixtures or equipment whether due to failure to properly secure the work site or for any other reason whatsoever.

## **1.8 OFFICES**

- .1 Provide and maintain, in a clean and orderly condition, during progress of Work, adequately lighted, heated and ventilated lockable temporary office shed or trailer. Permit the Departmental Representative and Owner to use the facilities
- .2 Office to be minimum of 10 m<sup>2</sup> in area, equipped with a desk, telephone, 2 chairs, filing cabinet, layout table, and plan hanging files.
- .3 Provide Contractor's offices with space for filing and layout of Contract Documents and Contractor's normal site office staff. Provide meeting room of adequate size to hold all required meetings.
- .4 Provide marked and fully stocked first-aid case in a readily available location, as required by authorities having jurisdiction.
- .5 Subcontractors to provide their own offices as necessary. Direct location of these offices.

## **1.9 EQUIPMENT, TOOL AND MATERIALS STORAGE**

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

## **1.10 SANITARY FACILITIES**

- .1 Provide sufficient portable sanitary facilities during the construction period for workers, in accordance with local health authorities.
- .2 Maintain in clean condition.
- .3 Permanent facilities are not to be used by workers.
- .4 Provide separate facilities, as required, for men and women, appropriately identified.

## **1.11 CONSTRUCTION SIGNAGE**

- .1 Provide and erect project sign, within three weeks of signing Contract, in a location designated by Departmental Representative.
- .2 No other signs or advertisements, other than warning signs, are permitted on site.
- .3 Signs and notices for safety and instruction in both official languages including graphic symbols to CAN/CSA Z321.
- .4 Maintain approved signs and notices in good condition for duration of project, and dispose of off-site on completion of project or earlier if directed by Departmental Representative.

## **1.12 PROTECTION AND MAINTENANCE OF TRAFFIC**

- .1 Carefully maintain existing benchmarks, monuments and other survey control references.
- .2 Take precautions at all times to protect persons, including the public, Contractor's employees, subcontractors and their employees, and property affected in any way by the work. Especially guard against or eliminate hazardous conditions.
- .3 Protect work and materials from damage due to building operation, from action of the elements, from carelessness of Contractor's employees or subcontractors and their employees, from vandalism and from any other cause until completion and the Owner's acceptance of the work.
- .4 Protect Work against possible damage from:
  - .1 Ground water and rain water.
  - .2 Snow, ice and frost. Remove snow, ice and frost where necessary for efficient progress.

- .3 Climatic and weather conditions.
- .4 Fire.
- .5 Be responsible for damage incurred due to lack of or improper protection, and remove and replace with new Work at no extra cost to the Owner.
- .6 Protect adjacent roads and private property from damage during construction.
- .7 Provide protection for finished and partially finished equipment during performance of the work.
- .8 Provide all necessary screens, covers, hoardings as required.
- .9 Provide access and temporary relocated roads as necessary to maintain traffic.
- .10 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by Departmental Representative.
- .11 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
- .12 Protect travelling public from damage to person and property.
- .13 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.
- .14 Verify adequacy of existing roads and allowable load limit on these roads.  
Contractor: responsible for repair of damage to roads caused by construction operations.
- .15 Construct access and haul roads necessary.
- .16 Haul roads: constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided.
- .17 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.
- .18 Dust control: adequate to ensure safe operation at all times.
- .19 Location, grade, width, and alignment of construction and hauling roads: subject to review by Departmental Representative.
- .20 Lighting: to assure full and clear visibility for full width of haul road and work areas during night work operations.
- .21 Provide snow removal during period of Work.
- .22 Remove, upon completion of work, haul roads designated by Departmental Representative.

.23 Special Controls

- .1 Noise and Dirt: Alert the Owner and Departmental Representative in advance of performing work creating unusual noise and dirt and schedule work at times mutually agreeable.

**1.13 CLEAN-UP**

- .1 Maintain the Work in tidy condition, free from the accumulation of waste products and debris.
- .2 Remove construction debris, waste materials, packaging material from work site and deposit into waste containers daily.
- .3 Clean dirt or mud tracked onto paved or surfaced roadways.
- .4 Store waste materials within the confines of the site hoarding in lidded metal waste bins for commercial use.

**Part 2 Products**

- .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**

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## **Part 1            General**

### **1.1                REFERENCES**

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB 1.59-97, Alkyd Exterior Gloss Enamel.
  - .2 CAN/CGSB 1.189-2000, Exterior Alkyd Primer for Wood.
- .2 Canadian Standards Association (CSA International)
  - .1 CSA O121-08 (R2013), Douglas Fir Plywood.
- .3 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C', In Effect as Of: May 14, 2004.

### **1.2                INSTALLATION AND REMOVAL**

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

### **1.3                HOARDING**

- .1 Erect hoarding around entire perimeter of site within reasonable distance from buildings as required to facilitate construction and to protect the public, workers, public and private property from injury or damage and to the approval of the authority having jurisdiction. Ensure hoarding does not interfere with other construction activities on site.
- .2 Provide hoarding with prefabricated temporary steel framed construction fence with mesh, 2400mm high, with sections interlocked together and fence being self-supporting, protecting public and private property from injury or damage.
- .3 Provide lockable entrance gates within hoarding for access to site by workers and vehicles. Equip gates with locks and keys. Ensure hoarding is completely secure when work is not in progress.
- .4 Locate all construction trailers, garbage bins, equipment, tools and the like, as directed by the General Contractor.
- .5 Provide barriers around trees and plants designated to remain. Protect from damage by equipment and construction procedures.
- .6 Neatly assemble and firmly brace.
- .7 Maintain as required during construction period.
- .8 Remove barriers prior to completion and final acceptance. Patch and repair surfaces to original condition damaged by erection of barriers.

**1.4 GUARD RAILS AND BARRICADES**

- .1 Provide secure, rigid guard rails and barricades as required by governing authorities.

**1.5 ACCESS TO SITE**

- .1 Maintain free and unimpeded access to and egress from site at all times. Provide and maintain temporary roadway access to site, suitable for all weather conditions so as not to delay construction.
- .2 Whenever interference with normal traffic becomes necessary for proper and convenient performance of the work, and no satisfactory detour route exists, provide satisfactory detour, or other proper facility for traffic to pass around or over interference, and maintain in satisfactory condition as long as interference continues. Provide before beginning interference.

**1.6 PUBLIC TRAFFIC FLOW**

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

**1.7 FIRE ROUTES**

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

**1.8 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY**

- .1 Protect surrounding private and public property from damage during performance of Work.
- .2 Be responsible for damage incurred.

**1.9 WASTE MANAGEMENT AND DISPOSAL**

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

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 Within text of each specifications section, reference may be made to reference standards.
- .2 Conform to these reference standards, in whole or in part as specifically requested in specifications. All standard specifications shall be the latest issue.
- .3 If there is question as to whether products or systems are in conformance with applicable standards, Departmental Representative reserves right to have such products or systems tested to prove or disprove conformance.
- .4 Cost for such testing will be borne by Departmental Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.
- .5 Where a material or item is required to conform to standards set out in a standard specification such as CSA or ASTM or CGSB or ABC and the like, obtain assurance from supplier, in writing, (including trade literature), that its product conforms.
- .6 Upon request, supply the Departmental Representative with satisfactory evidence that material complies with Standard Specification or test requirements.

**1.2 PRODUCT AND MATERIAL QUALITY**

- .1 Products, materials, equipment and articles incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- .2 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous reviews. Review does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- .3 Should disputes arise as to quality or fitness of products, decision rests strictly with Departmental Representative based upon requirements of Contract Documents.
- .4 Trademarks and labels, including applied labels, shall not be visible in the finished Work. Such trademarks or labels shall be removed by grinding if necessary, or painted out where the particular material has been painted. The exception of this requirement shall be those essential to obtain identification of mechanical and electrical equipment, and those required to be visible by authorities having jurisdiction such as ULC labels.

### **1.3 AVAILABILITY OF PRODUCTS**

- .1 Immediately upon signing of major subcontracts, review product delivery requirements and anticipate foreseeable supply delays for any items. If delays in supply of materials, equipment or articles are foreseeable, notify the Departmental Representative of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work. Submit proof of immediate ordering of materials to ensure delivery so as not to delay construction schedule.
- .2 In the event of failure to notify the Departmental Representative at commencement of Work and should it subsequently appear the Work may be delayed for such reason, the Departmental Representative reserves the right to substitute more readily available products of similar character, at no increase in Contract Price.

### **1.4 SUBSTITUTIONS**

- .1 For products specified only by reference to standards use any product which meets the standard, made by any manufacturer.
- .2 For acceptance of products other than those specified, submit a request in writing. Clearly define and describe the product for which acceptance is requested. Accompany requests with manufacturer's literature, specifications, drawings, cuts, performance, date, or other information necessary to completely describe the item. Acceptance by the Departmental Representative will be in the form of written acceptance of the alternative. Clearly indicate the amount of credit, or the additional cost involved, so that adjustment to the contract can be made.
- .3 With requests for substitution include:
  - .1 Complete data substantiating compliance of the proposed substitute with contract requirements.
  - .2 For products: product identification, including manufacturer's name and address; manufacturer's literature, including product description, performance and test data, reference standards, and limitations; samples, if appearance is relevant; names and addresses of similar projects where the product has been used.
  - .3 For construction methods: detailed description of the proposed method, and drawings illustrating it.
  - .4 Itemized comparison of proposed substitution with product or method specified.
  - .5 Data relating to changes in schedule.
  - .6 Quotation for change in contract sum if substitution is accepted.
  - .7 In making a request for substitution the Contractor represents that he has personally investigated the proposal and determined that it is equal or superior to the product or method specified; that the same guarantee will be furnished for the substitute as for the original; that he will coordinate installation of the accepted substitute into the work, making such changes in the work as may be required to accommodate the change; that he waives all claims for additional compensation for costs which subsequently become apparent arising out of the substitution; and that the quotation is complete and includes all related costs under this contract.

- .8 Substitutions will not be considered which are implicit in submitted shop drawings or samples rather than formally presented proposals as described above.
- .9 Substitutions will not be considered which require substantial changes in the contract documents.
- .4 Proposals will be considered by the Departmental Representative only if products selected from those specified are not available, or if delivery date of products selected from those specified would unduly delay completion of the Contract, or if alternative products to those specified, which are brought to the attention of and considered by the Departmental Representative as equivalent to those specified and will result in a credit to the Contract amount.
- .5 Advise the Departmental Representative of all adjustments and changes necessary in the work to accommodate the substitution. The decisions of the Departmental Representative as to whether the substitution proposed is acceptable is final. The proposed substitutions must meet or exceed the specified product.
- .6 If no substitution is requested, and if no provisions to the contrary have been made in the Contract, for the item in question, provide the item named in these specifications.
- .7 Should the proposed substitution be accepted either in part or in whole, assume full responsibility when the substitution affects the work of any other section of the specifications. Pay for any drawing changes required as a result of the substitution, and all costs for changes to the work resulting from the substitution.
- .8 Any and all Credits arising from the use of substitutions will be credited to the Contract in such amounts as may be determined by the Departmental Representative and the Contract price will be adjusted accordingly. No substitutions will be permitted without the prior written permission of the Departmental Representative.
- .9 All substitution acceptances of products shall include acceptability of the National Building Code if required.

## **1.5 STORAGE, HANDLING AND PROTECTION**

- .1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
- .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
- .3 Adequately and continuously protect items having high class factory finish such as baked enamel, porcelain enamel or polished metal, from scratches or other damage, while in transit, during installation and until completion of the contract.
- .4 Schedule deliveries to avoid interference and delays in Work. Provide for continuity of supply to avoid change of supplier or materials during all phases of the Work.

- .5 Store products subject to damage from weather in weatherproof enclosures.
- .6 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.
- .7 Touch-up damaged factory finished surfaces to Departmental Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

## **1.6 TRANSPORTATION**

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

## **1.7 MANUFACTURER'S INSTRUCTIONS**

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

## **1.8 QUALITY OF WORK**

- .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Departmental Representative if required Work is such as to make it impractical to produce required results.
- .2 Do not employ anyone unskilled in their required duties. Departmental Representative reserves right to require dismissal from site, workers deemed incompetent or careless.
- .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Departmental Representative, whose decision is final.

## **1.9 COORDINATION**

- .1 The General Contractor will coordinate the progress of the Work, progress schedules, submittals, use of the site, temporary utilities, construction facilities and controls.

- .2 The General Contractor will coordinate work of all trades and Trade Contractors to expedite progress and avoid interference. This applies particularly to work of trades which will be installed in close proximity with work of other trades. Requests for extras, as a result of lack of coordination will not be considered.
- .3 The General Contractor will coordinate installation of all utilities, including Power, Gas, Telephone, Cable and the like.
- .4 Each Trade Contractor shall examine the drawings and specifications covering the work of other trades which may affect the performance of their work. Examine adjacent work of other trades and report to the Departmental Representative (through the General Contractor) in writing, any defects or deficiencies which may affect the Work. In the absence of any such report, the Trade Contractor will be held to have waived all claims for damage to or defects in such work.
- .5 Signing the contract indicates acceptance by the Trade Contractor of conditions under which Work will be done.
- .6 Bring to the attention of the Departmental Representative all discrepancies between drawings, specification and existing and surrounding site conditions as soon as they are noticed. Intentional failure to do so, in no way relieves the Trade Contractor from performing the work as intended, at no additional cost to the Owner.
- .7 The Trade Contractor shall supply all items to be built in as part of the Work of his Trade Contract, including anchors, ties, nailing strips, blocks, bolts, sleeves, etc., as and when required, together with templates, measurements and shop drawings.
- .8 The Trade Contractor shall check and verify dimensions as the Work proceeds.

#### **1.10 REMEDIAL WORK**

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

#### **1.11 PRODUCT LOCATIONS**

- .1 Consider locations of fixtures, outlets, and mechanical and electrical items indicated as approximate.
- .2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.

- .3 Inform Departmental Representative of conflicting installation. Install as directed.
- .4 Submit field drawings to indicate relative position of various services and equipment when required by Departmental Representative.

#### **1.12 FASTENINGS**

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

#### **1.13 FASTENINGS - EQUIPMENT**

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

#### **1.14 EXISTING UTILITIES**

- .1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work, and pedestrian and vehicular traffic.
- .2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

**END OF SECTION**

**Part 1        General**

**1.1            REFERENCES**

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

**1.2            QUALIFICATIONS OF SURVEYOR**

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

**1.3            SURVEY REFERENCE POINTS**

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

**1.4            SURVEY REQUIREMENTS**

- .1        Establish two permanent bench marks on site, referenced to established bench marks by survey control points. Record locations, with horizontal and vertical data in Project Record Documents.
- .2        Establish lines and levels, locate and lay out, by instrumentation.
- .3        Stake for grading, fill and topsoil placement.
- .4        Stake slopes.
- .5        Establish pipe invert elevations.
- .6        Stake batter boards for foundations.
- .7        Establish lines and levels for mechanical and electrical work.

**1.5            EXISTING SERVICES**

- .1        Before commencing work, establish location and extent of service lines in area of Work and notify Departmental Representative of findings.

## **1.6 LOCATION OF EQUIPMENT AND FIXTURES**

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

## **1.7 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.

## **1.8 SUBMITTALS**

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

## **1.9 SUBSURFACE CONDITIONS**

- .1 Promptly notify Departmental Representative in writing if subsurface conditions at Place of Work differ materially from those indicated in Contract Documents, or a reasonable assumption of probable conditions based thereon.
- .2 After prompt investigation, should Departmental Representative determine that conditions do differ materially, instructions will be issued for changes in Work as provided in Changes and Change Orders.

**END OF SECTION**

**Part 1            General**

**1.1                REFERENCES**

- .1        Public Works Government Services Canada (PWGSC) Standard Acquisition  
          Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions "C", In  
          Effect as Of: May 14, 2004.

**1.2                PROJECT CLEANLINESS**

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

**1.3                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 Departmental Representative. Do not burn waste materials on site.
- .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .7 Clean and polish all mechanical and electrical equipment. Replace broken, scratched or disfigured glass.
- .8 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical equipment.
- .9 Clean lighting reflectors, lenses, and other lighting surfaces.
- .10 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .11 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .12 Remove dirt and other disfiguration from exterior surfaces.
- .13 Sweep and wash clean paved areas.
- .14 Clean equipment to sanitary condition; clean or replace filters of mechanical equipment.
- .15 Remove snow and ice from access to site.

#### **1.4 WASTE MANAGEMENT AND DISPOSAL**

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

**END OF SECTION**

## **Part 1        General**

### **1.1        WASTE MANAGEMENT GOALS**

- .1        Prior to start of Work conduct meeting with Departmental Representative to review and discuss PWGSC's Waste Management Plan and Goals.
- .2        PWGSC's Waste Management Goal: 75 percent of total Project Waste to be diverted from landfill sites. Provide Departmental Representative documentation certifying that waste management, recycling, reuse of recyclable and reusable materials have been extensively practiced.
- .3        Accomplish maximum control of solid construction waste.
- .4        Preserve environment and prevent pollution and environment damage.

### **1.2        DEFINITIONS**

- .1        Class III: non-hazardous waste - construction renovation and demolition waste.
- .2        Cost/Revenue Analysis Workplan (CRAW): based on information from WRW, and intended as financial tracking tool for determining economic status of waste management practices.
- .3        Inert Fill: inert waste - exclusively asphalt and concrete.
- .4        Materials Source Separation Program (MSSP): consists of series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.
- .5        Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.
- .6        Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
- .7        Recycling: process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- .8        Reuse: repeated use of product in same form but not necessarily for same purpose. Reuse includes:
  - .1        Salvaging reusable materials from re-modelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.
  - .2        Returning reusable items including pallets or unused products to vendors.
- .9        Salvage: removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.
- .10       Separate Condition: refers to waste sorted into individual types.

- .11 Source Separation: acts of keeping different types of waste materials separate beginning from first time they became waste.
- .12 Waste Audit (WA): detailed inventory of materials in building. Involves quantifying by volume/weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project. Indicates quantities of reuse, recycling and landfill. Refer to Schedule A.
- .13 Waste Management Co-ordinator (WMC): contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.
- .14 Waste Reduction Workplan (WRW): written report which addresses opportunities for reduction, reuse, or recycling of materials. Refer to Schedule B. WRW is based on information acquired from WA (Schedule A).

### **1.3 DOCUMENTS**

- .1 Maintain at job site, one copy of following documents:
  - .1 Waste Audit.
  - .2 Waste Reduction Workplan.
  - .3 Material Source Separation Plan.
  - .4 Schedules A, B, D and E completed for project.

### **1.4 SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prepare and submit following prior to project start-up:
  - .1 Submit 2 copies of completed Waste Audit (WA): Schedule A.
  - .2 Submit 2 copies of completed Waste Reduction Workplan (WRW): Schedule B.
  - .3 Submit 2 copies of Cost/Revenue Analysis Workplan (CRAW): Schedule D.
  - .4 Submit 2 copies of Materials Source Separation Program (MSSP) description.
- .3 Submit before final payment summary of waste materials salvaged for reuse, recycling or disposal by project using deconstruction/disassembly material audit form.
  - .1 Failure to submit could result in hold back of final payment.
  - .2 Provide receipts, scale tickets, waybills, and show quantities and types of materials reused, recycled, co-mingled and separated off-site or disposed of.
  - .3 For each material reused, sold or recycled from project, include amount in tonnes or quantities by number, type and size of items and the destination.
  - .4 For each material land filled or incinerated from project, include amount in tonnes of material and identity of landfill, incinerator or transfer station.

## **1.5 WASTE AUDIT (WA)**

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

## **1.6 WASTE REDUCTION WORKPLAN (WRW)**

- .1 Prepare WRW prior to project start-up.
- .2 WRW should include but not limited to:
  - .1 Destination of materials listed.
  - .2 Deconstruction/disassembly techniques and sequencing.
  - .3 Schedule for deconstruction/disassembly.
  - .4 Location.
  - .5 Security.
  - .6 Protection.
  - .7 Clear labelling of storage areas.
  - .8 Details on materials handling and removal procedures.
  - .9 Quantities for materials to be salvaged for reuse or recycled and materials sent to landfill.
- .3 Structure WRW to prioritize actions and follow 3R's hierarchy, with Reduction as first priority, followed by Reuse, then Recycle.
- .4 Describe management of waste.
- .5 Identify opportunities for reduction, reuse, and recycling of materials. Based on information acquired from WA.
- .6 Post WRW or summary where workers at site are able to review content.
- .7 Set realistic goals for waste reduction, recognize existing barriers and develop strategies to overcome these barriers.
- .8 Monitor and report on waste reduction by documenting total volume and cost of actual waste removed from project.

## **1.7 COST/REVENUE ANALYSIS WORKPLAN (CRAW)**

- .1 Prepare CRAW: Schedule D.

## **1.8 MATERIALS SOURCE SEPARATION PROGRAM (MSSP)**

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

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

#### **1.9 STORAGE, HANDLING AND PROTECTION**

- .1 Store, materials to be reused, recycled and salvaged in locations as directed by Departmental Representative.
- .2 Unless specified otherwise, materials for removal become Contractor's property.
- .3 Protect, stockpile, store and catalogue salvaged items.
- .4 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.
- .5 Protect surface drainage, mechanical and electrical from damage and blockage.
- .6 Separate and store materials produced during dismantling of structures in designated areas.
- .7 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.
  - .1 On-site source separation is recommended.
  - .2 Remove co-mingled materials to off-site processing facility for separation.
  - .3 Provide waybills for separated materials.

#### **1.10 DISPOSAL OF WASTES**

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

- .3 Keep records of construction waste including:
  - .1 Number and size of bins.
  - .2 Waste type of each bin.
  - .3 Total tonnage generated.
  - .4 Tonnage reused or recycled.
  - .5 Reused or recycled waste destination.
- .4 Remove materials from deconstruction as deconstruction/disassembly Work progresses.
- .5 Prepare project summary to verify destination and quantities on a material-by-material basis.

#### **1.11 USE OF SITE AND FACILITIES**

- .1 Execute work with least possible interference or disturbance to normal use of premises.
- .2 Maintain security measures established by existing facility or provide temporary security measures accepted by Departmental Representative.

#### **1.12 SCHEDULING**

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

#### **Part 2 Products**

- .1 Not Used.

#### **Part 3 Execution**

##### **3.1 APPLICATION**

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

##### **3.2 CLEANING**

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

### 3.3 DIVERSION OF MATERIALS

- .1 From following list, separate materials from general waste stream and stockpile in separate piles or containers, as reviewed by Departmental Representative, and consistent with applicable fire regulations.
  - .1 Mark containers or stockpile areas.
  - .2 Provide instruction on disposal practices.
- .2 On-site sale of salvaged, recovered, reusable or recyclable materials is not permitted.
- .3 Construction Waste:

Material Type	Recommended Diversion %	Actual Diversion %
Cardboard	100	
Plastic Packaging	100	
Rubble	100	
Steel	100	
Wood (uncontaminated)	100	
Other		

### 3.4 WASTE AUDIT (WA)

- .1 Schedule A - Waste Audit (WA):

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

(1) Material Category	(2) Material Quantity Unit	(3) Estimated Waste %	(4) Total Quantity of Waste (unit)	(5) Generation Point	(6) % Recycled	(7) % Reused
Metal						
Other						

### 3.5 WASTE REDUCTION WORKPLAN (WRW)

#### .1 Schedule B:

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

### 3.6 COST/REVENUE ANALYSIS WORKPLAN (CRAW)

#### .1 Schedule D - Cost/Revenue Analysis Workplan (CRAW):

(1) Material Description	(2) Total Quantity (unit)	(3) Volume (cum)	(4) Weight (cum)	(5) Disposal Cost/Credit \$(+/-)	(6) Category Sub-Total \$(+/-)
Wood					
Wood Stud					
Plywood					
Baseboard - Wood					
Door Trim - Wood					
Cabinet					\$
Doors and Windows					
Panel Regular					
Slab Regular					
Wood Laminate					
Byfold - Closet					
Glazing					\$
		(7) Cost (-) / Revenue (+)			\$

### 3.7 CANADIAN GOVERNMENTAL DEPARTMENTS CHIEF RESPONSIBILITY FOR THE ENVIRONMENT

#### .1 Schedule E - Government Chief Responsibility for the Environment:

Province	Address	General Inquires	Fax
Saskatchewan	Saskatchewan Environment and Resource Management 3211 Albert Street Regina SK S4S 5W6	306-787-2700	306-787-3941

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 Canadian Environmental Protection Act (CEPA)
- .1 SOR/2008-197, Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations.

**1.2 ADMINISTRATIVE REQUIREMENTS**

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

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.4 FORMAT**

- .1 Organize data as instructional manual.
- .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.
- .3 When multiple binders are used, correlate data into related consistent groupings.
  - .1 Identify contents of each binder on spine.

- .4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .5 Arrange content by systems, under Section numbers and sequence of Table of Contents.
- .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .7 Text: manufacturer's printed data, or typewritten data.
- .8 Drawings: provide with reinforced punched binder tab.
  - .1 Bind in with text; fold larger drawings to size of text pages.

## **1.5 CONTENTS - PROJECT RECORD DOCUMENTS**

- .1 Table of Contents for Each Volume: provide title of project;
  - .1 Date of submission; names.
  - .2 Addresses, and telephone numbers of Departmental Representative and Contractor with name of responsible parties.
  - .3 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system:
  - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .5 Typewritten Text: as required to supplement product data.
  - .1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.
- .6 Training: refer to Section 01 91 41 - Commissioning: Training.

## **1.6 AS-BUILT DOCUMENTS AND SAMPLES**

- .1 Maintain, in addition to requirements in General Conditions, at site for Departmental Representative one record copy of:
  - .1 Contract Drawings.
  - .2 Specifications.
  - .3 Addenda.
  - .4 Change Orders and other modifications to Contract.
  - .5 Reviewed shop drawings, product data, and samples.
  - .6 Field test records.
  - .7 Inspection certificates.
  - .8 Manufacturer's certificates.

- .2 Store record documents and samples in field office apart from documents used for construction.
  - .1 Provide files, racks, and secure storage.
- .3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual.
  - .1 Label each document "PROJECT RECORD" in neat, large, printed letters.
- .4 Maintain record documents in clean, dry and legible condition.
  - .1 Do not use record documents for construction purposes.
- .5 Keep record documents and samples available for review by Departmental Representative.

## **1.7 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS**

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

## **1.8 EQUIPMENT AND SYSTEMS**

- .1 For each item of equipment and each system include description of unit or system, and component parts.
  - .1 Give function, normal operation characteristics and limiting conditions.
  - .2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.
  - .1 Include regulation, control, stopping, shut-down, and emergency instructions.
  - .2 Include summer, winter, and any special operating instructions.
- .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide Contractor's coordination drawings, with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include PV reports as specified in Section 01 91 13 - General Commissioning (Cx) Requirements.
- .15 Aboveground storage tank inspection documentation, registration, forms, decommissioning and removal in accordance with CEPA SOR/2008-197.
- .16 Additional requirements: as specified in individual specification sections.

## **1.9 MATERIALS AND FINISHES**

- .1 Building products, applied materials, and finishes: include product data, with catalogue number, size, composition, and colour and texture designations.
  - .1 Provide information for re-ordering custom manufactured products.
- .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 Moisture-protection and weather-exposed products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .4 Additional requirements: as specified in individual specifications sections.

## **1.10 MAINTENANCE MATERIALS**

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

**1.11 DELIVERY, STORAGE AND HANDLING**

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

**1.12 WARRANTIES AND BONDS**

- .1 Develop warranty management plan to contain information relevant to Warranties.
- .2 Submit warranty management plan, 30 days before planned pre-warranty conference, to Departmental Representative for review.
- .3 Warranty management plan to include required actions and documents to assure that Departmental Representative receives warranties to which it is entitled.
- .4 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.
- .5 Submit, warranty information made available during construction phase, to Departmental Representative for review prior to each monthly pay estimate.
- .6 Assemble approved information in binder, submit upon acceptance of work and organize binder as follows:
  - .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
  - .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
  - .3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten (10) days after completion of applicable item of work.
  - .4 Verify that documents are in proper form, contain full information, and are notarized.
  - .5 Co-execute submittals when required.
  - .6 Retain warranties and bonds until time specified for submittal.
- .7 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.
- .8 Conduct joint 4 month and 9 month warranty inspections, measured from time of acceptance, by Departmental Representative.

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

### **1.13 WARRANTY TAGS**

- .1 Tag, at time of installation, each warranted item. Provide durable, oil and water resistant tag reviewed by Departmental Representative.
- .2 Attach tags with copper wire and spray with waterproof silicone coating.

- .3 Leave date of acceptance until project is accepted for occupancy.
- .4 Indicate following information on tag:
  - .1 Type of product/material.
  - .2 Model number.
  - .3 Serial number.
  - .4 Contract number.
  - .5 Warranty period.
  - .6 Inspector's signature.
  - .7 Construction Contractor.

**END OF SECTION**

## **Part 1        General**

### **1.1        GENERAL**

- .1    Acronyms:
  - .1    Cx - Commissioning.
  - .2    O&M - Operation and Maintenance.
  - .3    PI - Product Information.
  - .4    PV - Performance Verification.
- .2    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 reviewed. Objectives:
  - .1    Verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent.
  - .2    Effectively train O&M staff.
- .3    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.
- .4    Design Criteria: as per client's requirements or determined by designer. To meet Project functional and operational requirements.

### **1.2        COMMISSIONING OVERVIEW**

- .1    Section 01 91 31 - Commissioning (Cx) Plan.
- .2    For Cx responsibilities refer to Section 01 91 31 - Commissioning (Cx) Plan.
- .3    Cx to be a line item of Contractor's cost breakdown.
- .4    Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .5    Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in 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.

- .6 Departmental Representative will not issue Certificate of Substantial Performance until:
  - .1 Completed Cx documentation has been received, reviewed for suitability and accepted by Departmental Representative.
  - .2 Equipment, components and systems have been commissioned.
  - .3 O&M training has been completed.

### **1.3 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-functioning system, including related systems as deemed required by Departmental Representative, 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.

### **1.4 PRE-CX REVIEW**

- .1 Before Construction:
  - .1 Review contract documents, confirm by writing to Departmental Representative:
    - .1 Adequacy of provisions for Cx.
    - .2 Aspects of installation pertinent to success of Cx.
- .2 During Construction:
  - .1 Coordinate provision, location and installation of provisions for Cx.
- .3 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 Departmental Representative.
  - .7 Have Cx schedules up-to-date.
  - .8 Ensure systems have been cleaned thoroughly.
  - .9 Complete PV procedures on systems, submit PV reports to Departmental Representative for review and acceptance.
  - .10 Ensure "As-Built" system schematics are available.
- .4 Inform Departmental Representative in writing of discrepancies and deficiencies on finished works.

## **1.5 CONFLICTS**

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

## **1.6 SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Submit no later than 4 weeks after award of Contract:
    - .1 Name of Contractor's Cx agent.
    - .2 Draft Cx documentation.
    - .3 Preliminary Cx schedule.
  - .2 Request in writing to Departmental Representative for changes to submittals and obtain written acceptance at least 8 weeks prior to start of Cx.
  - .3 Submit proposed Cx procedures to Departmental Representative where not specified and obtain written acceptance at least 8 weeks prior to start of Cx.
  - .4 Provide additional documentation relating to Cx process required by Departmental Representative.

## **1.7 COMMISSIONING DOCUMENTATION**

- .1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI)/Performance Verification (PV) Forms for requirements and instructions for use.
- .2 Departmental Representative to review and accept Cx documentation.
- .3 Provide completed Cx documentation to Departmental Representative.

## **1.8 COMMISSIONING SCHEDULE**

- .1 Provide detailed Cx schedule as part of construction schedule.
- .2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
  - .1 Acceptance of Cx reports.
  - .2 Verification of reported results.
  - .3 Repairs, retesting, re-commissioning, re-verification.
  - .4 Training.

## **1.9 COMMISSIONING MEETINGS**

- .1 Convene Cx meetings following project meetings: as specified herein.
- .2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.

- .3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.
- .4 At 60% construction completion stage, Departmental Representative to call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:
  - .1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.
  - .2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.
- .5 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.
- .6 Meeting will be chaired by Cx Agent, who will record and distribute minutes.
- .7 Ensure subcontractors and relevant manufacturer representatives are present at 60% and subsequent Cx meetings and as required.

#### **1.10 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.

#### **1.11 WITNESSING OF STARTING AND TESTING**

- .1 Provide 14 days' notice prior to commencement.
- .2 Departmental Representative to witness start-up and testing.
- .3 Contractor's Cx Agent to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

#### **1.12 MANUFACTURER'S INVOLVEMENT**

- .1 Factory testing: manufacturer to:
  - .1 Coordinate time and location of testing.
  - .2 Provide testing documentation for acceptance by Departmental Representative.
  - .3 Arrange for Departmental Representative to witness tests.
  - .4 Obtain written acceptance of test results and documentation from Departmental Representative before delivery to site.
- .2 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with Departmental Representative
  - .1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
  - .2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.

- .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.

### **1.13 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 acceptance from Departmental Representative after distinct phases have been completed and before commencing next phase.
- .4 Document required tests on approved PV forms.
- .5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by the Departmental Representative. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:
  - .1 Minor equipment/systems: implement corrective measures accepted by Departmental Representative.
  - .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures accepted by Departmental Representative.
  - .3 If evaluation report concludes that major damage has occurred, Departmental Representative shall reject equipment.
    - .1 Rejected equipment to be removed from site and replace with new.
    - .2 Subject new equipment/systems to specified start-up procedures.

#### **1.14 START-UP DOCUMENTATION**

- .1 Assemble start-up documentation and submit to Departmental Representative for review before commencement of commissioning.
- .2 Start-up documentation to include:
  - .1 Factory and on-site test certificates for specified equipment.
  - .2 Pre-start-up inspection reports.
  - .3 Signed installation/start-up check lists.
  - .4 Start-up reports,
  - .5 Step-by-step description of complete start-up procedures, to permit Departmental Representative to repeat start-up at any time.

#### **1.15 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 to Departmental Representative for review 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.

#### **1.16 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.

#### **1.17 START OF COMMISSIONING**

- .1 Notify Departmental Representative at least 21 days prior to start of Cx.
- .2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

#### **1.18 INSTRUMENTS / EQUIPMENT**

- .1 Submit to Departmental Representative for review and acceptance:
  - .1 Complete list of instruments proposed to be used.
  - .2 Listed data including, serial number, current calibration certificate, calibration date, calibration expiry date and calibration accuracy.

- .2 Provide the following equipment as required:

- .1 2-way radios.
- .2 Ladders.
- .3 Equipment as required to complete work.

#### **1.19 COMMISSIONING PERFORMANCE VERIFICATION**

- .1 Carry out Cx:
  - .1 Under actual or accepted simulated 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.

#### **1.20 WITNESSING COMMISSIONING**

- .1 Departmental Representative to witness activities and verify results.

#### **1.21 AUTHORITIES HAVING JURISDICTION**

- .1 Where specified, start-up, testing or commissioning procedures duplicate verification requirements of authority having jurisdiction, arrange for authority to witness procedures so as to avoid duplication of tests and to facilitate expedient acceptance of facility.
- .2 Obtain certificates of approval, acceptance and compliance with rules and regulation of authority having jurisdiction.
- .3 Provide copies to Departmental Representative within 5 days of test and with Cx report.

#### **1.22 COMMISSIONING CONSTRAINTS**

- .1 Since access into secure or sensitive areas will be very difficult after occupancy it is necessary to complete Cx of occupancy, weather, and seasonal sensitive equipment and systems in these areas before issuance of the Interim Certificate, using, if necessary, simulated thermal loads.

#### **1.23 EXTRAPOLATION OF RESULTS**

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

#### **1.24 EXTENT OF VERIFICATION**

- .1 Elsewhere:
  - .1 Provide manpower and instrumentation to verify up to 30% of reported results, unless specified otherwise in other sections.
- .2 Number and location to be at discretion of Departmental Representative.
- .3 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.
- .4 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.
- .5 Perform additional commissioning until results are acceptable to Departmental Representative.

#### **1.25 REPEAT VERIFICATIONS**

- .1 Assume costs incurred by Departmental Representative for third and subsequent verifications where:
  - .1 Verification of reported results fails to receive Departmental Representative's acceptance.
  - .2 Repetition of second verification again fails to receive approval.
  - .3 Departmental Representative deems Contractor's request for second verification was premature.

#### **1.26 SUNDRY CHECKS AND ADJUSTMENTS**

- .1 Make adjustments and changes which become apparent as Cx proceeds.
- .2 Perform static and operational checks as applicable and as required.

#### **1.27 DEFICIENCIES, FAULTS, DEFECTS**

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

#### **1.28 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 Departmental Representative.

**1.29 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.

**1.30 TRAINING**

- .1 In accordance with Section 01 91 41 - Commissioning (Cx) - Training.

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

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

**1.32 OCCUPANCY**

- .1 Cooperate fully with Departmental Representative during stages of acceptance and occupancy of facility.

**1.33 INSTALLED INSTRUMENTATION**

- .1 Use instruments installed under Contract for PV if:
  - .1 Accuracy complies with these specifications.
  - .2 Calibration certificates have been deposited with Departmental Representative.

**1.34 PERFORMANCE VERIFICATION TOLERANCES**

- .1 Application tolerances:
  - .1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. Except for special areas, to be within +/-10% of specified values.
- .2 Instrument accuracy tolerances:
  - .1 To be of higher order of magnitude than equipment or system being tested.
- .3 Measurement tolerances during verification:
  - .1 Unless otherwise specified actual values to be within +/-2 % of recorded values.

**1.35 OWNER'S PERFORMANCE TESTING**

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

**END OF SECTION**

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## **Part 1        General**

### **1.1        REFERENCES**

- .1        Public Works and Government Services Canada (PWGSC)
  - .1        PWGSC - Commissioning Manual CP.1-4th edition-06.
- .2        Underwriters' Laboratories of Canada (ULC)

### **1.2        GENERAL**

- .1        Provide a fully functional facility:
  - .1        Systems, equipment and components meet user's functional requirements before date of acceptance, and operate consistently at peak efficiencies and within specified energy budgets under normal loads.
  - .2        Facility user and O&M personnel have been fully trained in aspects of installed systems.
  - .3        Optimized life cycle costs.
  - .4        Complete documentation relating to installed equipment and systems.
- .2        Term "Cx" in this section means "Commissioning".
- .3        Use this Cx Plan as master planning document for Cx:
  - .1        Outlines organization, scheduling, allocation of resources, documentation, pertaining to implementation of Cx.
  - .2        Communicates responsibilities of team members involved in Cx Scheduling, documentation requirements, and verification procedures.
  - .3        Sets out deliverables relating to O&M, process and administration of Cx.
  - .4        Describes process of verification of how built works meet design requirements.
  - .5        Produces a complete functional system prior to issuance of Certificate of Substantial Performance.
  - .6        Management tool that sets out scope, standards, roles and responsibilities, expectations, deliverables, and provides:
    - .1        Overview of Cx.
    - .2        General description of elements that make up Cx Plan.
    - .3        Process and methodology for successful Cx.
- .4        Acronyms:
  - .1        Cx - Commissioning.
  - .2        MSDS - Material Safety Data Sheets.
  - .3        PI - Product Information.
  - .4        PV - Performance Verification.
  - .5        WHMIS - Workplace Hazardous Materials Information System.

- .5 Commissioning terms used in this Section:
  - .1 Bumping: short term start-up to prove ability to start and prove correct rotation.
  - .2 Deferred Cx - Cx activities delayed for reasons beyond Contractor's control due to lack of occupancy, weather conditions, need for heating/cooling loads.

### **1.3 DEVELOPMENT OF 100% CX PLAN**

- .1 Cx Plan to be 100% completed within 8 weeks of award of contract to take into account:
  - .1 Reviewed shop drawings and product data.
  - .2 Approved changes to contract.
  - .3 Contractor's project schedule.
  - .4 Cx schedule.
  - .5 Contractor's, sub-contractors', suppliers' requirements.
  - .6 Project construction team's and Cx team's requirements.
- .2 Submit completed Cx Plan to Departmental Representative and obtain written acceptance.

### **1.4 REFINEMENT OF CX PLAN**

- .1 During construction phase, revise, refine and update Cx Plan to include:
  - .1 Changes resulting from Client program modifications.
  - .2 Approved design and construction changes.
- .2 At each revision, indicate revision number and date.
- .3 Submit each revised Cx Plan to Departmental Representative for review and obtain written acceptance.
- .4 Include testing parameters at full range of operating conditions and check responses of equipment and systems.

### **1.5 COMPOSITION, ROLES AND RESPONSIBILITIES OF CX TEAM**

- .1 Departmental Representative to maintain overall responsibility for project and is sole point of contact between members of commissioning team.
- .2 Project Manager will select Cx Team consisting of following members:
  - .1 PWGSC Design Quality Review Team: during construction, will conduct periodic site reviews to observe general progress.
  - .2 PWGSC Quality Assurance Commissioning Manager: ensures Cx activities are carried out to ensure delivery of a fully operational project including:
    - .1 Review of Cx documentation from operational perspective.

- .2 Review for performance, reliability, durability of operation, accessibility, maintainability, operational efficiency under conditions of operation.
- .3 Protection of health, safety and comfort of occupants and O&M personnel.
- .4 Monitoring of Cx activities, training, development of Cx documentation.
- .5 Work closely with members of Cx Team.
- .3 Departmental Representative is responsible for:
  - .1 Organizing Cx.
  - .2 Monitoring operations Cx activities.
  - .3 Witnessing, certifying accuracy of reported results.
  - .4 Witnessing and certifying PV and other tests.
  - .5 Ensuring implementation of final Cx Plan.
  - .6 Performing verification of performance of installed systems and equipment.
  - .7 Implementation of Training Plan.
- .4 Construction Team: contractor, sub-contractors, suppliers and support disciplines, is responsible for construction/installation in accordance with contract documents, including:
  - .1 Testing.
  - .2 PV.
  - .3 Performance of Cx activities.
  - .4 Delivery of training and Cx documentation.
  - .5 Assigning one person as point of contact with Consultant and PWGSC Cx Manager for administrative and coordination purposes.
- .5 Contractor's Cx agent implements specified Cx activities including:
  - .1 Demonstrations.
  - .2 Training.
  - .3 Testing.
  - .4 Preparation, submission of test reports.
- .6 Property Manager: represents lead role in Operation Phase and onwards and is responsible for:
  - .1 Receiving facility.
  - .2 Day-To-Day operation and maintenance of facility.

## 1.6 CX PARTICIPANTS

- .1 Employ the following Cx participants to verify performance of equipment and systems:
  - .1 Installation contractor/subcontractor:
    - .1 Equipment and systems except as noted.
  - .2 Equipment manufacturer: equipment specified to be installed and started by manufacturer.
    - .1 To include performance verification.

- .3 Specialist subcontractor: equipment and systems supplied and installed by specialist subcontractor.
- .4 Specialist Cx agency:
  - .1 Possessing specialist qualifications and installations providing environments essential to client's program but are outside scope or expertise of Cx specialists on this project.
- .5 Client: responsible for intrusion and access security systems.
- .6 Ensure that Cx participant:
  - .1 Could complete work within scheduled time frame.
  - .2 Available for emergency and troubleshooting service during first year of occupancy by user for adjustments and modifications outside responsibility of O&M personnel, including:
    - .1 Redistribution of electrical services.
- .7 Provide names of participants to Departmental Representative and details of instruments and procedures to be followed for Cx 3 months prior to starting date of Cx for review and acceptance.

## 1.7 EXTENT OF CX

- .1 Commission mechanical systems and associated equipment:
  - .1 Mechanical systems:
    - .1 Fuel piping.
    - .2 Fuel storage tanks and accessories.
    - .3 Fuel pumps.
    - .4 Fuel dispensers.
  - .2 Fire and life safety systems:
    - .1 Fire extinguishers.
  - .3 Noise and vibration control systems for mechanical systems.
  - .4 Seismic restraint and control measures.
  - .5 Energy metering systems for electricity.
- .2 Commission electrical systems and equipment:
  - .1 Low voltage below 750 V:
    - .1 Low voltage equipment.
    - .2 Low voltage distribution systems.
  - .2 Lighting systems:
    - .1 Lighting equipment.
    - .2 Distribution systems.
  - .3 Other systems and equipment:
    - .1 Emergency shutdown.
    - .2 Automated fuel control system/card reader.
    - .3 Automatic leak detection and tank monitoring system.

## **1.8 DELIVERABLES RELATING TO O&M PERSPECTIVES**

- .1 General requirements:
  - .1 Compile English documentation.
  - .2 Documentation to be computer-compatible format ready for inputting for data management.
- .2 Provide deliverables:
  - .1 Warranties.
  - .2 Project record documentation.
  - .3 Inventory of spare parts, special tools and maintenance materials.
  - .4 Maintenance Management System (MMS) identification system used.
  - .5 WHMIS information.
  - .6 MSDS data sheets.
  - .7 Electrical Panel inventory containing detailed inventory of electrical circuitry for each panel board. Duplicate of inventory inside each panel.

## **1.9 DELIVERABLES RELATING TO THE CX PROCESS**

- .1 General:
  - .1 Start-up, testing and Cx requirements, conditions for acceptance and specifications form part of relevant technical sections of these specifications.
- .2 Definitions:
  - .1 Cx as used in this section includes:
    - .1 Cx of components, equipment, systems, subsystems, and integrated systems.
    - .2 Factory inspections and performance verification tests.
- .3 Deliverables: provide:
  - .1 Cx Specifications.
  - .2 Start-up, pre-Cx activities and documentation for systems, and equipment.
  - .3 Completed installation checklists (ICL).
  - .4 Completed product information (PI) report forms.
  - .5 Completed performance verification (PV) report forms.
  - .6 Results of Performance Verification Tests and Inspections.
  - .7 Description of Cx activities and documentation.
  - .8 Description of Cx of integrated systems and documentation.
  - .9 Tests witnessed by PWGSC Design Quality Review Team.
  - .10 Tests performed by Owner.
  - .11 Training Plans.
  - .12 Cx Reports.
  - .13 Prescribed activities during warranty period.

- .4 Departmental Representative to witness and review tests and reports of results provided to Departmental Representative.
- .5 Departmental Representative to participate.

#### **1.10 PRE-CX ACTIVITIES AND RELATED DOCUMENTATION**

- .1 Items listed in this Cx Plan include the following:
  - .1 Pre-Start-Up Reviews: by Departmental Representative prior to permission to start up and rectification of deficiencies to Departmental Representative's satisfaction.
  - .2 Departmental Representative to use approved check lists.
  - .3 Departmental Representative will monitor some of these pre-start-up inspections.
  - .4 Include completed documentation with Cx report.
  - .5 Conduct pre-start-up tests: conduct pressure, static, flushing, cleaning, and "bumping" during construction as specified in technical sections. To be witnessed and accepted by Departmental Representative and does not form part of Cx specifications.
  - .6 Departmental Representative will monitor some of these inspections and tests.
  - .7 Include completed documentation in Cx report.
- .2 Pre-Cx activities - MECHANICAL:
  - .1 Mechanical systems:
    - .1 "Bump" each item of equipment in its "stand-alone" mode.
    - .2 At this time, complete pre-start-up checks and complete relevant documentation.
    - .3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.
    - .4 Perform PV on systems. PV reports to be reviewed by Departmental Representative.
- .3 Pre-Cx activities - ELECTRICAL:
  - .1 Low voltage distribution systems under 750 V:
    - .1 Requires independent testing agency to perform pre- energization and post-energization tests.
  - .2 Low voltage systems: these include:
    - .1 Low voltage detection/sensor wiring control systems.

#### **1.11 START-UP**

- .1 Start-up components, equipment and systems.
- .2 Equipment manufacturer, supplier, installing specialist sub-contractor, as appropriate, to start-up, under Contractor's direction.

- .3 Departmental Representative to monitor some of these start-up activities.
  - .1 Rectify start-up deficiencies to satisfaction of Departmental Representative.
- .4 Performance Verification (PV):
  - .1 Approved Cx Agent to perform.
    - .1 Repeat when necessary until results are acceptable to Departmental Representative.
  - .2 Use procedures modified generic procedures to suit project requirements.
  - .3 Departmental Representative to witness and review reported results using approved PI and PV forms.
  - .4 Departmental Representative to review completed PV reports.
  - .5 Departmental Representative reserves right to verify up to 30% of reported results at random.
  - .6 Failure of randomly selected item shall result in rejection of PV report or report of system start-up and testing.

#### **1.12 CX ACTIVITIES AND RELATED DOCUMENTATION**

- .1 Perform Cx by specified Cx agency using procedures developed by Cx agent and reviewed by Departmental Representative.
- .2 Departmental Representative to monitor Cx activities.
- .3 Upon satisfactory completion, Cx agency performing tests to prepare Cx Report using approved PV forms.
- .4 Departmental Representative to witness and review reported results of, Cx activities.
- .5 Departmental Representative reserves right to verify a percentage of reported results at no cost to contract.

#### **1.13 CX OF INTEGRATED SYSTEMS AND RELATED DOCUMENTATION**

- .1 Cx to be performed by specified Cx specialist, using procedures developed by Cx Agent and accepted by Departmental Representative.
- .2 Tests to be witnessed by Departmental Representative and documented on approved report forms.
- .3 Upon satisfactory completion, Cx specialist to prepare Cx Report, to be reviewed by Departmental Representative.
- .4 Departmental Representative reserves right to verify percentage of reported results.
- .5 Integrated systems to include:
  - .1 Automated fuel control system/card reader.
  - .2 Automatic leak detection and tank monitoring system.

.6 Identification:

- .1 In later stages of Cx, before hand-over and acceptance Departmental Representative, Contractor, Facility Manager and Cx Manager to co-operate to complete inventory data sheets and provide assistance to PWGSC in full implementation of MMS identification system of components, equipment, sub-systems, and systems.

**1.14 INSTALLATION CHECK LISTS (ICL)**

- .1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

**1.15 PRODUCT INFORMATION (PI) REPORT FORMS**

- .1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

**1.16 PERFORMANCE VERIFICATION (PV) REPORT**

- .1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

**1.17 CX SCHEDULES**

- .1 Prepare detailed Cx Schedule and submit to Departmental Representative for review at the same time as project Construction Schedule. Include:
  - .1 Milestones, testing, documentation, training and Cx activities of components, equipment, subsystems, systems and integrated systems, including:
    - .1 Design criteria, design intents.
    - .2 Cx agents' credentials: before start of Cx.
    - .3 Cx procedures: 3 months after award of contract.
    - .4 Cx Report format: 3 months after contract award.
    - .5 Submission of list of instrumentation with relevant certificates: 21 days before start of Cx.
    - .6 Notification of intention to start Cx: 14 days before start of Cx.
    - .7 Notification of intention to start Cx of integrated systems: after Cx of related systems is completed 14 days before start of integrated system Cx.
    - .8 Identification of deferred Cx.
    - .9 Implementation of training plans.
    - .10 Cx reports: immediately upon successful completion of Cx.
  - .2 Detailed training schedule to demonstrate no conflicts with testing, completion of project and hand-over to Facility Manager.
  - .3 6 months in Cx schedule for verification of performance in all seasons and wear conditions.

- .2 After approval, incorporate Cx Schedule into Construction Schedule.
- .3 Contractor, Contractor's Cx agent, and Departmental Representative will monitor progress of Cx against this schedule.

#### **1.18 CX REPORTS**

- .1 Submit reports of tests, witnessed by Departmental Representative to Departmental Representative for review.
- .2 Include completed and certified PV reports in properly formatted Cx Reports.
- .3 Before reports are accepted, reported results to be subject to verification by Departmental Representative.

#### **1.19 ACTIVITIES DURING WARRANTY PERIOD**

- .1 Cx activities must be completed before issuance of Interim Certificate, it is anticipated that certain Cx activities may be necessary during Warranty Period, including:
  - .1 Fine tuning of Mechanical systems.

#### **1.20 TESTS TO BE PERFORMED BY OWNER/USER**

- .1 None is anticipated on this project.

#### **1.21 TRAINING PLANS**

- .1 Refer to Section 01 91 41 - Commissioning (Cx) - Training.

#### **1.22 FINAL SETTINGS**

- .1 Upon completion of Cx to satisfaction of Departmental Representative lock control devices in their final positions, indelibly mark settings marked and include in Cx Reports.

**END OF SECTION**

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**Part 1            General**

**1.1                INSTALLATION/START-UP CHECK LISTS**

- .1     Include the following data:
  - .1     Product manufacturer's installation instructions and recommended checks.
  - .2     Special procedures as specified in relevant technical sections.
  - .3     Items considered good installation and engineering industry practices deemed appropriate for proper and efficient operation.
- .2     Equipment manufacturer's installation/start-up check lists are acceptable for use. As deemed necessary by Departmental Representative, supplemental additional data lists will be required for specific project conditions.
- .3     Use check lists for equipment installation. Document check list verifying checks have been made, indicate deficiencies and corrective action taken.
- .4     Installer to sign check lists upon completion, certifying stated checks and inspections have been performed. Return completed check lists to Departmental Representative. Check lists will be required during Commissioning and will be included in O&M Manual at completion of project.
- .5     Use of check lists will not be considered part of commissioning process but will be stringently used for equipment pre-start and start-up procedures.

**1.2                PRODUCT INFORMATION (PI) REPORT FORMS**

- .1     Product Information (PI) forms compiles gathered data on items of equipment produced by equipment manufacturer, includes nameplate information, parts list, operating instructions, maintenance guidelines and pertinent technical data and recommended checks that is necessary to prepare for start-up and functional testing and used during operation and maintenance of equipment. This documentation is included in the O&M Manual at completion of work.
- .2     Prior to Performance Verification (PV) of systems complete items on PI forms related to systems and obtain Departmental Representative's acceptance.

**1.3                PERFORMANCE VERIFICATION (PV) FORMS**

- .1     PV forms to be used for checks, running dynamic tests and adjustments carried out on equipment and systems to ensure correct operation, efficiently and function independently and interactively with other systems as intended with project requirements.
- .2     PV report forms include those developed by Contractor records measured data and readings taken during functional testing and Performance Verification procedures.
- .3     Prior to PV of integrated system, complete PV forms of related systems and obtain Departmental Representative's acceptance.

#### **1.4 SAMPLES OF COMMISSIONING FORMS**

- .1 Samples of Commissioning/PV forms are included in this Section.

#### **1.5 CHANGES AND DEVELOPMENT OF NEW REPORT FORMS**

- .1 When additional forms are required, but are not available from Departmental Representative, develop appropriate verification forms and submit to Departmental Representative for review prior to use.
  - .1 Additional commissioning forms to be in same format as provided by Departmental Representative.

#### **1.6 COMMISSIONING FORMS**

- .1 Use Commissioning forms to verify installation and record performance when starting equipment and systems.
- .2 Strategy for Use:
  - .1 Departmental Representative provides Contractor project-specific Commissioning forms with Specification data included.
  - .2 Contractor will provide required shop drawings information and verify correct installation and operation of items indicated on these forms.
  - .3 Confirm operation as per design criteria and intent.
  - .4 Identify variances between design and operation and reasons for variances.
  - .5 Verify operation in specified normal and emergency modes and under specified load conditions.
  - .6 Record analytical and substantiating data.
  - .7 Verify reported results.
  - .8 Form to bear signatures of recording technician and reviewed and signed off by Departmental Representative.
  - .9 Submit immediately after tests are performed.
  - .10 Reported results in true measured SI unit values.
  - .11 Provide Departmental Representative with originals of completed forms.
  - .12 Maintain copy on site during start-up, testing and commissioning period.
  - .13 Forms to be both hard copy and electronic format with typed written results in O&M.

#### **1.7 LANGUAGE**

- .1 To suit the language profile of the awarded contract.

**SYSTEM PERFORMANCE VERIFICATION FORM**

***FUEL PIPING VERIFICATION FORM***

Date: \_\_\_\_\_

Equipment ID \_\_\_\_\_

Equipment Data:

Manufacturer: \_\_\_\_\_

Model Number: \_\_\_\_\_

Serial Number: \_\_\_\_\_

Inspection Check List:

Strainers

- Size ☐
- Quantity ☐
- Cleaned ☐

Valves

- Seals ☐
- Operation – close ☐
- – open ☐

Cathodic Protection ☐

Clean External ☐

Clean Internal ☐

Not Damaged ☐

Service Space ☐

Comments


Sign Off

\_\_\_\_\_  
Contractor

\_\_\_\_\_  
Departmental Representative

\_\_\_\_\_  
Owner

## SYSTEM PERFORMANCE VERIFICATION FORM

### FUEL STORAGE TANKS VERIFICATION FORM

Date: \_\_\_\_\_

Equipment ID \_\_\_\_\_

Equipment Data:

Manufacturer: \_\_\_\_\_

Model Number: \_\_\_\_\_

Serial Number: \_\_\_\_\_

Nameplate Data

	Specified	Shop Drawing	Installed	Verified By
Capacity				
Pressure				

Inspection Check List:

Relief Valve Setting

Relief Valve Test

LWCO Test

Fill Valve Setting

☐☐☐☐

Clean

Not Damaged

Clearances

Service Space

☐☐☐☐

Venting Check List:

Size

Length

Grading

Joint Sealing

\_\_\_\_\_ Ø \_\_\_\_\_

☐☐☐

Termination

Drain

☐

Support Documents

Manufacturer's Report	Y / N / NA	Comments
Manufacturer's Certificates	Y / N / NA	Comments
Contractor's Start-up Report	Y / N / NA	Comments

Comments


Sign Off

\_\_\_\_\_  
Contractor

\_\_\_\_\_  
Departmental Representative

\_\_\_\_\_  
Owner

## SYSTEM PERFORMANCE VERIFICATION FORM

### PUMP VERIFICATION FORM

Date: \_\_\_\_\_

Equipment ID \_\_\_\_\_

Equipment Data:

Manufacturer: \_\_\_\_\_

Model Number: \_\_\_\_\_

Serial Number: \_\_\_\_\_

Operation:

	Specified	Shop Drawings	Installed	Verified By
Flow Rate				
Head				
Fluid				
Fluid Temperature				
Volts / Amps/ Phase				
Rotation Direction				

Operating Controls:

Start / Stop From \_\_\_\_\_

Test: ☐ \_\_\_\_\_

Support Documents

Manufacturer's Report	Y / N / NA	Comments	
Manufacturer's Certificates	Y / N / NA	Comments	
Contractor's Start-up Report	Y / N / NA	Comments	

Comments


Sign Off

\_\_\_\_\_  
 Contractor

\_\_\_\_\_  
 Departmental Representative

\_\_\_\_\_  
 Owner

**END OF SECTION**

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## **Part 1        General**

### **1.1        TRAINEES**

- .1        Trainees: personnel selected for operating and maintaining this facility. Includes Facility Manager, building operators, maintenance staff, security staff, and technical specialists as required.
- .2        Trainees will be available for training during later stages of construction for purposes of familiarization with systems.

### **1.2        INSTRUCTORS**

- .1        Departmental Representative will provide:
  - .1        Descriptions of systems.
  - .2        Instruction on design philosophy, design criteria, and design intent.
- .2        Contractor and certified factory-trained manufacturers' personnel: to provide instruction on the following:
  - .1        Start-Up, operation, shut-down of equipment, components and systems.
  - .2        Control features, reasons for, results of, implications on associated systems of, adjustment of set points of control and safety devices.
  - .3        Instructions on servicing, maintenance and adjustment of systems, equipment and components.
- .3        Contractor and equipment manufacturer to provide instruction on:
  - .1        Start-up, operation, maintenance and shut-down of equipment they have certified installation, started up and carried out PV tests.

### **1.3        TRAINING OBJECTIVES**

- .1        Training to be detailed and duration to ensure:
  - .1        Safe, reliable, cost-effective, energy-efficient operation of systems in normal and emergency modes under all conditions.
  - .2        Effective on-going inspection, measurements of system performance.
  - .3        Proper preventive maintenance, diagnosis and trouble-shooting.
  - .4        Ability to update documentation.
  - .5        Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

### **1.4        TRAINING MATERIALS**

- .1        Instructors to be responsible for content and quality.
- .2        Training materials to include:
  - .1        "As-Built" Contract Documents.
  - .2        Operating Manual.
  - .3        Maintenance Manual.

- .4 Management Manual.
- .5 PV Reports.
- .3 Project Manager, Commissioning Manager and Facility Manager will review training manuals.
- .4 Training materials to be in a format that permits future training procedures to same degree of detail.
- .5 Supplement training materials:
  - .1 Transparencies for overhead projectors.
  - .2 Multimedia presentations.
  - .3 Manufacturer's training videos.
  - .4 Equipment models.

## **1.5 SCHEDULING**

- .1 Include in Commissioning Schedule time for training.
- .2 Deliver training during regular working hours.
- .3 Training to be completed prior to acceptance of facility.

## **1.6 RESPONSIBILITIES**

- .1 Be responsible for:
  - .1 Implementation of training activities,
  - .2 Coordination among instructors,
  - .3 Quality of training, training materials,
- .2 Departmental Representative will evaluate training and materials.
- .3 Upon completion of training, provide written report, signed by Instructors, witnessed by Departmental Representative.

## **1.7 TRAINING CONTENT**

- .1 Training to include demonstrations by Instructors using the installed equipment and systems.
- .2 Content includes:
  - .1 Review of facility and occupancy profile.
  - .2 Functional requirements.
  - .3 System philosophy, limitations of systems and emergency procedures.
  - .4 Review of system layout, equipment, components and controls.
  - .5 Equipment and system start-up, operation, monitoring, servicing, maintenance and shut-down procedures.
  - .6 System operating sequences, including step-by-step directions for starting up, shut-down, operation of valves, dampers, switches, adjustment of control settings and emergency procedures.

- .7 Maintenance and servicing.
- .8 Trouble-shooting diagnosis.
- .9 Inter-Action among systems during integrated operation.
- .10 Review of O&M documentation.
- .3 Provide specialized training as specified in relevant Technical Sections of the construction specifications.

## **1.8 VIDEO-BASED TRAINING**

- .1 Manufacturer's videotapes to be used as training tool with Departmental Representative's review and written acceptance 3 months prior to commencement of scheduled training.
- .2 On-Site training videos:
  - .1 Videotape training sessions for use during future training.
  - .2 To be performed after systems are fully commissioned.
  - .3 Organize into several short modules to permit incorporation of changes.
- .3 Production methods to be high quality.

**END OF SECTION**

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**Part 1            General**

**1.1                REFERENCES**

- .1 Canadian Standards Association (CSA)
  - .1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - .2 CSA O86.1-94, Engineering Design in Wood (Limit States Design).
  - .3 CSA O86.1S1-98, Supplement No. 1 to O86.1-94, Engineering Design in Wood (Limit States Design).
  - .4 CSA O121-08 (R2013), Douglas Fir Plywood.
  - .5 CSA O153-13, Poplar Plywood.
  - .6 CSA S269.1-1975 (R2003), Falsework for Construction Purposes.
  - .7 CAN/CSA S269.3-M92 (R2013), Concrete Formwork.
- .2 Underwriters Laboratory Canada (ULC)
  - .1 CAN/ULC S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

**1.2                SHOP DRAWINGS**

- .1 Submit shop drawings for formwork and falsework in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts.
- .3 Comply with CAN/CSA S269.3 for formwork drawings and CSA S269.1 for falsework drawings.
- .4 Indicate formwork design data, such as permissible rate of concrete placement, and temperature of concrete, in forms.
- .5 Indicate sequence of erection and removal of formwork/falsework to Departmental Representative.
- .6 Shop drawing shall bear the stamp of qualified professional engineer registered in Province of Saskatchewan, Canada.
- .7 Formwork, falsework, and reshoring are to be reviewed by the same professional engineer prior to each concrete pour.

## **Part 2        Products**

### **2.1        FORMWORK MATERIALS**

- .1    Formwork materials:
  - .1        For concrete without special architectural features: plywood and wood formwork materials to CSA O121, CSA O86.1/O86.1S1, and CSA O153.
  - .2        For concrete with special architectural features: formwork materials to CSA A23.1.
- .2    Form liner:
  - .1        Plywood: high density overlay, Douglas Fir to CSA O121, T & G edge, 16mm thick. Sound, undamaged sheets with clean, smooth, true edges.
- .3    Tubular column forms: round, spirally wound laminated fiber forms, internally treated with release material. Spiral pattern to show in hardened concrete except where smooth finish is indicated.
- .4    Form ties:
  - .1        For concrete not designated 'Architectural' use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25mm diameter in concrete surface.
  - .2        For concrete designated 'Architectural' use snap ties complete with plastic cones and light grey concrete plugs.
- .5    Nails, spikes, lag bolts, through bolts, anchorages: sizes as required, of sufficient strength and character to maintain formwork in place while pouring concrete.
- .6    Falsework materials: to CSA S269.1.

### **2.2        ACCESSORIES**

- .1    Form release agent: chemically active release agents containing compounds that react with free lime present in concrete to provide water insoluble soaps.
- .2    Form stripping agent: colourless mineral oil, free of kerosene, with viscosity between 70 and 110s Saybolt Universal at 40 °C, flashpoint minimum 150 °C, open cup.
- .3    Fillets for chamfered corners: unless otherwise indicated 25 x 25 mm. Special sizes, shapes and profiles as indicated on drawings.

## **Part 3            Execution**

### **3.1                FABRICATION AND ERECTION**

- .1      Verify lines, levels, and centres before proceeding with formwork and falsework. Ensure dimensions agree with drawings.
- .2      Obtain Departmental Representative's permission for use of earth forms. Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
- .3      Construct falsework in accordance with CSA S269.1.
- .4      Form release agent: apply on formwork in accordance with manufacturer's specifications. Apply prior to placing reinforcing steel, anchoring devices and embedded parts. Do not apply form release agent where concrete surfaces are to receive special finishes or applied coverings, which are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces wet prior to placing concrete. Take precautions to keep form release agent from contacting reinforcing steel.
- .5      Do not place shores and mud sills on frozen ground.
- .6      Provide site drainage to prevent washout of soil supporting mud sills and shores.
- .7      Fabricate and erect formwork in accordance with CAN/CSA S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA A23.1.
- .8      Arrange and assemble formwork to permit easy dismantling and stripping, so that concrete is not damaged during its removal.
- .9      Arrange forms to allow stripping without removal of principle shores, where these are required to remain in place.
- .10     Form chases, slots, openings, drips, recesses, expansion and control joints as indicated. Obtain Departmental Representative's permission before framing openings not indicated on Structural Drawings.
- .11     Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections. Assure that all anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.
- .12     Camber slabs 6mm in 3000mm of span unless otherwise indicated on the drawing. Maintain slab thickness from cambered surface.
- .13     Align form joints and make watertight. Keep form joints to minimum.
- .14     Clean formwork in accordance with CSA A23.1 before placing concrete.

- .15 Inspect completed formwork, falsework, shoring and bracing to ensure that work is in accordance with formwork and falsework design and that supports, wedges, fastenings, ties and embedded parts are secure.
- .16 Inform Departmental Representative when formwork is complete and has been cleaned to allow for inspection. Obtain approval prior to placing concrete.

### 3.2 REMOVAL AND RESHORING

- .1 Notify Departmental Representative 48 hours in advance prior to removing formwork.
- .2 Do not remove forms and bracing until concrete has gained sufficient strength to carry its own weight, construction loads, design loads that are liable to be imposed upon it. Verify strength of concrete by compressive test results.
- .3 Leave formwork in place for following minimum periods of time after placing concrete:

LOCATION	TEMPERATURE IN °C		
	21-35	15-21	10-15
Side Forms	2 days	3 days	4 days

- .4 Loosen forms carefully. Do not wedge pry bars, hammers, or tools against concrete surfaces.
- .5 Store removed forms, for exposed concrete, so surfaces in contact with fresh concrete will not be damaged. Marked or scored forms will be rejected.
- .6 Tubular column forms:
  - .1 For concrete columns strip off laminated fibre from tubular column forms to expose concrete.
- .7 Re-use formwork and falsework subject to requirements of CSA A23.1.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 American Concrete Institute (ACI)
  - .1 ACI 315R-04, Manual of Engineering and Placing Drawings for Reinforced Concrete Structure.
  - .2 ACI 315-99, Details and Detailing of Concrete Reinforcement.
- .2 Canadian Standards Association (CSA)
  - .1 CSA A23.1-14, Concrete Materials and Methods of Concrete Construction.
  - .2 CSA A23.3-14, Design of Concrete Structures.
  - .3 CSA G30.3-M1983 (R1998), Cold-Drawn Steel Wire for Concrete Reinforcement.
  - .4 CSA G30.18-09, Carbon Steel Bars for Concrete Reinforcement.
  - .5 CSA G40.21-13, Structural Quality Steel.
  - .6 CSA W186-M1990 (R2012), Welding of Reinforcing Bars in Reinforced Concrete Construction.

**1.2 SOURCE QUALITY CONTROL**

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

**1.3 SHOP DRAWINGS**

- .1 Submit shop drawings consisting of bar bending details, lists, and placing of reinforcement in accordance with Section 01 30 00 - Submittal Procedures.
- .2 Indicate bar bending details, lists, quantities of reinforcement, sizes, spacing, locations of reinforcement and mechanical splices if approved by Departmental Representative, with identifying code marks to permit correct placement without reference to structural drawings. Indicate sizes, spacing and location of chairs, spacers and hangers.
- .3 Prepare reinforcement drawings in accordance with Reinforcing Steel Manual of Standard Practice - by Reinforcing Steel Institute of Canada , ACI 315, ACI 315R, Manual of Engineering and Placing Drawings for Reinforced Concrete Structures.
- .4 Design and detail lap lengths and bar development lengths to CSA A23.3, unless otherwise indicated. Provide type B tension lap splices where indicated unless otherwise indicated.

#### **1.4 SUBSTITUTES**

- .1 Substitute different size bars only if permitted in writing by Departmental Representative.

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

- .1 Store materials carefully, clear from ground and protect from rust, soiling, distortion and other damage.

### **Part 2 Products**

#### **2.1 MATERIALS**

- .1 Reinforcing steel: billet steel, grade 400, deformed bars to CSA G30.18, unless indicated otherwise.
- .2 Reinforcing steel: weldable low alloy steel deformed bars to CSA G30.18.
- .3 Cold-drawn annealed steel wire ties: to CSA G30.3.
- .4 Chairs, bolsters, bar supports, spacers: to CSA A23.1. Use PVC type.
- .5 Mechanical splices: subject to acceptance by Departmental Representative.
- .6 Plain round bars: to CSA G40.21.

#### **2.2 FABRICATION**

- .1 Fabricate reinforcing in accordance with CSA A23.1, ACI 315 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada, ACI 315R, Manual of Engineering and Placing Drawings for Reinforced Concrete Structures unless indicated otherwise.
- .2 Obtain Departmental Representative's acceptance for locations of reinforcement splices other than shown on placing drawings.
- .3 Upon acceptance by Departmental Representative, weld reinforcement in accordance with CSA W186.
- .4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

### **Part 3 Execution**

#### **3.1 FIELD BENDING**

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

### **3.2 PLACING REINFORCEMENT**

- .1 Place reinforcing steel as indicated on reviewed placing drawings and in accordance with CSA A23.1.
- .2 Keep reinforcing steel 65mm back from construction joints and non-doweled joints.
- .3 Use chairs, bolsters, bar supports, spacers acceptable to Departmental Representative.
- .4 Use continuous PVC high chairs to support top bars in slabs.
- .5 Securely tie reinforcing in place with No.16 gauge wire.
- .6 Do not use reinforcement having kinks or bends not indicated or detailed on drawings.
- .7 Obtain Departmental Representative's acceptance before welding or cutting reinforcing bars.
- .8 Splice reinforcement where indicated on drawings.
- .9 Prior to placing concrete, obtain Departmental Representative's acceptance of reinforcing steel and position.
- .10 Ensure cover to reinforcement is maintained during concrete pour.

### **3.3 FIELD TOUCH-UP**

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

**END OF SECTION**

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## **Part 1        General**

### **1.1        REFERENCES**

- .1 American Society for Testing and Materials (ASTM)
  - .1 ASTM C260/C260M-10a, Standard Specification for Air-Entraining Admixtures for Concrete.
  - .2 ASTM C309-11, Standard Specification for Liquid Membrane Forming Compounds for Curing Concrete.
  - .3 ASTM C494/C494M-13, Standard Specification for Chemical Admixtures for Concrete.
  - .4 ASTM D1751-04(2013)e1, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
- .2 Canadian Standards Association (CSA)
  - .1 CSA A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - .2 CSA A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
- .3 Canadian Government Standards Board (CGSB)
  - .1 CAN/CGSB 51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

### **1.2        CERTIFICATES**

- .1 Minimum 4 weeks prior to starting concrete work submit to Departmental Representative manufacturer's test data and certification by qualified independent inspection and testing laboratory that following materials will meet specified requirements:
  - .1 Portland cement.
  - .2 Blended hydraulic cement.
  - .3 Supplementary cementing materials.
  - .4 Grout.
  - .5 Admixtures.
  - .6 Aggregates.
  - .7 Water.
  - .8 Joint filler.
- .2 Provide certification that mix proportions selected will produce concrete of specified quality and yield and that strength will comply with CSA A23.1, and that mix design is adjusted to prevent alkali aggregate reactivity problems.
- .3 Provide certification that plant, equipment, and all materials to be used in concrete to comply with CSA A23.1.

### **1.3 QUALITY ASSURANCE**

- .1 Minimum 4 weeks prior to starting concrete work, submit proposed quality control procedures for Departmental Representative 's review for following items:
  - .1 Falsework erection.
  - .2 Hot weather concrete.
  - .3 Cold weather concrete.
  - .4 Curing.
  - .5 Finishes.
  - .6 Formwork removal.
  - .7 Joints.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Portland cement: to CSA A3000, normal Type GU or sulfate resistant Type HS where indicated on drawings or in mix design.
- .2 Blended hydraulic cement: to CSA A3001.
- .3 Supplementary cementing materials: to CSA A3000.
- .4 Water: to CSA A23.1.
- .5 Aggregates: to CSA A23.1. Coarse aggregates to be normal density.
- .6 Air entraining admixture: to ASTM C260/C260M.
- .7 Chemical admixtures: to ASTM C494/C494M. Departmental Representative to review accelerating or set retarding admixtures during cold and hot weather placing of concrete.
- .8 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents. Of pouring consistency, capable of developing compressive strength of 50 MPa after 28 day cure.
- .9 Non premixed dry pack grout: composition of non metallic aggregate Portland cement with sufficient water for the mixture to retain its shape when made into a ball by hand and capable of developing compressive strength of 50 MPa at 28 days.
- .10 Curing compound: to CSA A23.1 white and to ASTM C309.
- .11 Cushion pads: tough, resilient, weather, moisture, and oil resistant material that will not corrode or cause corrosion, consisting of either layers of approved cotton duck saturated and bound together by approved rubber or synthetic compounds, or made from specially compounded synthetic materials.

- .12 Premoulded joint fillers:
  - .1 Bituminous impregnated fiber board to ASTM D1751, thickness indicated.
- .13 Weep hole tubes: plastic.
- .14 Dovetail anchor slots: minimum 0.6mm thick (24 gauge) galvanized steel with insulation filled slots.
- .15 Dampproof membrane:
  - .1 Polyethylene film to CAN/CGSB 51.34, minimum 0.381mm (15 mil) thick.

## **2.2 CONCRETE MIXES**

- .1 All concrete work shall be in accordance with CSA A23.1, Alternative 1 Performance Specifications.
- .2 General Contractor to provide proprietary mix design performance record as required by the Saskatchewan Ready Mixed Concrete Association.
- .3 Provide concrete mixes as per the structural drawing requirements.

## **Part 3 Execution**

### **3.1 PREPARATION**

- .1 Obtain Departmental Representative's acceptance before placing concrete. Provide Departmental Representative 48 hours notice prior to concrete placing.
- .2 Pumping of concrete is permitted only after review of equipment and mix by Departmental Representative.
- .3 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .4 Prior to placing of concrete, obtain Departmental Representative's acceptance of proposed method for protection of concrete during placing and curing in adverse weather.
- .5 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .6 In locations where new concrete is doweled to existing work, drill holes in existing concrete. Place steel dowels of deformed steel reinforcing bars and pack solidly with epoxy grout to anchor and hold dowels in position.
- .7 Do not place load upon new concrete until authorized by Departmental Representative.

### **3.2 CONSTRUCTION**

- .1 Do cast-in-place concrete work in accordance with CSA A23.1.
- .2 Maintain concrete cover around reinforcing as indicated.

- .3 Place concrete in its final position as soon as possible after mixing and must be placed within 1.5 hours after the water has been added to the dry materials. Do not use any concrete more than 1.5 hours since mixing cement and water will have a partial set before placing.
- .4 Pour concrete continuously between predetermined construction and control joints. Do not "break" or interrupt successive pours such that "cold" joints occur.
- .5 Anchor bolts:
  - .1 Install anchor bolts for the fuel tanks supplied by tank supplier. Coordinate with tank shop drawings for anchor bolt information.
  - .2 Set anchor bolts to templates under supervision of trade supplying anchors prior to placing concrete.
- .6 Grout under base plates and machinery using procedures in accordance with manufacturer's recommendations which result in 100% contact over grouted area.
- .7 Joint Fillers
  - .1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by Departmental Representative. When more than one piece is required for a joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.
  - .2 Locate and form isolation and expansion joints as indicated. Install joint filler.
  - .3 Use 12mm thick joint filler to separate slabs-on-grade from vertical surfaces and extend joint filler from bottom of slab to within 12mm of finished slab surface unless indicated otherwise.
- .8 Dampproof Membrane
  - .1 Install dampproof membrane under all concrete slabs-on-grade.
  - .2 Lap dampproof membrane minimum 150mm at joints and seal.
  - .3 Seal punctures in dampproof membrane before placing concrete. Use patching material at least 150mm larger than puncture and seal.

### **3.3 COLD WEATHER CONCRETE PLACING**

- .1 Maintain following minimum requirements for protecting concrete during and after placement in freezing weather. Except as noted below, concrete curing and protection to be in accordance with CSA A23.1.
- .2 Before any concrete is placed, remove ice, snow, and frost completely from all formwork, reinforcing and other surfaces. Raise temperature of formwork, reinforcing, and other surfaces above 10°C for 24 hours minimum prior to concrete placing. Where concrete work is to come in contact with the earth, the surfaces of the earth shall be completely free of frost when the concrete is placed thereon.

- .3 Heat concrete aggregates and water to a temperature not over 80°C. Concrete shall not be less than 10°C and not more than 27°C in temperature when deposited. Concrete when placed during freezing weather (or if freezing is anticipated during curing period) shall be fully enclosed and the temperature of the concrete maintained at not less than 18°C for 3 days and not less than 10°C for an additional 4 days. Maintain +10°C temperature for the additional time necessary to attain 70% of the specified strength.
- .4 Keep protecting covering clear of concrete and form surfaces to permit full circulation of air. Maintain intact for at least 24 hours after the artificial heat is discontinued.
- .5 Construct heating enclosures/hoarding to be strong and windproof, well ventilated. Locate heating units to prevent local damage to concrete due to local overheating, over drying, or combustion gases.
- .6 Use only heat exchange fuel oil type heaters for slabs and flat areas. Vent units to outside the building/hoarding. Direct-fired units are not acceptable.

### **3.4 FINISHING**

- .1 Finish concrete in accordance with CSA A23.1.
- .2 Use procedures acceptable to Departmental Representative and as noted in CSA A23.1 to remove excess bleed water. Ensure surface is not damaged.
- .3 Do not sprinkle dry cement or dry cement and sand mixture over concrete surfaces.
- .4 Saw cut crack-control joints to CSA A23.1.
- .5 Rub exposed sharp edges of concrete with carborundum to produce 3mm radius edges unless otherwise indicated.
- .6 Fill and patch honeycomb areas, rub form joint lines from all exposed concrete.
- .7 Fill and patch form tie holes on exposed concrete.
- .8 Provide broomed non-slip surface to exterior concrete tank pads and apron slab.

### **3.5 SURFACE TOLERANCE FOR HORIZONTAL SURFACES**

- .1 Concrete tolerances in accordance with CSA A23.1 straight edge method. Measured within 72 hours of concrete placement, the gap at any point between a 3 metre long straight edge and the concrete surface shall not exceed requirements of the following classifications for areas specified:
  - .1 Conventional 12mm: exterior slabs, sidewalks, and concrete paving.

### **3.6 CURING AND SEALING**

- .1 Cure concrete in accordance with CSA A23.1.
- .2 Use curing compounds compatible with applied finish on concrete surfaces. Provide written declaration that compounds used are compatible.
- .3 Do not use curing and sealing compounds on surfaces where bond is required for additional concrete, floor finishes or other surface coatings.

### **3.7 DEFECTIVE CONCRETE**

- .1 Modify or replace concrete not conforming to lines, detail and elevations indicated on drawings.
- .2 Repair or replace concrete not properly placed, resulting in excessive honeycombing and other defects in critical areas of stress.
- .3 Notify Departmental Representative of proposed methods of repairing or replacing defective concrete. Methods of repairing or replacing defective concrete shall be acceptable to the Departmental Representative.

### **3.8 FIELD QUALITY CONTROL**

- .1 Inspection and testing of concrete and concrete materials will be carried out by a Testing Laboratory appointed by the Contractor.
- .2 Inspection and testing of concrete and concrete materials shall be done in accordance with CSA A23.1, and as specified below.
- .3 Take three test cylinders from each 50 cubic metres of each class of concrete placed or for each day of concrete placement if the latter is less than 50 cubic metres. Testing shall be as follows:
  - .1 One (1) 7 day laboratory cured test.
  - .2 Two (2) 28 day laboratory cured tests.
- .4 Take one additional test cylinder during cold weather concreting or if Sulphate resistance cement has been used. Cure cylinder on job site under same conditions as concrete that it represents.
- .5 Make at least one slump test for each set of test cylinders taken.
- .6 Cure concrete test cylinders in location designated by testing agency for a minimum of 48 hours prior to transporting to laboratory.
- .7 Additional testing required due to low, inaccurate or otherwise questionable results shall be paid by the Contractor.
- .8 Non-destructive Methods for Testing Concrete shall be in accordance with CSA A23.2.

- .9 Submit test results to Departmental Representative.
- .10 Review or testing by Departmental Representative will not augment or replace Contractor quality control nor relieve him of his contractual responsibility.

**END OF SECTION**

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## **Part 1 General**

### **1.1 REFERENCES**

- .1 The Aluminum Association Inc. (AA)
  - .1 AA DAF45-2003 (R2009), Designation System for Aluminum Finishes.
- .2 ASTM International Inc.
  - .1 ASTM A653/A653M-13, Standard Specification for Steel Sheet, Zinc-Coated, (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .3 Canadian Sheet Steel Building Institute (CSSBI)
  - .1 CSSBI SSF-6-2012, Sheet Steel Facts #6, Metallic Coated Sheet Steel for Structural Building Products-December 2012.

### **1.2 ACTION SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
  - .1 Submit shop drawings, catalogue sheets and full size templates.
  - .2 Indicate materials, thicknesses, sizes, finishes, colours, construction details, removable and interchangeable components, mounting methods, schedule of signs.
  - .3 Submit full size templates for individually fabricated or incised lettering indicating word and letter spacing.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Sheet aluminum: anodizing quality.
- .2 Prefinished sheet aluminum: plain utility sheet with manufacturer applied baked enamel finish to AA DAF45, 0.25mm thick on face and 0.0076mm thick on back.
- .3 Prefinished sheet steel: conforming to CSSBI SSF-6: for corrosive environment.
- .4 Galvanized steel sheet to ASTM A653/A653M: Commercial Quality with mill phosphatized Z275.

### **2.2 SIGN GRAPHICS**

- .1 Sign graphics: well defined, arranged for balanced appearance, and properly word and letter spaced.
- .2 Cut and spray process: mask surfaces, accurately cut-out image, spray apply uniform coating to obtain opaque finish.

- .3 Silk screen process: apply one colour photographic produced silk screen printed images to face side of opaque sign faces.
- .4 Self-stick vinyl film: individual letters and numerals die cut from 0.1mm thick black integral colour, matte finish, exterior grade PVC film, with self-stick adhesive backing.

## **2.3 FABRICATION**

- .1 Fabricate signs in accordance with details, specifications and shop drawings.
- .2 Build units square, true, accurate to size, free from visual or performance defects.
- .3 Fit and securely join sections to obtain tight, closed joints.
- .4 Allow for thermal movement without distortion of components.
- .5 Exposed fasteners of same finish and colour as base material.
- .6 Polish exposed edges of metal to smooth, slightly convex profile.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Manufacturer's Instructions: compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheets.
- .2 Provide signs as indicated on the drawings.
  - .1 Sign shall be black letters on white background, weather resistant finish on anodized aluminum or galvanized steel. Letters shall be minimum 25mm high.
  - .2 Sign shall be minimum 200mm x 260mm.
- .3 Erect and secure signs plumb and level at elevations indicated.
- .4 Comply with sign manufacturer's installation instructions and approved shop drawings.
- .5 Mechanical attachment:
  - .1 To steel: use bolts with nut and lock washers, self-tapping screws.
  - .2 Mechanical fasteners on exterior: non-staining, non-ferrous type.
  - .3 Fabricate special fasteners as required for installation conditions.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCES**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .2 National Fire Protection Association (NFPA)
  - .1 NFPA 10-2013, Standard for Portable Fire Extinguishers.

### **1.2 SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit two copies WHMIS MSDS - Material Safety Data Sheets.
- .3 Provide shop drawings.
- .4 Quality control submittals: submit the following:
  - .1 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.
- .5 Closeout Submittals:
  - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

### **1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:
  - .1 Dispose of waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **Part 2 Products**

### **2.1 MULTI-PURPOSE DRY CHEMICAL EXTINGUISHERS**

- .1 Stored pressure rechargeable type with hose and shut-off nozzle, ULC labelled for A, B and C class protection with a 4A060BC rating.
  - .1 Sizes: 4.5 kg.

## **2.2 CABINETS**

- .1 Surface type as indicated, constructed of 1.6mm thick steel, 180 degrees opening door of 2.5mm thick steel with latching device.
- .2 Cabinet door: with metal panel.
- .3 Suitable for outdoor use.

## **2.3 IDENTIFICATION**

- .1 Identify extinguishers in accordance with recommendations of NFPA 10.
- .2 Attach bilingual tag or label to extinguishers, indicating month and year of installation. Provide space for service dates.

## **Part 3 Execution**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

- .1 Install or mount extinguishers in cabinets in accordance with NFPA 10.

### **3.3 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Services:
  - .1 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

**END OF SECTION**

**Part 1            General**

**1.1            SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings; submit drawings stamped and signed by professional engineer registered or licensed in Province of Saskatchewan, Canada.
- .3 Shop drawings to show:
  - .1 Mounting arrangements.
  - .2 Operating and maintenance clearances.
- .4 Shop drawings and product data accompanied by:
  - .1 Detailed drawings of bases, supports, and anchor bolts.
  - .2 Acoustical sound power data, where applicable.
  - .3 Points of operation on performance curves.
  - .4 Manufacturer to certify current model production.
  - .5 Certification of compliance to applicable codes.
- .5 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
- .6 Closeout Submittals:
  - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
  - .2 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
  - .3 Operation data to include:
    - .1 Control schematics for systems including environmental controls.
    - .2 Description of systems and their controls.
    - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
    - .4 Operation instruction for systems and component.
    - .5 Description of actions to be taken in event of equipment failure.
    - .6 Valves schedule and flow diagram.
    - .7 Colour coding chart.
  - .4 Maintenance data to include:
    - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
    - .2 Data to include schedules of tasks, frequency, tools required and task time.
  - .5 Performance data to include:
    - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.

- .2 Equipment performance verification test results.
- .3 Special performance data as specified.
- .6 Approvals:
  - .1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for review. Submission of individual data will not be accepted unless directed by Departmental Representative.
  - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .7 Additional data:
  - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .8 Site records:
  - .1 Departmental Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur.
  - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
  - .3 Use different colour waterproof ink for each service.
  - .4 Make available for reference purposes and inspection.
- .9 As-built drawings:
  - .1 Prior to start of Testing and Commissioning of Mechanical Systems, finalize production of as-built drawings.
  - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
  - .3 Submit to Departmental Representative for review and make corrections as directed.
  - .4 Perform testing and commissioning of mechanical systems using as-built drawings.
  - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .10 Submit copies of as-built drawings for inclusion in final commissioning report.

## **1.2 MAINTENANCE**

- .1 Furnish spare parts in accordance with Section 01 78 00 - Closeout Submittals as follows:
  - .1 One set of packing for each pump.
  - .2 One casing joint gasket for each size pump.
  - .3 One glass for each gauge glass.
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00 - Closeout Submittals.

### **1.3 DELIVERY, STORAGE, AND HANDLING**

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

### **Part 2 Products**

- .1 Not Used.

### **Part 3 Execution**

#### **3.1 PAINTING REPAIRS AND RESTORATION**

- .1 Prime and touch up marred finished paintwork to match original.
- .2 Restore to new condition, finishes which have been damaged.

#### **3.2 CLEANING**

- .1 Clean interior and exterior of all systems including strainers.

#### **3.3 FIELD QUALITY CONTROL**

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

#### **3.4 DEMONSTRATION**

- .1 Departmental Representative may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.

- .5 Departmental Representative may record these demonstrations on video tape for future reference.

### **3.5 PROTECTION**

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

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCES**

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB 1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .2 American Society of Mechanical Engineers (ASME International)
  - .1 ASME B31.3-2014, Process Piping.
- .3 National Fire Code of Canada (NFCC 2010)
- .4 National Fire Protection Association (NFPA)
  - .1 NFPA 58-2014, Liquefied Petroleum Gas Code.
- .5 Canadian Council of Ministers of the Environment (CCME).
  - .1 CCME PN 1326-2003, Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

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

### **1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
  - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **Part 2 Products**

### **2.1 MATERIAL**

- .1 Paint: zinc-rich to CAN/CGSB 1.181.
  - .1 Primers, paints, and coatings: in accordance with manufacturer's recommendations for surface conditions.

## **Part 3            Execution**

### **3.1                APPLICATION**

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

### **3.2                CONNECTIONS TO EQUIPMENT**

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

### **3.3                CLEARANCES**

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

### **3.4                DIELECTRIC COUPLINGS**

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

### **3.5                PIPEWORK INSTALLATION**

- .1      Install pipework to ASME B31.3, NFPA 58 and CCME PN 1326.
- .2      Screwed fittings jointed with Teflon tape.
- .3      Protect openings against entry of foreign material.
- .4      Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .5      Assemble piping using fittings manufactured to ANSI standards.
- .6      Slope piping, except where indicated, back to storage tank.
- .7      Ream pipes, remove scale and other foreign material before assembly.

- .8 Provide for thermal expansion as indicated.
- .9 Valves:
  - .1 Install in accessible locations.
  - .2 Remove interior parts before soldering.
  - .3 Install with stems above horizontal position unless indicated.
  - .4 Valves accessible for maintenance without removing adjacent piping.
  - .5 Use ball or butterfly valves at branch take-offs for isolating purposes except where specified.

### **3.6 FLUSHING OUT OF PIPING SYSTEMS**

- .1 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 11 - Cleaning supplemented as specified in relevant mechanical sections.
- .2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

### **3.7 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK**

- .1 Advise Departmental Representative 48 hours minimum prior to performance of pressure tests.
- .2 PIPework: test as specified in relevant mechanical sections.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .5 Conduct tests in presence of Departmental Representative.
- .6 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests by Departmental Representative.

### **3.8 CLEANING**

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

**END OF SECTION**

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**Part 1 General**

**1.1 REFERENCES**

- .1 American Society of Mechanical Engineers (ASME).
- .1 ASME B40.100-2013, Pressure Gauges and Gauge Attachments.

**1.2 SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings and product data.
- .3 Submit manufacturer's product data for following items:
  - .1 Pressure gauges.

**1.3 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and dispose of waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Collect, separate and place in designated containers for reuse and recycling paper, plastic, polystyrene, and corrugated cardboard packaging in accordance with Waste Management Plan.
- .3 Fold up metal banding, flatten and place in designated area for recycling.
- .4 Place materials defined as hazardous or toxic waste in designated containers.
- .5 Ensure emptied containers are sealed, labelled and stored safely for disposal away from children.

**Part 2 Products**

**2.1 GENERAL**

- .1 Design point to be at midpoint of scale or range.

**2.2 PRESSURE GAUGES**

- .1 112mm, dial type: to ASME B40.100, Grade 2A, stainless steel bourdon tube having 0.5% accuracy full scale unless otherwise specified.
- .2 Provide:
  - .1 Bronze stop cock.
  - .2 Oil filled for high vibration applications.

**Part 3            Execution**

**3.1                GENERAL**

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

**3.2                PRESSURE GAUGES**

- .1        Install in following locations:
  - .1        Suction and discharge of pumps.

**3.3                NAMEPLATES**

- .1        Install engraved laminate nameplates as specified in Section 23 05 53.01 - Mechanical Identification, identifying medium.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCES**

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME B31.1-2014, Power Piping.
- .2 ASTM International
  - .1 ASTM A563-07a(2014), Standard Specification for Carbon and Alloy Steel Nuts.
- .3 Factory Mutual (FM)
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
  - .1 MSS SP-58-2009, Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application and Installation.
- .5 Underwriter's Laboratories of Canada (ULC)
- .6 National Building Code of Canada (NBCC)-2010

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit shop drawings for:
    - .1 Bases, hangers and supports.
    - .2 Connections to equipment and structure.
    - .3 Structural assemblies.
- .4 Certificates:
  - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Manufacturers' Instructions:
  - .1 Provide manufacturer's installation instructions.

### **1.3 CLOSEOUT SUBMITTALS**

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

## **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
  - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **Part 2 Products**

### **2.1 SYSTEM DESCRIPTION**

- .1 Design Requirements:
  - .1 Construct pipe support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
  - .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP-58.
  - .3 Design supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
  - .4 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP-58.
- .2 Performance Requirements:
  - .1 Design supports to withstand seismic events as required by the National Building Code of Canada.

### **2.2 GENERAL**

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP-58.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

### **2.3 PIPE SUPPORTS**

- .1 Finishes:
  - .1 Pipe supports: galvanized and painted with zinc-rich paint after manufacture.
  - .2 Use hot dipped galvanizing process.
- .2 Pipe attachments: material to MSS SP-58:
  - .1 Attachments for steel piping: carbon steel galvanized.
  - .2 Oversize pipe supports.

- .3 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP-58.
- .4 U-bolts: carbon steel to MSS SP-58 with 2 nuts at each end to ASTM A563.
  - .1 Finishes for steel pipework: galvanized.
  - .2 Finishes for copper, glass, brass or aluminum pipework: galvanized, with formed portion epoxy coated.
- .5 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP-58.

## **2.4 EQUIPMENT ANCHOR BOLTS AND TEMPLATES**

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

## **Part 3 Execution**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

- .1 Install in accordance with:
  - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
  - .1 Install on piping systems at pumps, and as indicated.
- .3 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

### **3.3 SUPPORT SPACING**

- .1 Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.
- .2 Within 300mm of each elbow.
- .3 Pipework greater than NPS 12: to MSS SP-58.

### **3.4 HANGER INSTALLATION**

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

### **3.5 HORIZONTAL MOVEMENT**

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

### **3.6 FINAL ADJUSTMENT**

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

### **3.7 FIELD QUALITY CONTROL**

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

### **3.8 CLEANING**

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

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 Canadian Gas Association (CGA)
  - .1 CSA B149.1-10, Natural Gas and Propane Installation Code.
  - .2 CSA B149.2-10, Propane Storage and Handling Code.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB 24.3-92, Identification of Piping Systems.
- .3 National Fire Protection Association (NFPA)
  - .1 NFPA 58-2014, Liquefied Petroleum Gas Code.
- .4 Canadian Council of Ministers of the Environment (CCME).
  - .1 CCME PN 1326-2003, Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products.

**1.2 SUBMITTALS**

- .1 Product Data:
  - .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Product data to include paint colour chips, other products specified in this section.
- .2 Samples:
  - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Samples to include nameplates, labels, tags, lists of proposed legends.

**1.3 QUALITY ASSURANCE**

- .1 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

**1.4 DELIVERY, STORAGE, AND HANDLING**

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

- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: dispose of waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Dispose of unused paint and coating material at official hazardous material collections site.
  - .3 Do not dispose of unused paint or coating material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

## **Part 2 Products**

### **2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES**

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers raised or recessed.
- .3 Information to include, as appropriate:
  - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
  - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

### **2.2 SYSTEM NAMEPLATES**

- .1 Colours:
  - .1 Hazardous: red letters, white background.
  - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
  - .1 3mm thick laminated plastic or white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:

- .1 Conform to following table:

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

- .2 Use maximum of 25 letters/numbers per line.

- .4 Locations:
  - .1 Terminal cabinets, control panels: use size #5.
  - .2 Other equipment: use size #9.

## **2.3 EXISTING IDENTIFICATION SYSTEMS**

- .1 Apply existing identification system to new work.
- .2 Where existing identification system does not cover for new work, use identification system specified this section.
- .3 Before starting work, obtain written acceptance of identification system from Departmental Representative.

## **2.4 PIPING SYSTEMS GOVERNED BY CODES**

- .1 Identification:
  - .1 Propane gas: to CSA B149.1, CSA B149.2, CCME PN 1326 and authority having jurisdiction.
  - .2 Liquefied petroleum: to NFPA 58, CCME PN 1326 and authority having jurisdiction.

## **2.5 IDENTIFICATION OF PIPING SYSTEMS**

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 and CCME PN 1326, except where specified otherwise.
- .2 Pictograms:
  - .1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.
- .3 Legend:
  - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3 and CCME PN 1326.
- .4 Arrows showing direction of flow:
  - .1 Outside diameter of pipe or insulation less than 75mm: 100mm long x 50mm high.
  - .2 Outside diameter of pipe or insulation 75mm and greater: 150mm long x 50mm high.
  - .3 Use double-headed arrows where flow is reversible.
- .5 Extent of background colour marking:
  - .1 To full circumference of pipe or insulation.
  - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
  - .1 Pipes and tubing 20mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.

- .2 Other pipes: pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.

.7 Colours and Legends:

- .1 Where not listed, obtain direction from Departmental Representative.

- .2 Colours for legends, arrows: to following table:

Background colour:	Legend, arrows:
Yellow	BLACK
Green	WHITE
Red	WHITE

- .3 Background colour marking and legends for piping systems:

Contents	Background colour marking	Legend
Diesel storage tank	White	DIESEL
Gasoline storage tank	White	GASOLINE
Propane storage tank	White	PROPANE
Diesel	Yellow	DIESEL
Gasoline	Yellow	GASOLINE
Propane	to Codes	
Gas regulator vents	to Codes	

## 2.6 VALVES, CONTROLLERS

- .1 Brass tags with 12mm stamped identification data filled with black paint.
- .2 Include flow diagrams for each system, of accepted size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

## 2.7 CONTROLS COMPONENTS IDENTIFICATION

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.
- .2 Inscriptions to include function and (where appropriate) fail-safe position.

## 2.8 LANGUAGE

- .1 Identification in English and French.
- .2 Use one nameplate and label for both languages.

## **Part 3            Execution**

### **3.1                MANUFACTURER'S INSTRUCTIONS**

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

### **3.2                TIMING**

- .1        Provide identification only after painting has been completed.

### **3.3                INSTALLATION**

- .1        Perform work in accordance with CAN/CGSB 24.3 and CCME PN 1326, except as specified otherwise.
- .2        Provide ULC, CSA or EC registration plates as required by respective agency.

### **3.4                NAMEPLATES**

- .1        Locations:
  - .1            In conspicuous location to facilitate easy reading and identification from operating floor.
- .2        Standoffs:
  - .1            Provide for nameplates on hot and/or insulated surfaces.
- .3        Protection:
  - .1            Do not paint, insulate or cover.

### **3.5                LOCATION OF IDENTIFICATION ON PIPING SYSTEMS**

- .1        On long straight runs: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2        Adjacent to each change in direction.
- .3        On both sides of visual obstruction or where run is difficult to follow.
- .4        Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .5        At beginning and end points of each run and at each piece of equipment in run.
- .6        At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.

- .7 Identification easily and accurately readable from usual operating areas and from access points.
  - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

### **3.6 VALVES, CONTROLLERS**

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Departmental Representative. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively.

### **3.7 CLEANING**

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

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM D4057-12, Standard Practice for Manual Sampling of Petroleum and Petroleum Products.

### **1.2 CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS**

- .1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

### **1.3 LIQUEFIED PETROLEUM FUEL SYSTEMS**

- .1 Perform systems performance verification after cleaning is completed, EC registration is completed, EC registration plates are installed and system is in full operation in accordance with ASTM D4057. Installation shall be reviewed by Departmental Representative prior to fuel being delivered to the tanks.
- .2 Environmental protection systems:
  - .1 Test fuel storage tank leakage detection system using manufacturer's recommended procedures.
  - .2 Test spill protection and over-fill protection systems using manufacturer's recommended procedures.
- .3 When systems are operational, perform following tests:
  - .1 Conduct full scale tests at maximum design flow rates and pressures to demonstrate compliance with design criteria.
  - .2 Verify performance of system pumps as specified, recording system pressures and fluctuations by simulating maximum design conditions and varying:
    - .1 Pump operation.

### **1.4 REPORTS**

- .1 In accordance with Section 01 91 13 - General Commissioning (Cx)  
Requirements: Reports, supplemented as specified herein.

### **1.5 TRAINING**

- .1 In accordance with Section 01 91 13 - General Commissioning (Cx)  
Requirements: Training of O&M Personnel, supplemented as specified herein.

## **Part 2 Products**

- .1 Not Used.

**Part 3            Execution**

.1        Not Used.

**END OF SECTION**

**Part 1 General**

**1.1 SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Instructions: submit manufacturer's installation instructions.

**1.2 DELIVERY, STORAGE, AND HANDLING**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:
  - .1 Construction/Demolition Waste Management and Disposal: dispose of waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**Part 2 Products**

**2.1 CLEANING SOLUTIONS**

- .1 As recommended by dispenser manufacturer.

**Part 3 Execution**

**3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 START-UP OF FUEL DISPENSING SYSTEMS**

- .1 After cleaning is completed, EC registration plates are installed and system is filled:
  - .1 Set pressure controls.
  - .2 Ensure air is removed.
  - .3 Check pumps to be free from air, debris, possibility of cavitation.
  - .4 Clean out strainers repeatedly until system is clean.
  - .5 Adjust pipe supports, hangers, springs as necessary.
  - .6 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
  - .7 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.
  - .8 Check operation of drain valves.
  - .9 Adjust valve stem packings as systems settle down.
  - .10 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

### **3.3 CLEANING**

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

**END OF SECTION**

## **Part 1        General**

### **1.1        REFERENCES**

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME B16.11-2011, Forged Fittings, Socket-Welding and Threaded.
- .2 American Petroleum Institute (API)
  - .1 API Spec 5L-12, Specification for Line Pipe, 45th Edition.
  - .2 API Spec 6D-2014, Specification for Pipeline Valves (Gate, Ball, and Check Valves), 24th Edition.
  - .3 API RP 651-2007, Cathodic Protection of Aboveground Petroleum Storage Tanks, Third Edition.
  - .4 API Std 653-2009, Tank Inspection, Repair, Alteration, and Reconstruction, Fourth Edition.
- .3 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A181/A181M-13, Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.
  - .2 ASTM A193/A193M-14, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
  - .3 ASTM A194/A194M-14, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
  - .4 ASTM A216/A216M-14, Standard Specification for Steel Castings, Carbon, Suitable For Fusion Welding, for High-Temperature Service.
- .4 Canadian Council of Ministers of the Environment (CCME).
  - .1 CCME PN 1326-2003, Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products.
- .5 Canadian Standards Association (CSA International)
  - .1 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
- .6 Department of Justice Canada (Jus)
  - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
  - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
  - .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
- .7 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .8 National Research Council Canada (NRCC).
  - .1 National Fire Code of Canada (NFCC)-2010.

## 1.2 SUBMITTALS

### .1 Product Data:

- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

### .2 Shop Drawings:

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate details of construction, appurtenances, installation, leakage detection system, etc.
- .3 Shop drawings to detail and indicate following as applicable to project requirements. Submit manufacturer's product data to supplement shop drawings.
  - .1 Size, materials and locations of steps and lifting lugs.
  - .2 Tanks capacity.
  - .3 Size and location of fittings.
  - .4 Environmental compliance package accessories.
  - .5 Decals, type size and location.
  - .6 Accessories: provide details and manufacturer's product data.
  - .7 Finishes.
  - .8 Electronic accessories: provide details and manufacturer's product data.
  - .9 Insulation types, locations and RSI values.
  - .10 Identification, name, address and phone numbers of corrosion expert where applicable. Note: Grading drawings to be stamped by licenced corrosion expert.
  - .11 Piping, valves and fittings: type, materials, sizes, piping connection details, valve shut-off type and location, cathodic protection system complete with stamp of corrosion expert indicating that design complies with standards, Federal and Provincial regulations.
  - .12 Spill containment: provide description of method(s) and show sizes, materials and locations for collecting spills at connection point between storage tank system and delivery truck, rail car, or vessel.
  - .13 Thermometers: provide details and manufacturer's product data.
  - .14 Anchors: description, material, size and locations.
  - .15 Concrete: type, composition and strength.
  - .16 Size and location of site pads.
  - .17 Level gauging: type and locations, include:
    - .1 Reporting systems, types of reports and report frequency.
    - .2 Maximum number of tanks to be monitored.

- .3 Number of probes required and sizes.
    - .4 Provide details and manufacturer's product data.
  - .18 Ancillary devices: provide details and manufacturer's product data.
  - .19 Leak detection system, type and locations, and alarm system.
  - .20 Grounding and bonding: provide details of design, type, materials and locations.
  - .21 Containment system for spills and overfills: provide details, materials used, and locations.
  - .22 Pipe network plan.
  - .23 Equipment layout.
  - .24 Connections at distribution points.
  - .25 Type and location of valves, strainers, disconnect and pipe couplings.
- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
- .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.
- .4 Provide maintenance data for tank appurtenances and leakage detection system for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

### **1.3 QUALITY ASSURANCE**

- .1 Regulatory Requirements: work to be performed in compliance with CEPA, CEAA, TDGA, and applicable Provincial regulations.

### **1.4 DELIVERY, STORAGE, AND HANDLING**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:
  - .1 Dispose of waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
  - .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
  - .4 Separate and place in designated containers steel, metal, and plastic waste in accordance with Waste Management Plan.
  - .5 Place materials defined as hazardous or toxic in designated containers.
  - .6 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.

- .7 Clearly label location of salvaged material's storage areas and provide barriers and security devices.
- .8 Ensure emptied containers are sealed and stored safely.
- .9 Divert unused metal materials from landfill to metal recycling facility.
- .10 Divert unused concrete materials from landfill to local quarry or facility.
- .11 Dispose of unused paint or coating material at an official hazardous material collections site.
- .12 Do not dispose unused paint material into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.
- .13 Fold up metal banding, flatten and place in designated area for recycling.

## **1.5 SITE CONDITIONS**

- .1 Environmental Requirements:
  - .1 Safeguard natural streams, waterways and storm drainage systems from possible contamination in accordance with authority having jurisdiction.

## **Part 2 Products**

### **2.1 TANKS: CONVENTIONAL STEEL**

- .1 One (1) vertical propane tank of 1,890 L capacity c/w cylinder fill cabinet including the following features and options:
  - .1 0.76 L/s (12 GPM) pump with explosion proof motor listed by ULC.
  - .2 12mm (1/2") x 1525mm (5 ft.) cylinder filling hose.
  - .3 1000# platform scale.
  - .4 Inlet strainer.
  - .5 All metal welded construction.
  - .6 Locking door.
  - .7 Refill, Haz-Mat, Propane and No Smoking decals.
  - .8 Emergency shut-off interlock assembly activated by door closure.
  - .9 Explosion proof light.

### **2.2 STEEL PIPING**

- .1 Pipe: to API Spec 5L, schedule 80.
- .2 Fittings: unless otherwise indicated, welding type, carbon steel, seamless or resistance weld. Wall thickness same as corresponding pipe size.
- .3 Flanges: forged carbon steel, raised face, weld neck, to ASTM A181/A181M, Grade II Class 150, 1 MPa.

- .4 Bolting materials:
  - .1 Bolts: carbon steel to ASTM A193/A193M.
  - .2 Nuts: carbon steel to ASTM A194/A194M.
  - .3 Gasket: capable of chemically withstanding fluids and temperatures of 650 degrees C.
- .5 Joints:
  - .1 Aboveground: threaded joints using compound reviewed by Departmental Representative for product being handled.
- .6 Corrosion and product protection:
  - .1 Protect piping against external corrosion.
- .7 Piping located below product level equipped with either manual or automatic shut-off at storage tank.
- .8 Provide means for collecting spills at connection point between storage tank system and delivery truck.

## **2.3 VALVES**

- .1 Steel without copper bearing alloy: to API SPEC 6D. Class 150, 1 MPa.
- .2 NPS 1 1/2 and smaller: ball valve.
- .3 Gate valves NPS2 and larger: to ASTM A216/A216M, Grade WCB, carbon steel, OS&Y, flanged ends.
- .4 Plug valves flanged ends: Class 300, 2 MPa, bolted bonnet, tapered plug and seat, carbon steel body and trim with plug, Teflon lining.
- .5 Glands and valve seats: materials resistant to conveyed fluid.
- .6 Rising stem or other indicating valves: where necessary, to establish visually whether valves are open or shut.

## **2.4 IDENTIFICATION**

- .1 Valves: identify with tags, octagonal anodized aluminum, flammable liquids resistant, fireproof, permanently inscribed with clear legible characters.
- .2 Flammable and combustible liquids pipe: label in accordance with Section 23 05 53.01 - Mechanical Identification.

## **2.5 PUMPS**

- .1 General: horizontal turbine, heavy duty ductile iron construction, direct drive, pressure rated up to 1.75 MPa.
- .2 Capacity: 45 L/min at 3450 r/min, with drip proof motor, 750 W.

- .3 Relief valve: external mounted, factory set at 140 kPa, piped to return surplus petroleum product to supply side of pump.
- .4 Duplicate control switches: to shut down pump in event of emergency.
- .5 Explosion proof protection: pump motors, switchgear, and electrically operated controls, in locations specified in Canadian Electrical Code, Part 1, Section 20: explosion-proof design and type.

## **2.6 ANCHORAGE**

- .1 As recommended by manufacturer.

## **2.7 CONCRETE**

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

## **2.8 LEVEL GAUGING**

- .1 Tank gauging stick: to manufacturer's standard.
- .2 Electronic solid state combination tank level sensor and leak detector: console containing visual LED display and printer algorithms to automatically compute required operations. System to be programmable for:
  - .1 Inventoring reporting with following features.
    - .1 Litres of fuel remaining.
    - .2 Temperature of fuel.
    - .3 Millimeters of water in bottom of tank.
    - .4 Millimeters of fuel in tank.
  - .2 Fuel delivery report.
  - .3 Single tank installation, interstitial space leak detection.
  - .4 Visual and audible alarm for:
    - .1 Overfill.
    - .2 Low product.
    - .3 High water.
    - .4 Theft.
    - .5 Leaks.
  - .5 Probe diagnostics.
  - .6 Leak tests.
  - .7 Probes and sensors: factory calibrated and pre-set, to suit diameter of tank.

## **2.9 LEAKAGE DETECTION SYSTEM**

- .1 To NFPA 329.
- .2 Leak detector: cable system.
  - .1 Monitoring instrument.
    - .1 Temperature compensated solid state circuitry to continuously monitor leak detection circuits for open circuit or alarm condition. Alarm condition to be indicated by [visual indicator light] [audible alarm] and operation of isolated relay to allow interface with other equipment.
    - .2 Supply voltage: 120 Vac.
    - .3 Module: complete with power-on lamp, alarm lamp, test switch and reset switch.
  - .2 Leak detection cable: twisted pair of 20 AWG woven conductors insulated with hydrocarbon degradable dielectric with loose interlocking aluminum alloy armour.
  - .3 Control cable: twisted pair of 20 AWG woven conductors with 300 V insulation and PVC jacket.
- .3 Vapour Monitoring.
  - .1 Vapour Phase Detector.
    - .1 Product stored, or tracer compound placed in storage tank system sufficiently volatile to result in vapour level that is detectable by monitoring device.
    - .2 Operative in groundwater, rainfall, soil moisture, and other interferences so that leaks are detected in less than 30 days.
    - .3 Leak detection from storage tank system not disturbed by background contamination.
    - .4 Designed to detect any significant increase in concentration above background level of product stored, and component(s) of product stored, or a tracer compound placed in tank system.

## **2.10 GROUNDING AND BONDING**

- .1 To Section 26 05 00 - Common Work Results - Electrical.

## **2.11 OVERFILL AND SPILL CONTAINMENT**

- .1 Shop-fabricated AST overfill protection.
  - .1 Automatic valve closure on product supply line, or automatic pump shut-off to terminate petroleum product flow upon detection of high levels in the storage tank.
  - .2 Overfill protection device compatible with intended method of filling designed, built and certified to ULC/ORD C58.15.
  - .3 Audible and visual alarm located where personnel are constantly on duty during transfer operation and can promptly stop or divert flow when detected levels are too high.

- .4 Storage tanks with capacity of 4,000 L or less.
  - .1 Visual monitoring and gauging for frequent monitoring throughout transfer operation permitting personnel to promptly shut down flow, or communicate immediately with person controlling delivery for shut down.

## **2.12 PRODUCT TRANSFER**

- .1 ASTs with normal vent and separate emergency vent.
  - .1 Liquid- and vapour-tight connection on fill pipes for flammable products.

## **2.13 TANK BOTTOM WATER**

- .1 Segregated from rainwater.
- .2 Disposed of in accordance with applicable provincial or territorial regulations, guidelines and policies.

## **2.14 SPILLS AND OVERFILLS**

- .1 Contained, treated and disposed of in accordance with applicable provincial or territorial regulations, guidelines and policies.

## **2.15 STRAINER**

- .1 Duplex style, cast iron body: to ASTM A48, malleable iron exterior trim, stainless steel baskets with 0.8 mm perforations, screwed ends, 860 kPa ANSI pressure rating.

## **2.16 PRESSURE GAUGES**

- .1 Pressure Gauges: to Section 23 05 19.01 - Thermometers and Pressure Gauges - Piping Systems.
- .2 Scale markings: 0 to 200 kPa.

## **Part 3 Execution**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 HANDLING**

- .1 Protect and shield pre-coated equipment and piping.

### **3.3 SITE WORK**

- .1 Departmental Representative to review alignment of piping system before welding or bolting.
- .2 Departmental Representative to review pre-assembly and bending of pipes. Follow Departmental Representative's instruction.

### **3.4 COATINGS**

- .1 Clean surfaces to base metal. Store clean pipe for short time period in sheltered dry location.
- .2 Shop application; prefabricated piping sections are limited to 15 m maximum length.
- .3 Reprime mill primed pipe before coating.
- .4 Coating: to manufacturer's recommendations.

### **3.5 TANKS**

- .1 Install tanks in accordance with CCME PN 1326, the National Fire Code of Canada, and manufacturer's recommendations.
- .2 Position tanks using lifting lugs and hooks, and where necessary use spreader bars. Do not use chains in contact with tank walls.
- .3 Install tanks using licensed, trained and certified installers.
- .4 Provide certification of installation to Departmental Representative.

### **3.6 ANCHORS AND GUIDES**

- .1 Install anchors and guides as indicated and at following points:
  - .1 Connections to pumps.
  - .2 Connections to storage tanks.
  - .3 At changes of pipe sizes.
  - .4 At branch line take offs.
  - .5 At changes of piping directions.
  - .6 At terminal points.
  - .7 Elsewhere as indicated.

### **3.7 SUPPORTS**

- .1 Above ground piping: prevent excessive vibration and stress on adjacent equipment.

### **3.8 PROTECTION**

- .1 Protect piping system from damage by vehicular traffic using guard devices, marked with fluorescent markers or painted with warning colours.

### **3.9 LOCATION OF PIPEWORK**

- .1 General: locate not to constitute hazard to personnel, buildings or equipment.

### **3.10 VALVES**

- .1 Install valves to control flow and to isolate equipment at following locations:
  - .1 Loading and unloading connections;
  - .2 Fill and withdrawal connections of above ground tanks;
  - .3 Suction and discharge of pumps;
  - .4 At equipment requiring periodic servicing such as filters, metres and automatic equipment.

### **3.11 PUMPS**

- .1 Pumps installed above ground and outside buildings: locate at least 3 m from building line and 1.5 m from building openings.
- .2 Install duplicate control switches at pump location or at a second remote location reviewed by Departmental Representative.
- .3 Anchor pumps to base. Protect from impact and damage from vehicular traffic.

### **3.12 FIELD QUALITY CONTROL**

- .1 Test tanks for leaks to requirements of and in presence of authority having jurisdiction.
- .2 Piping system testing:
  - .1 Prior to testing, remove foreign matter, flush piping and equipment using same petroleum product as one being transported.
  - .2 Dispose of testing and flushing liquid to approval of authority having jurisdiction.
  - .3 Pressure test with air, nitrogen or liquid reviewed by Departmental Representative to at least 1.5 times maximum operating pressure. Submit certificate of tests and test results to Departmental Representative.
  - .4 Isolate tanks from piping system pressure tests.
  - .5 Test piping systems and pumps with compressed air to 700 kPa. Hold pressure for 24 hours.
  - .6 Should there be loss of pressure, soap test each weld or use tracer gas with compressed air as directed by Departmental Representative.

### **3.13 TOUCH-UP**

- .1 Where coating is damaged, touch-up with original coating material.

**3.14            LEVEL GAUGE SYSTEM**

- .1      Provide leak and vapour proof caulking at connections.
- .2      Shield capillary and tubing connections in heavy duty 50mm polyethylene pipe.
- .3      Calibrate system.

**3.15            LEAK DETECTION SYSTEM**

- .1      Install in accordance with manufacturer's recommendations.

**3.16            CLEANING**

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

**END OF SECTION**

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## **Part 1 General**

### **1.1 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
  - .2 CSA C22.3 No. 1-10, Overhead Systems.
  - .3 CAN3 C235-83 (R2010), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
  - .4 CSA B651, Accessible Design for Built Environment
- .2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
  - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .3 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
  - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

### **1.2 DEFINITIONS**

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

### **1.3 DESIGN REQUIREMENTS**

- .1 Operating voltages: to CAN3 C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
  - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification nameplates and labels for control items in English and French.
- .4 Use one nameplate or label for both languages.

### **1.4 SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings:
  - .1 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.

- .2 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
- .3 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
- .4 If changes are required, notify Departmental Representative of these changes before they are made.
- .3 Quality Control:
  - .1 Submit to the Electrical Inspection Department and Supply Authority the necessary number of drawings and specifications for examination and approval prior to commencement of work. Pay all fees associated with this examination and approval.
  - .2 Obtain and pay fees associated with all electrical inspections.
  - .3 Submit test results for all electrical system testing including manufacturer's factory and Materials and Equipment field test reports.
- .4 Operation and Maintenance Data:
  - .1 Provide operation and maintenance data for incorporation into an electrical operation and maintenance manual as specified herein. The following are minimum requirements.
  - .2 Include in operations and maintenance data:
    - .1 Cover page including project name, year, name of Owner, Departmental Representative, and electrical contractor. Cover page shall be enclosed in a clear plastic cover.
    - .2 Index.
    - .3 Electrical Contractor's Guarantee.
    - .4 List of manufacturer and supplier for all items.
    - .5 Name, address and phone number of local suppliers for items included in Maintenance Manual.
    - .6 "SYSTEMS DEMONSTRATION" certificate.
    - .7 Load Balance report.
    - .8 A copy of all panelboard directories.
    - .9 216mm x 279mm (8-1/2" x 11") letter size drawing indicating Single Line Diagram for electrical distribution system.
    - .10 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.
    - .11 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items and parts lists. Advertising or sales literature not acceptable.
    - .12 Operating Instructions for All Systems.
  - .3 Operation and Maintenance Data shall be contained within a 50mm thick, black, hard cloth three ring binder. Binder shall be labelled directly on the front cover as well as the spine ("ELECTRICAL OPERATION AND MAINTENANCE MANUAL - PROJECT NAME - YEAR") with gold embossed lettering. Plastic sleeves for identification will not be accepted.

- .4 The following index tabs and associated product information shall be contained within the binder:
  - .1 Index
  - .2 Contractor Guarantee
  - .3 Manufacturer and Supplier List
  - .4 Supplier Addresses and Phone Numbers
  - .5 Systems Demonstration Certificate
  - .6 Panelboard Directories
  - .7 Load Balance Report
  - .8 Single Line Diagram
  - .9 Distribution Equipment
  - .10 Disconnect Switches
  - .11 Transformers
  - .12 Panelboards and Breakers
  - .13 Contactors
  - .14 Luminaires, Lamps, and Ballasts
  - .15 Motor Starters
  - .16 Devices:
    - .1 Receptacles
    - .2 Switches
- .5 Divider tab pages shall be laminated mylar plastic with reinforced holes. Plastic tabs with typed insertions will not be accepted.
- .6 Provide four (4) operating and maintenance manuals. Turn over one to Departmental Representative and the balance to the Owner.

## **1.5 QUALITY ASSURANCE**

- .1 All electrical work to be carried out by qualified, licensed electricians or apprentices as per the conditions of the Provincial Act respecting manpower, vocational training and qualification. Employees registered in a provincial apprentices program shall be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks - the activities permitted shall be determined based on the level of training attained and the demonstration of ability to perform specific duties.
- .2 The work of this division to be carried out by a contractor who holds a valid Master Electrical contractor license as issued by the Province that the work is being contracted.
- .3 Conduct a complete testing, start-up and commissioning program as specified in Division 01.
- .4 Submit a complete testing and commissioning schedule and notify the Departmental Representative a minimum of 40 hours prior to performance of testing.
- .5 Submit a complete testing and commissioning report at completion of the Work.

## **1.6 DELIVERY, STORAGE AND HANDLING**

- .1 Material Delivery Schedule: provide Departmental Representative with schedule within 4 weeks after award of Contract.

- .2 Construction/Demolition Waste Management and Disposal: dispose of waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **1.7 SYSTEM START-UP**

- .1 Instruct Departmental Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

## **1.8 OPERATING INSTRUCTIONS**

- .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
- .2 Operating instructions to include following:
  - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
  - .2 Start-up, proper adjustment, operating, lubrication, and shutdown procedures.
  - .3 Safety precautions.
  - .4 Procedures to be followed in event of equipment failure.
  - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
- .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
- .4 Post instructions where directed.
- .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
- .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

## **Part 2 Products**

### **2.1 MATERIALS AND EQUIPMENT**

- .1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.

- .2 Material and equipment to be CSA certified, and manufactured to standard quoted. Where CSA certified material and equipment are not available, obtain special approval from inspection authorities.
- .3 Factory-assemble control panels and component assemblies.
- .4 Uniformity of manufacturer shall be maintained for any particular item or type of equipment throughout the building.

## **2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS**

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Supplier and Installer responsibility is indicated in Motor Control and Equipment Schedule on electrical drawings and related Mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
- .3 Control wiring and conduit is specified in Division 26 except for conduit, wiring, and connections below 50V which are related to control systems specified in Division 23 and shown on mechanical drawings.

## **2.3 WARNING SIGNS**

- .1 Warning Signs: in accordance with requirements of inspection authorities.
- .2 Decal signs, minimum size 175 x 250 mm.

## **2.4 WIRING TERMINATIONS**

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

## **2.5 EQUIPMENT IDENTIFICATION**

- .1 Identify electrical equipment with nameplates as follows:
  - .1 Nameplates: plastic laminate engraving sheet, 3mm thick, black face, white core, self-adhesive. Nameplates identifying emergency power system circuits shall be red face with white core.
  - .2 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .2 Wording on nameplates to be reviewed by Departmental Representative prior to manufacture.

- .3 Allow for average of twenty-five (25) letters per nameplate.
- .4 Identification to be English and French.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .7 Transformers: indicate capacity, primary and secondary voltages.
- .8 All nameplates shall be mechanically attached with a minimum of two chrome self-tapping screws as well as the self-adhesive.

## **2.6 WIRING IDENTIFICATION**

- .1 Identify wiring with permanent indelible identifying markings, numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

## **2.7 CONDUIT AND CABLE IDENTIFICATION**

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with 305mm band of coloured spray paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

Telephone	Light Green
Fire Alarm	Red
Emergency Power	Orange
Computer Network (Data)	Blue

- .3 Identify all system junction boxes with enamel spray paint on entire cover. Colour shall match those specified for conduit and cable identification.
- .4 Identify all junction boxes, containing branch circuit conductors, with black felt marker indicating panel and breaker number (i.e. "B-24").

## **2.8 FINISHES**

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
  - .1 Paint outdoor electrical equipment "equipment green" finish to EEMAC Y1-1.
  - .2 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.

- .2 Clean and touch up surfaces to shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean, prime, and paint exposed hangers, racks, fastenings to prevent rusting.
- .4 All electrical fittings, supports, hanger rods, pull boxes, channel fittings, conduit racks, outlet boxes, brackets, clamps, etc. shall either have a galvanized finish, or have a painted finish over corrosion resistant primer.
- .5 Where indicated herein and on drawings, provide finishes to match samples as provided by the Departmental Representative.

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Do complete installation in accordance with the latest edition of the Canadian Electrical Code Part I (CSA C22.1) and the Saskatchewan Supplement, as well as Municipal and Provincial Codes and Regulations and the local authorities having jurisdiction. Where this specification is at variance with applicable Codes and Standards, the more stringent shall apply.
- .2 Do overhead and underground systems in accordance with CSA C22.3 No.1 except where specified otherwise.

#### **3.2 NAMEPLATES AND LABELS**

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

#### **3.3 CONDUIT AND CABLE INSTALLATION**

- .1 Install conduit and sleeves prior to pouring of concrete.
  - .1 Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50mm.
- .2 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.
- .3 Conduit shall be laid out to avoid interference with other trades, and to maintain maximum headroom. Arrange conduit to conserve space, allow maintenance, and avoid crossovers where possible.
- .4 Holes through exterior walls and roof shall be flashed and made completely weatherproof.
- .5 Identify on as-built drawings locations both ends of all conduits.

#### **3.4 LOCATION OF OUTLETS**

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.

- .2 Do not install outlets back-to-back in wall; allow minimum 150mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000mm, and information is given before installation.
- .4 Locate light switches on latch side of doors.
  - .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

### **3.5 MOUNTING HEIGHTS**

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise:
  - .1 Local switches: 1200mm
  - .2 Wall receptacles:
    - .1 General: 450mm
    - .2 Above top of counters or counter splash backs: 175mm.
    - .3 In mechanical rooms: 1400mm.
  - .3 Panelboards: as required by Code or 1800mm to top of panel.
  - .4 Motor starters (loose): 1200mm.

### **3.6 COORDINATION OF PROTECTIVE DEVICES**

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

### **3.7 FIELD QUALITY CONTROL**

- .1 Load Balance:
  - .1 Measure phase current to panelboards and distribution centres with all possible loads operating. Adjust branch circuit connections as required to obtain best balance of current between phases and record final measurements after adjustments have been completed. Load unbalance shall not exceed fifteen percent (15%).
  - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
  - .3 Submit, on completion of work, a report listing phase and neutral currents on panelboards, dry type transformers, and motor control centres operating under normal load. State hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests:
  - .1 Power distribution system including phasing, voltage, grounding and load balancing.

- .2 Circuits originating from branch distribution panels.
- .3 Lighting and its control.
- .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
- .5 Insulation resistance testing:
  - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
  - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
  - .3 Check resistance to ground before energizing.
- .3 Carry out tests in presence of Departmental Representative.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

### **3.8 CLEANING**

- .1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

**END OF SECTION**

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**Part 1 General**

**1.1 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CAN/CSA C22.2 No. 65-13, Wire Connectors.

**1.2 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

**Part 2 Products**

**2.1 MATERIALS**

- .1 All fixture and branch wiring joints in junction and outlet boxes shall be made with a CSA certified pressure type connector rated at 600 volts maximum. Connector body shall consist of a cone shaped coil spring insert, insulated with a colour coded flame retardant, thermoplastic shell, which shall be knurled for easy grip.
- .2 Lugs, terminals, and screws used for termination of conductors, shall be suitable for type of conductor used.
- .3 Wire connectors: to CSA C22.2 No. 65.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Remove insulation carefully from ends of conductors and:
  - .1 Install mechanical pressure type connectors and tighten as recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No. 65.

**END OF SECTION**

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**Part 1 General**

**1.1 REFERENCES**

- .1 Canadian Standards Association (CSA International)
- .1 CSA C22.2 No. 131-14, Type TECK 90 Cable.

**1.2 PRODUCT DATA**

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

**1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Packaging Waste Management: remove in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**Part 2 Products**

**2.1 GENERAL**

- .1 Branch circuit wiring shall be building wire in conduit unless noted otherwise.
- .2 Motor control and motor feeders shall be Teck cable or building wire in conduit as noted.
- .3 Minimum power conductor size shall be #12 AWG.
- .4 Minimum control conductor size shall be #14 AWG.
- .5 Maximum lighting circuit conductor size shall be #10 AWG.
- .6 Cable installed in hazardous areas shall be approved for that classification.
- .7 Wire and cables for 600 volt wiring shall be insulated to 1000 volts.
- .8 Wire and cables for 208 volt wiring shall be insulated to 600 volts.

**2.2 BUILDING WIRES**

- .1 Conductors: stranded for #12 AWG and larger.
- .2 Copper conductors: size as indicated, with insulation of chemically cross-linked thermosetting polyethylene material rated R90, RW90, and RWU90 as noted on drawings.

## 2.3 TECK CABLE

- .1 Cable: to CSA C22.2 No. 131.
- .2 Conductors:
  - .1 Grounding conductor: copper.
  - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation: chemically cross-linked thermosetting polyethylene rated minus 40 °C, RW90.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking aluminum.
- .6 Overall covering: thermoplastic polyvinyl chloride material, flame and acid resistant.

## 2.4 CONDUCTORS

- .1 Conductors shall be colour coded in accordance with the following:

.1	Single Phase	Hot	Black or Red
		Neutral	White
.2	Two Phase	Hot	Red
		Hot	Black
		Neutral	White
.3	Three Phase	A Phase	Red
		B Phase	Black
		C Phase	Blue
		Neutral	White
.4	Ground Wires	Equipment	Green

Continuous colour coding of insulation is required for conductors sized #2 AWG and smaller. Colour code phase taping for conductors sized #2 AWG and smaller will not be allowed

- .2 Conductor phasing shall be made phase A, B, C from left to right when facing equipment.

## 2.5 WIRE AND CABLE ACCESSORIES

- .1 Provide wire pulling compound which is compatible with the conduit system and the cable insulation.
- .2 Provide wire nut B-Cap type wire connectors, sized for the conductor for connection of lighting circuit connectors.
- .3 Provide watertight cable connectors with hazardous location rating where required.
- .4 Wire markers shall be mylar/cloth adhesive strip type.

- .5 Cable ties for indoor use shall be natural 6/6 nylon type with minimum 30 lb tensile strength. Cable ties for outdoor use shall be weather resistant nylon 12 type with minimum 90 lbs tensile strength.

## **2.6 CONNECTORS**

- .1 Pressure type wire connectors with current carrying parts of copper alloy sized to fit copper conductors as indicated.
- .2 Fixture type splicing connectors with fixture type current carrying parts of copper sized to fit copper #10 AWG or less.
- .3 Compression lugs shall be used for motor leads and power connections.
- .4 Explosion proof connectors and fitting in hazardous areas.

## **2.7 FASTENINGS**

- .1 One hole galvanized straps to secure surface cables 50mm and smaller.
- .2 Two hole galvanized straps for surface cables larger than 50mm.

## **Part 3 Execution**

### **3.1 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests using method appropriate to site conditions and to acceptance of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

### **3.2 GENERAL INSTALLATION**

- .1 Install the following as one continuous length, splices will not be permitted.
  - .1 Motor feeders from source to load.
  - .2 From junction/outlet box to junction/outlet box.
  - .3 Power service feeders.
- .2 Install wire and cables without damage to the insulation or conductor. Ensure maximum permissible pulling tensions recommended by the manufacturer are not exceeded.
- .3 All wiring, except at motors and wiring devices shall be terminated on terminal blocks.
- .4 Install wire markers at both ends of the wire and cable and conduit and wherever splices are made.

- .5 Wire Numbering:
  - .1 All cables and wires shall be numbered in accordance with the wiring schematics or diagrams.
  - .2 Wire numbers shall increase only after passing through a contact, relay, solenoid or other device. No change in wire number is required after a junction point or terminal.
  - .3 Single phase loads shall be identified as per the panelboard circuit numbers they are fed from.
- .6 Install cable connectors in accordance with manufacturer's recommended method.
- .7 Compression lugs for motor leads and power connections shall be bolted together using cadmium plated or anodized bolts.
- .8 All motor connections shall be adequately insulated.
- .9 Each wire entering a box, whether being terminated, spliced or pulled through, shall be left with at least 150mm of slack to facilitate future alterations.
- .10 Conductors in wireways, control panels and cabinets, etc. shall be secured with nylon cable ties, lacing with string or plastic tape is not acceptable.
- .11 Conductor length for parallel feeders shall be identical.
- .12 Identify all conductors (including neutral) with "Brady" marker to describe circuit number, wherever they are terminated in a junction box or panelboard.
- .13 Neutral conductors shall not be derated.
- .14 When changing the rotation of three phase motors, the change shall be made at the motor splice box.
- .15 Low voltage wiring shall be red, blue, and orange in colour, minimum #14 AWG, THHN.
- .16 Control wiring conductors shall be red in colour (except associated building neutral conductor shall be white in colour).
- .17 A separate insulated (green) ground conductor shall be installed in each conduit system. The conduit system will not constitute an adequate ground.
- .18 Install a separate insulated (green) ground conductor for each motor circuit.
- .19 Install a separate insulated (green) ground conductor for each panelboard feeder.
- .20 Insulation for all conductors installed exterior to the building shall be rated at minus 40 degrees Celsius.
- .21 Circuits sharing a neutral shall be consecutive breakers in the panel (i.e. 1,3,5 or 8,10,12).

### **3.3           INSTALLATION OF BUILDING WIRES**

- .1       Install conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings, using wire pulling compound as required.
- .2       Conductors drawn into conduit shall not be pulled more than 30 metres nor through more than three 90° bends without pullboxes.

**END OF SECTION**

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## **Part 1 General**

### **1.1 REFERENCES**

- .1 Institute of Electrical and Electronics Engineers (IEEE)
  - .1 IEEE 837-2002, Standard for Qualifying Permanent Connections Used in Substation Grounding.
- .2 Canadian Standards Association, (CSA International)
  - .1 CSA C22.2 No. 41-13, Grounding and Bonding Equipment.

### **1.2 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Fold up metal banding, flatten and place in designated area for recycling.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Grounding equipment to: CSA C22.2 No. 41.

### **2.2 EQUIPMENT**

- .1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.
- .2 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
  - .1 Grounding and bonding bushings.
  - .2 Protective type clamps.
  - .3 Bolted type conductor connectors.
  - .4 Compression connectors
  - .5 Bonding jumpers, straps.
  - .6 Pressure wire connectors.

## **Part 3 Execution**

### **3.1 INSTALLATION GENERAL**

- .1 Install complete permanent, continuous grounding system including, conductors, connectors, and accessories, as indicated, to conform to requirements of Departmental Representative and local authority having jurisdiction over installation.

- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .5 Soldered joints not permitted.
- .6 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .7 Install separate insulated green ground conductor in each conduit system. The conduit system will not be considered as providing an adequate ground.
- .8 Each motor shall be provided with a separate insulated (green) ground conductor originating at the panel or Motor Control Centre from which the motor is energized.
- .9 Install a continuous green insulated ground conductor (#6 AWG minimum), the entire length of cable tray. Bond the conductor to each section of the cable tray. Terminate the ground conductor at the main building ground grid.
- .10 Install a separate bonding conductor with each equipment branch circuit.

### **3.2 EQUIPMENT GROUNDING**

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, distribution panels, and outdoor lighting.

### **3.3 COMMUNICATION SYSTEMS**

- .1 Install grounding connections for telephone, computer, and fire alarm, as follows:
  - .1 Telephones: make telephone grounding system in accordance with telephone company's requirements. Install #6 insulated green copper grounding conductor from main telephone service entrance plywood to the main building ground grid.
  - .2 Computer and fire alarm shall each be provided with a separate ground conductor originating from the main building ground grid.

### **3.4 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions.

- .3 Measure ground grid resistance with earth test megohmmeter and install additional ground rods and conductors as required until resistance to ground complies with Code requirements and is less than  $1\Omega$ . Submit test results to Department Representative.
- .4 Carry out all tests required by the Electrical Inspection Authority and provide all required reports and copied to the Departmental Representative. Include all associated costs.
- .5 Ensure test results are satisfactory before energizing the electrical system.

**END OF SECTION**

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**Part 1 General**

**1.1 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.1-12, Canadian Electrical Code, Part 1, 22nd Edition.
  - .2 CSA C22.2 No. 40-M1989 (R2009), Cutout, Junction and Pull Boxes.
  - .3 CSA C22.2 No. 76-14, Splitters.

**1.2 SUBMITTALS**

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

**1.3 DELIVERY, STORAGE AND HANDLING**

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

**Part 2 Products**

**2.1 SPLITTER BOXES**

- .1 Construction: to CSA C22.2 No. 76, sheet metal, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Terminations: main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
- .3 Spare Terminals: minimum three spare terminals on each set of or lugs in splitters less than 400 A.
- .4 Full length of equipment arrangement except where indicated.
- .5 Explosion-proof boxes, fittings, and joints shall be threaded for connection to conduit and cable glands in hazardous locations.

## **2.2 JUNCTION AND PULL BOXES**

- .1 Construction: to CSA C22.2 No. 40, welded steel with screw-on flat covers for surface mounting.
- .2 Covers with 25mm minimum extension all around, for flush mounted pull and junction boxes.
- .3 Explosion-proof boxes, fittings, and joints shall be threaded for connection to conduit and cable glands in hazardous locations.

## **2.3 CABINETS**

- .1 Type T: sheet steel cabinet with hinged door, latch, lock (2 keys), containing 19mm G1S painted plywood backboard, suitable for flush or surface mounting as noted. Provide drip shield where cabinet is exposed to fire protection sprinklers.
- .2 Explosion-proof boxes, fittings, and joints shall be threaded for connection to conduit and cable glands in hazardous locations.

## **Part 3 Execution**

### **3.1 SPLITTER INSTALLATION**

- .1 Install splitters as indicated and mount plumb, true and square to building lines.

### **3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION**

- .1 Install junction and pull boxes in accessible locations.
- .2 Support boxes independently of connecting conduits. Secure boxes to building structure.
- .3 Mount cabinets with top not higher than 2 m above finished floor.
- .4 Extension rings will not be allowed on junction or pull boxes.
- .5 Only main junction and pull boxes are indicated. Provide pull boxes so as not to exceed 30 meters of conduit run between pull boxes.

### **3.3 IDENTIFICATION**

- .1 Junction, pull boxes and splitters with size 2 identification labels indicating system name, ampacity, voltage and phase in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Identify all 100mm square or 100mm octagon junction boxes, containing branch circuit conductors, with black felt marker indicating panel and breaker number (i.e. "B-24").

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.1-12, Canadian Electrical Code, Part 1, 22nd Edition.

**1.2 DEFINITIONS**

- .1 Outlet box: sheet steel enclosure for either electric wiring or fittings, having knockout openings in either sides or back, or both, for entrance of wire in conduit, electrical metallic tubing, cable, or flexible tubing. Cover is fastened by screws, not hung on hinges.
- .2 Conduit box: cast box having threaded openings for rigid conduit or cable connectors.
- .3 Fitting: fitting intended to secure rigid conduit or electrical metallic tubing to enclosure or to adjacent length of rigid conduit or electrical metallic tubing. Such fitting may be integral part of conduit or outlet box.
- .4 Conduit outlet body: cast fitting installed in conduit systems to act as pull outlets for conductors being installed or to make 90° bends.

**1.3 GENERAL**

- .1 Provide and set for each fixture, switch, wall receptacle or other outlet, a box suitable for the location and designed to accept its particular components.
- .2 Before locating the outlet boxes, check all of the architectural, structural, process and mechanical drawings for type of construction and to make sure that there is no conflict with other equipment. The outlet boxes shall be symmetrically located according to room layout and shall not interfere with other work or equipment. Also note any detail of the outlets shown on the drawings.
- .3 Outlets located in the finished areas of the building shall be installed in outlet boxes. Outlets located in the crawlspace and mechanical room or outdoors shall be installed in conduit boxes.

**1.4 SUBMITTALS**

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

**1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:
  - .1 Separate and dispose waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **Part 2        Products**

### **2.1        OUTLET AND CONDUIT BOXES, AND CONDUIT OUTLET BODIES**

- .1        Size boxes in accordance with CSA C22.1.
- .2        Blank cover plates for boxes without wiring devices.
- .3        Combination boxes with barriers where outlets for more than one system are grouped.
- .4        Outlet boxes:
  - .1        Outlet boxes shall be made of electro-galvanized sheet steel unless otherwise noted or required by the Canadian Electrical Code. Single or multi-gang flush device boxes shall be used for flush installations, minimum size 76 x 50 x 38 mm or as indicated. 102mm square outlet boxes shall be used when more than one conduit enters one side with extension and plaster rings as required.
  - .2        The outlet boxes shall be complete with raised device covers as required to accept device installed. All outlet boxes must be securely fastened in position with the exposed edge of the raised device cover set flush with the finished surface. Approved factory-made knockout seals shall be installed where knockouts are not intact.
  - .3        Electro-galvanized steel utility boxes (handy boxes) shall be used for outlets connected to surface mounted EMT conduit, minimum size 102 x 54 x 48 mm.
  - .4        102mm square or octagonal outlet boxes shall be used for lighting fixture outlets and as pull boxes or circuit junction boxes.
  - .5        102mm square outlet boxes with branch extension and plaster rings for flush mounting devices in finished walls.
  - .6        Electro-galvanized steel masonry gang boxes for devices flush mounted in concrete block walls.
  - .7        EDS backbox - Cooper-free aluminium explosion-proof box in hazardous location.
- .5        Conduit boxes:
  - .1        Conduit boxes shall be made of zinc plated cast iron.
  - .2        Provide 100mm round conduit boxes for mounting lighting fixtures, Fire Alarm devices and other ceiling mounted devices and as branch circuit junction boxes. Boxes shall be complete with surface mounting lugs and neoprene cover gaskets.
  - .3        Provide Type FS or FD conduit boxes for installation of wiring devices. Boxes shall be complete with threaded hubs suitable for the application, surface mounting lugs and neoprene cover gaskets.
  - .4        Cast copper-free aluminium explosion-proof box. Threaded construction throughout permit use in hazardous location.

### **2.2        FITTINGS**

- .1        Bushing and connectors with nylon insulated throats.
- .2        For rigid conduit, provide threaded type galvanized fittings.

- .3 For EMT, provide set screw type fittings with double locknuts for connection to sheet metal boxes and liquid tight fittings for connection to type FS or FD conduit boxes.
- .4 For rigid conduit in hazardous location, provide EYS fittings c/w CSA approved sealing compound.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6mm of opening.
- .4 Provide correct size of openings in boxes for conduit and cable connections. Do not install reducing washers.
- .5 Do not install coverplates until paint or other finish is applied

**END OF SECTION**

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## **Part 1 General**

### **1.1 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CAN/CSA C22.2 No. 18-98 (R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
  - .2 CSA C22.2 No. 45-M1981 (R2003), Rigid Metal Conduit.
  - .3 CSA C22.2 No. 56-13, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .4 CSA C22.2 No. 83-M1985 (R2013), Electrical Metallic Tubing.
  - .5 CSA C22.2 No. 211.1-06 (R2011), Rigid Types EB1 and DB2/ES2 PVC Conduit.

### **1.2 SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data: submit manufacturer's printed product literature, specifications and datasheets.
  - .1 Submit cable manufacturing data.
- .3 Quality assurance submittals:
  - .1 Test reports: submit certified test reports.
  - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .3 Instructions: submit manufacturer's installation instructions.

### **1.3 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and dispose of waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

## **Part 2 Products**

### **2.1 CONDUITS**

- .1 Rigid metal conduit: to CSA C22.2 No. 45.
- .2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83.
- .3 Minimum 21mm trade size conduits for lighting and power.

## **2.2 CONDUIT FASTENINGS**

- .1 One hole galvanized steel straps to secure surface conduits 50mm and smaller.
  - .1 Two hole galvanized steel straps for conduits larger than 50mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at the following maximum spacings:
  - .1 1500mm for 13mm and 19mm conduits.
  - .2 2000mm for 25mm and 32mm conduits.
  - .3 3000mm for 40mm and larger conduits.
- .4 Conduit clamps for conduits on channels.

## **2.3 CONDUIT FITTINGS**

- .1 Fittings for raceways: to CAN/CSA C22.2 No. 18.
- .2 Fittings manufactured for use with conduit specified.
- .3 Ensure factory "ells" where 90 degree bends for 19mm and larger conduits.
- .4 Explosion-proof EYS fittings filled with CSA approved sealing compound in hazardous or classified areas.

## **Part 3 Execution**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

- .1 Drawings do not show all conduits. Those shown are in diagrammatic form. Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Use rigid conduit in any location which, in the opinion of Departmental Representative, is subjected to mechanical damage or corrosion and where conduit is exposed in an inmate area.
- .3 Bend conduit cold:
  - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .4 Mechanically bend steel conduit over 19mm diameter.
- .5 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

- .6 Provide polypropylene fish cord in empty conduits to facilitate pulling wiring in future.
- .7 Where conduits become blocked, use of corrosive agents is prohibited. Remove and replace blocked section.
- .8 Dry conduits out thoroughly before installing wire.
- .9 Conduits shall not pass through structural members without the knowledge and consent of the Departmental Representative.
- .10 Locate conduits not less than 75mm parallel to steam or hot water lines with a minimum of 25mm at crossovers.
- .11 All conduit connectors shall be complete with a nylon insulated throat wherever conduit terminates in an outlet or junction box.
- .12 Conduit shall be secured to building structure. Do not fasten conduit to suspended ceiling or its support.
- .13 Run conduit parallel or perpendicular to building lines, when installed exposed or in ceiling spaces.
- .14 Locate conduits a minimum of 1.5 metres from infrared or gas fired heaters.
- .15 Conduits to be run in flanged portion of structural steel.
- .16 Group conduits wherever possible on surface channels.
- .17 Install CSA approved expansion fittings complete with grounding jumpers where conduits cross building expansion joints. Provide offsets in conduit adjacent to building expansion joints, where conduit is installed above suspended ceilings.
- .18 Conduits installed between heated and unheated spaces shall be sealed internally with a silicone sealant at the wall between the two spaces.
- .19 Install conduit sealing EYS fittings in hazardous areas. Fill with compound.

### **3.3 CONCEALED CONDUITS**

- .1 Do not install horizontal runs in masonry walls.
- .2 Do not install conduits in terrazzo or concrete toppings.

### **3.4 CONDUITS IN CAST-IN-PLACE CONCRETE**

- .1 Conduits shall not be installed in cast-in-place concrete slabs.

### **3.5 CONDUITS UNDERGROUND**

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (PVC accepted) with heavy coat of bituminous paint.

**3.6            CLEANING**

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

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.2 No.29-M1989 (R2004), Panelboards and Enclosed Panelboards.

**1.2 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

**1.3 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

**Part 2 Products**

**2.1 PANELBOARDS**

- .1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
  - .1 Install circuit breakers in panelboards before shipment.
  - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .2 Panelboards to be product of one manufacturer throughout project.
- .3 Panelboards designed for sequence phase connection of branch circuit devices.
- .4 Panelboards: mains ampacity, number of circuits, number and size of branch circuit breakers and minimum symmetrical interrupting capacity as indicated.
- .5 Panelboard enclosure shall be constructed of code gauge galvanized steel. Panelboard cover trim shall be finished with ANSI-61 grey enamel paint.
- .6 Tinned copper bus with full size neutral.
- .7 Mains: suitable for bolt-on breakers.
- .8 Trim and door finish: baked grey enamel.

- .9 Panelboards shall be complete with a factory mounted grounding bus with one terminal per circuit.
- .10 Include drip hood on panel boards when surface mounted in a room containing fire protection sprinklers.

## **2.2 BREAKERS**

- .1 Breakers: to Section 26 28 21 - Moulded Case Circuit Breakers.
- .2 All branch breakers shall be bolt-on, thermal magnetic type.
- .3 Breakers in panelboards shall have short circuit ratings as indicated or not less than the specified symmetrical interrupting capacity of the panelboard.

## **2.3 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Nameplate for each panelboard: size 5, engraved in accordance with Section 26 05 00 - Common Work Results - Electrical. Indicate panel designation, voltage, and phase (i.e. "PANEL A" 120/208V 3PH 4W). Mount on top front exterior face of panelboard.
- .3 Nameplate for each branch breaker: size 4, engraved in accordance with Section 26 05 00 - Common Work Results - Electrical. Indicate branch load designation. Mount on the panelboard front cover trim beside the branch breaker.
- .4 Identify all spare breakers with nameplates labelled "SPARE".

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on plywood backboards.
- .3 Mount panelboards to height specified in Section 26 05 00 - Common Work Results - Electrical or as indicated.
- .4 Connect loads to circuits.
- .5 Connect neutral conductors to common neutral bus.
- .6 Thoroughly vacuum all panelboards to remove construction debris and dust, prior to installation of panel cover trim.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.2 No.42-10, General Use Receptacles, Attachment Plugs and Similar Wiring Devices.
  - .2 CSA C22.2 No.111-10, General-Use Snap Switches (Bi-national standard, with UL 20).

**1.2 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

**1.3 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

**Part 2 Products**

**2.1 SWITCHES**

- .1 15 A, 120 V, single pole, three-way, four-way switches, as indicated, to: CSA C22.2 No.111.
- .2 Manually-operated specification grade AC switches, as indicated, with following features:
  - .1 Terminal holes approved for No. 10 AWG wire.
  - .2 Silver alloy contacts.
  - .3 Urea or melamine moulding for parts subject to carbon tracking.
  - .4 White toggle switch operator.
  - .5 Grounding terminal or self-grounding clip.
- .3 Switches of one manufacturer throughout project.

**2.2 RECEPTACLES**

- .1 Duplex receptacles, specification grade CSA type 5-15 R, 125 V, 15 A, U-ground, to: CSA C22.2 No. 42 with following features:
  - .1 Brown urea moulded housing.
  - .2 Suitable for No. 10 AWG for back and side wiring.
  - .3 Eight back wired entrances, four side wiring screws.
  - .4 Suitable for No. 10 AWG conductors back and side wiring.

- .5 Break-off links for use as split receptacles.
- .6 Triple wipe constant pressure power contacts with fingers in contact when receptacle is not in use.
- .2 Receptacles of one manufacturer throughout project.

## **2.3 COVER PLATES**

- .1 Cover plates from one manufacturer throughout project.
- .2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .3 Cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .4 Type 302 stainless steel cover plates for all other devices. Thickness shall be minimum .9mm (.04"). Finish shall be smooth satin without lines.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Switches:
  - .1 Install single throw switches with handle in "UP" position when switch closed.
  - .2 Install switches in gang type outlet box when more than one switch is required in one location.
  - .3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results - Electrical or as indicated.
  - .4 Locate light switches on latch side of doors.
- .2 Receptacles:
  - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
  - .2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results - Electrical or as indicated.
- .3 Cover plates:
  - .1 Protect cover plate finish with paper or plastic film until painting and other work is finished.
  - .2 Install suitable common cover plates where wiring devices are grouped.
  - .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 Canadian Standards Association (CSA International).
  - .1 CSA C22.2 No. 5-13, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489 and NMX-J-266-ANCE-2013).

**1.2 SUBMITTALS**

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Include time-current characteristic curves for breakers with ampacity of 400 A and over.

**1.3 WASTE MANAGEMENT AND DISPOSAL**

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

**Part 2 Products**

**2.1 BREAKERS GENERAL**

- .1 Moulded-case circuit breakers: to CSA C22.2 No. 5.
- .2 Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation.
- .3 Common-trip breakers: with single handle for multi-pole applications.
- .4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
  - .1 Trip settings on breakers with adjustable trips to range from 3-10 times current rating.
- .5 Breakers shall trip to "centre" position.

**2.2 THERMAL MAGNETIC BREAKERS**

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping under overload conditions and instantaneous magnetic tripping for short circuit protection.

**2.3 ENCLOSURE**

- .1 Breaker enclosures shall be surface mounted unless otherwise noted. The breaker shall be capable of being padlocked either in the "ON" or "OFF" position.

**Part 3          Execution**

**3.1            INSTALLATION**

- .1          Install circuit breakers as indicated.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 Canadian Standards Association (CSA International).
  - .1 CSA C22.2 No.4-04 (2009), Enclosed and Dead-Front Switches.
  - .2 CSA C22.2 No.39-13, Fuseholder Assemblies.

**1.2 SUBMITTALS**

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

**1.3 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and dispose of waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Fold up metal banding, flatten and place in designated area for recycling.

**Part 2 Products**

**2.1 DISCONNECT SWITCHES**

- .1 Enclosed manual air break switches in non-hazardous locations: to CSA C22.2 No. 4.
- .2 Fuseholder assemblies: to CSA C22.2 No. 39.
- .3 Fusible and non-fusible disconnect switch in CSA NEMA 1 as indicated.
- .4 Fusible and non-fusible disconnect switch in CSA NEMA 7 explosion proof in hazardous or classified areas.
- .5 Provision for padlocking in off switch position.
- .6 Mechanically interlocked door to prevent opening when handle in ON position.
- .7 Fuseholders in each switch: suitable without adaptors, for type and size of fuse indicated.
- .8 Quick-make, quick-break action.

- .9 ON-OFF switch position indication on switch enclosure cover.
- .10 Fusible and non-fusible disconnect switch shall be complete with solid neutral lug assembly.

## **2.2 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Indicate name of load controlled on size 4 nameplate.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install disconnect switches complete with fuses as indicated.
- .2 Mount securely at 1800mm above finished floor to top of switch. Provide a minimum of 1000mm clear floor space in front of the switch.

### **3.2 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Nameplate for each disconnect switch Size 5 engraved in accordance with Section 26 05 00 - Common Work Results - Electrical. Indicate disconnect load, amperage, voltage, and phase (i.e., rooftop unit, 60 amp, 120/208V, 3 phase).
- .3 Identify circuit number on disconnect switch (i.e. "B-36").

**END OF SECTION**

**Part 1            General**

**1.1            ACTION AND INFORMATIONAL SUBMITTALS**

- .1    Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2    Product Data:
  - .1    Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2    Provide complete photometric data prepared by independent testing laboratory for luminaires, for review by Departmental Representative.
  - .3    Photometric data to include:
    - .1    Total input watts.
    - .2    Candela.
    - .3    Distribution zonal lumen summary.
    - .4    Luminaire efficiency.
    - .5    Coefficient of utilization.
    - .6    Lamp type.
- .3    Quality assurance submittals: provide following:
  - .1    Manufacturer's instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence, and cleaning procedures.

**1.2            DELIVERY, STORAGE AND HANDLING**

- .1    Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2    Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3    Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .4    Divert unused metal materials from landfill to metal recycling facility.
- .5    Disposal and recycling of fluorescent lamps as per local regulations.
- .6    Disposal of old PCB filled ballasts.

**Part 2 Products**

**2.1 LUMINAIRES**

- .1 As indicated in luminaire schedule.
- .2 Stamped steel luminaire bodies not to be less than 0.91mm (20 gauge) thick cold rolled steel. Reflective steel plates of minimum 0.76mm (22 gauge) thick metal.
- .3 Where luminaires are mounted outdoors exposed to weather, the luminaire shall be complete with gaskets forming a weatherproof assembly. Luminaire shall be constructed of corrosion resistant materials, and electronic LED driver shall be suitable for operation in low ambient temperatures (-30 °C).

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Locate and install luminaires as indicated.

**3.2 WIRING**

- .1 Connect luminaires to lighting circuits as indicated.

**3.3 CLEANING**

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

**END OF SECTION**

## **Part 1        General**

### **1.1        REFERENCES**

- .1 American Society for Testing and Materials (ASTM)
  - .1 ASTM D698-12e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft.-lbf/ft<sup>3</sup> (600kN-m/m<sup>3</sup>)).
- .2 Federal Acts and Associated Regulations
  - .1 Fisheries Act
  - .2 Migratory Birds Convention Act
  - .3 Species at Risk Act
  - .4 Canadian Environmental Protection Act (CEPA)
  - .5 Federal Water Act
- .3 Provincial Acts and Associated Regulations
  - .1 The Environmental Management and Protection Act
  - .2 Environmental Assessment Act
  - .3 Clean Air Act
  - .4 Forest Resources Management Act
  - .5 Wildlife Act
  - .6 Wildlife Habitat Protection Act
  - .7 Saskatchewan Watershed Authority Act
  - .8 Noxious Weeds Act
  - .9 Heritage Property Act

### **1.2        DESCRIPTION**

- .1 Examine subsurface investigation report which is bound into specification following Section 33 56 13 - Above-ground Fuel Storage Tanks as Appendix A.
- .2 Known underground and surface utility lines and buried objects are as indicated on site plan.

### **1.3        PROTECTION**

- .1 Protect and/or transplant existing fencing, trees, landscaping, natural features, bench marks, buildings, pavement, surface or underground utility lines which are to remain as directed by Departmental Representative. If damaged, restore to original or better condition unless directed otherwise.
- .2 Maintain access roads to prevent accumulation of construction related debris on roads.

#### **1.4 TEMPORARY EROSION AND SEDIMENTATION CONTROL**

- .1 Provide sediment and erosion control plan, specific to site.
- .2 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.
- .3 Inspect, repair, and maintain erosion and sedimentation control measures during construction.
- .4 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

### **Part 2 Products**

#### **2.1 MATERIALS**

- .1 Only those materials present in the subgrade are required for subgrade preparation. No materials are required to be loaded and hauled as part of the shaping of the subgrade, unless indicated in the special provisions or plans.
- .2 The Contractor may be required to use sub-base or other materials, subject to the acceptance of the Departmental Representative, as backfill for subgrade failures. The specification for the materials used will apply.

### **Part 3 Execution**

#### **3.1 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.
- .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.

#### **3.2 STRIPPING OF TOPSOIL**

- .1 Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected as determined by Departmental Representative.

- .2 Commence topsoil stripping of areas as indicated or as directed by Departmental Representative after area has been cleared of brush, weeds and grasses and removed from site.
- .3 Strip topsoil to depths as required to suitable subsoil.
- .4 Stockpile in locations as directed by Departmental Representative. Stockpile height not to exceed 2.5m.
- .5 Dispose of unused topsoil to off-site location.

### **3.3 EXCAVATION**

- .1 Excavate to lines, grades, elevations and dimensions as indicated.
- .2 Remove concrete, masonry, paving, walks, demolished foundations and rubble and other obstructions encountered during excavation.
- .3 Excavation must not interfere with bearing capacity of adjacent foundations.
- .4 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.
- .5 For trench excavation 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.
- .6 Keep excavated and stockpiled materials safe distance away from edge of trench.
- .7 Restrict vehicle operations directly adjacent to open trenches.
- .8 Dispose of surplus and unsuitable excavated material in approved location off site.
- .9 Do not obstruct flow of surface drainage or natural watercourses.
- .10 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.
- .11 Notify Departmental Representative when bottom of excavation is reached.
- .12 Obtain Departmental Representative acceptance of completed excavation.
- .13 Remove unsuitable material from trench bottom including those that extend below required elevations to extent and depth as directed by Departmental Representative.
- .14 Correct unauthorized over-excavation as follows:
  - .1 Fill under bearing surfaces, road surfaces, footings and all other areas with Type 8 sub-base fill compacted in accordance with Section 32 11 16.01 - Granular Sub-Base.

- .15 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.
  - .2 Clean out rock seams and fill with concrete mortar or grout to acceptance of Departmental Representative.
- .16 Install geotextiles in accordance with Section 31 32 19.01 - Geotextiles.

### **3.4 DEWATERING AND HEAVE PREVENTION**

- .1 Keep excavations free of water while Work is in progress.
- .2 Provide for Departmental Representative's review details of proposed dewatering or heave prevention methods.
- .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 manner not detrimental to public and private property, or portion of Work completed or under construction.

### **3.5 GRADING**

- .1 Ensure that procedures are conducted in accordance with applicable Provincial and Municipal requirements.
- .2 Rough grade to levels, profiles, and contours allowing for surface treatment as indicated.
- .3 Verify that grades are correct and notify Departmental Representative if discrepancies occur. Do not begin work until instructed by Departmental Representative.
- .4 Prior to placing suitable site fill over existing ground, scarify surface to depth of 150 mm. Maintain fill and existing surface at approximately same moisture content to facilitate bonding.
- .5 Compact subgrade to maximum dry density to ASTM D698, as follows:
  - .1 The final top fifteen centimetres (15 cm) layer of the subgrade shall be compacted to not less than ninety-five percent (95%) of the maximum density under landscaped areas.
  - .2 The final top fifteen centimetres (15 cm) layer of the subgrade shall be compacted to not less than one hundred percent (100%) of the maximum density under paved and walk areas.

- .6 For the purpose of this specification, a failure is defined as a section of the existing subgrade that is unable to support normal traffic because of a condition that requires repair more than fifteen centimetres (15 cm) below the designated grade line. This definition will apply only to a section of subgrade before aggregate or mix is placed on it.
- .7 If the moisture existing in the soil is insufficient for compacting to the specified density and for finishing, the Contractor may elect to add water.
- .8 If excess moisture exists in the soil, the final top fifteen centimetres (15 cm) of the subgrade shall be dried, to the optimum moisture content as determined by testing, at no direct expense to the Owner.
- .9 Do not disturb soil within branch spread of trees or shrubs to remain.

### **3.6 PROOF ROLLING**

- .1 For proof rolling use standard roller of 45400 kg gross mass with four pneumatic tires each carrying 11350 kg and inflated to 620 kPa. Four tires arranged abreast with centre to centre spacing of 730 mm maximum.
- .2 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.
- .3 Where proof rolling reveals areas of defective subgrade:
  - .1 Remove subgrade material to depth and extent as directed by the Departmental Representative.
  - .2 Backfill excavated subgrade with Type 8 granular sub-base material and compact in accordance with section 32 11 16.01 - Granular Sub-Base.

### **3.7 TESTING**

- .1 Inspection and testing of soil compaction will be carried out by testing laboratory designated by Underwriters Laboratories of Canada.
- .2 Costs of all materials and performance tests will be paid by Contractor.
- .3 Submission of test results to the Departmental Representative will be required.

### **3.8 SURPLUS MATERIAL**

- .1 Remove surplus material and material unsuitable for fill, grading or landscaping to a location off site.

**END OF SECTION**

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## **Part 1 General**

### **1.1 REFERENCES**

- .1 ASTM International
  - .1 ASTM A123/A123M-13, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - .2 ASTM D3786/D3786M-13, Standard Test Method for Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method.
  - .3 ASTM D4355/D4355M-14, Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.
  - .4 ASTM D4491-99a (2014)e1, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
  - .5 ASTM D4533-11, Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
  - .6 ASTM D4632/D4632M-08(2013)e1, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
  - .7 ASTM D4751-12, Standard Test Method for Determining Apparent Opening Size of a Geotextile.
  - .8 ASTM D4833/D4833M-07(2013)e1, Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
  - .9 ASTM D6241-14, Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for geotextiles and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
  - .1 Submit following samples 4 weeks prior to beginning Work.
    - .1 Methods of joining.
- .4 Test and Evaluation Reports:
  - .1 Submit copies of mill test data and certificate at least 4 weeks prior to start of Work.

### **1.3 DELIVERY, STORAGE AND HANDLING**

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

- .2 Storage and Handling Requirements:
  - .1 Store materials in accordance with manufacturer's recommendations in clean, dry and well-ventilated area.
  - .2 Store and protect geotextiles from direct sunlight and UV rays.
  - .3 Replace defective or damaged materials with new.
- .3 Packaging Waste Management: remove for reuse and/or return to manufacturer of pallets, crates, padding, and packaging materials.

## Part 2 Products

### 2.1 MATERIALS

- .1 Geotextile: non-woven synthetic fibre fabric, supplied in rolls.
- .2 Separation Fabric will be non-woven and meet or exceed the following requirements:

Table 2.1.2 - Separation Geotextile Fabric - Non-Woven		
Physical Property	Standard	Test Method
Grab Tensile Strength	900 N - minimum	ASTM D4632/D4632M
CBR Puncture	2200 N - minimum	ASTM D6241
Trapezoid Tear	350 N - minimum	ASTM D4533
Apparent Opening Size	0.18mm - maximum	ASTM D4751
Permittivity	1.4 sec <sup>-1</sup> - minimum	ASTM D4491
Flow Rate	4000 l/min/m <sup>2</sup> - minimum	ASTM D4491
U.V. Resistance	70% per 500 hrs. - minimum	ASTM D4355/D4355M

- .3 When CBR Puncture and Trapezoid Tear material property values are not available from the manufacturer, the following material property values for Puncture Strength\* and Mullen Burst\*\* must be met as alternatives to CBR Puncture and Trapezoid Tear in Table 2.1.3:

Table 2.1.3 - Alternative Material Property Values		
Physical Property	Standard	Test Method
*Puncture Strength	575 N - minimum	ASTM D4833/D4833M
**Mullen Burst	2000 kPa - minimum	ASTM D3786/D3786M

- .4      Securing pins and washers: to CSA G40.21, Grade 300W, hot-dipped galvanized with minimum zinc coating of 600 g/m<sup>2</sup> to ASTM A123/A123M.
- .5      Factory seams: sewn in accordance with manufacturer's recommendations.
- .6      Thread for sewn seams: equal or better resistance to chemical and biological degradation than geotextile.

## **Part 3      Execution**

### **3.1      EXAMINATION**

- .1      Verification of Conditions: verify that conditions of substrate are acceptable for geotextile material installation in accordance with manufacturer's written instructions.
  - .1      Visually inspect substrate in presence of Departmental Representative.
  - .2      Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3      Proceed with installation only after unacceptable conditions have been remedied and after receipt of written acceptance to proceed from Departmental Representative.

### **3.2      INSTALLATION**

- .1      Place geotextile material smooth and free of tension stress, folds, wrinkles and creases.
- .2      Place geotextile material on sloping surfaces in one continuous length from toe of slope to upper extent of geotextile.
- .3      Overlap each successive strip of geotextile 600mm over previously laid strip.
- .4      Pin successive strips of geotextile with securing pins in accordance with manufacturer's written instructions.
- .5      Protect installed geotextile material from displacement, damage or deterioration before, during and after placement of material layers.
- .6      Place a minimum of 150mm of sub-base over the geotextile fabric before driving construction vehicles over the geotextile fabric. After installation, cover with overlying layer within 4 hours of placement.
- .7      Replace damaged or deteriorated geotextile to approval of Departmental Representative.
- .8      Place and compact soil layers.

### **3.3 TESTING**

- .1 Testing of geotextile for conformance to the specifications may be carried out at the request of Departmental Representative by testing laboratory designated by Underwriters Laboratories of Canada.
- .2 Costs of all materials and performance tests will be paid by Contractor.

### **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 Waste Management: separate waste materials for reuse and/or recycling.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.5 PROTECTION**

- .1 Vehicular traffic not permitted directly on geotextile.

**END OF SECTION**

## Part 1 General

### 1.1 REFERENCES

- .1 ASTM International
  - .1 ASTM C117-13, Standard Test Methods for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.
  - .2 ASTM C136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - .3 ASTM D698-12e1, 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>)).
  - .4 ASTM D1557-12, Standard 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>)).
- .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 Saskatchewan Highways and Transportation - Standard Specification Manual.

## Part 2 Products

### 2.1 MATERIALS

- .1 Sub-base aggregate shall be composed of sound, hard, and durable particles of sand, gravel and rock free from injurious quantities of soft or flaky particles, shale, loam, clay balls and organic or other deleterious material.
- .2 Granular sub-base material in accordance with the following requirements:
  - .1 Crushed, pit run 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 and/or CAN/CGSB 8.2.
  - .3 Sub-base course shall comply with the requirements listed in Table 2.1.1.3:

Table 2.1.1.3 - Sub-Base Course Material			
Sieve Designation	% Passing		
	Type 6	Type 8	Type 10
75 mm			
50 mm	100	100	100
37.5 mm			
25 mm			

<b>Table 2.1.1.3 - Sub-Base Course Material</b>			
<b>Sieve Designation</b>	<b>% Passing</b>		
19 mm			
12.5 mm			
9.5 mm			
4.75 mm			
2.00 mm	0 - 80	0 - 90	
0.400 mm	0 - 45	0 - 60	
0.160 mm	0 - 20	0 - 25	
0.071 mm	0 - 60	0 - 15	0 - 20
Plasticity Index	0 - 6.0		

- .4 A tolerance of 3% in the percent by weight passing the maximum size sieve shall be permitted providing 100% of the oversize passes the 63.0mm sieve.
- .5 Contractor to submit material source to verify that material is not contaminated.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- .1 Verify conditions of subgrade preparation under Section 31 22 13 - Rough Grading is acceptable for granular sub-base installation.
  - .1 Visually inspect subgrade in presence Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written acceptance to proceed from the Departmental Representative.

#### **3.2 PLACING**

- .1 Place granular sub-base after subgrade is reviewed and accepted by the Departmental Representative.
- .2 Construct granular sub-base to depth and grade in areas indicated.
- .3 Ensure no frozen material is placed.
- .4 Place material only on clean unfrozen surface, free from snow or ice.
- .5 Place granular sub-base materials using methods which do not lead to segregation or degradation.
- .6 For spreading and shaping material, use spreader boxes having adjustable templates or screeds which will place material in uniform layers of required thickness.

- .7 Place material to full width in uniform layers not exceeding 150mm compacted thickness.
- .8 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- .9 Remove and replace portion of layer in which material has become segregated during spreading.

### **3.3 COMPACTION**

- .1 Compaction equipment to be capable of obtaining required material densities.
- .2 Compact to density of not less than 98% maximum dry density in accordance with ASTM D698 and/or ASTM D1557.
- .3 Shape and roll alternately to obtain smooth, even and uniformly compacted sub-base.
- .4 Apply water as necessary during compaction to obtain specified density.
- .5 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers accepted by the Departmental Representative.
- .6 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

### **3.4 PROOF ROLLING**

- .1 For proof rolling use standard roller of 45400 kg gross mass with four pneumatic tires each carrying 11350 kg and inflated to 620 kPa. Four tires arranged abreast with centre to centre spacing of 730mm maximum.
- .2 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.
- .3 Where proof rolling reveals areas of defective subgrade:
  - .1 Remove granular sub-base and subgrade material to depth and extent as directed by the Departmental Representative.
  - .2 Backfill excavated subgrade with Type 8 granular sub-base material and compact in accordance with this section.
  - .3 Replace granular sub-base material and compact in accordance with this section.
  - .4 Removal and replacement of granular sub-base material to be performed at no extra cost.

### **3.5 TESTING**

- .1 Testing of granular sub-base for conformance to specifications and compaction requirements will be carried out by testing laboratory designated by Underwriters Laboratories of Canada.
- .2 Costs of all materials and performance tests will be paid by Contractor.
- .3 Submission of test results to the Departmental Representative will be required.

**3.6 CLEANING**

- .1 Progress Cleaning:
  - .1 Leave Work area clean at end of each day.

**3.7 SITE TOLERANCES**

- .1 Finished sub-base surface to be within 10mm of elevation as indicated but not uniformly high or low.

**3.8 PROTECTION**

- .1 Maintain finished sub-base in condition conforming to this section until succeeding base course layer is constructed.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCES**

- .1 American Society for Testing and Materials (ASTM)
  - .1 ASTM C117-13, Standard Test Methods for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.
  - .2 ASTM C136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - .3 ASTM D698-12e1, 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>)).
  - .4 ASTM D1557-12, 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>)).
- .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 Saskatchewan Highways and Transportation - Standard Specification Manual.

### **1.2 WASTE MANAGEMENT AND DISPOSAL**

- .1 Waste Management: separate waste materials for reuse and/or recycling.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
- .2 Divert unused granular material from landfill to local quarry facility.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Base aggregate shall be composed of sound, hard and durable particles of sand, gravel and rock free from injurious quantities of elongated, soft or flaky particles, shale, loam, clay balls and organic or other deleterious material.
- .2 Granular base: material in accordance with the following requirements:
  - .1 Crushed stone or gravel.
  - .2 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB 8.1 and/or CAN/CGSB 8.2.
    - .1 Base course shall comply with the requirements listed in Table 1.5.1.2.1.

<b>Table 2.1.2.2 –Base Course Material</b>			
<b>Sieve Designation</b>	<b>% Passing</b>		
	Type 31	Type 33	Type 35
31.5 mm	100.0		
18.0 mm	75.0 - 90.0	100.0	100.0
12.5 mm	65.0 - 83.0	75.0 - 100.0	81.0 - 100.0
5.0 mm	40.0 - 69.0	50.0 - 75.0	50.0 - 85.0
2.0 mm	26.0 - 47.0	32.0 - 52.0	32.0 - 65.0
900 µm	17.0 - 32.0	20.0 - 35.0	20.0 - 43.0
400 µm	12.0 - 22.0	15.0 - 25.0	15.0 - 30.0
160 µm	7.0 - 14.0	8.0 - 15.0	8.0 - 18.0
71 µm	6.0 - 11.0	6.0 - 11.0	7.0 - 12.0
Plasticity Index	0 - 7.0	0 - 6.0	0 - 5.0
Fractured Face %	50.0 Minimum		
Light Weight Pieces %	5.0 Minimum		

- .3 A tolerance of 3% in the percent by weight passing the maximum size sieve shall be permitted providing 100% of the oversize passes the 40.0mm sieve for Type 31 base course and the 22.4mm sieve for Types 33 and 35 base courses.
- .4 Contractor to submit material source to verify that material is not contaminated.

### **Part 3 Execution**

#### **3.1 SEQUENCE OF OPERATION**

- .1 Place granular base after sub-base surface is reviewed and accepted by Departmental Representative.
- .2 Placing
  - .1 Construct granular base to depth and grade in areas indicated.
  - .2 Ensure no frozen material is placed.
  - .3 Place material only on clean unfrozen surface, free from snow and ice.
  - .4 Place material using methods which do not lead to segregation or degradation of aggregate.
  - .5 For spreading and shaping material, use spreader boxes having adjustable templates or screeds which will place material in uniform layers of required thickness.
  - .6 Place material to full width in uniform layers not exceeding 150mm compacted thickness.
  - .7 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.

- .8 Remove and replace that portion of layer in which material becomes segregated during spreading.
- .3 Compaction Equipment
  - .1 Compaction equipment to be capable of obtaining required material densities.
- .4 Compacting
  - .1 Compact to density not less than 100% maximum dry density in accordance with ASTM D698 and/or ASTM D1557.
  - .2 Shape and roll alternately to obtain smooth, even and uniformly compacted base.
  - .3 Apply water as necessary during compacting to obtain specified density.
  - .4 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers reviewed by Departmental Representative.
  - .5 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.
- .5 Proof rolling
  - .1 For proof rolling use standard roller of 45400 kg gross mass with four pneumatic tires each carrying 11350 kg and inflated to 620 kPa. Four tires arranged abreast with centre to centre spacing of 730 mm maximum.
  - .2 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.
  - .3 Where proof rolling reveals areas of defective subgrade:
    - .1 Remove aggregate base course, granular sub-base and subgrade material to depth and extent as directed by the Departmental Representative.
    - .2 Backfill excavated subgrade with Type 8 granular sub-base material and compact in accordance with section 32 11 16.01.
    - .3 Replace granular sub-base material and compact in accordance with section 32 11 16.01.
    - .4 Replace aggregate base course material and compact in accordance with this section.
    - .5 Removal and replacement of granular sub-base material and aggregate base course to be performed at no extra cost.

### **3.2 TESTING**

- .1 Testing of aggregate base course for conformance to specifications and compaction requirements will be carried out by testing laboratory designated by Underwriters Laboratories of Canada.
- .2 Costs of all materials and performance tests will be paid by Contractor.
- .3 Submission of test results to the Departmental Representative will be required.

**3.3 CLEANING**

- .1 Progress Cleaning:
  - .1 Leave Work area clean at end of each day.

**3.4 SITE TOLERANCES**

- .1 Finished base surface to be within plus or minus 10mm of established grade and cross section but not uniformly high or low.

**3.5 PROTECTION**

- .1 Maintain finished base in condition conforming to this Section until succeeding material is applied.

**END OF SECTION**

## **Part 1        General**

### **1.1        REFERENCES**

- .1    ASTM International
  - .1    ASTM D140/D140M-14, 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.

### **1.2        ACTION AND INFORMATIONAL SUBMITTALS**

- .1    Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2    Product Data:
  - .1    Submit manufacturer's instructions, printed product literature and data sheets for asphalt prime coat and include product characteristics, performance criteria, physical size, finish and limitations.
- .3    Samples:
  - .1    Sample asphalt prime coat materials in accordance with ASTM D140/D140M.
  - .2    Provide access on tank truck for Departmental Representative to sample asphalt material to be incorporated into Work, in accordance with ASTM D140/D140M.

### **1.3        QUALITY ASSURANCE**

- .1    Upon request from Departmental Representative submit manufacturer's test data and certification that asphalt prime material meets requirements of this Section.

### **1.4        DELIVERY, STORAGE AND HANDLING**

- .1    Deliver materials in accordance with manufacturer's written instructions.
- .2    Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
  - .1    Make deliveries during normal work hours.
  - .2    Provide, maintain and restore asphalt storage area.
- .3    Storage and Handling Requirements:
  - .1    Deliver, store and handle materials to ASTM D140/D140M.
  - .2    Store materials and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .3    Store and protect asphalt prime coats from nicks, scratches, and blemishes.

.4 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and/or return of pallets, crates, padding, and packaging in accordance with Specifications.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Asphalt material: to CAN/CGSB 16.1 grade: RC-30, MC-30 and MC-250. CAN/CGSB 16.2 grade: SS-1.
- .2 Sand blotter: clean granular material passing 4.75mm sieve and free from organic matter or other deleterious materials.
- .3 Water: clean, potable, free from foreign matter.

### **2.2 EQUIPMENT**

- .1 Pressure distributor:
  - .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 0.2 to 5.4 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 travel distance in metres 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.
    - .1 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.
    - .1 Temperature to be measured to nearest whole number.
  - .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 in increments of 0.6 metres and capable of being raised or lowered.
  - .8 Cleaned if previously used with incompatible asphalt material.

- .2 Aggregate Spreader:
  - .1 Apply blotter sand to primed surfaces using roll type spreader, or rotating disc sander capable of applying aggregate at variable widths and at variable rates.

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### **3.2 APPLICATION**

- .1 Proceed with application of tack coat only after receipt of written acceptance of granular base surface from Departmental Representative.
- .2 Anionic emulsified asphalt:
  - .1 Dilute asphalt emulsion with clean water at 1:1 ratio for application.
  - .2 Mix thoroughly by pumping or other method accepted by Departmental Representative.
  - .3 Apply diluted asphalt emulsion at rate between 0.45 and 1.35 L/m<sup>2</sup>.
  - .4 Apply diluted asphalt emulsion on damp surface.
- .3 Apply asphalt prime only on unfrozen surface.
- .4 Apply asphalt tack coat only when air temperature is greater than 10 degrees C and when rain is not forecast within 2 hours minimum of application.
- .5 Paint contact surfaces of curbs, gutters, headers, manholes and like structures with thin, uniform coat of asphalt prime material.
- .6 Where traffic is to be maintained, treat no more than one-half width of surface in one application.
- .7 Prevent overlap at junction of applications.
- .8 Do not prime surfaces that will be visible when paving is complete.
- .9 Apply additional material to areas not sufficiently covered as directed by Departmental Representative.
- .10 Keep traffic off primed areas until asphalt prime has cured and set.
- .11 Permit prime to cure and set before placing asphalt paving.

### **3.3 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.
- .3 Apply second application of sand blotter as required.
- .4 Do not roll blotter sand.
- .5 Sweep and remove excess blotter material.

### **3.4 CLEANING**

- .1 Progress Cleaning:
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
- .3 Waste Management: separate waste materials for reuse and/or recycling.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

**Part 1 General**

**1.1 MEASUREMENT PROCEDURES**

- .1 There shall not be any measurement required for asphalt concrete paving.
- .2 Supply and installation of asphalt concrete pave shall be incidental to the work as a whole.

**1.2 REFERENCES**

- .1 American Society for Testing and Materials International, (ASTM)
  - .1 ASTM C117-13, Standard Test Method for Material Finer Than 0.075mm (No.200) Sieve in Mineral Aggregates by Washing.
  - .2 ASTM C136-06, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
  - .3 ASTM D5/D5M-13, Standard Test Method for Penetration of Bituminous Materials.
  - .4 ASTM D92-12b, Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester.
  - .5 ASTM D113-07, Standard Test Method for Ductility of Bituminous Materials.
  - .6 ASTM D995-95b(2002), Standard Specification for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
  - .7 ASTM D1557-12, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)).

**1.3 PRODUCT DATA**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit asphalt concrete mix design and trial mix test results to Departmental Representative for review at least two (2) weeks prior to beginning Work.
- .3 The Contractor shall provide a sieve analysis of the aggregate material to Departmental Representative for review at least two (2) weeks prior to beginning Work.
- .4 The Contractor shall pay for all costs of performing these tests.

**1.4 SAMPLES**

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

**1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

- .3 Divert unused aggregate materials from landfill to quarry facility for reuse.
- .4 Divert unused asphalt from landfill to facility capable of recycling materials.

## Part 2 Products

### 2.1 MATERIALS

- .1 The Contractor shall supply a five point, 50 blow, Marshall method mix design on the approved aggregate for the asphaltic mix to meet the following characteristics.

.1	Marshall Stability at 60°	not less than 8,000 N
.2	Marshall Flow Index	2.0 mm to 4.0 mm
.3	Percentage Voids of Total Mix	3.5% to 5.5%
.4	Percentage Aggregate Voids Filled with Asphalt	75% to 90%
.5	Voids in Mineral Aggregate (VMA)	14.0% minimum
.6	Permissible Variation of Asphalt Cement From Job Mix	0.25%
.7	Asphalt Film Thickness (um)	7.5 minimum
.8	The Asphalt Cement Content	5.7% minimum
.9	Anti-Stripping Agent or Lime	Stripping Potential <5%

The Marshall Stability value and Flow Index shall be tested by ASTM for Resistance to Plastic Flow of Bituminous Mixtures.

The Percentage Voids and Percentage Aggregate Voids filled with Asphalt shall be determined according to the Marshall Method of Mix Design for Hot Mix Asphalt Paving.

### 2.2 GRADATION FOR ASPHALT MIX

- .1 Aggregate shall consist of hard, durable, uniformly graded crushed gravel and shall not contain organic or soft materials that break up when alternately frozen and thawed or wetted and dried, nor other deleterious materials.
- .2 Aggregate shall meet the following gradation when tested to ASTM C136 and ASTM C117, and give a smooth curve without sharp breaks when plotted on semi-log grading chart.

.1 Table 2.2.1 Asphalt Aggregate

Sieve Designation (mm)	% Passing by Dry Mass Residential Class II	
	Lower Limit	Upper Limit
16	100	100
12.5	78	97
9.0	66	90
5.0	50	72
2.0	32	51
0.900	21	37
0.400	16	27
0.160	7	15
0.071	4	10

Sieve Designation (mm)	% Passing by Dry Mass Residential Class II	
	Lower Limit	Upper Limit
Sand Equivalent	50 minimum	
% Fractured Face	60.0 minimum	
% Light Weight Pieces	1.5 Maximum	

.2 The Liquid Limit shall not exceed 25 and the Plasticity Index shall not exceed 6 for the portion of material passing the 400 sieve.

.3 Los Angeles Abrasion: Maximum % loss by weight: 40%

.4 Crushed Fragments: At least 60% of fragments within following size ranges to have at least 2 freshly fractured faces:

**Passing**

20.0 mm

**Retained On**

to 5.0 mm

.5 Maximum of 3.0% total deleterious matter by total mass of combined aggregate.

.3 Should the grading of the mineral aggregates supplied to the plant not meet the gradation above, mineral filler shall be added in the weight hopper of the asphalt plant in such quantities as will be required to meet the specifications.

## 2.3 MINERAL FILLER

.1 Mineral filler shall consist of Portland Cement, Pozzolan, commercially ground stone dust or other mineral dust accepted by the Departmental Representative. Mineral filler shall have a Plasticity Index of Zero and, when tested by means of laboratory sieves, it shall meet the following gradation.

.1 Table 2.3.1 Mineral Filler

Sieve Size (mm)	Percent Passing (by weight)
0.400	100
0.160	Not less than 90
0.063	Not less than 70
0.045	Not less than 62

.2 Mineral filler to be dry and free flowing when added to aggregate.

## 2.4 ASPHALTIC BINDER

.1 The asphaltic binder shall be uniform in character, shall not foam when heated to 175°C, and shall meet the following requirements:

- |    |   |                             |
|----|---|-----------------------------|
| .1 | Designation   | A/C 150/200                 |
| .2 | Penetration (ASTM D5/D5M) under 100 g for 5 sec at 25°C | 170 to 240                  |
| .3 | Flash Point (ASTM D92) filled or unfilled greater than  | 232°C                       |
| .4 | Ductility (ASTM D113)                                   |                             |
|    | strain rate of cm/s at                                  | 25°C greater than 100(+) cm |
| .5 | Solubility in CC1 <sub>4</sub> . (unfilled)             | 99.0(+)%                    |
| .6 | Kinematic Viscosity in Centistokes at 135°C             | 150(+)                      |

## **2.5 STORAGE OF MATERIALS**

- .1 The aggregate shall be stockpiled at the mixing plant. Stockpiles shall be constructed by placing the aggregate in uniform layers over a predetermined stockpile area in such a manner that no segregation of the various particle sizes results. The asphalt binder shall be stored in suitable tanks at a temperature not exceeding 150 °C.

## **2.6 MIXING PLANT**

- .1 The mixing plant and auxiliary equipment shall be such as to combine, dry, and heat the mineral aggregate, heat the asphalt and accurately proportion the asphalt and aggregate to produce a uniform mixture. The mixing plant shall meet the requirements of ASTM D995 for Bituminous Mixing Plant Requirements.

## **Part 3 Execution**

### **3.1 PREPARATION OF SITE**

- .1 Patch and correct depressions and other irregularities to acceptance of the Departmental Representative before beginning paving operations. Prior to laying mix, clean surfaces of loose and foreign material and apply prime coat or tack coat in accordance with Section 32 12 13.23 - Asphalt Prime Coats.

### **3.2 PREPARATION OF MIXTURE**

- .1 The mineral aggregate, and mineral filler when required, shall be combined by means of hoppers and conveyors at the cold feed plant. The aggregate shall be dried and delivered at a temperature of 120 ° to 160 °C to the mixer. The temperature between these limits shall be regulated according to the penetration grade of the asphalt, temperature of the atmosphere and workability of the mixture. The aggregate shall be dry mixed in the mixer for not less than 15 seconds.
- .2 The asphalt cement shall be brought to temperature of 120 ° to 160 °C before mixing with aggregate. The temperature between these limits shall be regulated to the penetration grade of the asphalt used.
- .3 The aggregate and asphalt cement shall then be mixed in the proportions as determined by the design mix. The temperature of both the aggregate and asphalt cement shall be maintained between 120 °C and 150 °C until mixing is completed. The time of mixing shall be not less than 30 seconds, and shall be such that a homogenous mixture is produced in which all particles of the aggregate are uniformly coated with asphalt.
- .4 The bituminous mix temperature at mixer discharge shall be controlled between low temperature of 130 °C and a maximum high temperature of 150 °C.

.5 Mix Tolerances

- .1 All mixture furnished shall conform to the job mix formula within the range of tolerance specified.

<u>Aggregate Material Passing</u>	<u>Percent by Weight</u>
5.0 mm Sieve	± 5
0.90 mm Sieve	± 3
0.071 mm Sieve	± 1.5

- .2 The amount of bituminous material designated for the job mix shall be maintained within the tolerance of 0.25 percentage points.
- .3 The temperature for mixing asphaltic mixtures shall not vary from those specified in the job mix formula by more than 5°C.

**3.3 TRANSPORTATION OF MIX**

- .1 The mixture shall be transported from the mixing plant to the work in vehicles with tight metal boxes previously cleaned of all foreign materials. The vehicles shall be suitably insulated and each load shall be covered with canvas or other suitable material of sufficient size to protect it from weather conditions. The inside surface of all vehicles may be lightly lubricated with a thin oil or soap solution prior to loading, but excess lubricating will not be permitted.
- .2 Any accumulation of asphaltic material which was collected in the box shall be thoroughly cleaned before loading with hot mix.
- .3 Trucks shall be maintained perfectly clean of mud or any substance which could contaminate the working area.

**3.4 PAVER**

- .1 The mixture shall be laid with a mechanical self-powered spreader capable of spreading the mixture true to line, grade and crown as required. The paver shall be equipped with hopper and distributing screw of the reversing type to place the mixture evenly in front of adjustable screeds.
- .2 Mechanical self-powered pavers shall be equipped with electronic screed control system capable of automatically maintaining screed elevations on each side of the paver through any combination of stringline, 9.1 m long ski-type device or joint matching shoe.

**3.5 PLACING**

- .1 The Contractor shall remove all loose and foreign material and water prior to placing the asphaltic concrete mixture. The mixture shall be delivered at a minimum temperature of 130°C or maximum temperature of 150°C and laid in dry conditions and only when the ambient air temperature is 2°C and rising.
- .2 The mixture shall be laid and rolled to the widths and thickness shown on the drawings. The finished surface shall have the minimum number of longitudinal and horizontal joints as practicable.

- .3 The asphalt pavement shall be laid in two lifts; the second lift shall not be placed over the bottom layer within 24 hours. Before rolling is started, the surface shall be checked, inequalities in depth adjusted and fat spots or sandy accumulations replaced and irregularities in alignment or grade along the outside edge shall be corrected.
- .4 The maximum thickness of any lift shall not exceed 50mm compacted thickness.
- .5 The Contractor will only be allowed to place bituminous mix during daylight hours. Daylight hours are from sunrise to one-half hour before sunset.
- .6 When temperature of surface on which material is to be placed falls below 10°C, provide extra rollers as necessary to obtain required compaction before cooling.
- .7 Do not place hot mix asphalt when pools of standing water exist on surface to be paved, during rain, or when surface is damp.
- .8 In small areas where the use of mechanical finishing equipment is not practical, the mix may be spread and finished by hand, if so directed by the Departmental Representative. The material shall be distributed uniformly to avoid segregation of coarse and fine aggregates. Broadcasting of material shall not be permitted. During the spreading operation, all material shall be thoroughly loosened and uniformly distributed by lutes or rakes. Material that has formed into lumps and does not break down readily shall be rejected.

### **3.6 JOINTS**

- .1 A continuous well-sealed bond is required between old and new surfaces. The contact surface of all longitudinal joints shall be painted with a thin and uniform coat of hot asphalt primer before placing the new mix, and the same treatment shall be given to contact joints with curbs, gutters, manholes and other appurtenances.
- .2 When the work is resumed after a lapse of several hours, one end shall be cut back approximately 150mm to a new and clean surface before paving is started and heat shall be used as necessary to ensure a proper bond.
- .3 Where the asphaltic concrete material is placed in two layers; longitudinal joints in the two layers shall be staggered by a minimum of 150mm.
- .4 Where the proposed pavement meets the existing pavement, the Contractor shall cut to a neat square edge to ensure a good seam. The cost of this cutting shall be included in the unit price bid for hot mix asphaltic concrete.

### **3.7 ROLLERS**

- .1 The rollers used for compaction shall be self-propelled steel-wheeled and rubber tired rollers, weighing at least 3.6 kilograms per millimeter width of tread.
- .2 The rollers shall be in good condition without backlash when reversed and shall be operated by competent roller-person.
- .3 The wheels shall be kept properly moistened, but excess water or lubricant will not be permitted.

- .4 The rollers must be kept in continuous operation as nearly as practicable and all parts of the pavement shall receive substantially the same compaction.
- .5 The number of rollers used on the project shall be compatible with the rate the asphalt is being laid.

### **3.8 ROLLING AND COMPACTION**

- .1 Before rolling is started, the surface shall be checked, inequalities in depth adjusted and fat spots or sandy accumulations replaced, and irregularities in alignment or grades along the outside edge shall be corrected.
- .2 At least one steel wheeled and one rubber tire roller shall be used for every 40 tonnes of asphaltic concrete laid per hour.
- .3 Rolling shall start as soon as the pavement will bear the roller without checking or undue displacement, working from the lower part or edge to the high part or edge continuously until no roller marks are left in the finished surface and no further compaction is possible.
- .4 The rollers must be kept in continuous operation as nearly as practicable and all parts of the pavement shall receive substantially the same compaction. Rolling shall be done at a maximum speed of 5 km per hour.
- .5 All the curbs, manholes and other appurtenances, and at all locations not accessible to the roller, hand tampers shall be used to produce the same density as provided by the roller.
- .6 The completed pavement shall not have a density of less than 98% of the laboratory compacted density as determined by methods described in ASTM D1557, using a compaction of 50 blows for each face.

### **3.9 FINISH**

- .1 The finished pavement shall be true to the required profile and cross-section. The allowable tolerance for finished pavement shall be  $\pm 5\text{mm}$ , and the surface shall show no depressions or bumps exceeding 3mm under a straight-edge 3 m long placed parallel to the road centreline.
- .2 Finished surface shall have a tightly knit texture free of visible signs of poor workmanship such as, but not limited to:
  - .1 Segregation
  - .2 Areas exhibiting excess or insufficient asphalt
  - .3 Improper matching of longitudinal and transverse joints
  - .4 Roller marks, cracking, or tearing
- .3 If surface and grade tolerances are exceeded, or if surface texture is not met, repair defective areas as required by the Departmental Representative.

### **3.10 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 a true and even surface and compact immediately to specified density.
- .2 Repair areas showing checking or hairline crackling.

### **3.11 TESTING AND INSPECTION**

- .1 Bituminous Mixture Samples:
  - .1 Samples of the bituminous mixture shall be taken from the spreader or haul truck and forwarded to an approved laboratory for testing. One such sample shall be obtained per 2,000 square metres of area surfaced except during the initial period of construction when a greater number of samples will be necessary.
- .2 The following tests shall be performed on all samples of the bituminous mixture submitted to the laboratory.
  - .1 Bitumen Content
  - .2 Aggregate Gradation
- .3 On the first four samples submitted and on every third sample thereafter, the following additional tests shall be performed.
  - .1 VMA
  - .2 Per Cent Air Voids
  - .3 Marshall Stability
  - .4 Flow
  - .5 Density
- .4 One core sample shall be obtained for each one hundred lineal metres of street paved. Core sample locations should correspond to the same locations as samples gathered for Lab testing. All core samples shall be tested for bitumen content and density and measured for thickness. Every third specimen shall also be tested for aggregate gradation.
- .5 The contractor shall repair all test holes with fresh, hot mix asphaltic concrete mixture, and thoroughly compact it to the required density with no additional compensation.
- .6 Submission of test results to the Departmental Representative will be required.

### **3.12 TRAFFIC**

- .1 No traffic shall be allowed on the finished surface until it has cooled to atmospheric temperature.

**3.13 FAILURE TO MEET COMPACTION DENSITY AND THICKNESS REQUIREMENT**

- .1 The Owner reserves the right to reject any Hot Mix Bituminous Surface Course whatsoever which does not meet all the specified requirements for the Hot Mix Bituminous Surface Course.
- .2 If any Hot Mix Bituminous Surface Course tested in accordance with this Specification fails to meet the specified density, the Contractor may request coring of the Hot Mix Bituminous Surface Course in question. When such coring is accepted by the Departmental Representative, arrangements shall be made by the Contractor, through the Departmental Representative, to employ an independent, qualified testing service, all at the expense of the Contractor. The cores shall be taken and tested within three days of the testing of the cores representing the Hot Mix Bituminous Surface Course in question. One core shall be taken for each strength test previously taken and there shall be no doubt that the cores taken represent the area in question. Cores shall be tested in accordance with the requirements of ASTM D1557 and reported by the independent testing service shall constitute a test. When more than one core strength is taken, in one area the average of all the core strength tests shall represent the strength of the Hot Mix Bituminous Surface Course in question.

**3.14 ACCEPTANCE**

- .1 Locations shall be cleared of all excess material resulting from the paving operation and any damage caused by the Contractor shall be repaired to the Departmental Representative's satisfaction within 3 days of the date of completion of the street or lane. Failure to cleanup or repair damage may result in other crews undertaking this work without notice to the Contractor and deducting the costs from money due to the Contractor.

**END OF SECTION**

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## **Part 1        General**

### **1.1        REFERENCES**

- .1    National Fire Protection Association (NFPA).
  - .1        NFPA 329-2010, Recommended Practices for Handling Releases of Flammable and Combustible Liquids and Gases.
- .2    American Petroleum Institute (API).
  - .1        API Spec 5L-12, Specification for Line Pipe, 45th Edition.
  - .2        API Spec 6D-2014, Specification for Pipeline Valves (Gate, Ball, and Check Valves), 24th Edition.
  - .3        API RP 651-2007, Cathodic Protection of Aboveground Petroleum Storage Tanks, Third Edition.
  - .4        API Std 653-2009, Tank Inspection, Repair, Alteration, and Reconstruction, Fourth Edition.
- .3    American Society for Testing and Materials International (ASTM)
  - .1        ASTM A181/A181M-13, Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.
  - .2        ASTM A193/A193M-14, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
  - .3        ASTM A194/A194M-14, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
  - .4        ASTM A216/A216M-14, Standard Specification for Steel Castings, Carbon, Suitable For Fusion Welding, for High-Temperature Service.
- .4    Canadian Council of Ministers of the Environment (CCME).
  - .1        CCME PN 1326-2003, Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products.
- .5    Canadian Standards Association (CSA International)
  - .1        CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
- .6    Department of Justice Canada (Jus).
  - .1        Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
  - .2        Canadian Environmental Protection Act (CEPA), 1999, c. 33.
  - .3        Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
- .7    Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1        Material Safety Data Sheets (MSDS).
- .8    National Research Council Canada (NRCC).
  - .1        National Fire Code of Canada (NFCC)-2010.

- .9 Underwriters' Laboratories of Canada (ULC).
  - .1 CAN/ULC S601-14, Standard for Shop Fabricated Steel Aboveground Horizontal Tanks for Flammable and Combustible Liquids.
  - .2 CAN/ULC S602-07, Standard for Aboveground Steel Tanks for Fuel Oil and Lubricating Oil.

## 1.2 SUBMITTALS

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
    - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Indicate details of construction, appurtenances, installation, leakage detection system, etc.
  - .3 Shop drawings to detail and indicate following as applicable to project requirements. Submit manufacturer's product data to supplement shop drawings.
    - .1 Size, materials and locations of steps and lifting lugs.
    - .2 Tanks capacity.
    - .3 Size and location of fittings.
    - .4 Environmental compliance package accessories.
    - .5 Decals, type size and location.
    - .6 Accessories: provide details and manufacturer's product data.
    - .7 Finishes.
    - .8 Electronic accessories: provide details and manufacturer's product data.
    - .9 Insulation types, locations and RSI values.
    - .10 Identification, name, address and phone numbers of corrosion expert where applicable. Note: Grading drawings to be stamped by licenced corrosion expert.
    - .11 Piping, valves and fittings: type, materials, sizes, piping connection details, valve shut-off type and location, cathodic protection system complete with stamp of corrosion expert indicating that design complies with standards, Federal and Provincial regulations.
    - .12 Spill containment: provide description of method(s) and show sizes, materials and locations for collecting spills at connection point between storage tank system and delivery truck, rail car, or vessel.
    - .13 Thermometers: provide details and manufacturer's product data.
    - .14 Anchors: description, material, size and locations.
    - .15 Concrete: type, composition and strength.

- .16 Size and location of site pads.
  - .17 Level gauging: type and locations, include:
    - .1 Reporting systems, types of reports and report frequency.
    - .2 Maximum number of tanks to be monitored.
    - .3 Number of probes required and sizes.
    - .4 Provide details and manufacturer's product data.
  - .18 Ancillary devices: provide details and manufacturer's product data.
  - .19 Leak detection system, type and locations, and alarm system.
  - .20 Grounding and bonding: provide details of design, type, materials and locations.
  - .21 Containment system for spills and overfills: provide details, materials used, and locations.
  - .22 Pipe network plan.
  - .23 Equipment layout.
  - .24 Connections at distribution points.
  - .25 Type and location of valves, strainers, disconnect and pipe couplings.
- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
- .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.
- .4 Provide maintenance data for tank appurtenances and leakage detection system for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

### **1.3 DELIVERY, STORAGE, AND HANDLING**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:
  - .1 Dispose of waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
  - .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
  - .4 Separate and place in designated containers steel, metal, and plastic waste in accordance with Waste Management Plan.
  - .5 Place materials defined as hazardous or toxic in designated containers.
  - .6 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.

- .7 Clearly label location of salvaged material's storage areas and provide barriers and security devices.
- .8 Ensure emptied containers are sealed and stored safely.
- .9 Divert unused metal materials from landfill to metal recycling facility.
- .10 Divert unused concrete materials from landfill to local quarry or facility.
- .11 Dispose of unused paint or coating material at an official hazardous material collections site.
- .12 Do not dispose unused paint material into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.
- .13 Fold up metal banding, flatten and place in designated area for recycling.

#### **1.4 SITE CONDITIONS**

- .1 Environmental Requirements:
  - .1 Safeguard natural streams, waterways and storm drainage systems from possible contamination in accordance with authority having jurisdiction.

### **Part 2 Products**

#### **2.1 TANKS: CONVENTIONAL STEEL**

- .1 Two (2) horizontal tanks of 11,000 L capacity each, one for gasoline and one for diesel, dimensions and accessories as indicated, double wall, with 100% secondary integral containment with an easily accessible inspection port. Each tank shall include:
  - .1 Tank fill c/w vent: 100mm weld flange NPT w/ reducer bushing NPT w/ 50mm alum. fill / vent cap NPT.
  - .2 200mm emergency vent for interstitial space.
  - .3 Interstitial inspection: 50mm monitor pipe T.O.E. NPT w/ poly. cap NPT.
  - .4 Gauge: 100mm weld flange NPT w/ reducer bushing NPT w/ 50mm C.I. plug NPT.
  - .5 200mm primary tank emergency vent.
  - .6 Spare gauge: 100mm weld flange NPT w/ reducer bushing NPT w/ 50mm C.I. plug NPT.
  - .7 Normal vent: 50mm weld flange NPT w/ poly. Vent plug NPT.
  - .8 Tank discharge/pump out: 100mm weld flange NPT w/ reducer bushing NPT w/ 50mm poly vent plug NPT.
  - .9 Saddles supports.
  - .10 Lift lugs.
  - .11 Mounting brackets
  - .12 Two (2) step packages (one (1) step each): shipped installed.
  - .13 Tank skid c/w access step.
- .2 Horizontal tanks: to ULC S601.

## **2.2 STEEL PIPING**

- .1 Pipe: to API Spec 5L, schedule 40.
- .2 Fittings: unless otherwise indicated, welding type, carbon steel, seamless or resistance weld. Wall thickness same as corresponding pipe size.
- .3 Flanges: forged carbon steel, raised face, weld neck, to ASTM A181/A181M, Grade II Class 150, 1 MPa.
- .4 Bolting materials:
  - .1 Bolts: carbon steel to ASTM A193/A193M.
  - .2 Nuts: carbon steel to ASTM A194/A194M.
  - .3 Gasket: capable of chemically withstanding fluids and temperatures of 650 degrees C.
- .5 Joints:
  - .1 Aboveground: threaded joints using compound reviewed by Departmental Representative for product being handled.
- .6 Corrosion and product protection:
  - .1 Protect piping against external corrosion.
- .7 Piping located below product level equipped with either manual or automatic shut-off at storage tank.
- .8 Provide means for collecting spills at connection point between storage tank system and delivery truck.

## **2.3 VALVES**

- .1 Steel without copper bearing alloy: to API SPEC 6D. Class 150, 1 MPa.
- .2 NPS 1 1/2 and smaller: ball valve.
- .3 Gate valves NPS2 and larger: to ASTM A216/A216M, Grade WCB, carbon steel, OS&Y, flanged ends.
- .4 Plug valves flanged ends: Class 300, 2 MPa, bolted bonnet, tapered plug and seat, carbon steel body and trim with plug, Teflon lining.
- .5 Glands and valve seats: materials resistant to conveyed fluid.
- .6 Rising stem or other indicating valves: where necessary, to establish visually whether valves are open or shut.

## **2.4 IDENTIFICATION**

- .1 Valves: identify with tags, octagonal anodized aluminum, flammable liquids resistant, fireproof, permanently inscribed with clear legible characters.
- .2 Flammable and combustible liquids pipe: label in accordance with Section 23 05 53.01 - Mechanical Identification.

## **2.5 PUMPS**

- .1 General: submersible vertical turbine, with 100mm (4") riser with length to suit storage tank.
- .2 Pump motor: 3/4 HP fixed speed, 2875 r/min, multi-stage centrifugal type pump motor with integral, automatic, thermal overload protection.
- .3 Check valve: 70mm diameter fluorocarbon seal constructed on cast aluminum body and steel backing washer.
- .4 Pressure relief valve: integral to check valve, relieves at 276 kPa and resets above 241 kPa.
- .5 Pump shall include venturi-type syphon, air eliminator and electrical disconnect.
- .6 Duplicate control switches: to shut down pump in event of emergency.
- .7 Explosion proof protection: pump motors, switchgear, and electrically operated controls, in locations specified in Canadian Electrical Code, Part 1, Section 20: explosion-proof design and type.

## **2.6 DISPENSERS AND FUEL CONTROL SYSTEM/CARD READER**

- .1 Provide two (2) dispensers, as indicated, one for gasoline and one for diesel. Each dispenser shall include:
  - .1 Two (2) fuelling nozzles:
    - .1 One (1) commercial grade.
    - .2 One (1) ultra-high capacity.
  - .2 Breakaways: as required.
  - .3 Swivels: as required.
  - .4 Dispenser pedestal.
- .2 Provide one (1) automated fuel control system/card reader.
- .3 Fuel system to include, as required and as recommended by manufacturer, shut-off valves, hardware, hoses, pipes, fittings, decals, breakaways, flow limiters, hose whips, level gauges and indicators, anti-syphon valves, emergency stops and emergency shut-offs.

## **2.7 ANCHORAGE**

- .1 As recommended by manufacturer.

## **2.8 CONCRETE**

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

## **2.9 LEVEL GAUGING**

- .1 Tank gauging stick: to manufacturer's standard.
- .2 Electronic solid state combination tank level sensor and leak detector: console containing visual LED display and printer algorithms to automatically compute required operations. System to be programmable for:
  - .1 Inventoring reporting with following features.
    - .1 Litres of fuel remaining.
    - .2 Temperature of fuel.
    - .3 Millimeters of water in bottom of tank.
    - .4 Millimeters of fuel in tank.
  - .2 Fuel delivery report.
  - .3 Single tank installation, interstitial space leak detection.
  - .4 Visual and audible alarm for:
    - .1 Overfill.
    - .2 Low product.
    - .3 High water.
    - .4 Theft.
    - .5 Leaks.
  - .5 Probe diagnostics.
  - .6 Leak tests.
  - .7 Probes and sensors: factory calibrated and pre-set, to suit diameter of tank.

## **2.10 LEAKAGE DETECTION SYSTEM**

- .1 To NFPA 329.
- .2 Leak detector: cable system.
  - .1 Monitoring instrument.
    - .1 Temperature compensated solid state circuitry to continuously monitor leak detection circuits for open circuit or alarm condition. Alarm condition to be indicated by visual indicator light and audible alarm and operation of isolated relay to allow interface with other equipment.
    - .2 Supply voltage: 120 Vac.
    - .3 Module: complete with power-on lamp, alarm lamp, test switch and reset switch.
  - .2 Leak detection cable: twisted pair of 20 AWG woven conductors insulated with hydrocarbon degradable dielectric with loose interlocking aluminum alloy armour.
  - .3 Control cable: twisted pair of 20 AWG woven conductors with 300 V insulation and PVC jacket.

.3 Vapour Monitoring.

.1 Vapour Phase Detector.

- .1 Product stored, or tracer compound placed in storage tank system sufficiently volatile to result in vapour level that is detectable by monitoring device.
- .2 Operative in groundwater, rainfall, soil moisture, and other interferences so that leaks are detected in less than 30 days.
- .3 Leak detection from storage tank system not disturbed by background contamination.
- .4 Designed to detect any significant increase in concentration above background level of product stored, and component(s) of product stored, or a tracer compound placed in tank system.

**2.11 GROUNDING AND BONDING**

- .1 To Section 26 05 00 - Common Work Results - Electrical.

**2.12 OVERFILL AND SPILL CONTAINMENT**

- .1 Shop-fabricated AST overfill protection.
  - .1 Automatic valve closure on product supply line, or automatic pump shut-off to terminate petroleum product flow upon detection of high levels in the storage tank.
  - .2 Overfill protection device compatible with intended method of filling designed, built and certified to ULC/ORD C58.15.
  - .3 Audible and visual alarm located where personnel are constantly on duty during transfer operation and can promptly stop or divert flow when detected levels are too high.
  - .4 Storage tanks with capacity of 50,000 L or less.
    - .1 Level gauge located on storage tank for frequent monitoring throughout transfer operation permitting personnel to promptly shut down flow, or communicate immediately with person controlling delivery for shut down.
- .2 Remote spill container, as indicated on drawings, shall have a minimum capacity of 15 L.

**2.13 PRODUCT TRANSFER**

- .1 ASTs with normal vent and separate emergency vent.
  - .1 Liquid- and vapour-tight connection on fill pipes for flammable products.

**2.14 TANK BOTTOM WATER**

- .1 Segregated from rainwater.
- .2 Disposed of in accordance with applicable provincial or territorial regulations, guidelines and policies.

## **2.15 SPILLS AND OVERFILLS**

- .1 Contained, treated and disposed of in accordance with applicable provincial or territorial regulations, guidelines and policies.

## **2.16 STRAINER**

- .1 Duplex style, cast iron body: to ASTM A48, malleable iron exterior trim, stainless steel baskets with 0.8 mm perforations, screwed ends, 860 kPa ANSI pressure rating.

## **2.17 PRESSURE GAUGES**

- .1 Pressure Gauges: to Section 23 05 19.01 - Thermometers and Pressure Gauges - Piping Systems.
- .2 Scale markings: 0 to 200 kPa.

## **Part 3 Execution**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 HANDLING**

- .1 Protect and shield pre-coated equipment and piping.

### **3.3 SITE WORK**

- .1 Departmental Representative to review alignment of piping system before welding or bolting.
- .2 Departmental Representative to review pre-assembly and bending of pipes. Follow Departmental Representative's instruction.

### **3.4 COATINGS**

- .1 Clean surfaces to base metal. Store clean pipe for short time period in sheltered dry location.
- .2 Shop application; prefabricated piping sections are limited to 15 m maximum length.
- .3 Reprime mill primed pipe before coating.
- .4 Coating: to manufacturer's recommendations.

### **3.5 TANKS**

- .1 Install tanks in accordance with CCME PN 1326, the National Fire Code of Canada, and manufacturer's recommendations.
- .2 Position tanks using lifting lugs and hooks, and where necessary use spreader bars. Do not use chains in contact with tank walls.
- .3 Install tanks using licensed, trained and certified installers.
- .4 Provide certification of installation to Departmental Representative.

### **3.6 ANCHORS AND GUIDES**

- .1 Install anchors and guides as indicated and at following points:
  - .1 Connections to pumps.
  - .2 Connections to storage tanks.
  - .3 At changes of pipe sizes.
  - .4 At branch line take offs.
  - .5 At changes of piping directions.
  - .6 At terminal points.
  - .7 Elsewhere as indicated.

### **3.7 SUPPORTS**

- .1 Above ground piping: prevent excessive vibration and stress on adjacent equipment.

### **3.8 PROTECTION**

- .1 Protect piping system from damage by vehicular traffic using guard devices, marked with fluorescent markers or painted with warning colours.

### **3.9 LOCATION OF PIPEWORK**

- .1 General: locate not to constitute hazard to personnel, buildings or equipment.

### **3.10 VALVES**

- .1 Install valves to control flow and to isolate equipment at following locations:
  - .1 Loading and unloading connections;
  - .2 Fill and withdrawal connections of above ground tanks;
  - .3 Suction and discharge of pumps;
  - .4 At equipment requiring periodic servicing such as filters, metres and automatic equipment.

### **3.11 PUMPS**

- .1 Pumps installed above ground and outside buildings: locate at least 3 m from building line and 1.5 m from building openings.
- .2 Install duplicate control switches at pump location or at a second remote location reviewed by Departmental Representative.
- .3 Anchor pumps to base. Protect from impact and damage from vehicular traffic.

### **3.12 DISPENSERS AND FUEL CONTROL SYSTEM/CARD READER**

- .1 Install in accordance with manufacturer's recommendations.

### **3.13 FIELD QUALITY CONTROL**

- .1 Test tanks for leaks to requirements of and in presence of authority having jurisdiction.
- .2 Piping system testing:
  - .1 Prior to testing, remove foreign matter, flush piping and equipment using same petroleum product as one being transported.
  - .2 Dispose of testing and flushing liquid to approval of authority having jurisdiction.
  - .3 Pressure test with air, nitrogen or liquid reviewed by Departmental Representative to at least 1.5 times maximum operating pressure. Submit certificate of tests and test results to Departmental Representative.
  - .4 Isolate tanks from piping system pressure tests.
  - .5 Test piping systems and pumps with compressed air to 700 kPa. Hold pressure for 24 hours.
  - .6 Should there be loss of pressure, soap test each weld or use tracer gas with compressed air as directed by Departmental Representative.

### **3.14 TOUCH-UP**

- .1 Where coating is damaged, touch-up with original coating material.

### **3.15 LEVEL GAUGE SYSTEM**

- .1 Provide leak and vapour proof caulking at connections.
- .2 Shield capillary and tubing connections in heavy duty 50mm polyethylene pipe.
- .3 Calibrate system.

### **3.16 LEAK DETECTION SYSTEM**

- .1 Install in accordance with manufacturer's recommendations.

**3.17            CLEANING**

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

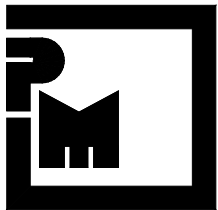
**END OF SECTION**

## **APPENDIX A**

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### **Geotechnical Investigation**

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**GEOTECHNICAL INVESTIGATION  
PROPOSED FUEL STORAGE TANK PAD & PROPANE  
DISPENSER FILL STATION  
SASKATCHEWAN PENITENTIARY  
PRINCE ALBERT, SASKATCHEWAN  
PMEL FILE NO. S14-8725  
APRIL 11, 2014**

**PREPARED FOR:**

**WSP CANADA INC.  
1600 BUFFALO PLACE  
WINNIPEG, SASKATCHEWAN  
R3T 6B8**

**ATTENTION: ALANA GAUTHIER, P. ENG.**

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## **1.0 INTRODUCTION**

The following report has been prepared on the subsurface soil conditions existing at the site of the proposed Fuel Storage Tank Pad & Propane Dispenser Fill Station to be constructed at the Saskatchewan Penitentiary in Prince Albert, Saskatchewan. The site is located approximately 150 metres south of 15<sup>th</sup> Street West.

The terms of reference for this investigation were presented in P. Machibroda Engineering Ltd. (PMEL) Proposal No. 0301-7798REV, dated March 3, 2014.

The field test drilling and soil sampling were conducted on March 18, 2014.

## **2.0 FIELD INVESTIGATION**

### **2.1 Field Drilling**

Two test holes, located as shown on the Site Plan, Drawing No. S14-8725-1, were dry drilled using our truck-mounted continuous flight, solid stem auger drill rig. The test holes were 150 mm in diameter and extended to depths of 9 to 12 metres below the existing ground surface.

Test hole drill logs were compiled during test drilling to record the soil stratification, the groundwater conditions, the position of unstable sloughing soils and the depths at which cobblestones and/or boulders were encountered.

Disturbed samples of auger cuttings were collected during test drilling and sealed in plastic bags to minimize moisture loss. The soil samples were taken to our laboratory for analysis.

Standard penetration tests (N-index), utilizing a safety hammer with automatic trip, were performed during test drilling.

## 2.2 Piezocone Penetration Testing

One piezocone penetration test (CPTu) was conducted during the field investigation and extended to a depth of 6.5 metres below existing grade. The CPTu location is shown on the Site Plan, Drawing No. S14-8725-1.

The piezocone penetration test consisted of pushing a cone, on the end of a series of rods, into the ground at a constant rate and continuous measurements were made of the resistance to penetration of the cone. Local side friction resistance measurements were also made on a friction sleeve during penetration. Pore-water pressure response generated from the advancement of the cone into the soil was measured via a pore pressure filter located directly behind the cone tip. The piezocone tip had an apex angle of 60° and a 10 cm<sup>2</sup> base area. The friction sleeve had a perimeter area of 150 cm<sup>2</sup>.

The equipment and procedures for conducting the cone penetration testing were undertaken in accordance with ASTM D-5778, "Standard Test Method for Performing Electronic Friction Cone and Piezocone Testing of Soils".

The test plot generated during the cone sounding have been presented in Appendix C.

## 3.0 FIELD DRILL LOGS

The field drill logs recorded during test drilling have been shown plotted on Drawing Nos. S14-8725-2 and 3.

The ground surface elevation at each Test Hole location was referenced to top of the existing concrete floor slab, located approximately as shown on the Site Plan, Drawing No. S14-8725-1. A datum elevation of 100.00 metres was assumed for the top of the concrete floor slab.

### 3.1 Soil Profile

The general subgrade soil conditions consisted of granular fill (approximately 150 to 400 mm) overlying sand (extending to depths of about 5.4 to 5.7 metres), followed by clay, extending to a depth of at least 12 metres below existing grade, the maximum depth explored with our Test Holes at this site. A layer of clay was encountered in Test Hole No. 14-1 at approximately 0.2 metres below grade extending to a depth of about 1.3 metres.

### 3.2 Groundwater Conditions, Sloughing

Extensive groundwater seepage and sloughing conditions were encountered in the sand stratum during test drilling. The depths at which groundwater seepage and sloughing conditions were encountered have been shown plotted on Drawing Nos. S14-8725-2 and 3. Based on the depths in which groundwater seepage and sloughing was encountered, the groundwater table appears to be situated approximately 2.2 metres below existing ground surface. Higher groundwater conditions could be encountered, particularly during or after periods of precipitation or spring thaw.

### 3.3 Cobblestones and Boulders

Cobblestones and/or boulders were not encountered within the depths explored during test drilling.

## 4.0 LABORATORY ANALYSIS

The soil classification and index tests performed during this investigation consisted of a visual classification of the soil, water contents, Atterberg limits and organic content.

The results of the soil classification and index tests conducted on representative samples of soil have been plotted on the drill logs alongside the corresponding depths at which the samples were recovered, as shown on Drawing Nos. S14-8725-2 and 3.

The results of the grain size distribution analysis have been enclosed in Appendix D.

## **5.0 DESIGN RECOMMENDATIONS**

Based on the foregoing outline of the soil test results, the following foundation considerations and design recommendations have been presented.

### **5.1 Design Considerations**

It is understood that the proposed Structures will consist of proposed Gasoline and Diesel Above Ground Storage Tanks (ASTs) and a Propane Fill Station. It is understood that the proposed Gasoline, Diesel and Propane Tanks will be about 10,000 to 11,000 L in volume.

The general subgrade soil conditions consisted of granular fill overlying sand followed by clay. A layer of clay was encountered in Test Hole No. 14-1 at approximately 0.2 metres below grade extending to a depth of about 1.3 metres. The subgrade soils are frost susceptible and the average depth of frost penetration for the Prince Albert area is approximately 2.0 metres for heated buildings and 2.5 metres for unheated structures.

Extensive groundwater seepage and sloughing conditions were encountered within the sand stratum during test drilling. Based on the depths at which groundwater seepage and sloughing was encountered, the groundwater table appears to be situated approximately 2.2 metres below existing ground surface. Higher groundwater levels could be encountered, particularly during and/or following periods of precipitation or spring thaw.

A perimeter edge thickened slab could perform satisfactorily as a foundation system for this site, provided some differential foundation movements are considered acceptable. Potential differential movements would be attributed to the variable soil types at the site and frost action. The clay has the potential to undergo volume changes with fluctuations in moisture content.

In order to minimize any potential movements that may develop, over-excavation and replacement of some of the clay is recommended to improve the load carrying characteristics of the subgrade soils and provide a uniform subgrade condition. A minimum of 600 mm of granular base course fill is recommended beneath the perimeter thickened edge slab.

If potential differential foundation movements are not considered tolerable, a deep foundation system consisting of driven, timber piles or helical screw piles could be considered and should perform satisfactorily at this site.

Drilled, cast-in-place concrete piles were considered but are not recommended due to the extensive groundwater seepage and sloughing conditions expected within the sand stratum.

It should be noted that soil subsidence has historically been observed near the proposed AST pad locations. As such, a deep foundation may be a more viable option for the site.

Recommendations have been prepared for site preparation; thickened edge raft; driven, timber piles; helical screw piles; factor of safety/reduction factors; grade-supported floor slabs; and, foundation concrete.

## 5.2 Site Preparation

All loose fill, construction debris and deleterious materials should be removed from the construction area. Staining and root intrusion from organic material and roots may be encountered during excavation within the subsurface mineral soils. If these conditions are suspected, a representative of the geotechnical consultant should inspect the site during excavation to verify the depth of unsuitable soil which should be removed in preparation of the site for construction. See Appendix B for further information with respect to topsoil composition and soil structure.

The surface of the subgrade should be leveled and compacted to the following minimum density requirements.

Building Areas	- 96 percent of standard Proctor density at optimum moisture content;
Roadway Areas	- 96 percent of standard Proctor density at optimum moisture content;
Landscape Areas	- 90 percent of standard Proctor density at optimum moisture content.

Subgrade fill, if required, should preferably consist of granular fill. The fill should be placed in thin lifts (maximum 150 mm loose) and compacted as noted above. All proposed subgrade fill should be approved by the Geotechnical Consultant prior to placement.

The site should be graded to ensure positive site drainage away from the proposed Structures.

### 5.3 Perimeter Thickened Edge Raft Foundation

The following minimum recommendations should be incorporated into the design of a perimeter edge thickened raft foundation supported on structural granular fill.

1. Over-excavate the clay soils to provide a minimum of 600 mm of granular base course fill beneath the slab. Level and compact the uppermost 150 mm of the subgrade surface to 96 percent of standard Proctor density at optimum moisture content. Do not allow the subgrade surface to dry out. The fill should be placed as soon as possible to minimize drying of the clay soils.

2. Place woven geotextile (Geotex 2x2 HF) (by hand) over the levelled subgrade surface. Overlap adjoining pieces of geotextile a minimum of 600 mm. Over the geotextile, place and level a minimum of 200 mm of sub-base (25 mm maximum size), in a single lift, ensuring equipment is working on top of the lift and not in contact with the geotextile. Compact the granular fill material to 96 percent of standard Proctor density using static compaction equipment (no vibratory equipment).
3. The 600 mm layer of granular fill should be placed and compacted in thin lifts (150 mm loose, maximum) to 100 percent of standard Proctor density at optimum moisture content. The granular fill should extend laterally away from the edge of the raft a distance equal to the depth of the fill.
4. The raft foundation, constructed in accordance with the above recommendations, may be designed to exert an ultimate soil bearing pressure of 275 kPa (ultimate Limit State – ULS). The serviceability Limit State (SLS) bearing pressure equivalent to 25mm of raft settlement is equal to 100 kPa.
5. Continuous quality control inspection should be provided during fill placement.
6. The raft foundation should not be constructed on desiccated or frozen subgrade soil.
7. Separate the slab from the fill by means of a polyethylene vapour barrier. Care should be taken during and following installation to minimize damaging the vapour barrier. Placing two layers or using a heavier gauge of poly should be considered to minimize damage to the barrier system. A cushioning layer of bedding sand above and below the vapour barrier is recommended.
8. Frost should not be allowed to penetrate beneath the raft foundation prior to or during construction.

9. The finished grade should be landscaped to provide for positive site drainage away from the raft.

To minimize the amount of differential movement associated with potential frost heaving, it is recommended that rigid polystyrene insulation be placed around the perimeter of the raft and should extend under the entire foundation area. The insulation should be at least 50 mm in thickness and should extend out a minimum of 1.2 metres from the edge of the slab foundation. The insulation should be placed a minimum of 300 mm below finished grade and should be sloped away from the structure.

#### 5.4 Driven, Treated Timber Piles

Driven, treated timber piles may be designed on the basis of skin friction only. The ultimate skin friction bearing pressures for driven, treated timber piles are as follows:

**TABLE I. SKIN FRICTION BEARING PRESSURES (TIMBER PILES)**

<b>Zone (metres)</b>	<b>Ultimate Skin Friction Bearing Pressure (kPa)</b>
0 to 2	0
2 to 5	70
Below 5	50

#### Notes:

1. For drop hammers, a minimum drop hammer mass of twice the mass of the pile, but not exceeding five times the mass of the pile, is recommended.
2. A pre-bore diameter of at least the pile diameter plus 50 mm should be used through the depth of fill and/or frost penetration. Where piles are pre-bored and subject to lateral loading, a pre-bore annulus that is smaller than the pile diameter (i.e., 90%) is recommended to ensure full contact between the pile shaft and surrounding soil.

3. To minimize the potential for frost jacking, driven, treated timber piles should have a minimum embedment length of 6 metres. If the termination criteria is achieved at a depth which is significantly shallower than the design depth, then the pile capacity should be reviewed. Pre-boring may be required if the termination criteria is achieved prematurely.
4. A minimum centre-to-centre spacing of not less than three pile diameters is recommended.
5. Although not anticipated, timber piles should not be subject to hard driving. The potential problems as a result of hard driving are splitting of the pile, brooming of the pile toe and bowing or breaking of the pile. Pile banding may be required to minimize potential damage during driving. To reduce the potential for damage, driving must be stopped upon satisfying the following termination criteria.

**TABLE II. TERMINATION CRITERIA (TIMBER PILES)**

<b>Nominal Pile Size mm/No.</b>	<b>Rated Energy Per Hammer Blow (Joules)*</b>	<b>Termination Criteria Hammer Blows for 25 mm Penetration</b>
250/10	25,000 (18,500 ft - lbs)	2
275/11	27,000 (20,000 ft - lbs)	3
300/12	30,000 (22,000 ft - lbs)	3
355/14	35,000 (26,000 ft - lbs)	4

\*1 foot - pound - force = 1.356 Joules

6. The structural capacity of each pile should be confirmed by a structural engineer to ensure that over-stressing of the pile does not occur.
7. A representative of the Geotechnical Consultant should inspect and document the installation of each driven, treated timber pile.

## 5.5 Helical Screw Piles

Helical screw piles are installed by rotating a steel pipe, equipped with one or more helix flightings, into the ground. For single helix screw piles, pile capacity is derived from shearing resistance along the pile shaft (i.e., skin friction) as well as end bearing capacity of the helix.

For multi-helix piles, pile capacity may be derived from the sum of the shearing resistance along the portion of pile shaft above the uppermost helix and end bearing capacity of each helix. The helical plates should be spaced a minimum of 3 helix diameters apart.

The ultimate skin friction and end bearing pressures for design of screw piles have been presented below.

**TABLE III. SKIN FRICTION BEARING PRESSURES (SCREW PILES)**

<b>Zone (metres)</b>	<b>Ultimate Skin Friction Bearing Pressure (kPa)</b>
0 to 2	0
2 to 5	35
Below 5	25

**TABLE IV. END BEARING PRESSURES (SCREW PILES)**

<b>Depth (metres)</b>	<b>Ultimate End Bearing Pressure (kPa)</b>
3 to 5	500
Below 5	375

Notes:

1. The minimum embedment depth of uppermost helix for multi-helix piles should be  $\geq 3\text{m}$  or  $H/D = 5$  (whichever is greater), where  $H$  = depth to top helix,  $D$  = helix diameter.

2. Single helix screw piles should extend to a minimum depth of 5 metres below grade or  $H/D = 5$  (whichever is greater).
3. For determination of skin friction capacity, the effective shaft length may be taken as the depth of embedment of the pile shaft (to the top of the uppermost helix) minus the diameter of the uppermost helix.
4. A minimum centre-to-centre pile spacing of  $2.5B$ , where  $B$ =helix diameter, is recommended.
5. The helical plate shall be normal to the central shaft (within 3 degrees) over its entire length. Multiple helixes (if applicable) should be spaced at increments of the helix pitch to ensure that all helixes travel the same path during installation.
6. Continuous monitoring of the installation torque should be undertaken during installation to determine whether the screw pile has been damaged during installation and to monitor the consistency of the subsurface soils.
7. Screw piles should be designed on the basis of conventional static analysis using the bearing pressures provided in Tables III and IV. Installation torque should be used for monitoring purposes only and not to determine pile capacity.
8. A representative of the Geotechnical Consultant should inspect and document the installation of each screw pile on a continuous basis.

## 5.6 Factor of Safety/Resistance Factors

When using traditional Working (allowable) Stress Design (WSD) to design the foundations, an appropriate Factor of Safety must be applied to the ultimate bearing pressures presented in this report. PMEL typically recommends a Factor of Safety of 2.5 for compressive loading and 3.5 to 4 for tensile loading. The actual Factor of Safety should be based on the governing design requirements/codes.

As with WSD, an appropriate reduction must be applied to the ultimate bearing pressures (otherwise known as Ultimate Limit State, ULS) when designing the foundations on the basis of Limit States Design (LSD). This is accomplished in the form of using resistance factors ( $\Phi$ ). As per the National Building Code of Canada - NBCC (2010), the following resistance factors are considered appropriate for the design of:

- Deep foundations:
  - Compressive Resistance,  $\Phi = 0.4$
  - Tensile Resistance,  $\Phi = 0.3$

For both WSD and LSD, a settlement analysis of the foundation must also be evaluated to ensure the structure is not negatively impacted by excessive settlement at the design load. This is also known as Serviceability Limit States (SLS) when designing on the basis of LSD.

With respect to a raft foundation at this site, the provided SLS bearing capacity is based on a settlement of 25 mm. If a lesser settlement is required for the raft foundation, PMEL should re-evaluate the recommended SLS bearing capacity.

Provided the foundation is designed using the appropriate factors of safety or resistance factors presented above, the amount of settlement of a deep foundation at the design load will be small and within tolerable limits (typically less than 10 mm). Hence, settlement typically does not govern in the majority of cases of deep foundation design.

## 5.7 Grade-Supported Floor Slabs

If a pile and grade-beam foundation system is implemented, the recommendations provided in Section 5.3 – Perimeter Thickened Edge Raft, should be followed for a conventional, lightly loaded grade supported floor slab.

## 5.8 Foundation Concrete

The results of water soluble sulphate testing on soil samples recovered from the subject site have been summarized in Table V.

**TABLE V. WATER SOLUBLE SULPHATE TEST RESULTS**

<b>Test Hole No.</b>	<b>Depth (m)</b>	<b>Soil Type</b>	<b>Water Soluble Sulphate (%)</b>	<b>Class of Exposure</b>	<b>Degree of Sulphate Exposure</b>
14-1	1.0	Clay	0.01	--	Negligible
14-2	7.5	Clay	0.04	--	Negligible

An examination of Table V revealed that the measured sulphate contents varied from 0.01 to 0.04 percent, which is considered negligible to severe in terms of potential degree of sulphate attack. Based on the test results General use cement (CSA Designation GU) may be used for all foundation concrete in contact with the soil. However, water-soluble sulphate salts (gypsum crystals) are known to exist in the geologic deposits in this region. PMEL recommends that sulphate resistant cement be used for all concrete in contact with the subgrade soil. All concrete at this site should be manufactured in accordance with current CSA standards.

It should be recognized that water soluble sulphate salts, combined with moist soils or low pH soils could render the soil highly corrosive to some types of metals in contact with the soil.

## **6.0 LIMITATIONS**

The presentation of the summary of the field drill logs and design recommendations has been completed as authorized. Two, 150 mm diameter test holes were dry drilled using our truck-mounted, continuous flight auger drill rig. Field drill logs were compiled for the Test Holes during test drilling which, we believe, were representative of the subsurface conditions at the Test Hole locations at the time of test drilling.

One piezocone penetration test (CPTu) was also conducted during the field investigation. The inferred soil stratigraphy has been shown on the attached CPTu plot.

Variations in the subsurface conditions from that shown on the drill logs at locations other than the exact Test Hole locations should be anticipated. If conditions should differ from those reported here, then we should be notified immediately in order that we may examine the conditions in the field and reassess our recommendations in the light of any new findings.

No detectable evidence (i.e., odor or visual) of environmentally sensitive materials was detected during the actual time of the field test drilling program. If, on the basis of any knowledge, other than that formally communicated to us, there is reason to suspect that environmentally sensitive materials may exist, then additional test holes should be drilled and samples recovered for chemical analysis.

The subsurface investigation necessitated the drilling of deep test holes. The test holes were backfilled at the completion of test drilling. Please be advised that some settlement of the backfill materials will occur which may leave a depression or an open hole. It is the responsibility of the client to inspect the site and backfill, as required, to ensure that the ground surface at each Test Hole location is maintained level with the existing grade.

This report has been prepared for the exclusive use of WSP Canada Inc. and their agents for specific application to the proposed Fuel Tank Pad and Fill Station to be constructed within the Saskatchewan Penitentiary in Prince Albert, Saskatchewan. It has been prepared in accordance with generally accepted geotechnical engineering practices and no other warranty, express or implied, is made.

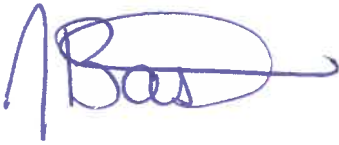
Any use which a Third Party makes of this report, or any reliance on decisions to be made based on it, is the responsibility of such Third Party. Governing Agencies such as municipal, provincial, or federal agencies having jurisdictions with respect to this development and/or construction of the facilities described herein have full jurisdiction with respect to the described development. Any other unspecified subsequent development would be considered Third Party and would, therefore, require prior review by PMEL. PMEL accepts no responsibility for damages, if any, suffered by any Third Party as a result of decisions made or actions based on this report.

The acceptance of responsibility for the design/construction recommendations presented in this report is contingent on adequate and/or full time inspection (as required, based on site conditions at the time of construction) by a representative of the Geotechnical Consultant. PMEL will not accept any responsibility on this project for any unsatisfactory performance if adequate and/or full time inspection is not performed by a representative of PMEL.

If this report has been transmitted electronically, it has been digitally signed and secured with personal passwords to lock the document. Due to the possibility of digital modification, only originally signed reports and those reports sent directly by PMEL can be relied upon without fault.

We trust that this report fulfils your requirements for this project. Should you require additional information, please contact us.

**P. MACHIBRODA ENGINEERING LTD.**



Jason Bast, Engineer-in-Training

Association of Professional Engineers &  
Geoscientists of Saskatchewan

**CERTIFICATE OF AUTHORIZATION**

P. MACHIBRODA ENGINEERING LTD.

Number 172

Permission to Consult held by:

Discipline Sk. Reg. No. Signature

Geotechnical 4955   
(4-04-11)



Terry Werbovetski, P. Eng.

JB/TW/ldw





**P. MACHIBRODA  
ENGINEERING LTD.**  
CONSULTING  
GEOTECHNICAL/GEOENVIRONMENTAL  
ENGINEERS

**DRAWINGS**



DEPTH  
(m)

N U  $\gamma_w$  Pw Lw w ELEV: 99.6 m

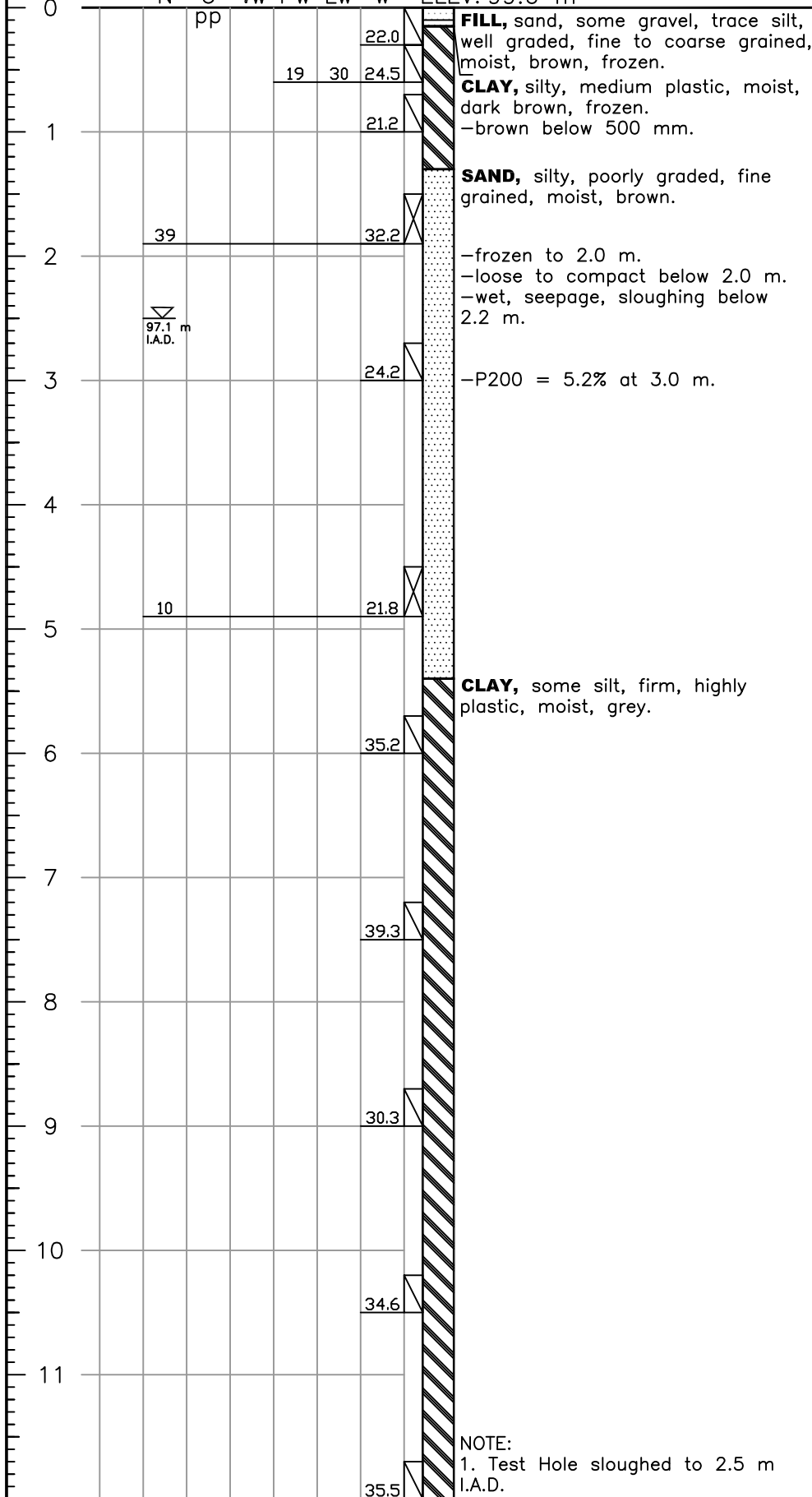


Diagram illustrating the patterns used to represent different soil types in a cross-section:

- TOPSOIL**: Diagonal cross-hatch pattern.
- FILL**: Horizontal lines.
- GRAVEL**: Large circles.
- SAND**: Small dots.
- SILT**: Vertical lines.
- CLAY**: Diagonal lines.
- GLACIAL TILL**: Diagonal cross-hatch pattern (identical to Topsoil).

w.....WATER CONTENT  
(PERCENT OF DRY SOIL WEIGHT)

Lw...LIQUID LIMIT

Pw...PLASTIC LIMIT

 $\gamma_w$ ...WET UNIT WEIGHT (kN/m<sup>3</sup>)

U.....UNCONFINED COMPRESSIVE  
STRENGTH (kPa)

pp...POCKET PENETROMETER (kg/cm<sup>2</sup>)

N.....STANDARD PENETRATION TEST  
(SAFETY HAMMER w/AUTOMATIC TRIP)  
(50/125 = BLOWS/SAMPLER  
PENETRATION [mm])

SO<sub>4</sub> .....SULPHATE CONTENT  
(PERCENT OF DRY SOIL WEIGHT)

P200...% PASSING No. 200 SIEVE

I.A.D.....IMMEDIATELY AFTER DRILLING

▽...RECORDED WATER LEVEL  
(TEST HOLE I.A.D.)

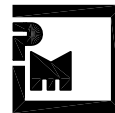
▼....RECORDED WATER LEVEL (PIEZO)



SHELBY  
TUBE

  
SPLIT  
SPOON

**LIMITATIONS:** THE FIELD DRILL LOG IS A SUMMARY OF THE SUBSURFACE CONDITIONS ENCOUNTERED AT THE SPECIFIC TEST HOLE LOCATION AT THE TIME OF TEST DRILLING. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS OF THIS SITE AND, IN TIME, MAY CHANGE AT THIS SPECIFIC TEST HOLE LOCATION.



**P. MACHIBRODA  
ENGINEERING  
LTD.**

# FIELD DRILL LOG AND SOIL TEST RESULTS

**PROJECT:**

## PROPOSED FUEL TANK PAD AND FILL STATION

**LOCATION:**

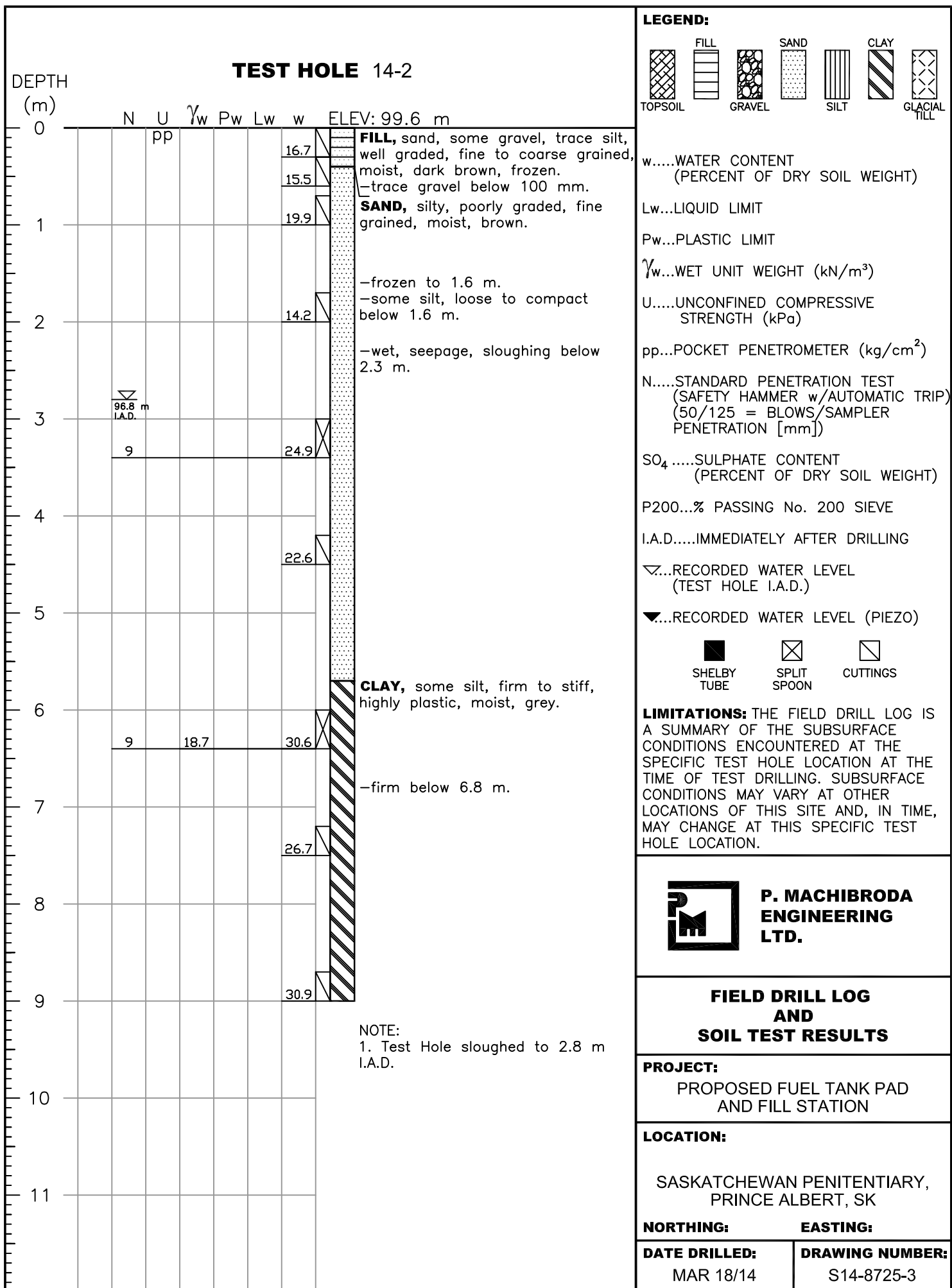
SASKATCHEWAN PENITENTIARY,  
PRINCE ALBERT, SK

## NORTHING:

**EASTING:**

**DATE DRILLED:**  
MAR 18/14

**DRAWING NUMBER:**  
S14-8725-2



# **APPENDIX A**

## **EXPLANATION OF TERMS ON TEST HOLE LOGS**

## **CLASSIFICATION OF SOILS**

**Coarse-Grained Soils:** Soils containing particles that are visible to the naked eye. They include gravels and sands and are generally referred to as cohesionless or non-cohesive soils. Coarse-grained soils are soils having more than 50 percent of the dry weight larger than particle size 0.080 mm.

**Fine-Grained Soils:** Soils containing particles that are not visible to the naked eye. They include silts and clays. Fine-grained soils are soils having more than 50 percent of the dry weight smaller than particle size 0.080 mm.

**Organic Soils:** Soils containing a high natural organic content.

### **Soil Classification By Particle Size**

Clay – particles of size	< 0.002 mm
Silt – particles of size	0.002 – 0.060 mm
Sand – particles of size	0.06 – 2.0 mm
Gravel – particles of size	2.0 – 60 mm
Cobbles – particles of size	60 – 200 mm
Boulders – particles of size	>200 mm

### **TERMS DESCRIBING CONSISTENCY OR CONDITION**

**Coarse-grained soils:** Described in terms of compactness condition and are often interpreted from the results of a Standard Penetration Test (SPT). The standard penetration test is described as the number of blows, N, required to drive a 51 mm outside diameter (O.D.) split barrel sampler into the soil a distance of 0.3 m (from 0.15 m to 0.45 m) with a 63.5 kg weight having a free fall of 0.76 m.

<b>Compactness Condition</b>	<b>SPT N-Index (blows per 0.3 m)</b>
Very loose	0-4
Loose	4-10
Compact	10-30
Dense	30-50
Very dense	Over 50

**Fine-Grained Soils:** Classified in relation to undrained shear strength.

<b>Consistency</b>	<b>Undrained Shear Strength (kPa)</b>	<b>N Value (Approximate)</b>	<b>Field Identification</b>
Very Soft	<12	0-2	Easily penetrated several centimetres by the fist.
Soft	12-25	2-4	Easily penetrated several centimetres by the thumb.
Firm	25-50	4-8	Can be penetrated several centimetres by the thumb with moderate effort.
Stiff	50-100	8-15	Readily indented by the thumb, but penetrated only with great effort.
Very Stiff	100-200	15-30	Readily indented by the thumb nail.
Hard	>200	>30	Indented with difficulty by the thumbnail.

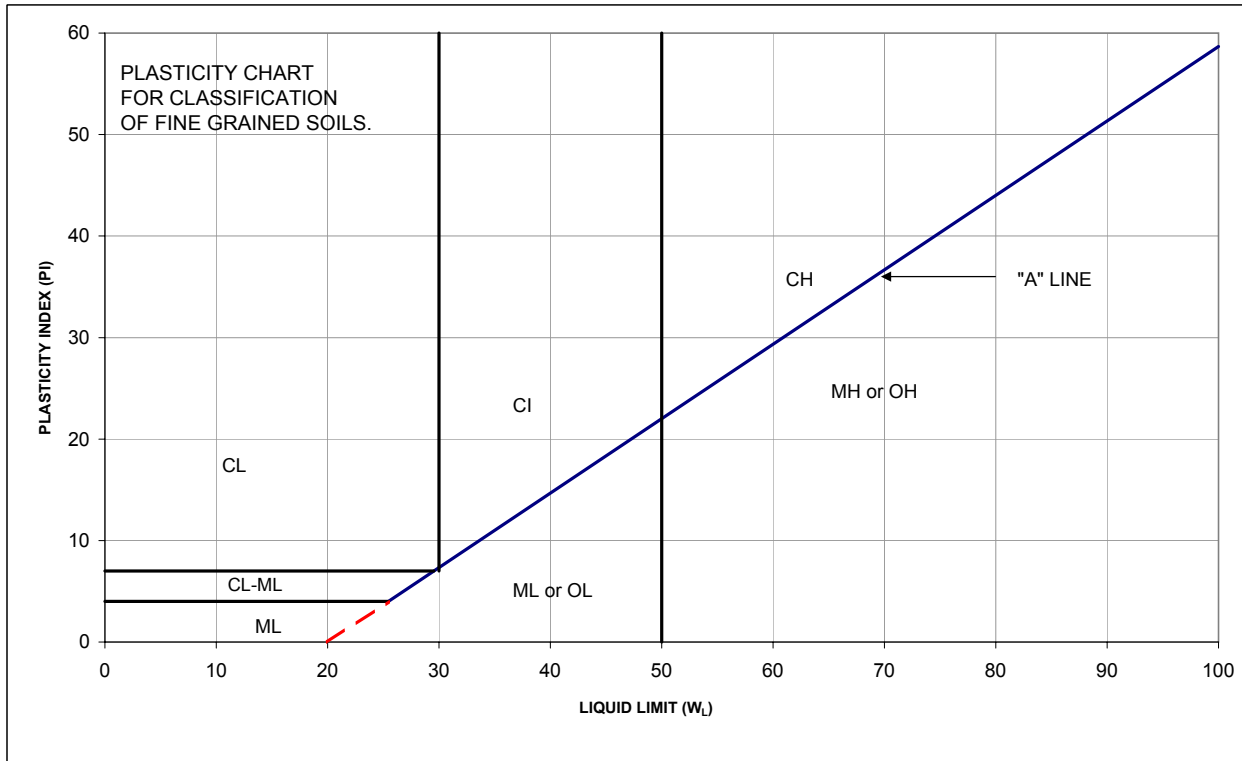
**Organic Soils:** Readily identified by colour, odour, spongy feel and frequently by fibrous texture.

### **DESCRIPTIVE TERMS COMMONLY USED TO CHARACTERIZE SOILS**

Poorly Graded	- predominance of particles of one grain size.
Well Graded	- having no excess of particles in any size range with no intermediate sizes lacking.
Mottled	- marked with different coloured spots.
Nuggety	- structure consisting of small prismatic cubes.
Laminated	- structure consisting of thin layers of varying colour and texture.
Slickensided	- having inclined planes of weakness that are slick and glossy in appearance.
Fissured	- containing shrinkage cracks.
Fractured	- broken by randomly oriented interconnecting cracks in all 3 dimensions.

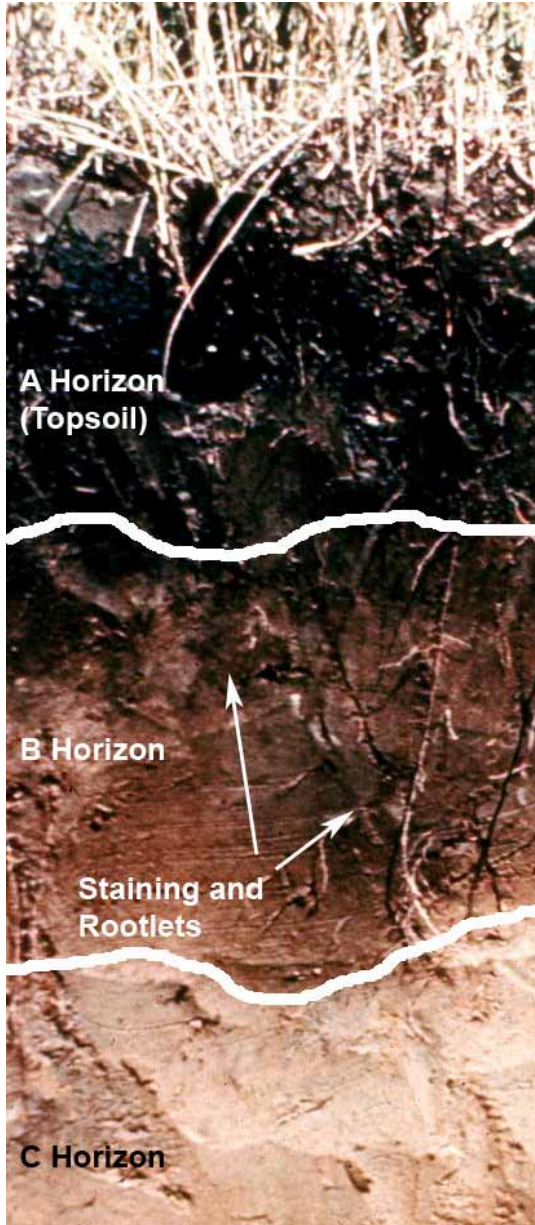
# SOIL CLASSIFICATION SYSTEM (MODIFIED U.S.C.)

MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOUR OR ODOUR AND OFTEN FIBROUS TEXTURE
COARSE-GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN NO. 200 SIEVE SIZE)	GRAVELS More than half coarse fraction larger than No. 4 sieve size	CLEAN GRAVELS	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES <5% FINES	$C_u = \frac{D_{60}}{D_{10}} > 4$ $C_c = \frac{(D_{30})^2}{D_{60} \times D_{10}} = 1 \text{ to } 3$
			GP	POORLY-GRADED GRAVELS AND GRAVEL-SAND MIXTURES <5% FINES	NOT MEETING ALL ABOVE REQUIREMENTS FOR GW
		DIRTY GRAVELS	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES >12% FINES	ATTERBERG LIMITS BELOW "A" LINE OR $PI < 4$
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES >12% FINES	ATTERBERG LIMITS ABOVE "A" LINE WITH $PI > 7$
	SANDS More than half coarse fraction smaller than No. 4 sieve size	CLEAN SANDS	SW	WELL-GRADED SANDS, GRAVELLY SANDS MIXTURES <5% FINES	$C_u = \frac{D_{60}}{D_{10}} > 6$ $C_c = \frac{(D_{30})^2}{D_{60} \times D_{10}} = 1 \text{ to } 3$
			SP	POORLY-GRADED SANDS OR GRAVELLY SANDS <5% FINES	NOT MEETING ALL GRADATION REQUIREMENTS FOR SW
		DIRTY SANDS	SM	SILTY SANDS, SAND-SILT MIXTURES >12% FINES	ATTERBERG LIMITS BELOW "A" LINE OR $PI < 4$
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES >12% FINES	ATTERBERG LIMITS ABOVE "A" LINE WITH $PI > 7$
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT PASSING NO. 200 SIEVE SIZE)	SILTS Below "A" line on plasticity chart; negligible organic content		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	$W_L < 50$
			MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS	$W_L > 50$
	CLAYS Above "A" line on plasticity chart; negligible organic content		CL	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS	$W_L < 30$
			CI	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS	$W_L > 30 < 50$
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	$W_L > 50$
	ORGANIC SILTS & ORGANIC CLAYS Below "A" line on plasticity chart		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	$W_L < 50$
			OH	ORGANIC CLAYS OF HIGH PLASTICITY	$W_L > 50$



# **APPENDIX B**

## **TOPSOIL, ORGANIC MATTER AND ORGANICS**



#### A Horizon

The A horizon is the topsoil layer of the soil strata. It is characterized by a build up of organic matter, and a lower unit weight than subsequent layers. The organic matter content of this layer is typically 4-10% by mass.

The colour of this horizon varies from dark black to brown, depending on surface vegetation and climatic conditions.

#### B Horizon

Typically reddish brown in colour and contains accumulations of matter that have been washed down from the A Horizon. The B horizon is generally composed of clay that has been washed out of the A Horizon, but can also contain iron, calcium and sodium deposits as well.

#### C Horizon

Unweathered parent soil.

Topsoil is a mixture of mineral soil and organic matter. The organic matter is developed from decaying biological material (leaves, grass, trees, animals, etc.) and contributes to the brown to black colour of the soil. Following the topsoil is the B horizon which is a transition layer, where staining from the overlying topsoil is common. This results in a darker colour of the soil immediately below the organic topsoil layer. Depending on the surface vegetation, rootlets may be present below the depth of topsoil. However it should be recognized that these rootlets are not the same as organic matter in topsoil.

Physically speaking in comparison to mineral soil, topsoil has a significantly lower bulk density and a lower unit weight as compared to the underlying parent soil. This is due to larger pore spaces and non mineral materials in the soil matrix. Along with lower density, topsoil is often spongy and colloidal/fibrous. The following figure is of a typical prairie soil. Each horizon is labelled accordingly to demonstrate a typical soil profile.

#### Reference

Henry L. 2003. Henry's Handbook of Soil and Water, Henry Perspectives, Saskatoon, SK.

# **APPENDIX C**

## **CPTu Plot**



**P. Machibroda Engineering Ltd.**

806 - 48th Street East, S7K 3Y4

Saskatoon, Saskatchewan

www.machibroda.com

**Project:** Proposed Fuel Tank Pad & Fill Station

**Location:** Saskatchewan Penitentiary, Prince Albert

**CPT: CPTu 14-1**

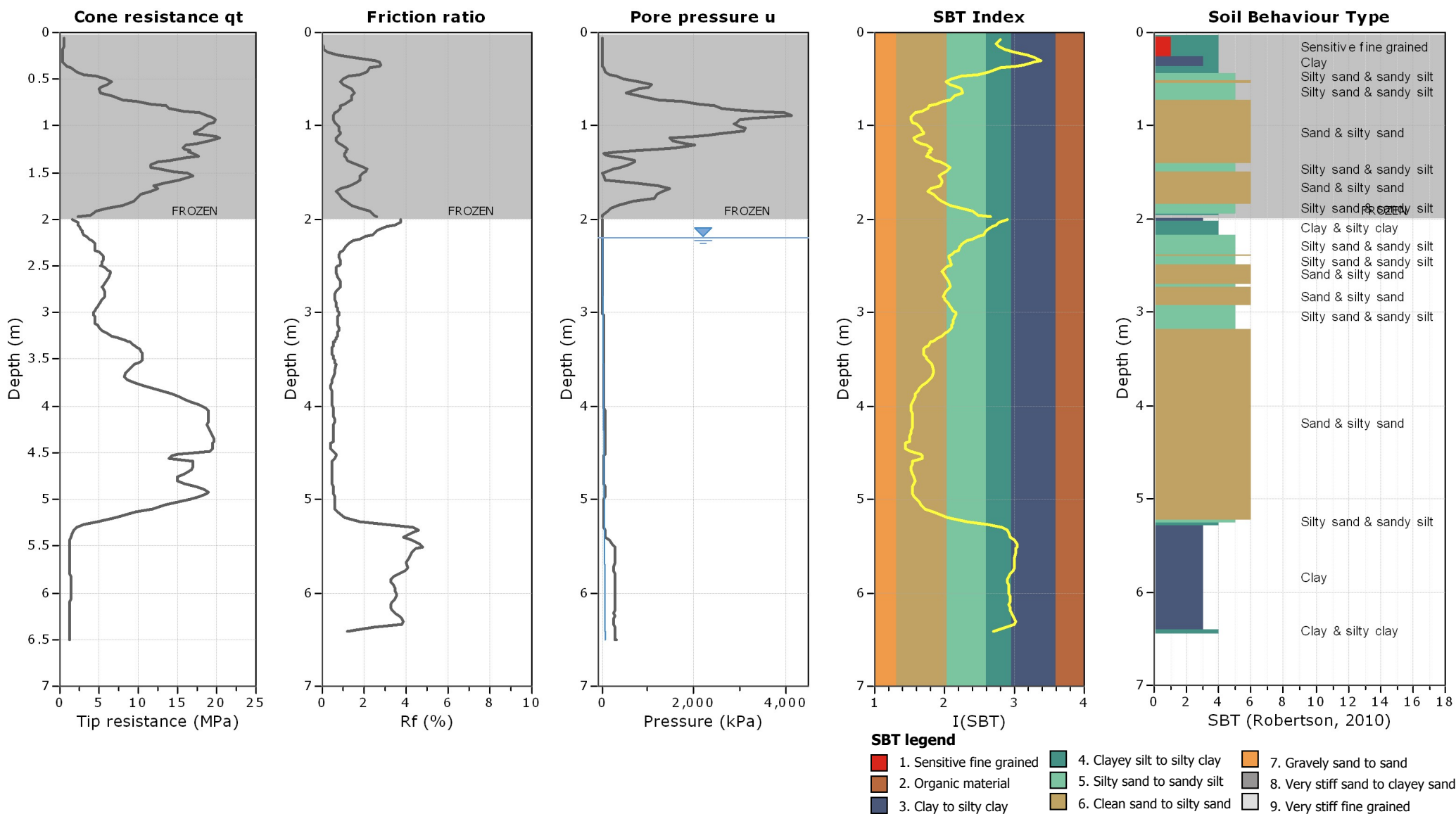
Total depth: 6.50 m, Date: 3/25/2014

Surface Elevation: 0.00 m

Coords: X:0.00, Y:0.00

Cone Type: Vertek 15cm<sup>2</sup>

Cone Operator: PMEL



# **APPENDIX D**

## **Laboratory Results**

ASTM D422: GRAIN SIZE ANALYSIS OF SOIL

Project: FUEL TANK PAD AND FILL STATION  
P.A. PEN, SASKATCHEWAN

Project No.: S14-8725

Date Tested: MARCH 24, 2014

Test Hole No.: 14-2

Sample No.: 15

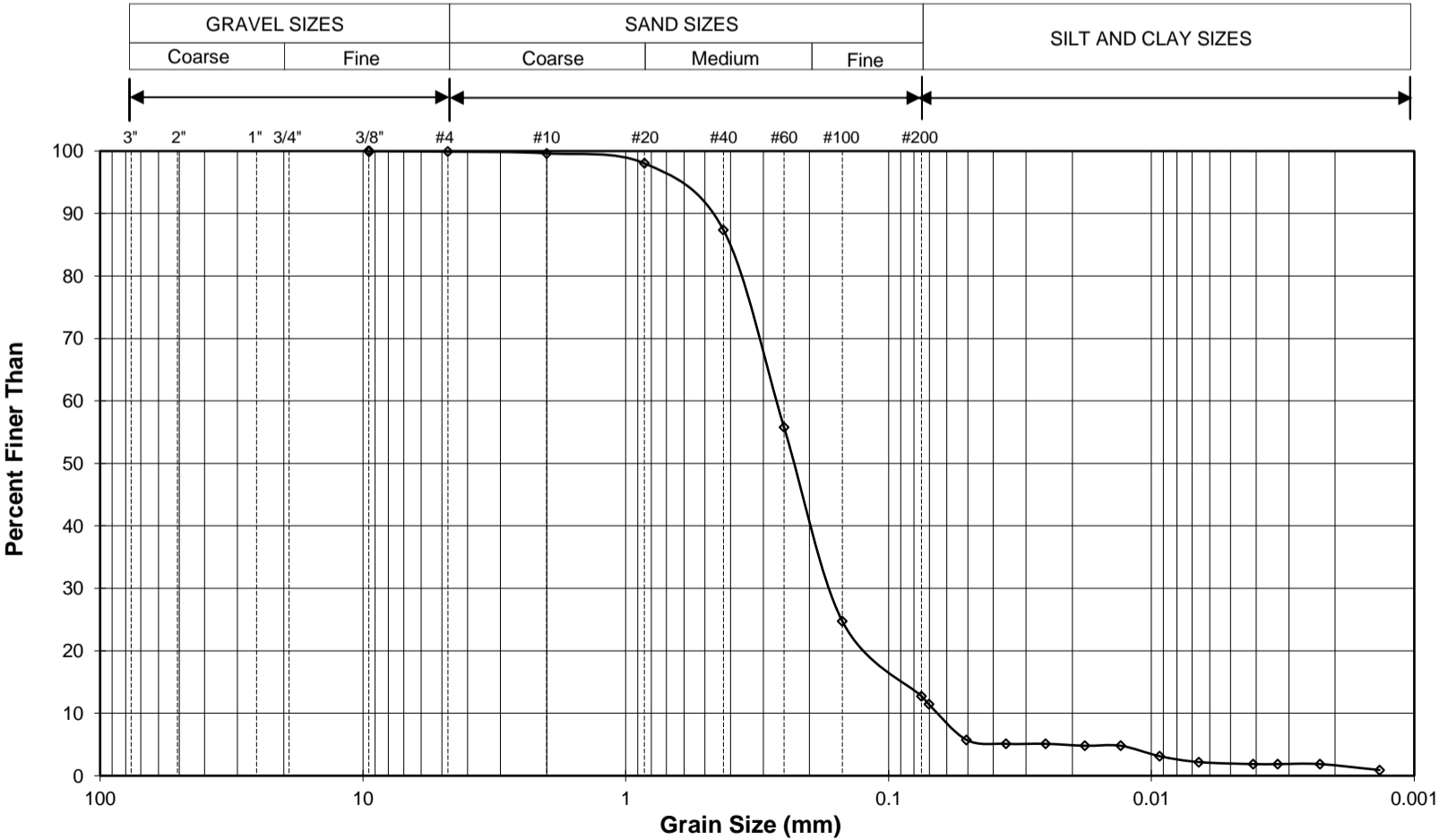
Depth (m): 2.0

Sieve Analysis:	Sieve	Diameter	%	Hydrometer Analysis:	Diameter	%
		mm	Finer		mm	Finer
	1.5"	38.1	100	Dispersing Agent:	0.0703	11.4
	1"	25.4	100	Sodium Hexametaphosphate	0.0506	5.7
	3/4"	19.1	100		0.0358	5.1
	1/2"	12.7	100		0.0253	5.1
	3/8"	9.5	100		0.0179	4.8
	# 4	4.75	100		0.0131	4.8
	# 10	2	100		0.0093	3.1
	# 20	0.85	98		0.0066	2.2
	# 40	0.425	87.4		0.0041	1.9
	#60	0.25	55.8		0.0033	1.9
	# 100	0.15	24.7		0.0023	1.9
	# 200	0.075	12.7		0.0014	0.9

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
0	87	11	2

Remarks:



P. MACHIBRODA  
ENGINEERING LTD.

DRAWING NO.

Appendix D - 1